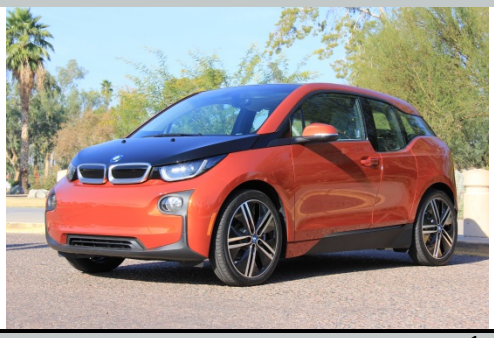
2014 BMW i3

Advanced Vehicle Testing – Baseline Vehicle Testing Results



VEHICLE SPECIFICATIONS[1]

Vehicle Features

VIN: WBY1Z2C50EV285658
Class: Compact
Seatbelt Positions: 4
Type: BEV
CARB[2]: Type II ZEV
EPA Fuel Economy: 137 MPGe (City)/111 MPGe (Highway)/124 MPGe (Combined)
EPA Range: 81 miles
On-Board Charger: 7.4 kW

Electric Motor

Type: Permanent Magnet AC Synchronous
Maximum Power: 125 kW
Maximum Torque: 250 Nm

Transmission

Type: Single Speed

Battery

Manufacturer: Samsung SDI
Type: Lithium-Ion
Cathode Material: NCM (Nickel-Cobalt-Manganese)
Number of Cells: 96
Cell Configuration: 8 Modules, 12 Cells Per Module, Connected In Series
Nominal Cell Voltage: 3.7 V
Nominal System Voltage: 355.2 V
Rated Pack Capacity: 60 Ah
Rated Pack Energy: 18.8 kWh
Weight of Pack: 235 kg
Pack Specific Energy: 79.8 Wh/kg
Pack Energy Density: 98.5 Wh/L (Approximate)
Pack Location: Underneath Vehicle Center
Thermal Management: Active – Refrigerant

Weights

Design Curb Weight: 2,799 lb
Delivered Curb Weight: 2,850 lb
Distribution F/R: 48%/52%
GVWR: 3,615 lb
GAWR F/R: 1,720 lb/2,005 lb
Maximum Payload: 816 lb

Dimensions

Wheelbase: 101.2 in
Track F/R: 61.9 in/62.1 in
Length/Width: 157.0 in/80.3 in
Height: 62.1 in

Tires

Manufacturer: Bridgestone
Model: Ecopia EP500
Size F|R: 155/60R20|175/55R20
Pressure F/R: 33 psi/41 psi
Spare: 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.

PERFORMANCE STATISTICS[1]

TRACK TESTING[2]

Acceleration 0-60 mph[3]

Measured Time: 7.2 s

Performance Goal: ≤13.5 s

Peak Power from Battery: 139.4 kW

Maximum Speed

At ¼ Mile: 86.1 mph

Maximum Speed[4]: 91.5 mph

Performance Goal: ≥90 mph at 1-mile mark

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

Measured Time: 3.3 s

Distance: 116 ft

Peak DC Power into Battery: 27.2 kW

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

Measured Time: 3.4 s

Distance: 111 ft

Peak DC Power into Battery: 25.2 kW

Deceleration 60-10 mph[6]

Measured Time: 12.8 s

Distance: 648 ft

Peak DC Power into Battery: 53.7 kW

Total DC Energy into Battery: 119.7 Wh

DYNAMOMETER TESTING[7]

Cycle Results[8]

	72 °F	20 °F	95 °F + 850 W/m^2
UDDS (Cold Start)	189.9 Wh/mi	489.6 Wh/mi	233.7 Wh/mi
UDDS	176.3 Wh/mi	368.2 Wh/mi	210.0 Wh/mi
HWFET	210.2 Wh/mi	321.8 Wh/mi	216.0 Wh/mi
US06	281.1 Wh/mi	384.2 Wh/mi	304.2 Wh/mi
SC03			228.0 Wh/mi

Fuel Economy at Steady-State Speed, 0% Grade

10 mph	115.7 Wh/mi		50 mph	205.8 Wh/mi
20 mph	119.7 Wh/mi		60 mph	246.3 Wh/mi
30 mph	140.1 Wh/mi		70 mph	301.4 Wh/mi
40 mph	181.1 Wh/mi		80 mph	363.0 Wh/mi

Duration of Passing Maneuver at Grade[9]

	0% Grade	3% Grade	6% Grade
35-55 mph	2.9 s	3.5 s	3.7 s
55-65 mph	2.4 s	2.6 s	3.3 s
35-70 mph	6.3 s	7.2 s	9.1 s
55-80 mph	6.9 s	8.5 s	11.8 s
Maximum Speed at 25% Grade from Stop: 55.4 mph			

NOTES:

1. Performance numbers based on "Comfort" 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 3,182 lb, distributed in a manner similar to the original curb loading of the vehicle. Track testing took place between April 7 and April 14, 2015 with a beginning vehicle odometer reading of 4,056 miles. The ambient temperatures ranged from 45 °F to 82 °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 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 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 May 8, 2015, with the vehicle odometer reading 4,405 miles. A comprehensive explanation of the dynamometer facility and methodology can be found at http://www.transportation.anl.gov/D3/, titled "Chassis Dynamometer Testing Reference Document". The ABC coefficients derived from track coastdown testing and matched on the dynamometer were A: 23.6021 lb, B: 0.6633 lb/mph, and C: 0.01166 lb/mph^2.
8. The Cycle Results table presents the fuel economy achieved by the vehicle on five EPA drive cycles at three different ambient temperatures: (1) 72 °F with vehicle climate-control off, (2) 20 °F with vehicle climate-control set to 72 °F Auto, and (3) 95 °F with vehicle climate-control set to 72 °F Auto. 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):	9.3	16.4	21.9
(A) DC energy out of battery at set speed (kWh)[5,7,9]:	18.4	17.9	18.3
(A+) Total DC energy out of battery (kWh)[5,7,9]:	18.7	18.4	18.8
Battery capacity discharge at set speed (Ah):	50.4	49.4	50.5
(B) Range at set speed (mi)[6,8,10]:	89.6	65.5	58.4
(C) Post-test charge AC energy from EVSE @ 240 V to onboard charger (kWh):	21.6	21.2	22.4
(D) Post-test charge DC energy into battery from onboard charger (kWh):	19.3	19.2	18.4[16]
Post-test charge duration (HH:MM):	04:17	04:12	04:22
AC electricity consumption rate (Wh/mi)[11]:	239	314	373
DC electricity consumption rate (Wh/mi)[12]:	205	273	313
(A+/D) Battery Roundtrip Efficiency[13]:	97%	96%	102%[16]
(D/C) On-Board Charger Efficiency[14]:	89%	91%	82%
(A+/C) Overall Trip Efficiency[15]:	86%	87%	84%

NOTES:

1. See Note 1 and Note 2 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 collected for this vehicle.
2. During the 45 mph range test, the average ambient temperature was 13 °C. During the post-test charge, the average ambient temperature was 23 °C.
3. During the 60 mph range test, the average ambient temperature was 13 °C. During the post-test charge, the average ambient temperature was 18 °C.
4. During the 70 mph range test, the average ambient temperature was 25 °C. During the post-test charge, the average ambient temperature was 18 °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 0.31 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 (18.7 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 1.09 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 2.32 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 (93.0 miles). However, the energy consumption values consider only the distance traveled during the test at the specified speed, 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 0.43 kWh while the post-test drive required 0.02 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 (18.4 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 1.29 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 0.54 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 (66.8 miles). However, the energy consumption values consider only the distance traveled during the test at the specified speed, 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 0.43 kWh while the post-test drive required 0.02 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 (18.8 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 1.11 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 0.86 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 (60.4 miles). However, the energy consumption values consider only the distance traveled during the test at the specified speed, 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 at the set speed **(A)** by the range at the set speed **(B)**.
13. Battery Roundtrip Efficiency is calculated by dividing the DC energy out of the battery **(A+)** by the DC energy from the on-board charger into the battery **(D).**
14. On-Board Charger Efficiency is calculated by dividing the DC energy from the on-board charger into the battery **(D)** by the AC energy from the EVSE **(C).**
15. Overall Vehicle Efficiency is calculated by dividing the DC energy out of the battery **(A+)** by the AC energy from the EVSE **(C)**.
16. In some charging event instances, the amount of electrical energy can be less than the amount of energy that was discharged. The amount of energy that is allowed to be input to the ESS is determined by the vehicle battery management system (BMS), and factors such as ESS state of health and temperature, as well as ambient temperature are used in the proprietary algorithms of the BMS. The battery roundtrip efficiency being greater than 100% is a result of the BMS allowing less energy to be input in the subsequent charge event than it allowed to output during the range test.

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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