2015 Volkswagen e-Golf

Advanced Vehicle Testing – Baseline Vehicle Testing Results

VEHICLE SPECIFICATIONS[1]

Vehicle Features
VIN: WVWPP7AU7FW902140
Class: Five-Door Hatchback
Seatbelt Positions: 5
Type: BEV
CARB[2]: Type II ZEV
EPA Fuel Economy:
126 MPGe (City)
105 MPGe (Highway)
116 MPGe (Combined)
EPA Range: 83 miles
On-Board Charger: 7.2 kW

Motor
Type: Permanent Magnet AC Synchronous
Max Power: 85 kW
Max Torque: 270 Nm

Transmission
Type: Single Speed
Layout: Front Wheel Drive
Final Drive Ratio: 9.8

Battery
Manufacturer: Panasonic
Type: Lithium-ion Polymer
Cathode Material: Nickel-rich NMC (Nickel-Manganese-Cobalt-Oxide)
Cells/Modules: 264 Cells/17 Modules with 12 Cells, 10 Modules with 6 Cells
Cell Configuration: 2 or 4 Cells in Series, 3 Cells in Parallel per Module
Nominal Pack Voltage: 323 V
Nominal Cell Voltage: 3.6 V
Rated Pack Capacity: 75 Ah
Rated Pack Energy: 24.2 kWh
Pack Specific Density: 77.3 Wh/kg
Approx. Pack Energy Density: 105.5 Wh/L
Pack Location: Below center of vehicle
Pack Weight: 313 kg
Thermal Management: Passive – Air

Weights
Design Curb Weight: 3,391 lb
Delivered Curb Weight: 3,412 lb
Distribution F/R: 55.5%/45.5%
GVWR: 4,321 lb
Max. Payload: 909 lb

Dimensions
Wheelbase: 103.6 in
Track F/R: 60.8/59.5 in
Length/Width: 168.1 in/70.8 in
Height: 57.1 in

Tires
Manufacturer: Continental
Model: ProContact
Size: 205/55R16
Pressure F/R: 41 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.

PERFORMANCE STATISTICS[1]

TRACK TESTING[2]

Acceleration 0-60 mph[3]

Measured Time: 12.2 s

Performance Goal: ≤13.5 s

Peak DC Power from Battery: 94.8 kW

Maximum Speed

At ¼ Mile: 79.1 mph

Maximum Speed[4]: 84.8 mph

Performance Goal: ≥90 mph at 1-mile mark

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

Measured Time: 2.9 s

Distance: 128 ft

Peak DC Power into Battery: 33.6 kW

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

Measured Time: 2.9 s

Distance: 126 ft

Peak DC Power into Battery: 47.0 kW

D1 Deceleration Mode 60-10 mph[6]

Measured Time: 47.5 s

Distance: 2,326 ft

Peak DC Power into Battery: 16.0 kW

Total DC Energy into Battery: 109 Wh

D2 Deceleration Mode 60-10 mph[6]

Measured Time: 30.2 s

Distance: 1,502 ft

Peak DC Power into Battery: 28.9 kW

Total DC Energy into Battery: 131 Wh

D3 Deceleration Mode 60-10 mph[6]

Measured Time: 23.2 s

Distance: 1,191 ft

Peak DC Power into Battery: 30.7 kW

Total DC Energy into Battery: 137 Wh

DYNAMOMETER TESTING[7]

Cycle Results[8]

	72 °F	20 °F	95 °F + 850 W/m^2
UDDS (Cold Start)	212.1 Wh/mi	397.7 Wh/mi	264.2 Wh/mi
UDDS	201.1 Wh/mi	314.4 Wh/mi	255.8 Wh/mi
HWFET	220.2 Wh/mi	288.0 Wh/mi	229.5 Wh/mi
US06	296.4 Wh/mi	356.9 Wh/mi	308.6 Wh/mi
SC03			250.7 Wh/mi

	0 °F
UDDS (Cold Start)	656.2 Wh/mi
UDDS	608.5 Wh/mi
HWFET	362.2 Wh/mi
US06	401.3 Wh/mi
SC03	

Fuel Economy at Steady-State Speed, 0% Grade

10 mph	137.0 Wh/mi		50 mph	212.4 Wh/mi
20 mph	126.5 Wh/mi		60 mph	254.6 Wh/mi
30 mph	146.6 Wh/mi		75 mph	303.0 Wh/mi
40 mph	176.1 Wh/mi		80 mph	373.9 Wh/mi

Duration of Passing Maneuver at Grade[9]

	0% Grade	3% Grade	6% Grade
35-55 mph	4.6 s	5.3 s	6.2 s
55-65 mph	3.2 s	4.0 s	5.2 s
35-70 mph	9.7 s	11.7 s	15.0 s
55-80 mph	9.8 s	12.9 s	19.8 s
Maximum Speed at 25% Grade from Stop: 41.4 mph			

NOTES:

1. Performance numbers based on "Normal" vehicle mode. Performance numbers are averages from multiple tests. 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 3,744 lb, distributed in a manner similar to the original curb loading of the vehicle. Track testing took place between August 21 and September 4, 2015 with a beginning vehicle odometer reading of 4,003 miles. The ambient temperatures ranged

from 82 °F to 97 °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 November 03, 2015, with the vehicle odometer reading 4,545 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: 41.6754 lb, B: 0.6423 lb/mph, and C: 0.00992 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):	7.0	12.9	18.6
(A) DC energy out of battery at set speed (kWh)[5,7,9]:	18.8	18.4	18.4
(A+) Total DC energy out of battery (kWh) [5,7,9]:	18.9	18.7	19.0
Battery capacity discharge at set speed (Ah):	58.4	57.0	57.5
(B) Range at set speed (mi)[6,8,10]:	127.4	86.6	68.7
(C) Post-test charge AC energy from EVSE @ 240 V to onboard charger (kWh):	24.2	22.9	22.7
(D) Post-test charge DC energy into battery from onboard charger (kWh):	23.4	21.9	20.9
Post-test charge duration (HH:MM):	07:21	06:48	06:51
AC electricity consumption rate (Wh/mi)[11]:	189	260	320
DC electricity consumption rate (Wh/mi)[12]:	147	212	268
(A+/D) Battery Roundtrip Efficiency[13]:	81%	85%	91%
(D/C) On-Board Charger Efficiency[14]:	97%	96%	92%
(A+/C) Overall Trip Efficiency[15]:	78%	82%	84%

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. Because the range of the vehicle at certain speeds is large, a driver exchange occurred during the 45 mph test for driver safety.
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 0.14 kWh, the driver exchanges when the vehicle slowed to zero then returned to speed required 0.10 kWh, and the post-test drive returned 0.024 kWh. These energy inputs can be added to the energy consumed during the range test (**A**) to obtain the total output from the battery (18.9 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 1.18 miles from test prep area to point at which vehicle test speed is achieved and maintained. The driver exchanges of the vehicle slowing to zero then returning to speed required 0.52 miles. After the range at 45 mph was completed, the post-test drive required an additional drive of 0.55 miles for the vehicle to come to a stop to be transported 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 (129.1 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 0.33 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 (18.7 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 1.20 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 1.02 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 (88.8 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 0.47 kWh while the post-test drive required 0.17 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 (19.0 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 1.41 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 1.71 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 (71.8 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. 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)**.

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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