93-23-04 - Service Information, Electric Vehicle Range Too Low **Release date:** 9/21/2023

Condition

Applicable Vehicles

Model(s)	Year	Eng. Code	Trans. Code	VIN Range From	VIN Range To
e-Golf	2015 - 2019	All	All	All	All
ID.4	2021 - 2024	All	All	All	All

Revision Table

Instance Number	Published Date	Version Number	Reason For Update
2071494/1	9/21/23	93-23-04	Original publication.

The range of an electric vehicle is a complex function, with several contributing factors. When diagnosing a customer complaint related to the remaining range of an electrical vehicle, all of the possible influencing factors need to be considered in the diagnosis.

This information-only document supports this diagnosis by providing an overall summary of the range and contributing factors. It details how the EPA estimated range is determined, which external factors contribute to the calculated range, which customer behaviors influence the calculated range, and how the customer may better improve their energy efficiency through various best practices.

Sections:

1. The EPA estimated range of an electric vehicle
2. Calculation of the remaining range
3. Factors influencing the energy consumption
4. How can the customer influence / increase their range?

93-23-04 - Service Information, Electric Vehicle Range Too Low **Release date:** 9/21/2023

Technical Background

1. The EPA estimated range of an electric vehicle

The methods to calculate the range of an electric vehicle are outlined by the EPA.

The defined EPA process is as follows:

1. *A vehicle with a fully charged battery is driven continuously over the EPA city cycle until the battery is depleted and the vehicle can drive no further. The distance driven is recorded. This is repeated, again starting with a full charge, over the EPA highway cycle, again recording the distance driven when the battery is depleted. This "single cycle" test consists of multiple repeat drives of the city or highway cycle.*
2. *Automakers also have the option of doing a multi-cycle test, which consists of four city cycles, two highway cycles, and two constant speed cycles.*
3. *All testing is done in a laboratory on a dynamometer.*
4. *The city and highway driving ranges determined from this testing are adjusted to account for real-world factors that are not represented on the laboratory test procedures. These factors include such things the impact of air conditioning, of cold temperatures, and of high speed and aggressive driving behavior. Although the regulations allow some optional approaches, the most common approach is to use a factor of 0.7 to adjust all the test parameters, including range. For example:*
    - *An EV achieves 200 miles on the highway laboratory test.* ***Real-world highway driving range → 200 x 0.7 = 140 miles*** *to account for aggressive driving and HVAC use.*
5. *The adjusted city and highway range values are weighted together by 55% and 45%, respectively, to determine the combined city and highway driving range that appears on the EPA fuel economy label. For example:*
    - *Assume an adjusted city range of 168 miles and an adjusted highway range of 140 (from example above).* ***The official combined range value → (0.55 x 168) + (0.45 x 140) = 155 miles*** *(values are rounded to the nearest whole number).*

[Fuel Economy and EV Range Testing | US EPA. (2023, August 17). US EPA. https://www.epa.gov/greenvehicles/fuel-economy-and-ev-range-testing]

The conditions for these tests are precisely defined and exactly specified, and the same for all manufacturers, including:

- The ambient temperature
- The load / special equipment
- The speed during the drive cycle
- The rate of stop / go
- All electrical consumers are switched off

A standardized driving cycle such as this cannot give customers precise information about their actual, individual energy consumption and the related range, because every trip and driver are unique.

Tip:

The official estimated range of an electric vehicle is not suitable to predict the customer-specific energy consumption, because every customer has their own unique driving style.

2. Calculation of the remaining range

The calculation of the displayed remaining range is based on the most recent driving cycles.

Therefore, the remaining range can depend on:

- The vehicle speed
- The customer's driving style (for example frequent strong acceleration)
- The use of electrical consumers
- The ambient temperature
- The load / special equipment
- The topography (road surface, hills, etc)

3. Factors influencing energy consumption

Approximately two-thirds of the energy consumption of a vehicle is determined by its design and by external factors that cannot be influenced. External factors are environmental, such as weather, temperature, topography, or road surface. These cannot be changed, but sometimes may significantly influence the range.

The remaining third of energy consumption can be influenced by the driver through their personal driving habits and use of the vehicle. Every driver can positively influence their individual energy consumption – for instance, by reduced load, lowering air resistance, or through efficient use of electrical consumers.

The additional consumers (including heating/air conditioning) do not depend on the vehicle speed, as they are supplied with energy by the high-voltage battery. That's why the electric range also may continue to decrease while the vehicle is stopped.

Greatest influence on the range in the electric drive mode:	**Range loss in %:**
Heating/air conditioning:	Up to 30%
Additional equipment (seat heating, heated rear window, radio):	Up to 10%
Tires (dimension, summer/winter tire):	Up to 10%

4. How can the customer influence / increase their range?

“Energy Recovery” – When braking, slowing down while coasting, or driving downhill, the electric drive motor generates electric energy which is stored in the high-voltage battery. In this mode the drive motor is acting as a generator, creating an effect similar to engine-braking. This is referred to “energy recovery”. Energy recovery feeds energy back to the high-voltage battery, where it had originally been used to set the vehicle in motion. This is a multiple energy conversion, which always results in energy losses due to inefficiencies.

“Coasting Function” – Depending on the vehicle model, the intensity of the energy recovery can be adjusted to different levels, or even switched off altogether. The “coasting function” is when the energy recovery is switched off completely. The coasting function avoids the multiple energy conversion from energy recovery, and instead preserves the vehicle’s kinetic energy.

Each mode should be used in different scenarios, to maximize energy efficiency. The coasting function is preferable when a complete stop is not needed. Energy recovery should be used in predictable braking scenarios, such as approaching traffic lights. Mastering this behavior will increase the energy efficiency, and limit the driver’s individual energy consumption.

In addition to these functions, the driver can also use pre-conditioning climate controls before driving, while the vehicle is still connected to a charger. This ensures that the energy needed for the initial heating (or cooling) of the passenger compartment does not have to be provided by the high-voltage battery, maximizing the energy available for the overall range of the vehicle.

Production Solution

Not applicable.

Service

Not applicable.

Warranty

Not applicable.

Required Parts and Tools

Not applicable.

Additional Information

All part and service references provided in this Technical Bulletin are subject to change and/or removal. Always check with your Parts Dept. and Repair Manuals for the latest information.