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The retrofitting a chevrolet spark into an electric car.

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A B S T R A C T

This article provides instructions on how to dismantle the unnecessary equipment for the electric car in the Spark passenger car and install the necessary equipment for the electric car. in addition, the article calculates the selection of an electric engine and electrical equipment with a power suitable for the weight and external dimensions of the Chevrolet Spark car. Economic calculations and indicators for retrofitting a Chevrolet Spark car into an electric car are also covered in the article.

A R T I C L E I N F O

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K E Y W O R D S: bLDC electric motor, GBS-LFP400Ah storage battery, controller, inverter, DC/DC converter, electronic gas pedal, charger, air aerodynamic coefficient, vehicle cross-sectional area, free fall acceleration, friction coefficient, power, energy, voltage

The 21st century, with the development of technologies and the limitation of oil reserves on earth, showed the need to start a period of changes and developments in the field of automobile transport. in a number of developed countries, the production of gasoline cars has slowed down, and the production of electric cars has accelerated. here the question arises, well, electric cars have started to be produced, what will happen to them if the use of gasoline cars is stopped after some time? We will consider the work of solving this urgent problem by re-equipping a gasoline car into an electric car, that is, installing electric car equipment on gasoline cars, using the example of a Chevrolet Spark car.

Chevrolet Spark car has been produced since 2010. chevrolet Spark car is very easy to drive due to its compact size and good controllability. Thanks to the spacious cabin, the Chevrolet Spark can accommodate 170 liters of cargo. chevrolet Spark car model looks compact from the outside, but five people can comfortably fit in its cabin. The table below shows the characteristics of the Chevrolet Spark car.

The body	structure/material	xetchbek/iron
	number of seats	5
Dimensions(mm)	Length	3640

	width	1597
	High	1522
	vehicle base	2375
	track (front/back)	132
	distance from the lowest point to the ground (clarnes)	1410/1417
volumes and weights	fuel tank volume (L)	35
	trunk volume (L)	170
	vehicle weight (kg)	895-915

Electric vehicle is a vehicle powered by one or more electric motors. In this case, the electric motor consumes energy from the batteries.

Basic equipment needed to convert a Chevrolet Spark into an electric car:

Electric motor;

accumulator battery;

Controller;

DC/DC converter;

Inverter;

Charging device;

Electronic gas pedal..

An electric motor is a device that converts electrical energy into mechanical energy. Asynchronous electric motors are used for electric cars.

The accumulator battery is an energy source that supplies the electric motor with electric energy.

controller - a low-voltage electrical device designed to start (start), adjust the speed, reverse (change the direction of rotation of the motor axis) and stop electric motors.

dC/DC converter - its task is to change the voltage value of electricity (DC-direct current). It has two types of voltage transformers: step-up and step-down.

inverter - serves to charge the battery by converting the alternating current coming through the charging device into direct current.

The charging device is responsible for charging the battery of an electric car from a household electrical outlet through an inverter.

electronic gas pedal - serves to control the rotation speed of the electric engine and electric car.

Converting a chevrolet Spark to an electric car begins with the selection of an electric motor, taking into account the weight of the car and the resistance forces acting on it.

BLDC electric motor and GBS-LFP400Ah battery were selected for the Chevrolet Spark electric car.

Calculation of electric motor power.

calculations for the required power of the electric motor were made at a speed of 60 km/h, with a road slope angle of 0 degrees.

Empty weight of Spark car is 900 kg;

One 400 A*hour battery weighs 13.2 kg. A set of 16 batteries weighs 211.2 kg;

The weight of the electric motor is 17 kg;

The total weight of the controller, inverter, electronic gas pedal, DC/DC converter and wires connecting the equipment is 26 kg;

4 passengers weighing 75 kg weigh 300 kg;

The total approximate mass is 1454 kg.

$W=g* \mu*m*V*\cos\alpha + 0,5*k*S* \rho*V^3 + g*m*\sin\alpha.$

- k=0,342 (air aerodynamic coefficient);
- S=2,4 m2 (car cross-sectional area);
- g=9,81 m/s^2 (free fall acceleration);
- m=1454 (car weight);
- μ=0,018 (coefficient of friction for asphalt);
- V=60 km/soat=16,67 m/s;
- α=0 (slope angle of the road);
- ρ=1,225 kg/m^3.

$W=9,81*0,018*1454*16,67*1+0,5*0,342*2*1,225*(16,67)^3 + 9,81*1300*0 = 6220$ W

part of the energy is lost on the way out of the battery. Pure energy must be spent on movement. Therefore, we divide the obtained result by the total efficiency (0.76 in the transmission, 0.90 in the electric motor, 0.95 in the controller) by about 0.65.

6220/0.65=9569W

according to the calculations, a Chevrolet Spark car that is being converted to an electric car needs an electric motor with a power of 9569 W to move at a speed of 60 km/h on a flat road.

A battery with a suitable energy for an electric motor with a capacity of 10 kW was selected. according to statistics, electric cars consume 170-180 W*h of energy per 1 km in urban conditions.

Electric cars consume an average of 10 kW per hour at a speed of 60 km/h. chevrolet Spark electric car should travel 100 km at a speed of 60 km/h in 1.66 hours (100 km/60 km/h = 1.66 hours). A battery with a voltage of 48 V is enough for a 10 kW electric motor.

we calculate the energy capacity of the battery using voltage and time. 16600 V*A*h/48 V= 346 A*h, which means that the battery has an energy capacity of 346 A*h at 48 V. in the winter, the energy capacity of the battery decreases to 20%, therefore, the GBS-LFP400Ah brand battery with a voltage of 3.2V and an energy capacity of 400 A*hour was chosen as an energy source.

the energy capacity of the battery is 400 A*hour, 48/3.2 = 15 3.2 V batteries are needed. But usually it is better to install an even number of accumulator batteries. Thus, 16 3.2 V GBS-LFP400Ah batteries are an alternative source of energy for Chevrolet Spark, which has been retrofitted to an electric car.

Let's compare the prices of fuel (energy) consumption per 100 km of a Chevrolet Spark retrofitted to an electric car and a gasoline-powered Chevrolet Spark:

Chevrolet Spark consumes a maximum of 8 liters of gasoline per 100 km. As of 2023, the price of AI-80 gasoline in the Republic of Uzbekistan will be 6,050 soums, and the price of 8 liters of gasoline will be 48,400 soums.

In the Republic of Uzbekistan in 2023, 1 kW*h of electricity costs 295 soums. The cost of 16.6 kW*h of energy for a distance of 100 km of a Chevrolet Spark equipped with an electric car is 4,897 soums.

The calculations showed that the difference in fuel (energy) costs for a 100-km distance between a gasoline-powered Chevrolet Spark car and an electric Chevrolet Spark car in the Republic of Uzbekistan amounts to 43,500 soums.

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