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Controller for Automobile Electrical Power Steering

汽车电动助力转向装置用控制器

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Number, name and date of implementation of 22 automotive industry standards

No.	Standard number	Standard name	Number of standard replaced	Date of implementation
301	QC/T 727-2017	Instrument for automobile and motorcycle	QC/T 727-2007	2017-10-01
302	QC/T 803-2017	Oxygen sensor for automobile	QC/T 803.1-2008	2017-10-01
303	QC/T 1072-2017	Gear position sensor for automobiles		2017-10-01
304	QC/T 1073.1-2017	Accelerometers for automobiles - Part 1: Linear accelerometers		2017-10-01
305	QC/T 1074-2017	Technical specifications for automotive parts remanufacturing products		2017-10-01
306	QC/T 1075-2017	Technical conditions for metal honeycomb carrier of exhaust catalytic converter		2017-10-01
307	QC/T 777-2017	Technical conditions for electromagnetic fan clutch of automobile	QC/T 777-2007	2017-10-01
308	QC/T 1076-2017	Performance requirements and test methods for continuously variable transmission (CVT)		2017-10-01
309	QC/T 1077-2017	Terminology and definitions for classification of automatic control transmission for automobile		2017-10-01
310	QC/T 1078-2017	Advertising vehicle		2017-10-01
311	QC/T 1079-2017	Suction & delivery vehicle		2017-10-01
312	QC/T 1080-2017	Mobile loudspeaker for popularization of science		2017-10-01
313	QC/T 1081-2017	Electric power steering device for automobile		2017-10-01
314	QC/T 1082-2017	Motor for electric power steering device of automobile		2017-10-01
315	QC/T 1083-2017	Controller for electric power steering device of automobile		2017-10-01
316	QC/T 1084-2017	Sensor for electric power steering device of automobile		2017-10-01
317	QC/T 1085-2017	X-ray testing for light-alloy wheel of motorcycle		2017-10-01
318	QC/T 1086-2017	Technical conditions for range extenders for electric vehicles		2017-10-01

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Controller for Automobile Electrical Power Steering

1 Scope

This Standard specifies the technical requirements and test methods of the controller for automobile electrical power steering.

This Standard is applicable to the controller for various automobile electrical power steering (hereinafter referred to as controller).

2 Normative References

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this document.

GB/T 2423.1 Environmental Testing for Electric and Electronic and Electronic Products - Part 2: Test Methods - Tests A: Cold

GB/T 2423.2 Environmental Testing for Electric and Electronic Products - Part 2: Test Methods - Tests B: Dry Heat

GB/T 2423.3 Environmental Testing - Part 2: Testing Method - Test Cab: Damp Heat, Steady State

GB/T 2423.17 Environmental Testing for Electric and Electronic Products - Part 2: Test Method - Test Ka: Salt Mist

GB/T 2423.22 Environmental Testing - Part 2: Tests Methods - Test N: Change of Temperature

GB/T 2423.34 Environmental Testing - Part 2: Test Methods - Test Z/AD: Composite Temperature/Humidity Cyclic Test

GB/T 4942.2 Low Voltage Electrical Enclosure Protection Class

GB/T 5179 Term and Definition for the Automobile Steering System

GB/T 17619 Limits and Methods of Testing for Immunity of Electrical / Electronic Sub-Assemblies in Vehicles to Electromagnetic Radiation

GB/T 18655 Vehicles, Boats and Internal Combustion Engines-Radio Disturbance Characteristics - Limits and Methods of Measurement for the Protection of on-Board Receivers

GB/T 19951 Road Vehicles - Test Methods for Electrical Disturbances from Electrostatic Discharge

GB/T 21437.2 Road Vehicles - Electrical Disturbances from Conduction and Coupling - Part 2: Electrical Transient Conduction Along Supply Lines Only

QC/T 305 Motor Vehicles - Hydraulic Power Steering Control Valve - Performance Requirements and Test Methods

QC/T 306 Test Method for Vehicle Power Steering Control Valve Assembly Bench

QC/T 413 Basic Technical Requirements for Automotive Electric Equipment

QC/T 484 Automobile Paint Coating

QC/T 647 Automobile Steering Universal Joint Assembly Performance Requirements and Test Methods

QC/T 649 Automobile Steering Shaft Assembly Performance Requirements and Test Methods

QC/T 29096 The Bench Test Methods of Automobile Steering Gear

QC/T 29097 The Technical Specifications of Automobile Steering Gear

3 Terms and Definitions

For the purposes of this Standard, the terms and definitions given in GB/T 5179 and the following apply.

3.1 Controller working properly

The automobile electric power steering device (hereinafter referred to as device) shall be installed on the test bench; the controller, motor and sensor are normally connected; the whole vehicle signal is normally input. After the power is turned on, rotate the steering wheel device left and right to assist normally.

3.2 Controller failure

The controller is considered invalid in case one of the following conditions:

a) During the function test, due to the controller, there is non-smooth, stuck, obvious

4.1.4.1 Nominal voltage: 12V or 24V.

4.1.4.2 The allowed voltage change range:

a) 9V ~16V (nominal voltage of 12V)

b) 20V ~ 32V (nominal voltage of 24V).

4.1.5 Self-test function and fault code.

The controller shall have self-test function, and can store the fault code.

4.2 Performance

4.2.1 Function.

During the process of manually rotating the steering wheel at different speeds, it shall be smooth, without stuck or obvious inertia delay.

4.2.2 Power current characteristics.

At different speeds, the relationship between the input torque and the output current, i.e. the power current characteristics, shall meet the manufacturer's requirements. The symmetry of the curve at each vehicle speed (allowed to be represented by 0 km/h speed) shall be ≥ 90%.

4.2.3 Failure alarm.

The controller shall have the function of failure alarm. When the motor, sensor and the entire vehicle input signal are detected to be abnormal or controller itself fails, the controller shall output the fault alarm signal. In the event of any fault, the mechanical part of the device shall work properly.

4.2.4 Resistance to power supply voltage fluctuation.

The controller shall have the ability to adapt to fluctuations for the power supply voltage. When the vehicle power supply changes within the range of 9V ~ 16V (nominal voltage of 12V) or 21.6V ~ 32V (nominal voltage of 24V), the controller shall work properly. After the test, the variation of the power current characteristics shall be <15%.

4.2.5 Reverse connection of power supply and voltage overload.

The controller shall have the ability to resisting the reverse connection of power supply and voltage overload. After test, the controller can work properly.

4.2.6 Drop.

After the drop test, the controller shall work normally; and meet the requirements of

After the test, the controller can work properly, and meet the requirements of 4.2.1.

4.3.8 Electromagnetic compatibility.

4.3.8.1 Radio disturbance characteristics.

The controller shall meet the requirements stipulated in GB/T 18655, and shall reach the Class-I level of the limit value.

4.3.8.2 Electromagnetic radiation immunity.

The controller shall meet the requirements stipulated in GB/T 17619.

4.3.8.3 Electrical disturbances caused by electrostatic discharge.

The controller shall conform to the provisions of GB/T 19951, and reach the Class-A requirements.

4.4 Reliability

4.4.1 Fatigue test.

4.4.1.1 After the fatigue test, the controller is not allowed to have any failure.

4.4.1.2 It shall meet the requirements of 4.2.1.

4.4.2 Vibration.

4.4.2.1 After the vibration test, the controller is not allowed to have any cracks or breaks.

4.4.2.2 It shall meet the requirements of 4.2.1.

5 Test Methods

5.1 Test conditions

5.1.1 Temperature deviation.

This Standard specifies that the temperature deviation in the test method is ±2°C, unless otherwise specified.

5.1.2 Test voltage.

This Standard specifies the test voltage is 12V±0.5V (nominal voltage of 12V) or 24V±1V (nominal voltage of 24V), unless otherwise specified.

5.1.3 DC power supply for test.

A vehicle battery or a DC stabilized power supply with a ripple ratio of ≤0.5% can be used.

5.1.4 The installation of the controller shall be performed as per the test requirements.

5.1.5 Only the drop test and connector strength test can be performed alone, other tests of the controller shall be carried out together with the device.

5.1.6 Test apparatus requirements.

5.1.6.1 In the temperature range of 23°C±5°C, the accuracy of the measurements for torque, force, displacement, rotation angle, speed, current, and voltage shall be no less than 0.5%FS.

5.1.6.2 In the temperature range of 23°C±5°C, the resolution for temperature measurement shall be no less than 1°C.

5.1.6.3 In the temperature range of 23°C±5°C, the resolution for humidity measurement shall be no less than 10%RH.

5.2 Performance

5.2.1 Function.

Install the device on the test bench; the system works properly; the input end is in the straight running position; while the output end is applied test load (evenly divided into 5 points, including 0 and T_c); the speed is divided into 5 points in the range of 0~V_{max} (by the interval of 5km/h~20km/h); manually turn the steering wheel to left and right for test, feeling smooth and no stuck.

5.2.2 Power current characteristics.

5.2.2.1 Install the device on the test bench, the system works properly; the input end is in the straight running position; rotate the input end at a constant speed; so that the load on the output end reach the rated load; set different speeds (evenly divided into 5 points, including 0 and V_{max}); record the relationship curve between the input torque and output current under each speed (Figure 1).

the test is completed, check whether the controller works properly.

5.2.5.2 Voltage overload

5.2.5.2.1 If the nominal voltage is 12V, the input end is connected to the +24V power supply for 1min; after the test is completed, check whether the controller works properly.

5.2.5.2.2 If the nominal voltage is 24V, the input end is connected to the +32V power supply for 1min; after the test is completed, check whether the controller works properly.

5.2.6 Drop.

5.2.6.1 Place the controller at the height of 1m (the lowest point of the controller) by the longest diagonal line vertically downwards; then drop it freely (the ground is hard ground); after the test is completed, check whether the controller works properly.

5.2.6.2 Then perform the tests in 5.2.1~5.2.5.

5.2.7 Connector strength.

5.2.7.1 The controller connects to the corresponding connector; apply a force of 147N in the direction of insertion and plugging for 5s; do it 5 times continuously; then apply a force of 49N in the up and down, right and left directions for 5s; do it 2 times separately. After the test is completed, check whether the controller works properly.

5.2.7.2 Then perform the test in in 5.2.1~5.2.5.

5.2.8 Power consumption at static state.

If the controller works properly, when the ignition switch is off, measure the current flowing through the controller and power supply line.

5.3 Environment

5.3.1 High temperature.

5.3.1.1 The device works properly; perform the test as per the test B: high temperature test method stipulated in GB/T 2423.2.

5.3.1.2 Place it for 96h at a temperature of +85°C or +105°C (controller is installed outside the cab).

5.3.1.3 After the test is completed, directly take test in the test chamber as per 5.2.1; check whether the controller works properly.

5.3.2 Low temperature

5.3.2.1 The device works properly; perform the test as per the test A: low temperature

tests in the shielded room by the free filed method and large current injection method. The immunity level limit for the free filed method is 30V/m; while the immunity level limit for the large current injection method is 60mA.

5.3.8.3 Electrical disturbances caused by electrostatic discharge.

The controller works properly. According to the Class-III test level stipulated in GB/T 19951, perform the test at the speed of 8km/h. The measuring points shall be around the connector and on the edges of the upper surface of the housing of motor, sensor and controller; the number of the measured points shall be no less than 10.

5.3.8.4 Electrical transient conduction along the power line.

The controller works properly. Perform the test according to Class-III test level stipulated in GB/T 21437.2.

5.4 Reliability

5.4.1 Endurance test.

5.4.1.1 The controller works properly. Simulate the current output state of the entire vehicle; ensure the maximum output of the controller.

5.4.1.2 Finish a total of 7750000 current output periods for 125000 cycles at 25°C; the current output period for each cycle can refer to Table 2. The current output waveform for each current period can refer to Figure 5 (allow to enter into the thermal protection mode designed by the manufacturer).

5.4.1.3 After the test is completed, the controller can work properly.

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