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**Technical requirements and test method for motor
vehicle-electronically controlled hydraulic power
steering gear**

汽车电控液压助力转向器总成技术要求及试验方法

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Appendix:**Number, name, and date of implementation of 32 automotive industry standards**

No.	Standard number	Standard name	Number of standards replaced	Date of implementation
1	QC/T 231-2014	Specification of kick-starter for motorcycles and mopeds	QC/T 231-1997	October 01, 2014
2	QC/T 233-2014	Performance and measurement method for static intensity of motorcycles and mopeds	QC/T 233-1997	October 01, 2014
3	QC/T 66-2014	Wet clutch for moped and motorcycles	QC/T 66-1993	October 01, 2014
4	QC/T 962-2014	Technical specifications for coating of motorcycles and moped		October 01, 2014
5	QC/T 680-2014	General technical specifications for voltage regulators for motorcycles and moped	QC/T 680-2002	October 01, 2014
6	QC/T 963-2014	Drum brakes of motorcycles and mopeds wheels		October 01, 2014
7	QC/T 234-2014	General technical specifications for steering shaft for motorcycles and moped	QC/T 234-1997	October 01, 2014
8	QC/T 964-2014	The strength of plastic seats and their anchorages for city buses		October 01, 2014
9	QC/T 644-2014	Technical specifications for automotive metallic fuel tank	QC/T 644-2000 QC/T 488-2000	October 01, 2014
10	QC/T 965-2014	Driver of electric rear-view mirrors for motor vehicles		October 01, 2014
11	QC/T 966-2014	Technical specifications for automotive plastic parts coatings		October 01, 2014
12	QC/T 459-2014	Truck with loading crane	QC/T 459-2004	October 01, 2014
13	QC/T 29106-2014	Technical specification of automobile wire harness	QC/T 29106-2004	October 01, 2014
14	QC/T 198-2014	General technical specification for automotive switch	QC/T 198-1995	October 01, 2014
15	QC/T 220-2014	Technical specifications for automotive fusible links	QC/T 220-1996	October 01, 2014
16	QC/T 967-2014	Port fuel injector for gasoline engine		October 01, 2014
17	QC/T 968-2014	Determination methods of platinum, palladium, and rhodium contents in metallic catalytic converters		October 01, 2014
18	QC/T 969-2014	Interior truck release for compartment of a passenger car		October 01, 2014
19	QC/T 636-2014	Electric window regulator specification for vehicles	QC/T 636-2000	October 01, 2014
20	QC/T 970-2014	Passenger car air filter technical specification		October 01, 2014
21	QC/T 971-2014	Specification of air filter element for		October 01,

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Technical requirements and test method for motor vehicle-electronically controlled hydraulic power steering gear

1 Scope

This standard specifies the technical requirements and test method, for motor vehicle-electronically controlled hydraulic power steering gear.

This standard applies to motor vehicle-electronically controlled hydraulic power steering gear, including recirculating ball type electronically controlled hydraulic power steering gear AND rack and pinion type electronically controlled hydraulic power steering gear.

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) is applicable to this standard.

GB/T 2423.17 Environmental testing for electric and electronic products - Part 2: Test method - Test Ka: Salt mist (idt IEC 60068-2-11:1981)

GB/T 2423.22 Environmental testing for electric and electronic products - Part 2: Test methods Test N: Change of temperature (idt IEC 60068-2-14:1984)

GB/T 2423.34 Environmental testing for electric and electronic products - Part 2: Test methods - Test Z/AD: Composite temperature/humidity cyclic test (idt IEC 60068-2-38:1974)

GB/T 5179 Terms and definitions of automotive steering system

GB/T 18655-2010 Vehicles boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers (CISPR25:2008, IDT)

GB/T 21437.2-2008 Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only

gear

The electronically controlled hydraulic power steering gear, whose transmission pair is recirculating ball type.

3.7**Rack and pinion electronically controlled hydraulic power steering gear**

The electronically controlled hydraulic power steering gear, whose transmission pair is rack and pinion type.

3.8**Maximum speed $V_{\max}$**

The maximum speed of the vehicle equipped with the assembly. The unit is km/h.

4 Technical requirements**4.1 Performance****4.1.1 Recirculating ball electronically controlled hydraulic power steering gear.**

4.1.1.1 The total number of turns of the steering gear AND the angle of the rocker shaft shall meet the design requirements.

4.1.1.2 No-load steering torque. For the variation range of the mean value of the left and right steering torques, it shall meet the design requirements. For the variation range from the maximum value to the minimum value, it shall meet the design requirements. For the variation range of adjacent crests and troughs in the curve, it shall meet the design requirements.

4.1.1.3 Free clearance $\leq 5^\circ$.

4.1.1.4 Function. In the process of rotating the input end, it feels smooth, without jamming; meanwhile the steering control valve can automatically return.

4.1.1.5 Return ability. The return time is ≤ 5 s.

4.1.1.6 Steering force characteristics. The steering torque and characteristic curve, at the maximum working pressure, shall meet the design requirements. The symmetry of the curve shall be $\geq 85\%$.

4.1.1.7 The internal leakage shall meet the design requirements. After the

changes within the range of (10.8 ~ 16.0) V (for 12V power system) OR (21.6 ~ 32.0) V (for 24 V power system), the controller shall be able to work normally.

4.1.3.3 Resistance to reverse polarity of power supply. The controller shall be able to withstand the reverse polarity test of the power supply, for 1 min, without damage. The controller shall be able to work normally after the test.

4.1.3.4 Withstand power supply overvoltage. The controller shall be able to withstand the power supply overvoltage test, for 1 min, without damage. The controller shall be able to work normally after the test.

4.1.3.5 Drop. The controller shall be able to work normally, after the drop test. According to the test method of steering force characteristic, it meets the requirements for steering force characteristic performance. It allows partial damage of the control box AND deformation of the bracket.

4.2 Reliability

4.2.1 Recirculating ball electronically controlled hydraulic power steering gear.

4.2.1.1 Forced steering. There must be no abnormal conditions during the test; there must be no damage to the assembly.

4.2.1.2 Overpressure. No extravasation shall occur during the test. The shell shall neither be cracked nor broken.

4.2.1.3 Reverse fatigue. There must be no extravasation and other abnormal conditions during the test. There must be no damage to the assembly.

4.2.1.4 Reverse overload. Same as 4.2.1.3.

4.2.1.5 Wear resistance. There must be no extravasation and other abnormal conditions during the test. After the test, the free clearance is $\leq 12^\circ$; the assembly must not be damaged.

4.2.2 Rack and pinion electronically controlled hydraulic power steering gear.

4.2.2.1 Forced steering. The assembly must not be damaged.

4.2.2.2 Overpressure. During the test, the assembly shall be free from damage, extravasation, or other abnormal conditions.

4.2.2.3 Reverse fatigue. The internal leakage meets the requirements; there must be no leakage, damage, or falling off of seals.

4.2.2.4 Reverse overload. Same as 4.2.2.2.

4.2.2.5 Forward steering muddy water durability. Same as 4.2.2.3.

5.1.1 The bench installation type and test conditions of the assembly.

5.1.1.1 When testing the assembly, refer to the layout of the whole vehicle OR install it straightly on the test bench. The fuel tank is allowed to use the test bench fuel tank. The absolute filtration accuracy of the filter shall not be less than 20 μm . Other devices are allowed to be replaced by the devices, which are equipped on the test bench. For the vehicle speed signal, which is input to the controller, it may be a pulse frequency signal or a network digital signal.

5.1.1.2 The oil used for the test shall meet the requirements of the assembly manual. The oil temperature for performance test is $(50 \pm 5) ^\circ\text{C}$. The oil temperature for reliability test is $(80 \pm 5) ^\circ\text{C}$. The test flow shall be based on the rated flow Q_n , which is specified in the assembly manual or design.

5.1.1.3 For the DC power supply for the test, use an automobile battery OR a rectified stabilized power supply, which has a ripple coefficient of not greater than 0.1%, OR the above two power supplies connected in parallel. When the test voltage is not specified, the 12 V electrical system is $(14 \pm 0.1) \text{ V}$; the 24 V electrical system is $(28 \pm 0.2) \text{ V}$.

5.1.2 Accuracy of the test instrument.

- a) The error of the pressure test system is not more than 1%.
- b) The error of the flow test system is not more than 1%.
- c) The error of the angle test system is not more than 0.5° .
- d) The error of the displacement test system is not more than 0.1 mm.
- e) The error of the torque test system is not more than 1%.
- f) The error of the force test system is not more than 1%.
- g) The error of the current test system is not more than 1%.
- h) The error of the voltage test system is not more than 1%.
- i) The error of the noise test system is not more than $\pm 2 \text{ dB}$.
- j) The error of the temperature test system is not more than $\pm 1 ^\circ\text{C}$.
- k) The error of the humidity test system is not more than 10% RH.

5.1.3 Test method.

For the recirculating ball AND rack and pinion electronically controlled hydraulic power steering gears, take 3 sets from each to carry out all performance tests.

- e) During the test, carry out measurement and data processing, respectively taking the 90% range of the left and right maximum rotation angles;
- f) Draw the relationship curve, BETWEEN the input torque M AND the rotation angle θ (as shown in Figure 1).

5.2.1.3 Free clearance.

- a) Install the assembly on the test bench. Rigidly fix the output end in the middle position;
- b) Rotation speed at the input end: ≤ 0.25 r/min;
- c) Measure the angle that the input end turns, when the pressure at the fuel inlet of the assembly increases by 0.1 MPa, in both directions.

5.2.1.4 Function.

- a) Install the assembly on the test bench;
- b) At the input end, apply a resistance torque, which is equivalent to one-third of the maximum resistance torque of the assembly;
- c) Rotate the input end within the full stroke, to feel smoothness and continuity; meanwhile check the return of the steering control valve.

5.2.1.5 Return ability. Under the condition that the controller receives the 30 km/h vehicle speed signal, perform the test according to the following methods:

- a) Install the assembly on the test bench, with the input end under no load;
- b) In the case of presence of power, apply a return load of 6% of the maximum output torque, at the output end;
- c) Respectively measure the time for the output end to return, FROM the two extreme positions TO the middle position; take the longer time, as the return time.

the output terminal in the middle position. The flow rate is $0.5Q_n$. Rotate the input shaft. Draw the relationship curve between input shaft torque and rotation angle.

5.2.2.12 Noise.

Under the condition that the controller receives the 0 km/h and $V_{\max}$ vehicle speed signals, the tests are carried out according to the following methods:

- a) Install the assembly on the test bench. The installation condition is equivalent to the actual vehicle;
- b) Drive the input end, so that the oil pressure at the oil inlet is $0.5 p_z$ and p_z , respectively;
- c) At the oil temperature of 50 °C, 80 °C, 100 °C, respectively, complete the test; the test environment noise is less than or equal to 30dB(A);
- d) Use the sound level meter, to measure the sound value, at the 100 mm spherical surface, from the oil inlet of the control valve.

5.2.3 Electronically controlled device.

For the recirculating ball AND rack and pinion electronically controlled hydraulic power steering gears, they shall meet the test method of the electronically controlled device.

5.2.3.1 Self-check function.

Install the electronically controlled device, under test, on the test bench. The electronically controlled device will work normally, to simulate various fault conditions set. Check whether the fault display lamp or the fault code alarm signal is normal.

5.2.3.2 Voltage fluctuations.

The controller is connected to a power supply, which has adjustable output power. In the case of 12 V power system, the power supply voltage changes at (10.8 ~ 16.0) V. In the case of 24 V power system, the power supply voltage changes at (21.6 ~ 32.0) V.

5.2.3.3 Resistance to reverse polarity of power supply.

Connect the controller, as a load, normally. In the non-working state, when the input power voltage is the reverse voltage value, reverse the power polarity for 1 min. Reverse connection voltage value: The 12 V electrical system is (14 ± 0.1) V; the 24 V electrical system is (28 ± 0.2) V.

Under the condition that the controller receives the 0 km/h vehicle speed signal, the assembly is tested according to the following methods:

- a) Install the assembly on the test bench. Keep the input end in the middle position, with a clearance of about 0.5° . Use a stopper to limit the position;
- b) Load bidirectionally at the output end, to ensure that the working pressure is the maximum working pressure;
- c) The frequency is (0.6 ~ 1.2) Hz;
- d) After the completion of 1 million alternative loads, continue the test according to 5.2.1.4 after the test.

5.3.1.4 Reverse overload.

Under the condition that the controller receives the $V_{\max}$ vehicle speed signal, the assembly is tested according to the following methods:

- a) Install the assembly on the test bench;
- b) In the presence of power, rigidly fix the input end at the middle position. At the connection between the steering rocker and the straight tie rod, quickly apply the load, at 90° to the center line of the steering rocker, until the load is equivalent to 3 times of the maximum output force; stop the test;
- c) Complete it in two directions, respectively. After the test, continue to carry out the test according to 5.2.1.4.

5.3.1.5 Wear resistance.

Input the vehicle speed signal to the controller, at a frequency of 0.5 Hz, according to the speed change mode of 0 km/h ~ $V_{\max}$ ~ 0 km/h. Under the condition of normal operation of the electronically controlled valve, carry out the test according to the following methods:

- a) Install the assembly on the test bench;
- b) The test oil pressure is the maximum working pressure. Make the steering rocker reach the maximum output torque, during the test;
- c) The input end runs at a speed of (20 ~ 30) r/min. The input end's angle is greater than or equal to 90% of the total angle;
- d) After completing 25000 cycles, continue to test according to 5.2.1.3, 5.2.1.4, 5.2.1.6, 5.2.1.7 after the test, to check whether the assembly is working properly.

completed, conduct a steering force characteristic test, to check whether the device is working properly.

5.3.3.2 Electromagnetic compatibility.

- a) Transient immunity. When the electric control device is energized, carry out the transient immunity test, of test pulse 1, 2a, 2b, 3a, 3b, 4, in accordance with the relevant requirements of 4.4 for transient immunity test, in GB/T 21437.2-2008. The grade of test impulse is grade III (in Appendix A).
- b) Electromagnetic harassment. When the electric control device is energized, respectively carry out the following two tests, according to the relevant requirements of the measurement of parts and modules, in Chapter 6 of GB/T 18655-2010:
 - 1) Measurement of conducted emission of parts;
 - 2) Measurement of radiation emission of parts.

5.3.3.3 Temperature resistance.

- a) Resistance to low temperature. Place the electrically controlled device, at a temperature of $(-40 \pm 3) ^\circ\text{C}$, for 96 h. After the test, place it at room temperature for 12 h. Continue to test according to the test method of steering force characteristics, to check whether the assembly is working properly.
- b) Resistance to high temperature. Place the electrically controlled device, at a temperature of $(125 \pm 3) ^\circ\text{C}$, for 96 h. After the test, place it at room temperature for 12 h. Continue to test according to the test method of steering force characteristics, to check whether the assembly is working properly.
- c) Resistance to temperature changes. Carry out the test, according to the test Na: test method of temperature change, in GB/T 2423.22. Cool the temperature control box, to a low temperature of $(-40 \pm 2) ^\circ\text{C}$. Put it in the electrically controlled device for 2 h. THEN, put it in a high temperature environment of $(65 \pm 2) ^\circ\text{C}$ for 2 h, reciprocating 5 cycles. After the test, continue to test, according to the test method of steering force characteristics, to check whether the assembly is working properly.

5.3.3.4 Resistance to combined temperature/humidity cycle.

Carry out test, according to the relevant requirements of test Z/AD: test method of combined temperature/humidity cycle, in GB/T 2423.34. After the test, continue to test, according to the test method of steering force characteristics,

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