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QC

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OF THE PEOPLE'S REPUBLIC OF CHINA

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Vehicle air conditioning fan

汽车空调风机

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Vehicle air conditioning fan

1 Scope

This standard specifies the terms and definitions, requirements, test methods, inspection rules, marking, packaging, storage, custody of vehicle air-conditioning fans (including evaporator blowers, condenser fans, air heater blowers).

This standard applies to vehicle air-conditioning fans (including evaporator blowers, condenser fans, air heater blowers), hereinafter referred to as fans.

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 1236 Industrial fan - Performance testing using standardized airways

GB/T 2423.17-2008 Environmental testing for electric and electronic products - Part 2: Test method - Test Ka: Salt mist

GB/T 2828.1 Sampling procedures for inspection by attributes - Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection

GB/T 18655-2018 Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers

GB/T 19951-2019 Road vehicles - Disturbances test methods for electrical/electronic component from electrostatic discharge

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

GB/T 28046.1 Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 1: General

GB/T 28046.3-2011 Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: Mechanical loads

GB/T 28046.4-2011 Road vehicles - Environmental conditions and testing

for electrical and electronic equipment - Part 4: Climatic loads

GB/T 28046.2-2019 Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 2: Electrical loads

GB/T 30038-2013 Road vehicles - Degrees of protection (IP-code) - Protection of electrical equipment against foreign objects, water and access

GB/T 33014.2-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy - Part 2: Absorb-lined shielded enclosure

GB/T 33014.4-2016 Road vehicles - Component test methods for electrical/electronic disturbances from narrowband radiated electromagnetic energy - Part 4: Bulk current injection (BCI)

QC/T 413-2002 Basic technical requirements for automotive electric equipment

QC/T 29106-2014 Technical specification of automobile wire harness

3 Terms and definitions

The terms and definitions in GB/T 28046.1, as well as the following terms and definitions, apply to this document.

3.1

Compressor blower and fan

An air drive assembly, which consists of an electric motor, a fan blade or rotor, a casing, etc.

3.2

Evaporator blower

A fan, that delivers air volume to the cabin, in an automotive air conditioner.

3.3

Condenser fan

A fan, which is used to remove energy from the condenser, in an automotive air conditioner.

3.4

run, to carry out the temperature rise test. After the temperature rise of the motor is stable, the temperature rise of the motor casing shall not exceed 55K.

4.6 Vibration resistance

During the vibration test of the fan, there shall be no damage to the parts. After the test, the performance of the fan shall not change by more than 15%, as specified in 4.2; the noise value is allowed to increase by up to 3dB (A).

4.7 Connection strength of condenser fan blade

The motor and the fan blade of the condenser fan shall be able to withstand the connection strength test of 8 times the rated torque; there shall be no visible deformation, after the test.

4.8 Strength of wire harness and terminal connection

The wiring harness and terminal of the fan connector shall be firmly connected; the minimum tensile force shall comply with the provisions of 4.4.6 in QC/T 29106-2014.

4.9 Stall resistance

4.9.1 Stall resistance of brushed motor

The brushed fan shall meet the requirements of the stall test, when energized with the test voltage U_A for 30s and 30min, respectively. After the power-on test for 30s, the fan is not allowed to be damaged; its basic performance shall comply with the provisions of 4.2.1; during the power-on test for 30min, smoke is allowed, BUT open fire is not allowed.

4.9.2 Stall resistance of brushless motor

The brushless fan shall meet the locked-rotor test, when the test voltage U_A is applied for 30 minutes. After the test, the fan is not allowed to be damaged; the basic performance shall meet the requirements of 4.2.1.

4.10 Overvoltage resistance

The fan shall meet the requirements of 4.2.1 after the voltage test.

4.11 Resistance to superimposed AC voltage

The fan shall meet the requirements of 4.2.1, after the superimposed AC voltage test.

4.12 Resistance to power supply voltage ramp down and ramp up

The fan shall meet the requirements of 4.2.1, after subject to the power supply voltage ramp down and ramp up test.

4.13 Resistance to power supply voltage transient change

The fan shall meet the requirements of 4.2.1, after subject to the power supply voltage transient change test.

4.14 Resistance to reverse voltage

The fan shall meet the requirements of 4.2.1, after the reverse voltage test.

4.15 Open circuit performance (for brushless fans)

The fan shall meet the requirements of 4.2.1, after the open-circuit test.

4.16 Short-circuit protection (for brushless fans)

After the short-circuit protection test, the fan shall meet the requirements of 4.2.1.

4.17 Withstanding voltage performance

The fan armature shall withstand a sinusoidal voltage of 500V (effective value, 50Hz ~ 60Hz), for a duration of 60s. There shall be no breakdown and flashover during the test; the leakage current shall not exceed 5mA. In the case of continuous production in large quantities, it can be replaced by a test of sine voltage of 660V (effective value, 50Hz ~ 60Hz), which lasts for 1s.

4.18 Insulation resistance

The resistance of the fan armature, through the insulation resistance test, shall not be less than 10MΩ.

4.19 Salt spray resistance

The salt spray resistance of the fans shall be carried out in a non-working state. The continuous test duration of the evaporator blower and the air heater blower is 48h; the continuous test duration of the condenser fan is 96h. After the test, the corrosion rate on the sprayed surface shall not be higher than 20%; rust and air bubbles shall be allowed within 2mm from the edge and weld; the performance shall meet the requirements of 4.2.1.

4.20 Low-temperature storage performance

After the fan has been tested for low-temperature storage, its performance shall meet the requirements of 4.2.1, after returning to normal temperature.

severity level and frequency band of the test shall be in accordance with the level L3, as specified in Table C.1, AND the frequency band F1 and F2 in Table C.2, in GB/T 33014.2-2016.

- After the fan is tested by the electromagnetic radiation immunity-big current injection (BCI) method, it shall meet the requirements of 4.2.1. The severity level and frequency band of the test shall be in accordance with the level L3, as specified in Table C.1, AND the full frequency band in Table C.2, in GB/T 33014.4-2016.
- The fan shall meet the requirements of 4.2.1, after the electrical transient conduction transient test, along the power line. The pulse type and severity level of the test shall be in accordance with the test pulse 1, 2a, 2b, 3a, 3b, pulse 4, which are specified in Table A.1 ($U_N = 12V$) or Table A.2 ($U_N = 24V$) in GB/T 21437.2-2008, under the test level III.
- The fan shall meet the requirements of 4.2.1, after the electrostatic discharge test. The severity level of the test shall be carried out, according to the level L3 category 2, which is specified in Tables C.1, C.2, C.3 of GB/T 19951-2019.

4.29 Durability

The durability performance test of the fan is divided into conventional durability and enhanced durability. Under the condition that the supplier seeks the approval of the purchaser, it may select one of the durability performances of the fan for testing. Durability test requirements are as follows:

- Conventional durability of the fan: All parts of the fan shall not be damaged, within the specified life cycle; the performance change, according to 4.2 of this standard after the test, does not exceed 15%; the noise value is allowed to increase at most 3dB(A);
- Enhanced durability of the fan: There is no damage to the parts of the fan, within the specified life cycle; the performance change, according to 4.2 of this standard after the test, does not exceed 15%. The wear of brushes and commutators of brushed fans does not exceed 15% of the effective wear; the noise value can be increased by up to 3dB(A).

5 Test methods

5.1 General requirements

5.1.1 Test conditions

5.1.1.1 Test voltage

When the test voltage of the fan is not specified, if the nominal voltage U_N is 12V, the test voltage U_A is $14V \pm 0.2V$; if the nominal voltage U_N is 24V, the test voltage U_A is $28V \pm 0.2V$.

5.1.1.2 The normal working environment conditions of the fan

Unless otherwise specified, all tests shall be carried out under the following conditions:

- Ambient temperature: $18^{\circ}\text{C} \sim 28^{\circ}\text{C}$;
- Relative humidity: $25\% \sim 75\%$;
- Atmospheric pressure: $86\text{kPa} \sim 106\text{kPa}$.

5.1.1.3 Test instruments and equipment

Test equipment and instruments are required to have sufficient resolution, accuracy, stability, to ensure that the error limit is within the allowable range of the item under test:

- Voltmeter: The accuracy is not less than level 0.5;
- Ammeter: The accuracy is not less than level 0.5;
- Tachometer: The accuracy is not less than 1%;
- Test chamber's temperature control: The accuracy is $\pm 2^{\circ}\text{C}$;
- The DC power supply is a vehicle battery OR a rectified regulated power supply with a ripple factor of not more than 0.1%, or the above two power supplies working in parallel.

5.1.2 Outline, installation dimension, tightening torque

The outline and installation dimensions of the fan shall be measured, by a general or special-purpose measuring tools, that has passed the calibration; the appearance shall be checked with the naked eye. The tightening torque of the fasteners on the fan is measured by a torque wrench.

5.1.3 Operating voltage range

The fan is fixed on the tooling table, according to the actual loading method. Apply the minimum power supply voltage $U_{S\text{min}}$ and the maximum power supply voltage $U_{S\text{max}}$, to let it run for 30 minutes. For multi-speed fans, the high-speed gear shall prevail. After the test, apply the test voltage, to test the current and speed.

Fans shall be tested, in accordance with 4.1.2.4 Test IV - Passenger car elastomers (body) or 4.1.2.7 Test VII - Commercial vehicle elastomers, in GB/T 28046.3-2011. The fan is fixed on the vibration test bench, by the actual loading method AND is in working state; the test voltage is U_A .

5.7 Connection strength test of condenser fan blade

Under normal working conditions, assemble the fan blade on the motor shaft; fix the fan blade on the fixture of the torsion test machine; apply 8 times the rated torque to the motor shaft, to move it at a constant speed; the torsion speed is $3^\circ/\text{min} \sim 30^\circ/\text{min}$.

5.8 Strength test of connection between wire harness and terminal

The strength test of the connection, between the fan wiring harness and the terminal, shall be carried out, in accordance with the provisions of 5.4.5 in QC/T 29106-2014.

5.9 Stall resistance test

Fix the rotating part of the fan. Apply the test voltage U_A , to carry out the stall resistance test.

5.10 Overvoltage resistance test

The fan's overvoltage test is carried out, in accordance with the provisions of 4.3.1.1.2 or 4.3.2.2 in GB/T 28046.2-2019. At the temperature $T = (T_{\text{max}} - 20^\circ\text{C})$, apply a terminal voltage of 18V ($U_N = 12\text{V}$) or 36V ($U_N = 24\text{V}$) to the fan, for a duration of 60min.

5.11 Resistance to superimposed AC voltage test

The fan's superimposed AC voltage test is carried out, in accordance with the provisions of 4.4.2 in GB/T 28046.2-2019.

5.12 Resistance to power supply voltage ramp down and ramp up test

The ramp down and ramp up test of the fan power supply voltage shall be carried out, in accordance with the provisions of 4.5.2 in GB/T 28046.2-2019.

5.13 Resistance to power supply voltage transient change test

The transient change test of the fan power supply voltage is carried out, in accordance with the provisions of 4.6.1.2, 4.6.2.2, 4.6.3.2 in GB/T 28046.2-2019.

5.14 Resistance to reverse voltage test

The fan's reverse voltage test is carried out, in accordance with the provisions of 4.7.2.2 or 4.7.2.3 in GB/T 28046.2-2019.

5.15 Open-circuit test

The fan's open-circuit test shall be carried out, in accordance with the provisions of 4.9.1.2 or 4.9.2.2 in GB/T 28046.2-2019.

5.16 Short-circuit protection test

The fan's short-circuit protection test is carried out, in accordance with the provisions of 4.10.2.1 in GB/T 28046.2-2019.

5.17 Withstanding voltage test

The fan's withstanding voltage test is carried out, in accordance with the provisions of 4.11.2 in GB/T 28046.2-2019.

5.18 Insulation resistance test

The fan's insulation resistance test is carried out, in accordance with the provisions of 4.12.2 in GB/T 28046.2-2019.

5.19 Salt spray resistance test

The salt spray resistance test shall be carried out, in accordance with the provisions of the test Ka: salt spray test method, in GB/T 2423.17-2008.

5.20 Low-temperature storage test

The low-temperature storage test of the fan shall be carried out, in accordance with the provisions of 5.1.1.1.2 in GB/T 28046.4-2011; the test time shall be 24h; the test temperature shall meet the provisions of 4.1.3.

5.21 Low-temperature working test

The low-temperature working test of the fan shall be carried out, in accordance with the provisions of 5.1.1.2.2 in GB/T 28046.4-2011; the test time shall be 24h; the test temperature shall meet the provisions of 4.1.3.

5.22 High-temperature storage test

The fan's high-temperature storage test shall be carried out, in accordance with the provisions of 5.1.2.1.2 in GB/T 28046.4-2011; the test time shall be 48h; the test temperature shall comply with the provisions of 4.1.3.

5.23 High-temperature working test

The high-temperature working test of the fan shall be carried out, in accordance

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