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Electrically driven motor vehicle air-conditioning unit

汽车用电驱动空调器

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Electrically driven motor vehicle air-conditioning unit

1 Scope

This Standard specifies the terms and definitions, types and basic parameters, technical requirements, test methods, inspection rules, marking, packaging, transport, and storage of electrically driven motor vehicle air-conditioning unit (hereinafter referred to as "air-conditioning unit").

This Standard applies to the electrically driven motor vehicle air-conditioning unit, which uses R134a, R407C, R410A, R744, R1234yf as refrigerants. Other special-purpose air-conditioning units or air-conditioning units using other substances as refrigerants can refer to it for implementation.

Note: For the definition of motor vehicle, see GB/T 3730.1.

This Standard does not apply to electrically driven air-conditioning units for rail vehicles.

2 Normative references

The following documents are indispensable for the application of this document. For the dated references, only the editions with the dates indicated are applicable to this document. For the undated references, the latest edition (including all the amendments) are applicable to this document.

GB/T 191 Packaging - Pictorial marking for handling of goods

GB 4706.32 Household and similar electrical appliances - Safety - Particular requirements for heat pumps, air-conditioners and dehumidifiers

GB 5226.1 Electrical safety of machinery - Electrical equipment of machines - Part 1: General requirements

GB/T 6388 Transport package shipping mark

GB 8410 Flammability of automotive interior materials

GB/T 9237-2017 Refrigerating systems and heat pumps - Safety and environmental requirements

GB/T 13306 Plates

GB/T 17619-1998 Limits and methods of testing for immunity of electrical/electronic sub-assemblies in vehicles to electromagnetic radiation

GB/T 17729 Hygienic standard for the air quality inside long distance coach

GB/T 18384.3 Electrically propelled road vehicles - Safety specifications - Part 3: Protection of persons against electric shock

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

GB/T 18837-2015 Multi-connected air-condition (heat pump) unit

GB/T 19951-2005 Road vehicles - Test methods for electrical disturbances from electrostatic discharge

GB/T 21361-2017 Motor vehicle air-conditioning unit

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

GB/T 21437.3 Road vehicles - Electrical disturbances from conduction and coupling - Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines

GB/T 27630 Guideline for air quality assessment of passenger car

GB/T 28370 Detect methods for the air quality inside long distance coach

GB/T 30512 Requirements for prohibited substances on automobiles

JB/T 7249 Terminology of refrigeration equipment

JB/T 10562 Technical specification for general purposes axial fans

JB/T 10563 Technical specification for general purposes centrifugal fans

JB/T 12845 Electrically driven compressor for automobile air conditioning

QC/T 413 Basic technical conditions of automotive electrical equipment

SAE J 1627-2011 Performance criteria for electronic refrigerant leak detectors

SAE J 1628 Technician procedures for refrigerant leak detection in service of mobile air conditioning systems

The sum of compressor power and accessory electric power of the air-conditioning unit under the specified refrigerating/heating capacity test conditions.

Note: The unit is watt (W).

3.6

Energy efficiency ratio; EER/coefficient of performance; COP

The ratio OF refrigerating/heating capacity TO total electric power of the air-conditioning unit under the specified refrigerating/heating capacity test conditions.

Note: The unit is watts per watt (W/W).

3.7

Voltage grade of power supply

The air-conditioning unit is powered by a motor vehicle power supply. The voltage grades of power supply are 12 V, 24 V, 36 V, 42 V, 48 V, 72 V, 120 V, 144 V, 168 V, 192 V, 216 V, 240 V, 264 V, 288 V, 312 V, 336 V, 360 V, 384 V, 408 V, 540 V , 600 V, 730 V, etc.

3.8

Refrigerating capacity weight ratio

The ratio of the refrigerating capacity of the air-conditioning unit to the total mass of the air-conditioning unit under the specified refrigerating capacity test conditions.

Note: The unit is watts per kilogram (W/kg).

4 Types and basic parameters

4.1 Types

4.1.1 According to the structural style of air-conditioning unit, it can be divided into:

- Integral type;

- Split type.

4.1.2 According to the layout method of the evaporator for air-conditioning unit,

- Ultra-low temperature type.

4.2 Basic parameters

4.2.1 The basic parameters of the air-conditioning unit include refrigerating/heating capacity, air supply volume, total electric power, energy efficiency ratio, refrigerating capacity weight ratio, noise.

4.2.2 The ambient temperature conditions for the normal operation of the air-conditioning unit are as follows:

- Normal type: -5 °C~50 °C;

- Low temperature type: -15 °C~50 °C;

- Ultra-low temperature type: -25 °C~50 °C.

4.2.3 The working condition parameters of the air-conditioning unit are specified as follows:

- The test conditions of the air-conditioning unit shall be in accordance with Table 1;

- The full-performance conditions of normal air-conditioning unit shall be in accordance with Table 2;

- The full-performance conditions of low temperature air-conditioning unit shall be in accordance with Table 3;

- The full-performance conditions of ultra-low temperature air-conditioning unit shall be in accordance with Table 4.

5.1.1 The air-conditioning unit shall comply with the provisions of this Standard; and, be manufactured in accordance with the drawings and technical documents approved by the prescribed procedures.

5.1.2 The prohibited substances on the air-conditioning unit shall meet the requirements of GB/T 30512.

5.2 Requirements for parts and materials

5.2.1 All parts and materials of the air-conditioning unit shall comply with the relevant standards, respectively; meet the use performance requirements and ensure safety.

5.2.2 The heat insulation layer of the air-conditioning unit shall have good thermal insulation and non-absorbency, be non-toxic and non-odorous. The heat insulation layer shall be pasted firmly and evenly.

5.2.3 The selection and installation of electrical components of air-conditioning unit shall meet the requirements of GB 4706.32 and GB 5226.1.

5.2.4 The outer insulation layer of the wire and cable for air-conditioning unit shall be made of flame-retardant, low-smoke, and halogen-free materials. The current carrying capacity of wire and cable shall meet the requirements of use.

5.2.5 On the surface of the painted parts, there shall be no obvious bubbles, flow marks, missing coating, exposed primer, and undesirable wrinkles and damage.

5.2.6 The air-conditioning unit and indoor circulating wind contact materials, etc. shall be made of environmentally-friendly materials, which are lightweight, easy to process, pollution-free, and recyclable. The selection of relevant materials shall meet the requirements of GB/T 17729, GB/T 27630, and GB/T 28370.

5.2.7 The flame-retardant property of horizontal firing of rubber, rubber products, and heat insulation materials used in air-conditioning unit shall meet the requirements of class B in GB 8410. The flame-retardant property of horizontal firing of other non-metallic parts shall meet the requirements of A-0 mm/min in GB 8410.

5.2.8 The electrical equipment of air-conditioning unit shall meet the requirements of GB/T 18384.3 and QC/T 413.

5.2.9 The air-conditioning unit is powered by the whole vehicle; shall meet the requirements of the vehicle power supply.

5.2.10 Fans for air-conditioning units shall meet the requirements of JB/T 10562, JB/T 10563, or corresponding fan standards.

The measured total electric power of the air-conditioning unit shall not be greater than 110% of the nominal total electric power.

5.5.5 Air supply volume

The measured air supply volume of the air-conditioning unit shall not be less than 95% of the nominal air supply volume.

5.5.6 Refrigerating at maximum operation

5.5.6.1 During refrigerating at maximum operation, all components of the air-conditioning unit shall not be damaged and shall be able to operate normally; the overload protector shall not trip.

5.5.6.2 After the air-conditioning unit is shut down for 3 min, then start the continuous operation for 1 h; but within the first 5 min of starting operation, the overload protector is allowed to trip; no action is allowed thereafter. If the overload protector is not reset within the first 5 min of operation, but is reset within 30 min of shutdown, it shall be operated continuously for 1 h.

For a manually-reset overload protector that trips within the first 5 min, it shall be forced to reset after tripping for 10 min. After which, it shall be able to run continuously for another 1 h.

5.5.7 Condensation

During the condensation operation, there shall be no condensation water dripping for the installation surface of the air-conditioning unit inside the vehicle. The air supply inside the vehicle shall not carry water droplets.

5.5.8 Refrigerating at minimum operation

During refrigerating at minimum operation, the air-conditioning unit starts after stopping for 10 min; and then continuously runs for 4 h. During the operation, the safety device shall not trip. The area of frost condensed on the windward surface of the evaporator shall not be greater than 50% of the evaporator area. The air duct of the evaporator shall not be blocked by frost. Flake ice or water droplets shall not blow out from the air outlet of the air-conditioning unit.

Note 1: During the operation of the air-conditioning unit, the anti-freezing automatic reset device is allowed to operate.

Note 2: When the frosting area of the evaporator's windward surface is not easy to be seen visually, it can be judged by the air volume (the air volume drops no more than 25% of the initial air volume).

5.5.9 Heating at maximum operation

design requirements and be sensitive and reliable.

5.6.3 Machinery safety

The design of the air-conditioning unit shall ensure reliable stability during normal transport, installation, and use. During the vibration test operation, the parts of the air-conditioning unit shall not be damaged; the fasteners shall not be loose. After the vibration test, the air tightness test shall be carried out; the refrigerating system shall have no refrigerant leak. The protective cover, protective net, or similar components shall have sufficient mechanical strength.

5.6.4 Electrical safety performance

5.6.4.1 Insulation resistance

The insulation resistance of the charged parts of the air-conditioning unit to the ground and to non-charged metal parts shall not be less than 2 MΩ.

5.6.4.2 Electrical strength

The insulation between the charged parts of the air-conditioning unit and the non-charged metal parts shall be able to withstand the specified test voltage, without breakdown or flashover.

5.6.4.3 Electromagnetic compatibility

5.6.4.3.1 The electromagnetic immunity of the air-conditioning unit shall meet the following requirements:

a) During the operation of immunity to electromagnetic radiation, under normal use conditions, the air-conditioning unit shall be able to operate normally;

b) During the operation of immunity to electrical transient conduction, under normal use conditions, the air-conditioning unit shall be able to operate normally;

c) During the operation of immunity to electrostatic discharge, under normal use conditions, the air-conditioning unit shall be able to operate normally.

5.6.4.3.2 The electromagnetic disturbance of the air-conditioning unit shall meet the following requirements:

a) The conducted disturbance, generated by the operation of the air-conditioning unit under normal conditions of use, shall comply with the requirements for the conducted disturbance limits of parts specified in 6.2 or 6.3 of GB/T 18655-2010.

6.3 Content of test methods

6.3.1 Test of sealing performance

The test method of sealing performance is as follows:

a) For air-conditioning unit using R134a refrigerant, the refrigerating system and components of the air-conditioning unit are under normal refrigerant charge. USE an electronic refrigerant leak detector which meets the technical requirements of SAE J 1627-2011 for R134a and can test the component leak rate at 14 g/a. Inspect in accordance with the technician procedures specified in SAE J 1628. Each refrigerating system component of split air-conditioning unit can be tested separately.

b) For air-conditioning unit using non-R134a refrigerant, the refrigerating system and components of the air-conditioning unit are under normal refrigerant charge. USE an electronic refrigerant leak detector which meets non-R134a refrigerant and can test the component leak rate at 14 g/a. Inspect in accordance with the technician procedures specified in SAE J 1628. Each refrigerating system component of split air-conditioning unit can be tested separately.

6.3.2 Running test

The air-conditioning unit is continuously operated at room temperature. TEST the current, voltage, and input power of the air-conditioning unit. CHECK the sensitivity and reliability of the safety protection device. Inspect whether the operation of control elements such as thermostats and electrical appliances is normal.

6.3.3 Test of refrigerating/heating capacity

6.3.3.1 Under the nominal refrigerating conditions specified in 4.2.3 and the external static pressure specified in 4.2.4, in accordance with Appendix A of GB/T 21361-2017, perform the refrigerating capacity test.

6.3.3.2 Under the nominal heating conditions specified in 4.2.3 and the external static pressure specified in 4.2.4, in accordance with Appendix A, perform the heating capacity test.

6.3.4 Test of total electric power

At the same time as the 6.3.3 test, determine the total electric power of the air-conditioning unit.

6.3.5 Test of air supply volume

6.3.10 Test of heating at minimum operation

PUT the air-conditioning unit in working condition. Without violating the manufacturer's regulations, adjust its temperature controller, fan speed, damper, and guide grille to the state of maximum heating capacity. After stable operation according to the minimum heating operating conditions specified in 4.2.3, operate for 4 h more.

6.3.11 Test of heating defrosting

PUT the air-conditioning unit in working condition. Without violating the manufacturer's regulations, adjust the temperature controller, fan speed, damper, and guide grille equipped with automatic defrosting device to the state, which is most likely to cause frost on the outside heat exchanger of the vehicle. After stable operation according to the heating defrosting test conditions specified in 4.2.3, continuously operate for 3 h (the total test time starts from the end of the first defrosting cycle). At the end of the defrosting cycle, the temperature of the air outside the vehicle shall not increase by more than 5 °C.

6.3.12 Test of heating power consumption of electric heating device

The test method of heating power consumption of electric heating device is as follows:

a) The air-conditioning unit operates according to the nominal heating conditions specified in 4.2.3. After the heating capacity of heat pump has stabilized, determine the input power of the electric heating device.

b) For the PTC element as an auxiliary electric heating device, during the test, the heat pump system of the air-conditioning unit does not run. TURN on the electric heating device and make it operate in the working state of maximum calorific value; determine its input power.

6.3.13 Test of full-condition performance

Under the full-performance conditions specified in 4.2.3 and the external static pressure specified in 4.2.4, in accordance with Appendix A of GB/T 21361-2017, perform the refrigerating capacity test; in accordance with Appendix A of this Standard, perform the heating capacity test. Determine the refrigerating/heating capacity of the air-conditioning unit and the corresponding total electric power.

6.3.14 Noise test

The air-conditioning unit is operated continuously at room temperature. In accordance with the provisions of Appendix B of GB/T 21361-2017, measure the noise. The external static pressure of the air-conditioning unit connected to the air duct is tested at 100 Pa.

of the air-conditioning unit is tested in accordance with the methods specified in GB/T 21437.2 and GB/T 21437.3 or the method approved by both parties through consultation with the user.

c) Under the level III immunity limits specified in Table B.1 of GB/T 19951-2005, the immunity to electrostatic discharge of the air-conditioning unit is tested according to the method specified in Clause 5 of GB/T 19951-2005.

6.3.17.3.2 The electromagnetic disturbance test of the air-conditioning unit is carried out according to the following regulations:

a) Conducted disturbance of the air-conditioning unit is tested according to the method specified in 6.2 or 6.3 of GB/T 18655-2010.

b) Radiated disturbance of the air-conditioning unit is tested according to the method specified in 6.4 or 6.5 of GB/T 18655-2010.

7 Inspection rules

7.1 Exit-factory inspection

Each air-conditioning unit is subjected to exit-factory inspection. The inspection items, technical requirements, and test methods shall be in accordance with Table 11.

7.2 Sampling inspection

7.2.1 The air-conditioning unit shall be sampled from the products, which have passed the exit-factory inspection. The inspection items and test methods shall be in accordance with Table 11.

7.2.2 The sampling method is determined by the sampling party itself. The sampling inspection items, lot size, sampling plan, inspection level, and acceptance quality level, etc. of the lot-by-lot inspection are determined by the quality inspection department of the manufacturer itself.

7.3 Type inspection

New products and stereotyped products for major improvements or the first product shall be type-inspected. The inspection items shall be in accordance with Table 11.

Table 11 -- Inspection items

No.	Items	Exit-factory inspection	Sampling inspection	Type inspection	Technical requirements	Test methods
1	General inspection	△	△	△	5.1, 5.2, 5.3, 5.4	Visual

- Exit-factory date of production;

- Main technical performance parameters (refrigerant code and other such as: rated voltage, nominal refrigerating/heating capacity, nominal total electric power, air supply volume, external static pressure, refrigerant charge, refrigerating capacity weight ratio, and noise).

8.1.2 The air-conditioning unit shall have a mark indicating the operation status (such as the arrow of the control switch and the direction of rotation of fan), indicating instrument, and obvious grounding sign, etc.

8.1.3 In an easily-visible part of the normal installation state, the air-conditioning unit shall be provided with a permanent safety identification (such as a warning identification, etc.).

8.1.4 The following marks shall be on the packaging case of the air-conditioning unit:

- Name of the manufacturer;

- Name and model of product;

- Mass (net mass, gross mass);

- Overall dimensions;

- "Handle with care", "Upward", "Keep dry", and the number of stacked layers, etc. Relevant packaging and handling marks shall meet the relevant regulations of GB/T 6388 and GB/T 191.

8.2 Packaging

8.2.1 Before packaging, air-conditioning unit shall be cleaned. The integral air-conditioning unit shall be filled with rated amount of refrigerant. The split air-conditioning unit can be filled with rated mount of refrigerant; or can be filled with dry nitrogen or inert gas; the pressure can be controlled within the range of 0.1 MPa~0.3 MPa (gauge pressure). All parts shall be clean and dry. Easy-to-rust parts shall be coated with rust inhibitor.

8.2.2 The packaging case shall be accompanied with the exit-factory accompanying documents. The exit-factory accompanying documents shall be moisture-proof and sealed; placed in a suitable position in the packaging case. The accompanying documents shall contain the product conformity certificate, instructions for installation and use, and packing list.

a) The content of the product conformity certificate shall include at least:

A.3.1 Requirements of test room

A.3.1.1 There shall be a test room on the evaporator side. The test conditions of the room shall be kept within the allowable range.

A.3.1.2 There shall be a test room on the condenser side. The room shall have sufficient volume, to allow the same conditions for air circulation and normal operation. In addition to the dimensional relationship required by the installation, the distance between the room and the air discharge side of the air-conditioning unit condenser shall not be less than 2 m; the distance between other surfaces of the air-conditioning unit and the room is not less than 1 m. The flow rate of the air handled by the room air-conditioning unit shall not be less than the flow rate of the outdoor air. After being treated according to the required working conditions, at a low speed, it is evenly sent back to the test room on the condenser side. During the test, the velocity of air near the air-conditioning unit shall not exceed 2.5 m/s.

A.3.2 Installation of air-conditioning unit

A.3.2.1 The air-conditioning unit under test shall be installed according to the installation requirements of the manufacturer. The air-conditioning unit is installed in the room on the condenser side. The evaporator side of the air-conditioning unit shall be connected to the evaporator side by the air duct.

A.3.2.2 Except for installing the required test devices and instruments according to the prescribed method, the air-conditioning unit shall not be refitted.

A.3.2.3 When necessary, the air-conditioning unit shall be evacuated and charged with the type and quantity of refrigerant specified in the manufacturer's instructions.

A.3.3 Test procedure of heating capacity

The test procedure of heating capacity shall be in accordance with the provisions of Appendix C of GB/T 18837-2015.

A.4 Test records and test results

A.4.1 The test data to be recorded for the heating capacity test of the air-conditioning unit is shown in Table A.1.

Table A.1 -- Test data

No.	Record items	Unit
1	Test date	
2	Tester	
3	Model and exit-factory number of the test air-conditioning unit	

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