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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

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Logistics robots - Test methods for electrical safety

物流机器人 电气安全测试方法

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4.1 Preparation of test samples The test sample should be a complete robot system that represents the state of formal production, including all protective housings and covers. Before testing, it should be confirmed that all electrical functions of the sample are normal and there are no pre-existing faults or losses. The manufacturer should provide the following technical documents.

a) Electrical schematic diagram and safety function description;

b) Specifications and certifications for key components (battery, charger, protection devices).

4.2 Preprocessing Test preprocessing should include the following.

a) Electrical system pretreatment. Before testing, connect the logistics robot to the rated power supply, start it, and run it to normal operating condition (usually continuous). Continue running for 30 minutes to ensure that electrical components (such as motors and control modules) reach a stable operating temperature, avoiding problems caused by cold starts. Test data deviation;

b) Battery system pretreatment. If the test item is related to battery safety performance (such as overcharge protection, power failure recovery), the pretreatment stage must first... Fully charge the battery according to the manufacturer's standard charging procedure, then let it stand for 1 hour to allow the battery temperature to equalize with the ambient

temperature.

c) Safety Status Confirmation. Check that the robot's safety protection devices (such as emergency stop button, overload protection, and leakage protection) are in their initial effective state. The power system is in "standby" mode, with no abnormal alarm signals.

4.3 Environmental Conditions The performance of logistics robots should be tested under the following conditions.

a) Ambient temperature. 0°C~40°C;

b) Relative humidity. 0%~80%;

c) Ground or slope. Friction system within the range of

0.75 to 1.0, measured according to GB/T 18029.13. If the environmental conditions specified by the manufacturer exceed the above conditions, this should be stated in the test report.

5.Basic Testing Requirements The basic requirements during the testing process are as follows:

a) Measuring instruments (such as oscilloscopes, insulation resistance testers, temperature recorders, withstand voltage testers, etc.) should be connected according to the requirements of the test items. The instrument must be within its valid calibration period.

6.1 General Requirements Test Methods

6.1.1 Equipotential bonding The operational observation inspection method was used to check whether the protective connection circuit of the sample met the corresponding technical requirements. When observation and inspection methods cannot determine the cause, the logistics robot (hereinafter referred to as "the robot") should be completely powered off, and three connections should be randomly sampled. Connect a current of at least 24V and 10A to test the impedance between any connection points and record the DC resistance value between any connection points.

6.1.2 Anti-static grounding The test shall be conducted in accordance with the method in section

18.2 of GB/T 5226.1-2019.

6.1.3 Insulation Insulation resistance was tested using a megohmmeter. The megohmmeter output voltage was 500V DC, and the test voltage was applied for 1 minute. This is performed while the robot is powered off. During testing, the battery should be disconnected from the circuit. Components unsuitable for withstanding a 500V test voltage (such as semiconductor devices, communication devices) should not be tested. Interfaces, etc., and surge protection devices that may activate during testing should be disconnected or short-circuited from the test circuit. Measure the insulation resistance between all

electrical lines (excluding the battery) and the robot chassis (or protective grounding terminal), and record the measured resistance. Resistance value.

6.1.4 Dielectric Strength Conduct the test according to section

5.4.9 of GB 4943.1-2022.Record whether breakdown, flashover, or arcing occurs during the test.

6.1.5 Protection against electric shock Visually inspect whether the robot has external structural protection or electrical isolation protection devices. After disconnecting the robot's power switch and removing the power connection, measure the voltage between each pin of the power interface within 5 seconds and record the measured values. The voltage value.

6.1.6 Overcurrent Protection Visually inspect the robot's overcurrent protection components for markings, ratings, and installation locations. Jam the robot's wheels and observe whether the robot can stop safely and sound an alarm. At the same time, observe whether a fire or smoke occurs. The robot short-circuit fault test is performed according to the following steps. only one component is short-circuited at a time, and each identified component only withstands [the short-circuit test]. Subjected to a short-circuit test.

a) Use a cable with a cross-sectional area of not less than

2.5 mm^2, and apply a short circuit to the component under test by adding an appropriate switching device. This test should only target one component, and the part most likely to cause the most adverse or dangerous situation should be selected for testing;

b) Keep the equipment powered on until the short-circuit protection circuit trips or the protective device disconnects;

c) After the protection action, wait at least 10 minutes to allow the system to reach steady-state temperature;

d) Observe for signs of fire, smoke, or molten metal spillage, and monitor the cable's temperature during the short circuit using temperature measuring instruments. Does the temperature rise exceed its specified temperature limit?

6.1.7 Electromagnetic Compatibility The test was conducted according to the test method in GB/T 17799.2 to verify whether the robot's safety functions were compromised after being subjected to external electromagnetic interference. Invalid.

6.1.8 Temperature rise The temperature rise of the heating element and its surrounding components shall be measured in accordance with test

9.3 of GB 4943.1-2022.

6.1.9 Protection Level The robot's shell protection capability should be tested according to the following methods.

a) IK level tests are conducted according to Chapter 6 of GB/T 20138-2023;

b) IP rating shall be tested in accordance with Chapters 13 and 14 of GB/T 4208-2017;

6.2 Power Supply Test Method

6.2.1 Power Supply Voltage Measure and record the power supply voltage according to the manufacturer's stated specifications. Low voltage may indicate a problem. To check for risks, examine the electrical connection drawings provided by the manufacturer, and check the description of the low-voltage protection function in the drawings.

6.2.2 Charging Interface

6.2.2.1 Docking The robot charging docking should be tested according to the following steps.

a) During the test, except when continuous charging is required during operation, confirm that the robot is in a state where it is prohibited from moving;

b) Repeat the docking process 100 times, observing for potential ignition sources such as electric arcs and sparks throughout each docking and separation process;

c) After 100 docking cycles, check the charging docking structure for mechanical deformation and test its electrical functions to ensure they are normal.

6.2.2.2 Reverse Connection Protection Reverse the positive and negative electrodes of the robot charging system's output port to the charger's output port, and connect a multimeter to the circuit. When the circuit is open, observe the ammeter reading. After maintaining the connection for 15 seconds, disconnect the circuit, correctly connect the positive and negative electrodes, and record the ammeter reading.

6.2.3 Power off When using a disconnect switch or a detachable connector as a power disconnect device, perform the following tests.

a) Power disconnection test. 1) Connect the switch/connector under test to the test circuit and connect the drive component. Set the power supply voltage to the nominal value and the load to [value missing]. Rated current; 2) Start the system to full load operation, triggering the cut-off device to disconnect the power supply; 3) Use a voltmeter to measure the voltage at the input terminals of each component, confirm that the voltage has dropped to a safe range, and verify that it cannot be restored without manual operation. powered by; 4) Operate the manual reset device to check if the power supply has been restored and if the drive components are functioning normally; 5) Repeat the above steps 10 times, recording the success rate of the reset and any abnormal phenomena each time; 6) If the voltage of the drive component is <=60VDC after power failure, the reset device has no automatic recovery function, and there is no failure after 10 cycles, then it is considered as... Test passed.