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NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA

ICS 33.100.20;53.060

CCS J 83

GB/T 30031-2021

Replacing GB/T 30031-2013

Industrial trucks - Electromagnetic compatibility

工业车辆 电磁兼容性

Issued on: December 31, 2021

Implemented on: July 01, 2022

Issued by: State Administration for Market Regulation;

Standardization Administration of the People's Republic of China.

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Industrial trucks - Electromagnetic compatibility

1 Scope

This Standard specifies the requirements and limits, test procedures and judgment criteria for electromagnetic emission and immunity to external electromagnetic fields of industrial vehicles that use any power source (hereinafter referred to as vehicles) and their electrical/electronic systems (hereinafter referred to as systems) defined in GB/T 6104.1-2018.

This Standard applies to vehicles and their systems used in residential, commercial, light industrial and industrial environments (see GB 17799.3-2012 and IEC 61000-6-2:2016).

This Standard does not apply to:

- Low-lift straddle carriers for non-stacking;
- High-lift straddle carriers for stacking;
- Pedestrian vehicles, other than vehicles equipped with load handling devices with electric lift;
- Vehicles with a maximum speed of more than 30km/h on ordinary roads;
- Positioning systems for unmanned industrial vehicles;
- Mutual interference between vehicle systems;
- Interference problems of in-vehicle wireless communication equipment;
- Devices (such as a car charger) connected to AC power and only used when the vehicle is not moving.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 10827.1, *Industrial trucks - Safety requirements and verification - Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*

GB/T 17626.2-2018, *Electromagnetic compatibility - Testing and measurement techniques - Electrostatic discharge immunity test*

GB/T 17626.3-2016, *Electromagnetic compatibility - Testing and measurement techniques - Radiated, radiofrequency, electromagnetic field immunity test*

GB 17799.3-2012, *Electromagnetic compatibility (EMC) - Generic standards - Emission standard for industrial environments*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments*

CISPR16-1-1:2019, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus*

CISPR16-1-4:2019, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Antennas and test sites for radiated disturbance measurements*

CISPR16-2-3:2019, *Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 10827.1 as well as the followings apply.

3.1 test sample

vehicles and/or their electrical/electronic systems, electrical equipment, system configurations used for type test

NOTE 1: Electric motors and generators are examples of electrical equipment.

NOTE 2: System configuration with maximum length of cable and wiring.

3.2 electrical/electronic system

a combination of electrical/electronic components or parts connected by ancillary electrical connections and cables, capable of working independently and performing one or more specific functions as part of a machine

3.3 narrowband emission

significantly from the manufacturer's instructions, the vehicle/system needs to be tested.

NOTE: The entire system refers to the internal combustion engine or the electrical/electronic module.

All test results, test procedures and working modes during the test shall be accurately recorded in the test report.

5.2 Electromagnetic field emission test

5.2.1 General requirements

The emission of all functions/units of the vehicle/system shall be tested in accordance with the methods of 5.2.3, 5.2.4, 5.2.5, 5.2.6. System tests can be performed separately or in any combination.

The emission value shall meet the limit requirements specified in 4.1.

5.2.2 Test and measurement instruments

Test and measurement instruments shall comply with CISPR 16-1-4:2019 and CISPR 16-1-1:2019 (except for antenna location).

5.2.3 Test steps

Antenna shall be 3m high. Place it 10m away from the side of the vehicle/system. According to Figure 2, the antenna shall be at right angles to the specimen except for the load handling device and located on its centerline.

The test shall be performed on both sides of the vehicle/system. The antenna is in both vertical and horizontal polarization states.

When the above steps are completed, determine from the results the five radiated peak frequencies associated with the reference limit curve. Then by changing the height of the antenna (from 2m to 4m), repeat the test according to the above frequency, so as to determine that the measured value does not exceed the reference limit curve.

When electrical components emit narrowband emissions, the narrowband emissions shall be measured using an EMI receiver with averaging or quasi-peak filtering.

NOTE 1: For other relevant information, see GB 14023-2011.

When a high-voltage ignition internal combustion engine system emits broadband emissions, the broadband emissions shall be measured using an EMI receiver with quasi-peak filtering.

NOTE 2: For other relevant information, see GB 14023-2011.

shall be set to the maximum operating speed.

For internal combustion vehicles, the spark ignition engine shall run at 1500r/min. Diesel engines shall run at a low idle speed of 1.5 times.

5.2.5 Load handling drive system test driven by electric motor

When the load handling drive system can be controlled by pulse width modulation, the motor speed shall be controlled to 60% to 80% of the maximum speed. When there is no speed control, the motor speed shall be set to the maximum operating speed. If the specifications of the vehicle hydraulic system prohibit continuous operation, the hydraulic system of the test vehicle shall be modified. Enable the test procedure to proceed.

When the motor of the low-lift vehicle is allowed to open time to prohibit its continuous operation, the test shall be carried out using a spectrum analyzer (the filter shall be adjusted to the peak mode). In this case the frequency range can be divided into 10 sub-intervals. Each subinterval is measured in peak mode by using the max hold function or using the FFT method defined in CISPR 16-2-3:2019.

NOTE: The time required to obtain the value depends on the test equipment.

When the load handling drive system uses electrical/electronically operated components, such as solenoid valves or proportional control valves, the components shall be energized during the test.

5.2.6 Power steering system test driven by electric motor

During the test, the steering motor shall run continuously. When the steering system is controlled by pulse width modulation, the test shall be carried out in the state of pulse speed regulation.

In non-pulse speed regulation, the motor speed shall be set to the maximum speed.

When a low-lift vehicle's electric motor allows its on-time to prohibit its continuous operation, it shall use a spectrum analyzer to test (filters shall be adjusted to peak mode). In this case the frequency range can be divided into 10 sub-intervals. Each sub-interval is measured in peak mode by using the max hold function or using the FFT method defined in CISPR 16-2-3:2019.

NOTE 1: To achieve the above test conditions, it may be necessary to separate the steering motor.

NOTE 2: The time required to obtain the value depends on the test equipment.

5.2.7 Auxiliary electrical equipment test

During the test, auxiliary components, such as transformers, fans, wiper motors, shall be connected. Electrical/electronic accessories that work for a short time (several

seconds), such as horns, motors for automatic windshield washers, shall not be included in this test.

5.3 Electromagnetic radiation immunity test

5.3.1 General requirements

Immunity tests shall be carried out for various functions that may lose their original performance under the influence of electromagnetic radiation. Each function can be tested separately or in any combination.

When the vehicle/system's service and/or parking brakes are electrically/electronically controlled, their function shall remain normal during the test.

Interference during testing shall not:

- Affect the driver's direct control of the vehicle;
- Affect the performance of safety-related components of the vehicle or system;
- Generate any incorrect signals that could lead to dangerous maneuvers by the driver.

When the requirements of 5.3.4~5.3.8 are met, the electromagnetic radiation immunity of the vehicle is qualified.

The test shall be carried out in accordance with the electromagnetic field limit requirements specified in 4.2.

5.3.2 Test and measurement instruments

Test and measurement instruments shall comply with the provisions of GB/T 17626.3-2016.

5.3.3 Basic test steps

The antenna shall be installed no more than 3m away from the vehicle/system side, facing the midpoint of the vehicle/system length and perpendicular to the longitudinal center plane of the test sample. Vehicle length does not include load handling device (see Figure 3). If the uniform field strength required by serial numbers 1, 2, and 3 in Table 1 can be achieved, the distance between the vehicle/system and the antenna can be reduced. Other test methods such as those mentioned in GB/T 17626.3-2016 can also be used.

The test shall be performed on both sides of the vehicle/system. The antenna is in both vertical and horizontal polarization states.

meters

5.3.5 Low speed test of travel drive system

Prop up the vehicle (drive wheels in the air) to test the drive system.

The driving wheel shall rotate at 20%~40% of the maximum speed. When the vehicle limits the speed of the vehicle for safety reasons, if the speed limit value is less than 40% of the maximum driving speed, the test is carried out at the limit speed.

The speed change shall not exceed 20% of its set value.

5.3.6 Load handling drive system test

The immunity of the load handling drive system shall be tested under any of the following conditions:

- The hydraulic valve is controlled by an electrical/electronic device;
- The load handling drive system and the power steering system are driven by the same electric motor.

The test shall be carried out with no load. The motor speed shall be set to 10%~30% of the maximum operating speed. If the specifications of the vehicle hydraulic system prohibit the continuous operation of the electric motor, the hydraulic system of the test vehicle shall be modified, so that the test procedure can be carried out.

The speed change shall not exceed 20% of its set value.

For the electric oil pump system that only supplies energy for hoisting, the speed test requirement is not required for vehicles with low hoisting height, but the electric oil pump shall enter the standby state.

There shall be no unexpected movement of any part of the load handling drive system during the test.

5.3.7 Electric power steering system test

The steering motor shall be:

- a) Connected to an energized control system without operating the steering controls;
- b) Rotate at 20%~40% of its maximum speed.

Condition b) shall only be used when the design of the vehicle steering system allows continuous operation of the steering motor.

During the test according to a), the steering speed of the wheels shall not exceed 0.5°/s. During the test according to b), the actual steering speed change shall not exceed 20% of its set value.

When the power steering system is part of the electronic automatic guidance system, the test shall be carried out on the basis of system simulation (actual operating conditions) and with energy supply. The vehicle shall be locked on the guide set with the nominal value. The steering motor shall not operate. If a mechanical steering limiter is installed, it shall be in effect throughout the test.

The steering motor shall not rotate during the test. When the system is in calibration error, small rotations are allowed. The system shall remain in boot mode and shall not return to manual mode.

5.3.8 Auxiliary electronic equipment test

The test shall be carried out with the system energized. When verifying the requirements of 4.2, the equipment shall not undergo dangerous changes during the test.

5.4 Electrostatic discharge immunity test

The electrostatic discharge test shall comply with the provisions of GB/T 17626.2-2018 (test according to level 4).

If under the interference of electrostatic discharge, the vehicle may start driving by itself. The driving wheel shall be supported and suspended in the air to prevent the vehicle from hitting people and objects.

All systems shall be powered on. The vehicle/system shall be in a ready-to-run state at the start of the test, but the speed control shall be released. For internal combustion vehicles, the gear lever shall be in neutral (neutral). The load handling function is not activated. The steering control does not operate.

The ground terminal of the ESD (Electrostatic Discharge) test equipment shall be connected to the vehicle frame. Record the location of the grounding point.

Temporary reduction or loss of function that is self-recovering is acceptable.

5.5 Auxiliary magnetic field immunity test

Immunity tests shall be performed on any safety-relevant part that may be affected by magnetic radiation which could lead to a hazardous situation or deviate from the acceptance criteria defined above. Components are allowed to be tested after separation from the vehicle.

NOTE: Safety components that can be affected by magnetic radiation, such as accelerators, altitude sensors and joysticks.

The test shall be carried out in a uniform magnetic field and shall meet the specified values in Table 1. Components shall be tested in all three axes (x, y, z).

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