BS EN 12895:2015

BSI Standards Publication

Industrial trucks — Electromagnetic compatibility

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National foreword

This British Standard is the UK implementation of EN 12895:2015. It supersedes BS EN 12895:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MHE/7, Industrial trucks.

A list of organizations represented on this committee can be obtained on request to its secretary.

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European foreword

This document (EN 12895:2015) has been prepared by Technical Committee CEN/TC 150 “Industrial trucks - Safety”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2016, and conflicting national standards shall be withdrawn at the latest by September 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12895:2000.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA and Annex ZB, which are an integral part of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

With the use of electronic devices in areas where industrial trucks operate, there is a need to ensure that industrial trucks are provided with adequate immunity to external electromagnetic fields. As industrial trucks are fitted with electrical and electronic devices, there is a need to ensure that emission of electromagnetic fields from the trucks meets acceptable limits.

High frequency electrical disturbances emerge during the normal operation of many parts of the industrial trucks and systems. They are generated within a large frequency range with different electrical characteristics.

Electrostatic discharges are relevant to industrial trucks.

The test methods and acceptance criteria included in this document are suitable for industrial trucks in view the specific characteristics and the operating parameters of this machinery; the tests have been designed to reflect the construction of industrial trucks.

Two approaches are described to achieve compliance:

— complete truck tests;

— electrical/electronic systems with the components in the same configuration as in the truck.

In some situations trucks can be foreseen to be used in environments where the level of electromagnetic disturbances are likely to exceed the test levels within the scope of this European Standard. In these situations, levels and/or frequencies outside the specified test parameters will need to be applied. In addition, many areas are not homogeneous for their EMC classification; for example, hospitals and airports have areas with different levels of classifications, for the areas outside the generic standard definitions special rules can be applicable.

1 Scope

This European Standard is applicable to industrial trucks, regardless of the power source (called only trucks) as defined in ISO/FDIS 5053-1, and their electrical/electronic systems when used in residential, commercial, light industry and industrial environments (specified in EN 61000-6-3:2007 and EN 61000-6-2:2005).

This European Standard specifies:

— the requirements and the limit values for electromagnetic emission and immunity to external electromagnetic fields;

— the procedure and criteria for testing trucks and their electrical/electronic systems.

This European Standard is not applicable to:

— non-stacking low-lift straddle carriers;

— stacking high-lift straddle carriers;

— any pedestrian propelled trucks, excepted those which are equipped with load handling devices which have electrical powered lifting devices;

— trucks intended for use in the public domain[1)] with maximum speed exceeding 30 km/h;

— positioning system of driverless industrial trucks;

— interaction between systems on the trucks;

— interference to on-board radio equipment;

— equipment connected to AC-mains which is only used when the truck is not being operated (e.g. on board charger).

2 Normative references

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

EN 55016-1-1, *Specification for radio disturbance and immunity measuring apparatus and methods — Part-1-1: Radio disturbance and immunity measuring apparatus — Measuring apparatus*

EN 55016-1-4, *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*

EN 55016-2, *Specification for radio disturbance and immunity measuring apparatus and methods — Part 2: Methods of measurement of disturbances and immunity*

EN 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test (IEC 61000-4-2)*

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1) For trucks used in the public domain, other specific European Directives and national requirements are to be applied.

EN 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test (IEC 61000-4-3)*

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

EN 61000-6-2:2005, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments (IEC 61000-6-2:2005)*

EN 61000-6-3:2007, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3:2006)*

EN ISO 3691-1:2012, *Industrial trucks — Safety requirements and verification — Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks (ISO 3691-1:2011)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in applicable parts of EN ISO 3691 and the following apply.

3.1
test sample
truck and/or electrical/electronic system, electrical machines, system configuration for subjecting to type test

Note 1 to entry: Motors and generators are examples of electrical machines.

Note 2 to entry: The system configuration is set up with maximum cable and harness lengths.

3.2
electrical/electronic system
electrical/electronic component(s) or a set of components intended to be part of a machine together with any associated electrical connections and wiring, that performs one or more specialized functions and operates on its own

Note 1 to entry: Also referred to as system.

3.3
narrowband emission
emission that has a bandwidth less than that of a measuring apparatus or receiver

Note 1 to entry: The bandwidth set at 9 kHz from 0,15 MHz - 30 MHz and 120 kHz above 30 MHz.

Note 2 to entry: Electrical components will radiate emissions of narrow- or broadband type.

3.4
broadband emission
emission that has a bandwidth greater than that of a measuring apparatus or receiver

Note 1 to entry: The bandwidth set at 9 kHz from 0,15 MHz - 30 MHz and 120 kHz above 30 MHz.

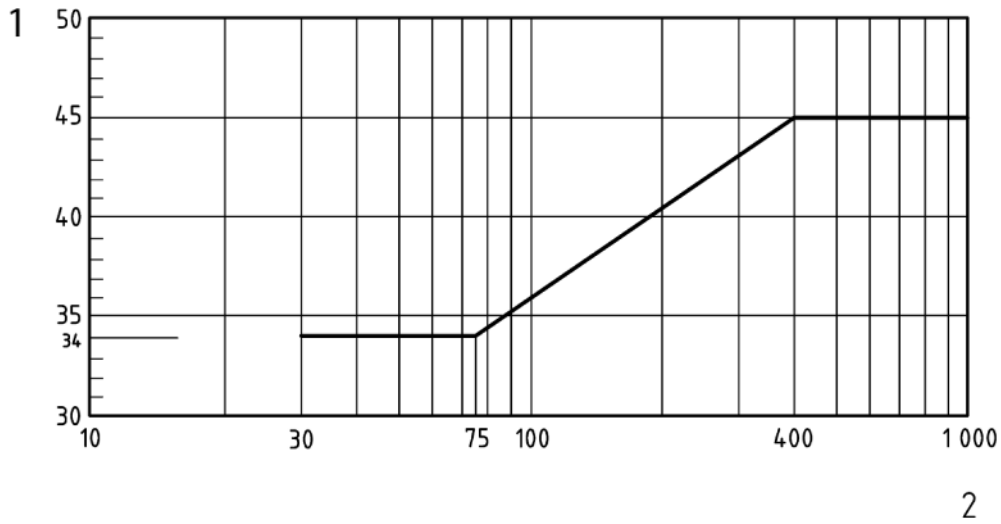
Note 2 to entry: High voltage ignition system will radiate broadband emissions.

4 Requirements

4.1 Emission

For trucks/systems the limit values for the electric field at 10 m distance from the truck with an antenna height of 3 m shall be in accordance with Figure 1.

30 MHz to 75 MHz	34 dB µV/m
75 MHz to 400 MHz	34 dB µV/m to 45 dB µV/m increasing in direct proportion with the frequency
400 MHz to 1 000 MHz	45 dB µV/m



Key

1 electric field (dB µV/m)

2 frequency (MHz)

Figure 1 — Maximum limits of electromagnetic emissions

For trucks that can be connected to the AC-mains network while operational, in addition to the above the limits stated in Table 2 of EN 61000-6-3:2007 shall be met.

4.2 Immunity

For trucks/systems the immunity to electromagnetic environments shall be above or equal to the limit values specified in Table 1 when tested in accordance to the test methods specified in Table 1.

Table 1 — Immunity - Enclosure port

	Environmental Phenomena	Limit values	Units	Normative references	Test in accordance with clause
1. Truck					
1.1	Electromagnetic field: - Frequency - Strength - Amplitude modulated	 27 – 1 000 20 80	 MHz V/m (unmodulated,rms) % AM (1 kHz)	EN 61000-4-3	5.3
1.2	Electromagnetic field: - Frequency - Strength - Amplitude modulated	 >1,0 – 2,0 3 80	 GHz V/m (unmodulated,rms) % AM (1 kHz)	EN 61000-4-3	5.3
1.3	Electromagnetic field: - Frequency - Strength - Amplitude modulated	 > 2,0 – 2,7 1 80	 GHz V/m (unmodulated,rms) % AM (1 kHz)	EN 61000-4-3	5.3
1.4	Electrostatic discharge: - Charge voltage	 8 Contact 15 Air discharge	 kV (330Ω - 150pF)	EN 61000-4-2 (Level 4)	5.4
2. Components test					
2.1	Magnetic field: - Frequency - Time period - Strength	 0 3 1 000	 Hz s A/m (1A/m≈ 1.257 μT)	 Test arrangement according to EN 61000-4-8	5.5
2.2	Magnetic field: - Frequency - Time period - Strength	 50 3 30	 Hz s A/m (1A/m ≈ 1.257 μT)	 Test arrangement according to EN 61000-4-8	5.5

For trucks/systems that can be connected to the AC-mains network, in addition to the above, the limits stated in Table 4 of EN 61000-6-2:2005 apply.

In practice, in the range 27 MHz to 80 MHz it can be difficult to reach uniformity of the field over the whole area where the truck/system is placed; it should be ensured however that all the critical parts are at least submitted to a field of 20 V/m. The substitution method may be used with the radiating antenna repositioned at 1,5 m intervals.

NOTE Substitution method is to calibrate the field strength without test item and to record the corresponding forward power. After that calibration, the test item will be set up and the immunity test will start with the forward power already recorded.

5 Tests

5.1 General

The conformity with the limit values shall be verified. The tests specified below are simplified tests without load; tests for all the possible working conditions are not practical for technical and economic reasons.

Testing shall be performed in accordance with 5.2 to 5.5.

One of the following approaches shall be taken to achieve compliance:

— complete truck test:

  — this test shall be performed on a single test sample (type test);

— system test:

  — the system may be tested separated from the truck. The installation of the system in the truck shall use the same components and harness physically and electrically to those tested.

The test sample/system shall be in operating condition. For the tests it might be necessary to change the normal operating condition. If test sample/systems are designed to operate with different nominal voltages, they shall be tested in the worst case condition.

The test sample/system shall be representative of the series production.

Complete systems may be used without the need for additional tests if they are certified to be within the limits of this standard. If the installation differs significantly from the installation instructions of the systems manufacturer, the truck/test sample shall be tested.

NOTE Examples of complete systems are internal combustion engines and electrical/electronic modules.

All test results, the test procedure and the mode of operation during the test shall be recorded accurately in the test report.

5.2 Emission test of electromagnetic fields

5.2.1 General

The emissions of all function/units of the test sample/systems shall be tested in accordance with 5.2.3, 5.2.4, 5.2.5 and 5.2.6 . The systems test may be performed separately or in any combination.

The emission values shall conform to the limit values specified in 4.1.

5.2.2 Test and measurement equipment

The test and measurement equipment shall conform to EN 55016-1-4 and EN 55016-1-1 (with the exception of the antenna positioning).

5.2.3 Test procedure

The antenna shall be 3 m high. It shall be placed at a distance of 10 m from the side of the truck/system. It shall be placed at a right angle to and on the centre line of the test sample excluding the load handling devices in accordance with Figure 2.

Measurement shall be taken on both sides of the truck/system with vertical and horizontal polarization of the antenna.

When stage a) is completed, from the results identify the frequencies of the 5 highest peak emission relative to the reference limit curve; then by varying between 2 m and 4 m the antenna height repeat

the test at the above frequencies to ensure that the values at the reference limits curve are not exceeded.

The electric components radiate emissions of narrowband type and this emission shall be measured with either Average or Quasi Peak filter of the EMI receiver.

NOTE 1 For additional information, see EN 55012.

Combustion engines with high voltages ignition system radiate emissions of broadband type and this emission shall be measured with QuasiPeak filter of the EMI receiver.

NOTE 2 For additional information, see EN 55012.

Dimensions in metres

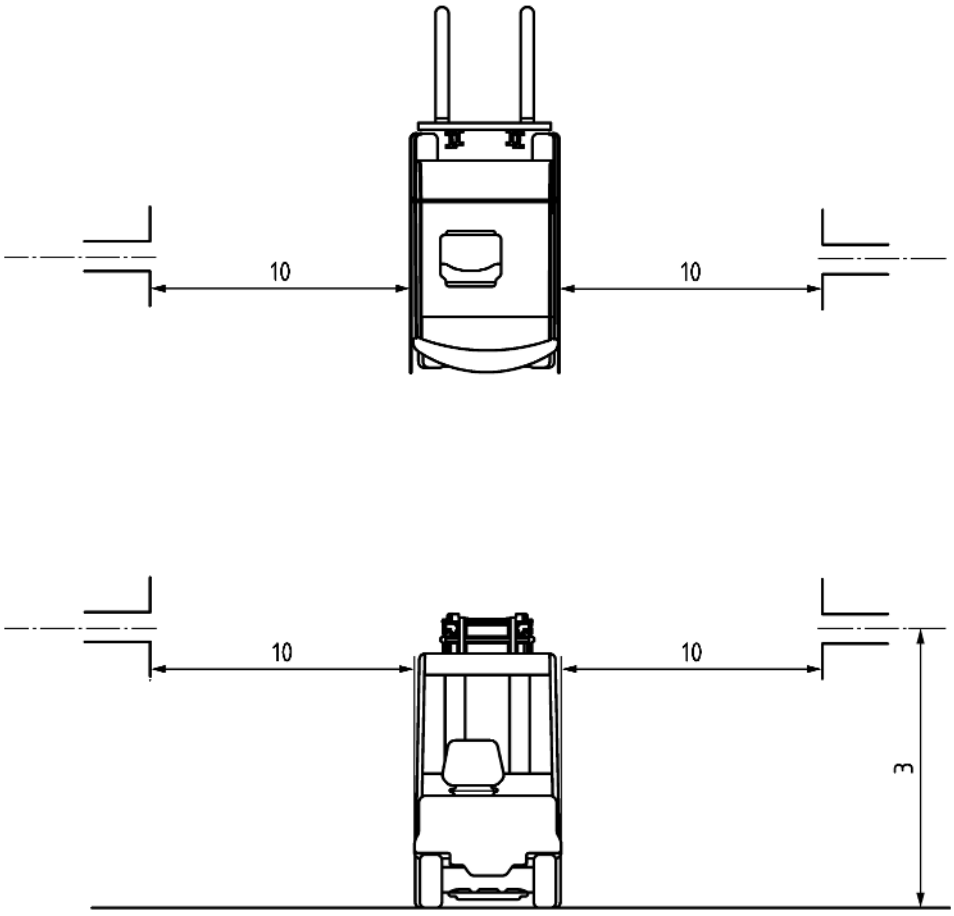


Figure 2 — Emission test

NOTE 3 Example for the position of the antenna relative to the truck. In the rear view, the antenna is shown in the vertical position and in the top view in the horizontal position.

If the field strength measurement at 10 m cannot be made because of high ambient noise levels, or for other reasons, measurement of the equipment under test may be made at a closer distance in accordance with EN 55012.

An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance to verify conformity with the limit values specified in 4.1.

Care should be taken in the measurement of large equipment at shorter distances for frequencies near 30 MHz, due to near field effects.

5.2.4 Test of the driving system

The truck shall be jacked up (idled driving wheels) in order to test the driving system.

Where the traction system employs speed control, it shall be set to control the electric motor between 60 % and 80 % of its maximum operational speed. Where it is not possible, the electric motor speed shall be set to the maximum operational speed.

For IC trucks, spark ignition engine shall be run at 1 500 min^{-1} and diesel engine at 1,5 times the low idle speed.

5.2.5 Test of load handling system with electric motor drive

Where the load handling system employs electronic pulse control, it shall be set to control the electric motor between 60 % and 80 % of its maximum operational speed. Where it does not, the motor speed shall be set to its operational maximum. Where the specification of the hydraulic system of the truck prohibits continuous operation, the hydraulic system of the test truck shall be amended to enable the required test procedure.

Where the permitted switch-on time of the electric motor in low lift trucks prohibits its continuous operation the test shall be done by use of a spectrum analyser (the filter shall be adjusted to peak mode). For that the frequency range might be split into 10 sub-ranges and each sub-range might be measured in peak mode by use of the max hold function or according to FFT method as defined in the relevant parts of EN 55016-2.

NOTE The time needed to obtain the values depends on the test equipment.

Where the load handling system employs components that are electrically/electronically operated, e.g. solenoid valves or proportional valves, the test shall be carried out with energized components.

5.2.6 Test of the power steering system with electric motor drive

The test shall be carried out with the steering motor continuously rotating. Where the steering system employs electronic pulse control, the test shall be carried out under pulsed condition.

Where it does not, the motor speed shall be set to its maximum.

Where the permitted switch-on time of the electric motor in low lift trucks prohibits its continuous operation the test shall be done by use of a spectrum analyser (the filter shall be adjusted to peak mode). For that the frequency range might be split into 10 sub-ranges and each sub-range might be measured some seconds in peak mode by use of the max hold function or according to FFT method as defined in the relevant standard of EN 55016-2 series.

NOTE 1 It might be necessary to decouple the steering motor to achieve the above condition.

NOTE 2 The time needed to obtain the values depends on the test equipment.

5.2.7 Test of the auxiliary electrical equipment

During the test, auxiliary components, such as voltage converters, fans, wiper motors, shall be switched on. Electrical/electronic accessories, such as horns, screen washer motors, etc., which operate only for short periods (a few seconds), shall be excluded from this test.

5.3 Immunity test against electromagnetic radiation

5.3.1 General

Immunity shall be tested for functions that could be influenced by electromagnetic radiation and for this reason could produce out of range performance**.** The functions may be tested separately or in any combination.

Where the service and/or parking brakes are electrically/electronically controlled, they shall remain functional during the test.

Any disturbances induced during testing shall not:

— affect the driver's direct control of the truck;

— affect the performance of safety related parts of the truck or system;

— produce any incorrect signal that might cause the driver to perform hazardous operations.

The test is successful when the requirements from 5.3.4 to 5.3.8 are fulfilled.

The test shall be performed with the electromagnetic field limit values specified in 4.2.

5.3.2 Test and measurement equipment

The test and measurement equipment shall conform to the relevant clauses of EN 61000-4-3.

5.3.3 Basic test procedure

The antenna shall be placed at a minimum distance of 3 m from the side of the truck/system at a right angle to and on the centreline of the test sample excluding the load handling device in accordance with Figure 3. The distance may be reduced provided that the uniform field as specified in Table 1 in rows 1.1, 1.2 and 1.3 is achieved. The test methods as specified in EN 61000-4-3 may also be used.

Measurement shall be made on both sides of the truck/system with vertical and horizontal polarization of the antenna.

Dimensions in metres

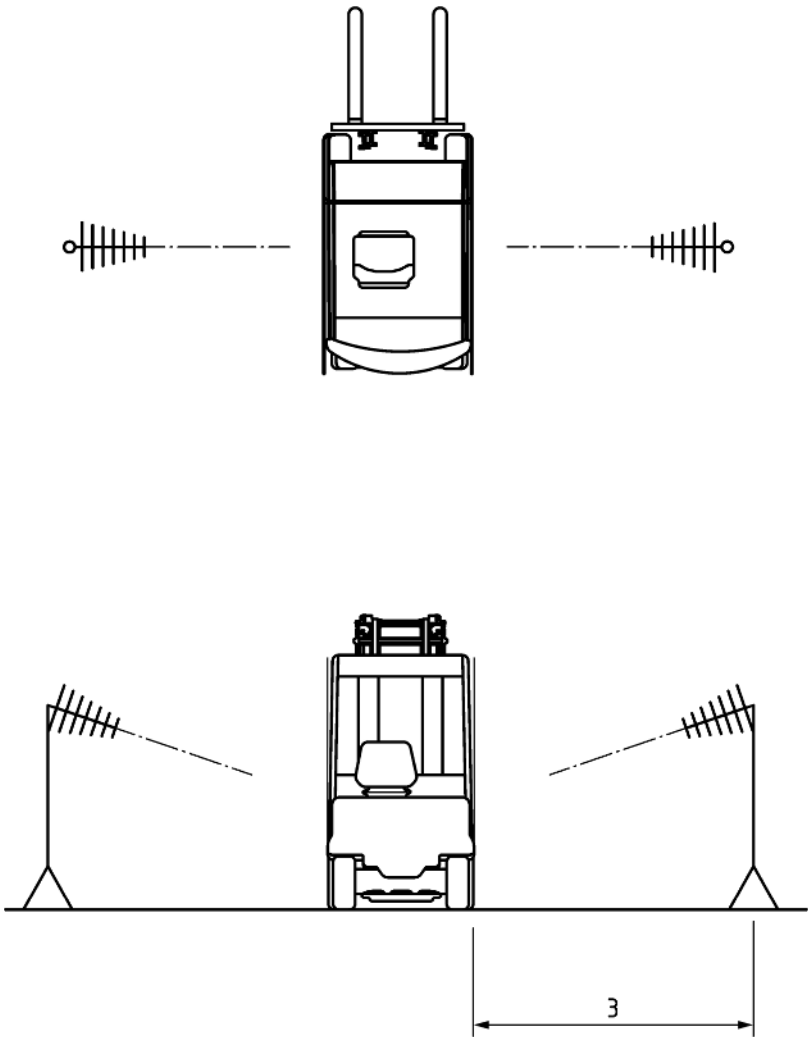


Figure 3 — Immunity test

NOTE Example for the position of the antenna relative to the truck. In the rear view, the antenna is shown in the vertical position and in the top view in the horizontal position.

5.3.4 Test of driving system at zero speed

The truck shall be jacked up (idled driving wheels) in order to test the driving system.

For electrically powered trucks the driving system shall be ready to operate, but speed control released. For IC trucks the direction control shall be in neutral.

During the test the drive wheel speed shall not exceed the value corresponding to a truck speed of 0,05 m/s. With certain types of transmission on IC trucks it will not be possible to carry out the test with the truck jacked up due to mechanical/hydraulic drag in the transmission system; in this case the test shall be carried out with the wheels on the floor and the truck restrained against large movements. When this method is used the truck shall not move during the test.

5.3.5 Test of the driving system at low rotational speed

The truck shall be jacked up (idled driving wheels) in order to test the driving system.

The drive wheels shall rotate with a speed between 20 % and 40 % of the maximum operational speed, or in the case of trucks for which travel speed is limited for safety reasons, at the speed corresponding to this limit value if this value is lower than 40 % of the maximum travel speed.

The speed shall not result in a variation of more than 20 % of its set values.

5.3.6 Test of load handling system

The immunity of the load handling system shall be tested:

— if the hydraulic valves are controlled by an electrical/electronic device;

and/or

— if the steering assistance system is powered by the same electric motor as the load handling system.

The test shall be carried out without load. The electric motor's rotational speed shall be set between 10 % and 30 % of its maximum operational speed. Where the specification of the hydraulic system of the truck prohibits continuous operation of the electric motor, the hydraulic system of the test truck shall be amended to enable the required test procedure.

The speed shall not result in a variation of more than 20 % of its set values.

Electric pump drive, energizing just the lift, in low lift height (as defined in EN ISO 3691-1:2012, 3.11) trucks is excluded from the rotational speed test requirement; the electric pump shall be ready to operate.

During the test there shall not be any unintended movement in any part of the load handling system.

5.3.7 Test of the electric power steering system

The steering motor shall be:

a) connected to its energized control system with steering control device not operated;

and

b) rotating between 20 % and 40 % of its maximum operational speed.

The b) condition shall be applied only when the design of the truck steering system permits the continuous operation of the steering motor

During test, in accordance with a), the wheels shall not steer more than 0,5°/s and, in accordance with b), the actual values shall not vary more than 20 % of its set values.

Where the power steering system is part of an electronic automatic guidance system, the test shall be carried out with the system simulated and energized. The truck shall be locked onto the guidance means set to the nominal value and with the steering motor stationary. Where a mechanical steering limiter is fitted, the limiter shall remain engaged throughout the test.

The steering motor shall not move during the test, small movements are permitted where the system is correcting for induced errors. The system shall remain in guidance mode and shall not revert back to manual.

5.3.8 Test of the auxiliary electrical equipment

The test shall be carried out with the system energized. During the test to verify the requirements of 4.2, no change shall occur that could give rise to a hazard.

5.4 Immunity test against electrostatic discharge

The electrostatic discharge shall be tested in accordance with EN 61000-4-2 (Test level 4).

The truck shall be jacked up (idled driving wheels) if there is a risk of hazard to persons and equipment during the test.

All systems shall be energized. The test shall be carried out with the truck/system ready to operate, but speed control released; for IC trucks the direction control shall be in neutral. Load handling functions shall not be activated, the steering control device shall not be operated.

The ESD test equipment shall be grounded to the frame of the truck. The selected points shall be recorded.

Temporary degradation or loss of function which is self-recoverable is permitted.

5.5 Immunity test against auxiliary magnetic field

Immunity shall be tested for any safety relevant component(s) that could be influenced by magnetic radiation and for this reason can cause hazardous situations or deviation from the acceptance criteria defined above. The components may be tested separately from truck.

NOTE Examples of safety components that could be influenced by magnetic radiation are accelerator sensors, lift height sensors and joysticks.

The test shall be carried out with the component in a homogeneous magnetic field and each component shall conform to the values for components in 4.2, Table 1. Component(s) shall be tested positioned in all three axes (x,y,z).

6 Test report

The test report shall include at least the following information:

— manufacturer;

— model;

— product identification number;

— configuration of test truck or component;

— involved measurement equipment;

— results of the performed tests, including specific data, e.g. plots of measuring results versus frequency;

— place and date, person(s) and / or test laboratory responsible.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2004/108/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission to provide a means of conforming to Essential Requirements of the New Approach Directive 2004/108/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Annex ZB
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2014/30/EU

This European Standard has been prepared under a mandate given to CEN by the European Commission to provide a means of conforming to Essential Requirements of the New Approach Directive 2014/30/EU.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] EN 55012, *Vehicles, boats and internal combustion engines — Radio disturbance characteristics — Limits and methods of measurement for the protection of off-board receivers*

[2] ISO/FDIS 5053-1, *Industrial trucks — Terminology and classification — Part 1 Types of industrial trucks*