



**International
Standard**

ISO 22915-1

**Industrial trucks — Verification of
stability —**

**Part 1:
General**

*Chariots de manutention — Vérification de la stabilité —
Partie 1: Généralités*

**Third edition
2024-06**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 110, *Industrial trucks*, Subcommittee SC 2, *Safety of powered industrial trucks*.

This third edition cancels and replaces the second edition (ISO 22915-1:2016), which has been technically revised.

The main changes are as follows:

- the scope has been expanded due to the extension of the ISO 22915 series with parts for other truck types and for low-lift trucks;
- the weight of the operator on sit-on and stand-on trucks has been increased to reflect the latest developments of ISO 3411;
- a clause has been added to specify the minimum requirements for the test report.

A list of all parts in the ISO 22915 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Industrial trucks — Verification of stability —

Part 1: General

1 Scope

The ISO 22915 series deals with the safety of industrial trucks, as defined in ISO 5053-1, relative to their stability and the verification of that stability.

This document specifies basic test criteria and requirements for verifying the stability of industrial trucks, hereafter referred to as "trucks".

It is applicable to the following truck types and special conditions:

- a) counterbalanced trucks with mast as specified in ISO 22915-2;
- b) reach and straddle trucks as specified in ISO 22915-3;
- c) pallet stackers, double stackers, and order-picking trucks with operator position elevating up to and including 1 200 mm lift height as specified in ISO 22915-4;
- d) single-side-loading trucks as specified in ISO 22915-5;
- e) bidirectional and multidirectional trucks as specified in ISO 22915-7;
- f) additional stability test for trucks operating in special conditions of stacking with the mast tilted forward as specified in ISO 22915-8;
- g) counterbalanced trucks with mast handling freight containers of 6 m (20 ft) length and longer as specified in ISO 22915-9;
- h) additional stability test for trucks operating in special conditions with the load substantially laterally displaced by powered devices as specified in ISO 22915-10;
- i) industrial variable-reach trucks as specified in ISO 22915-11;
- j) industrial variable-reach trucks handling freight containers of 6 m (20 ft) length and longer as specified in ISO 22915-12;
- k) rough-terrain trucks with mast as specified in ISO 22915-13;
- l) rough-terrain variable-reach trucks as specified in ISO 22915-14;
- m) counterbalanced trucks with articulated steering as specified in ISO 22915-15;
- n) pedestrian-propelled trucks as specified in ISO 22915-16;
- o) towing tractors, burden and personnel carriers as specified in ISO 22915-17;
- p) additional stability test for trucks operating in the special condition of offset load, offset determined by utilization as specified in ISO 22915-20;
- q) order-picking trucks with operator position elevating above 1 200 mm as specified in ISO 22915-21;

- r) lateral- and front-stacking trucks with and without elevating operator position as specified in ISO 22915-22;
- s) slewing variable-reach rough-terrain trucks as specified in ISO 22915-24.

It is also applicable to trucks operating under the same conditions when equipped with load-handling attachments and low-lift trucks with lift height up to and including 500 mm.

This document does not apply to the following:

- trucks handling suspended loads which can swing freely.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 3411, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope*

ISO 5053-1, *Industrial trucks — Vocabulary — Part 1: Types of industrial trucks*

ISO 5353, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5053-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

industrial truck

wheeled vehicle having at least three wheels designed to carry, tow, push, lift, stack or tier loads

Note 1 to entry: Industrial trucks can be self-propelled or pedestrian-propelled.

Note 2 to entry: Industrial trucks can be operator-controlled or driverless.

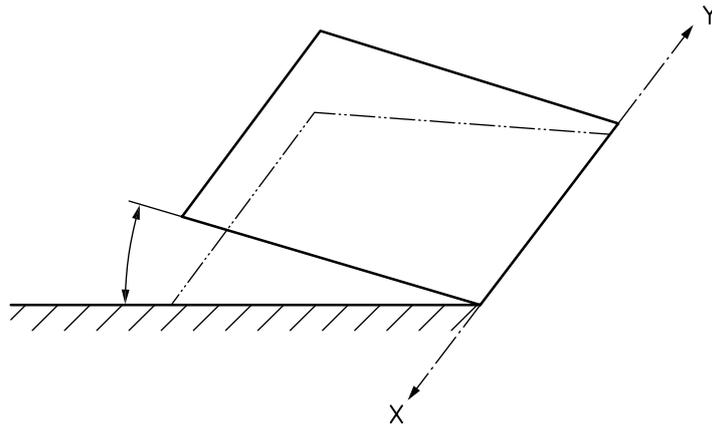
Note 3 to entry: Vehicles running on rails are not defined as industrial truck.

3.2

tilt table

rigid table tilted at least to one side to prove the lateral and longitudinal stability of a truck positioned on that table

Note 1 to entry: See [Figure 1](#).



Key

X-Y indicates the *tilt axis* (3.3) of the tilt table

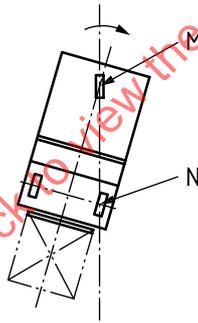
Figure 1 — Tilt table

3.3

tilt axis

axis about which the truck tips over, longitudinally or laterally, when a sufficient static or dynamic force is applied above the centre of gravity of the truck

Note 1 to entry: See [Figure 2](#) as an example.



Key

M-N indicates the lateral tilt axis of the truck

Figure 2 — Tilt axis

3.4

tip-over

loss of stability where the truck completely tips over

4 Stability tests for trucks

4.1 General

4.1.1 Stability test as defined in the ISO 22915 series are simulating dynamic forces affecting the stability when operating an industrial truck.

Sufficient stability is verified by the defined tests if industrial trucks are operated under normal operating conditions or operating conditions other than normal if they are foreseen by the manufacturer.

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4.1.2 For trucks other than variable-reach and rough-terrain trucks, normal operating conditions are as follows:

- a) stacking with fork arms horizontal whilst on substantially firm, smooth, level, and prepared surfaces;
- b) operating with a load centre of gravity approximately on the longitudinal centre plane of the truck;
- c) travelling with the mast or fork arms tilted rearward, if possible, and the load in the lowered (travel) position on substantially firm, smooth, level, and prepared surface, and for reach trucks, with the mast or forks fully retracted;
- d) travelling or manoeuvring with elevated load/operator (if the truck is specifically designed for this condition).

4.1.3 For variable-reach and rough-terrain trucks, normal operating conditions are as follows:

- a) stacking with a combination of boom elevation/extension and the fork arms horizontal whilst on substantially firm, smooth, level, and prepared surfaces;
- b) operating with the load centre of gravity approximately on the longitudinal centre plane of the truck;
- c) trucks with a mast manoeuvring an elevated load with the mast neither tilted rearwards more than 10° nor the centre of gravity of the load displaced rearwards more than 600 mm;
- d) manoeuvring an elevated load with the fork arms tilted rearwards;
- e) rough-terrain trucks travelling with the mast or fork arms tilted rearwards and the load in the lowered (travelling) position on unimproved natural terrain and disturbed-terrain areas;
- f) travelling or manoeuvring with elevated load/operator (if the truck is specifically designed for this condition).

NOTE In operating condition e), where applicable, any reaching/telescopic mechanism is fully retracted.

4.1.4 Operating conditions other than normal operating conditions necessitate a truck that complies with either:

- a) appropriate International Standards covering the different specific conditions (e.g. trucks operated with offset load by powered devices or by utilization, trucks with mast tilted forward, and trucks handling freight containers), or
- b) stability requirements agreed upon by the interested parties in consultation with the manufacturer and being not less than required by the tests specified for normal operating conditions for that type of truck.

4.2 Test procedure

Truck stability shall be verified by one of the procedures described in [4.3](#).

The truck is considered stable if it passes all tests without tip-over or meets the requirements by calculation.

When comparing calculated and test values, the test values are considered the true measure of stability.

4.3 Verification procedure

4.3.1 Operation of the tilt table and test criteria

The truck shall be placed on the tilt table under the conditions specified in the relevant part of ISO 22915. In each of these tests, the tilt table shall be tilted smoothly to the slope indicated in the reference document.

The truck shall not tip-over when the required tilt table slope is attained for all the specified tests.

It is permissible that one or more wheels leave the tilt table or parts of the truck frame contact the tilt table. If this occurs, the truck may seek its new stable position or may seek to tip-over.

For trucks designed to handle freight containers 6 m (20 ft) length and above any separation of the wheel(s) from the tilt table surface is considered a tip-over, see ISO 22915-9:2014, Clause 6.

The means for preventing tip-over shall impose no appreciable restriction on the truck until the tip-over instant occurs.

4.3.2 Calculation

Conformance with the specified stability values can be determined by calculation.

Such calculations shall be based on empirical data for similar trucks.

Such calculations shall take into account manufacturing variations and deflections of mast, tyres, etc.

4.3.3 Other methods

Other methods for verifying the stability that give the same result may be used, e.g. fixed slope.

4.4 Test conditions

4.4.1 Condition of the truck

The tests shall be carried out on an operational truck.

The weight of the operator on sit-on and stand-on trucks shall be simulated by an object having a mass of 114 kg, in accordance with ISO 3411, if the stability during a test is thereby decreased. For a truck designed for operation with a stand-on operator, the centre of gravity of the object shall be secured 1 000 mm above the floor of the operator's platform at the centre of the position normally occupied by the operator. For a truck designed for operation with a sit-on operator, the centre of gravity of the object shall be secured 150 mm above the seat index point (SIP) as determined in accordance with ISO 5353 with the seat at the mid-point of the adjustment, if provided.

The fuel tank(s) fill volume of internal combustion engine trucks shall be that which results in the condition of least stability. All other tanks shall be filled to their correct operating levels, as applicable.

For battery-powered trucks, applicable tests to be carried out with minimum or maximum authorised battery mass, whichever results in the least stable condition.

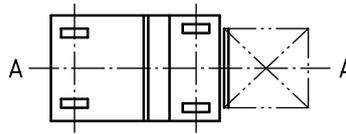
NOTE It is possible to have differences in the actual capacity for a comparable truck design in respect to the authorized battery type.

Pneumatic tyres shall be inflated to their correct pressure as specified by the truck manufacturer. Where tyre ballast is incorporated in the truck design, the use of ballast shall be in accordance with the truck manufacturer's instructions.

4.4.2 Position of the truck on the tilt table

The truck shall be positioned on the tilt table under the conditions specified in the relevant part of ISO 22915. Lateral tests shall be conducted to the side that is least stable.

The indication of axles is the centreline of the respective axle. As shown in [Figure 3](#), the longitudinal centre plane is the vertical longitudinal plane between the centreline of the steer axles and the centreline of the load axles.



Key

A-A longitudinal centre plane of the truck

Figure 3 — Indication of longitudinal centre plane and axles

The initial location of the truck on the tilt table can be maintained by the following:

- applying parking or service brakes which can be secured in the “on” position or by wedging the wheels against the truck frame ensuring however that articulation is not affected;
- using blocks or chocks having a maximum height not exceeding the value indicated in [Table 1](#);
- increasing the coefficient of friction of the table surface, if necessary, by an appropriate friction-increasing material.

Table 1 — Maximum height of blocks or chocks

Tyre outside diameter <i>d</i> mm	Maximum height of blocks or chocks mm
$d \leq 250$	25
$250 < d \leq 500$	$0,1 d$
$d > 500$	$0,1 d$ (max 100)

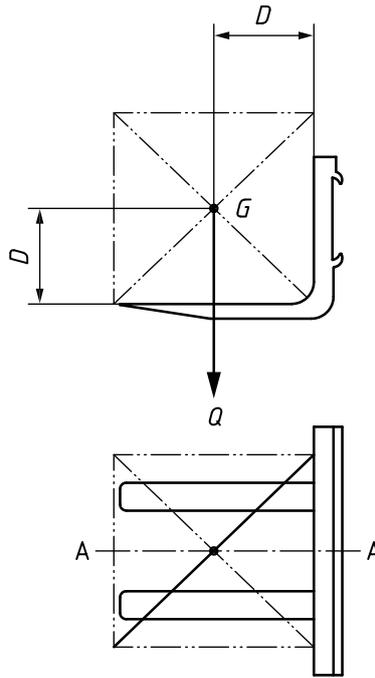
4.4.3 Test load, lift height and standard load centre distance

The test load shall have a mass equivalent to the actual capacity, Q , that the truck can elevate to the corresponding height acting through the centre of gravity, G , nominally positioned at the standard load centre distance, D , (see [Figure 4](#) and ISO 3691-1, ISO 3691-2, ISO 3691-3, ISO 3691-4 and ISO 3691-5) as indicated on the information plate of the truck both horizontally from the front face of the fork arm shank and vertically from the upper face of the fork arm blade.

Other means may be used provided that these means give the equivalent effect as a homogeneous mass.

When additional lift heights, loads, and load centre distances are to be indicated on the information plate, the truck shall meet the requirements established by the tests specified in this document for these additional capacities.

The centre of gravity, G , of the test load shall be located in the longitudinal centre plane, A-A, of the truck.



Key

D standard load centre distance

G load centre of gravity positioned in the longitudinal centre plane (A-A) of the truck

Q actual capacity

Figure 4 — Standard load centre distance

4.5 Safety precautions for testing

Precautions shall be taken to prevent the tip-over of the truck or displacement of the test load during the course of the test.

- a) Complete tip-over of the truck shall be prevented by the following:
 - wire ropes, straps, or chains;
 - overhead crane;
 - other means.
- b) Displacement of the test load shall be prevented by means such as the following:
 - firmly securing the test load to the load carrier or equivalent structure;
 - suspending the test load near the ground from an appropriate support placed on the fork arms so that the suspension point is at the point where the centre of gravity, G , of the test load would be if the test load were to be placed on the fork.

4.6 Stability verification for trucks with attachments

Trucks fitted with attachments other than fork arms shall be subject to the same stability tests. If the centre of gravity is substantially displaced, additional tests may be required (see ISO 22915-10 and ISO 22915-20).

For verification of the vertical position of the mast, a reference point having a fixed relationship to the centre of gravity, G , of the test load shall be chosen (see [Figure 4](#)).