
Industrial variable-reach trucks —

Part 2:

**Additional stability tests for trucks handling
freight containers of length 6 m and above**

Chariots de manutention à portée variable —

*Partie 2: Essais de stabilité supplémentaires pour les chariots
manutentionnant des conteneurs de fret de 6 m de long et plus*



Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 13562 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 13562-2 was prepared by Technical Committee ISO/TC 110, *Industrial trucks*, Subcommittee SC 2, *Safety of powered industrial trucks*. It is based on annex C of EN 1459:1998.

ISO 13562 consists of the following parts, under the general title *Industrial variable-reach trucks*:

- *Part 1: Stability tests*
- *Part 2: Additional stability tests for trucks handling freight containers of length 6 m and above*

Industrial variable-reach trucks —

Part 2:

Additional stability tests for trucks handling freight containers of length 6 m and above

1 Scope

1.1 This part of ISO 13562 specifies additional tests to verify the stability of industrial variable-reach fork-lift trucks handling empty or laden freight containers of length 6 m and above, swap bodies or semi-trailers.

1.2 This International Standard specifies tests in addition to those specified in ISO 13562-1.

It is applicable to self-propelled, seated-rider operated, counterbalanced industrial variable-reach fork-lift trucks

- with non-slewing booms or a slewing movement not greater than 5° either side of the longitudinal centre plane of the truck,
- fitted with fork arms or load-handling attachments,
- with a rigid chassis,
- that may have stabilizers or axle-locking devices, and
- with two-wheel steering systems.

1.3 The stability tests contained in this part of ISO 13562 ensure that variable-reach trucks handling freight containers have satisfactory stability when reasonably and appropriately used under the following conditions.

a) The truck is operating (travelling with the freight container at normal travelling height and stacking) in conditions where the wind speed is up to 12,2 m/s (Beaufort Scale Force 6).

NOTE 1 When the truck is operating in higher wind speeds, alternative ratings for use should be developed by use of higher values of v_w in equations (1) and (2).

b) The truck is travelling forward with the freight container leading, elevated so that the base is no higher than 1 m above the point of maximum depression of the seat cushion under the operator with the boom retracted as far as possible.

NOTE 2 The elevated load permits an operator in a low position on the truck to see underneath the container.

The stability tests to cover the conditions stated in a) above and Note 1 are applicable to all trucks.

The stability tests to cover the conditions stated in b) only are applicable to trucks with a partially elevated container.

1.4 This part of ISO 13562 is not applicable to the trucks specified in 1.2 when

- they are handling suspended loads that may swing freely, or
- they are handling a container with a mobile centre of gravity (see ISO 3874).

1.5 The tests take into account the normal degree of eccentric loading of containers defined in ISO 3874.

When handling empty refrigerated containers, as specified in ISO 1496-2, with an integral refrigeration unit (reefers), account should be taken of the offset of the load.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 13562. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 13562 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1496-2:1996, *Series 1 freight containers — Specification and testing — Part 2: Thermal containers*.

ISO 3874:1997, *Series 1 freight containers — Handling and securing*.

ISO 5353:1995, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*.

3 Stability tests

3.1 Test requirements

The stability of a truck handling freight containers of length 6 m and above shall be verified by one of the procedures specified in 3.2.

3.2 Verification procedure

3.2.1 Tilting platform

Use a test platform that can be tilted about one side. Place the truck being tested for stability on the initially horizontal test platform in accordance with 3.3 and, successively, in each of the positions described in Table 3.

In each of the tests, tilt the test platform slowly to the slope specified in Table 3.

The truck is considered stable if it passes tests 1, 2 and 3 without overturning. For the purposes of the tests, overturning is defined as the test platform slope value that, if increased, would cause the truck to overturn.

For test 4, the overturning value is reached when a wheel loses contact with the test slope. It is permissible in test 3 for one load wheel to lose contact with the test platform. It is acceptable for parts of the structure or designed features to make contact with the test platform.

3.2.2 Fixed slope

Use fixed slopes, with inclinations equivalent to the specified test slope. The slope surface shall be smooth and capable of supporting the truck mass with no deformation that could affect the test results.

Drive the truck under test onto the fixed slopes with the boom in the lowered and retracted position and positioned as specified in Table 3. For each of the truck positions with an elevated load or load carrier, the boom shall be elevated and extended smoothly to the position specified in Table 3.

3.2.3 Calculation

Determine compliance with the specified stability values by calculation methods verified by empirical data.

The calculated capacities shall take into account manufacturing variations and deflections of the boom, tyres, etc.

3.3 Test conditions

3.3.1 Prevailing wind

The tests shall not be performed in a prevailing wind that would significantly affect the test results.

3.3.2 Condition of the truck

The tests shall be carried out on an operational truck.

The operator shall be simulated by an object having a mass of 90 kg if the stability during the test is thereby decreased. The centre of gravity of the object shall be 150 mm above the seat index point (SIP), as determined in accordance with ISO 5353, with the seat at the closest position to the mid-point of the adjustments provided.

The load-carrying means shall be fully equipped with any protective or supplementary lifting apparatus as included in the rating. The fork arms, if adjustable for tilt, shall be positioned in accordance with the table of tests.

Fuel tanks of internal combustion engine trucks shall be full if the stability is thereby decreased. All other tanks shall be filled to their correct operating levels, as applicable.

Tyres shall be inflated to the pressure 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.

3.3.3 Lift height for tests simulating stacking

For tests simulating stacking, the load shall be in the least stable combination of lift and reach, as determined by the manufacturer, with the fork arms/load in the horizontal position.

3.3.4 Lift height for tests simulating travelling with the container substantially elevated

For tests simulating travelling, the centre of gravity of the test load shall be positioned 2 300 mm above the point of maximum depression of the operator's seat cushion.

These tests do not apply where it is not necessary to elevate the container to obtain adequate visibility in the direction of travel, for example, high level operator position or driving in reverse (freight container trailing).

3.3.5 Position of truck on platform

For test 1 and 2 (see Table 3), the truck shall be placed on the test platform or slope so that the load axle is parallel to the tilt axis, XY, of the test platform.

For test numbers 3 and 4 (see Table 3), the truck shall be placed on the test platform or slope in a turning position with the line MN parallel to the tilt axis, XY, of the test platform.

The wheel on the steer axle nearest to the platform tilt axis shall be parallel to the platform tilt axis.

Lateral stability tests shall be conducted on the side of the truck which is the less stable.

Point N is the centre point of the area of contact between the test platform surface and the front wheel or stabilizer pad nearest to the tilting axis of the test platform.

Point M is defined as follows.

- a) For trucks with an oscillating steer axle: the projection onto the test platform of the intersection of the longitudinal centre plane, AB, of the truck with the axis of the steer axle.
- b) For trucks with axle locking: the centre point of the area of contact between the test platform and the rear wheel nearest the test platform tilting axis.

3.3.6 Trucks with selectable stabilizers and/or axle locking

Tests 1 and 3 shall be conducted with stabilizers/axle locking engaged and then disengaged.

3.4 Test load

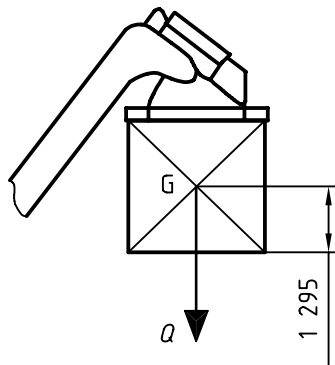
3.4.1 General

The test load shall consist of a basic load corresponding to the weight of the freight container, and a load or force simulating the effect of the wind on the container.

3.4.2 Basic load

The basic test load shall be equivalent to a 2 590 mm high ISO container, in either the laden or unladen condition, with a mass equivalent to the rated load, Q , as specified by the manufacturer, acting through its centre of gravity, G (see Figure 1).

Dimensions in millimetres



NOTE See 3.4.2 for an explanation of symbols.

Figure 1 — Test load centre of gravity

When using fork arms to handle containers, the test load shall act through the centre of gravity, G , positioned 1 220 mm horizontally from the front face of the fork arm shank and at a height that corresponds to the mid-point of the height of a 2 590 mm container.

When using other handling means such as a top lift or side lift spreader, the position of the centre of gravity, G , shall be determined by the connection points to the test load (e.g. twist locks into the corner fittings).

Where the load-handling means has positional adjustment capability lateral to the truck longitudinal centre line, the lateral adjustment shall be at its mid-point.

Where the load-handling means has positional adjustment capability in the direction of the truck longitudinal centre line, other than boom reach, the tests shall be carried out at both extremes of adjustment.

3.4.3 Wind force

3.4.3.1 Longitudinal tests

For the longitudinal tests, the critical wind force acting on the freight container is calculated by the following formula:

$$F = k h L v^2 C_{f1} \quad (1)$$

where

F is the wind force, in newtons;

k is the constant for wind pressure

$$k = 0,613 \left[\frac{\text{N} \cdot \text{s}^2}{\text{m}^4} \right]$$

h is the freight container height (= 2,59 m);

L is the freight container length, in metres;

v is the wind speed (= 12,2 m/s) (Beaufort Scale 6);

C_{f1} is the shape coefficient (= 1,3).

NOTE Reference sources (e.g. crane and building standards) confirm that a value of 1,3 for C_{f1} is appropriate for a wind acting normal to the longitudinal axis of freight containers.

The effect of this force can be simulated in the tests by one of the following methods:

- a) by applying this force in the direction of longitudinal forward overturn acting horizontally through the centre of gravity of the test load; or
- b) by applying a vertical load, in addition to the test load, giving an equivalent moment to the wind force acting when the slope is at the required tilt angle as specified in Table 3.

3.4.3.2 Lateral tests

The effect of wind in lateral stability tests has been shown to be significant only when stacking empty containers. For the lateral tests the critical wind force acting on the container shall be calculated by the following formula (see Figure 2):

$$F = k v^2 C_{f2} h (L \sin \alpha + w \cos \alpha) \quad (2)$$

where

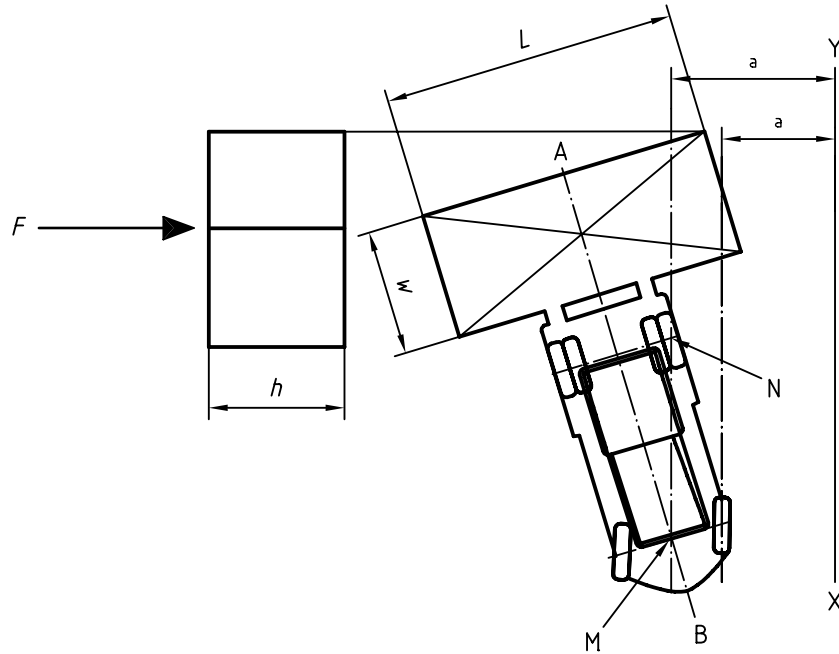
C_{f2} is the shape coefficient (= 0,8);

w is the container width (= 2,44 m);

α is the angle of lateral tipping axis relative to the longitudinal axis of the truck, in degrees.

The other symbols are as in equation (1).

NOTE Reference sources (e.g. crane and building standards) confirm that a value of 0,8 for C_{f2} is appropriate for a wind acting normal to the lateral tipping axis of a freight container handling variable-reach truck.



NOTE For symbols, see 3.4.3.

a Parallel.

Figure 2 — Critical wind force for lateral tests

The effect of this force can be simulated in the tests by one of the following methods:

- a) by applying this force normal to the lateral tipping axis of the truck horizontally through the centre of gravity; or
- b) by applying a vertical load, in addition to the test load, giving an equivalent moment to the wind force acting when the slope is at the required tilt angle as specified in Table 3.

3.5 Location of the truck on the test platform

The location of the truck on the test platform or slope shall be maintained during each test.

This may be achieved by application of 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.

Blocks (chocks) with a maximum height not exceeding $0,1 d$ (where d is the outside diameter of the wheel) may be used, if required, to maintain the initial position of the truck on the test platform. Blocks (chocks), if used, shall not artificially improve stability.

The coefficient of friction of the platform surface or slope may be increased, if required, by an appropriate friction-increasing material.

3.6 Safety precautions

Precautions shall be taken to prevent the truck overturning or displacement of the load during the tests. If the truck is prevented from overturning by rope lashing or chain, this shall be sufficiently slack to impose no appreciable restriction on the truck until the overturning point is reached.

Displacement of the test load shall be prevented by means such as:

- a) Firmly securing the test load to the load carrier or equivalent structure.
- b) Suspending the test load near to 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 placed on the fork arms.

4 Schedule of tests

4.1 For all trucks additional stability tests as shown by X in Table 1 shall be carried out, based on the standard wind speed specified in 1.3 a) or the higher wind speed (see Note 1 in 1.3), as appropriate.

Table 1 — Additional stability tests

Trucks handling laden containers				Trucks handling empty containers			
Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4
X	–	–	–	X	–	X	–

4.2 For trucks which are also able to operate under conditions described in 1.3 b), further stability tests as shown by X in Table 2 shall be carried out.

Table 2 — Further stability tests

Trucks handling laden containers				Trucks handling empty containers			
Test 1	Test 2	Test 3	Test 4	Test 1	Test 2	Test 3	Test 4
–	X	–	X	–	X	–	X

5 Marking

The additional capacity as determined by these stability tests shall be indicated on a capacity plate.

The plate shall specify the container-handling attachment used for the tests and whether the truck is capable of travelling with an elevated container as described in 1.3 b).

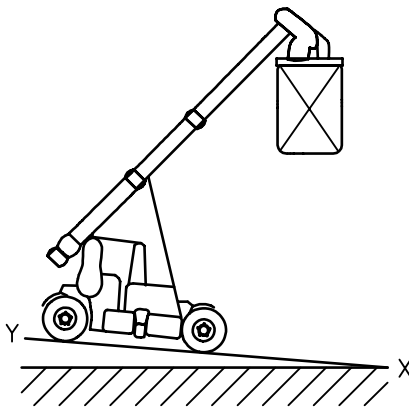
The wind speed used for the calculations in 3.4.3 shall be indicated.

Table 3 — Summary of tests

Test	1	2	3	4
Stability	Longitudinal		Lateral	
Operation	Stacking	Travelling	Stacking	Travelling
Load	Test load (see 3.4)	Test load (see 3.4)	Test load (see 3.4)	Test load (see 3.4)
Lift height	See 3.3.3	See 3.3.4	See 3.3.3	See 3.3.4
Stabilizer device and/or axle locking	With and without	Without	With and without	Without
Position on test platform	Figures 3, 7 and 9	Figures 4 and 7	Figure 5 and Figure 8, 10 or 11	Figures 6 and 8
Test platform slope	3,5 %	18 %	6 %	(5 + 1,1 v_s) % max.20 % Notes 1 and 2

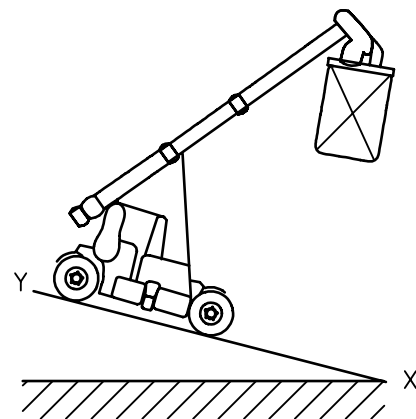
NOTE 1 v_s is normally the laden truck maximum speed (km/h), but it may be a lower speed that will be specified by the manufacturer together with clear instructions on how the operator may comply with this requirement.

NOTE 2 No wheels may lose contact with the test platform in test 4 nor may any of the structure or other feature make contact with the platform.



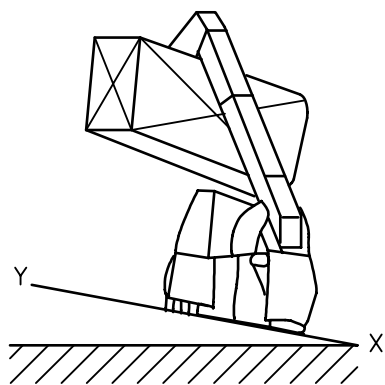
XY is the tilt axis.

Figure 3 — Position of truck for test 1



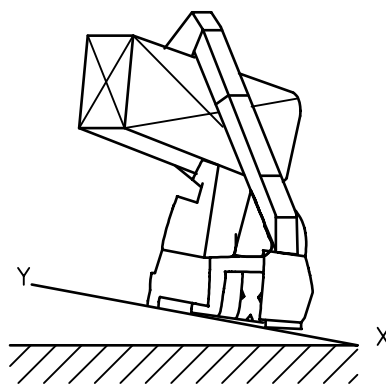
XY is the tilt axis.

Figure 4 — Position of truck for test 2



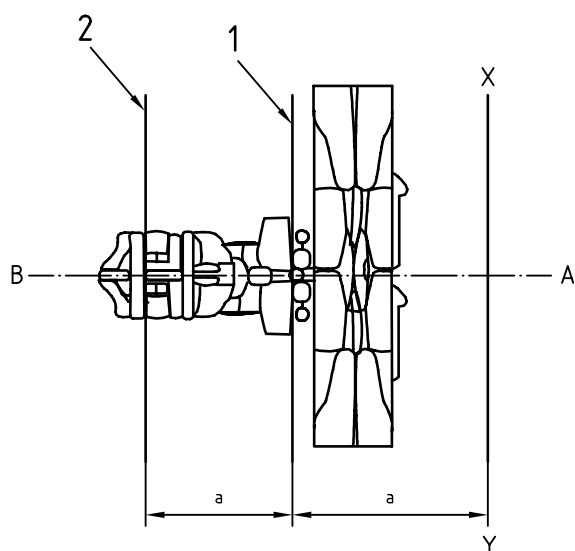
XY is the tilt axis.

Figure 5 — Position of truck for test 3



XY is the tilt axis.

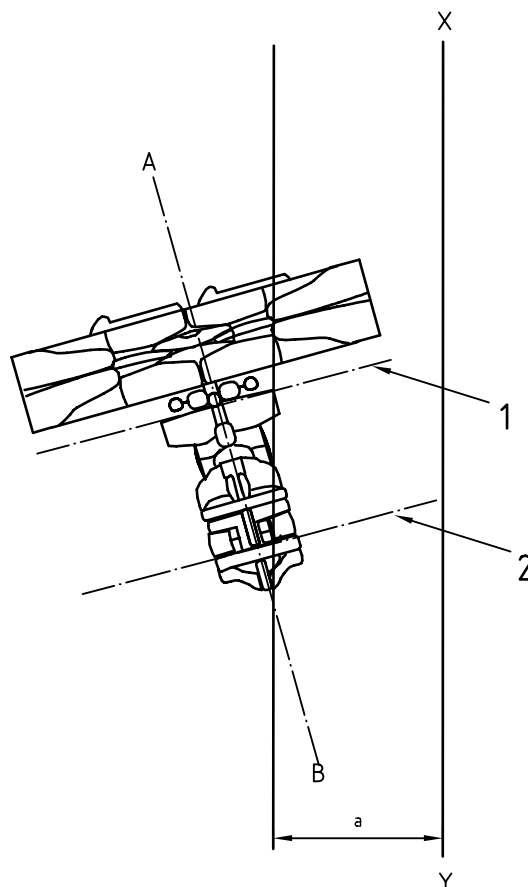
Figure 6 — Position of truck for test 4



Key

- 1 Load axle
- 2 Steer axle
- XY is the tilt axis.
- a Parallel.

Figure 7 — Position of truck for longitudinal stability tests



Key

- 1 Load axle
- 2 Steer axle
- XY is the tilt axis.
- a Parallel.

Figure 8 — Position of truck for lateral stability tests

Key

- 1 Load axle
- 2 Steer axle
- XY is the tilt axis.
- ^a Parallel.

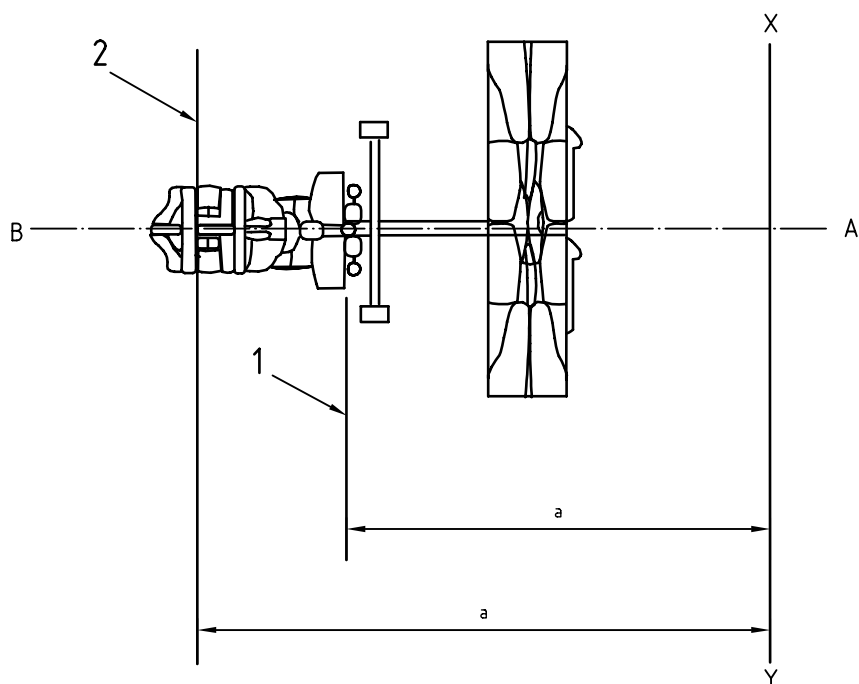


Figure 9 — Truck with stabilizers

Key

- 1 Load axle
- 2 Steer axle
- XY is the tilt axis.
- ^a Parallel.

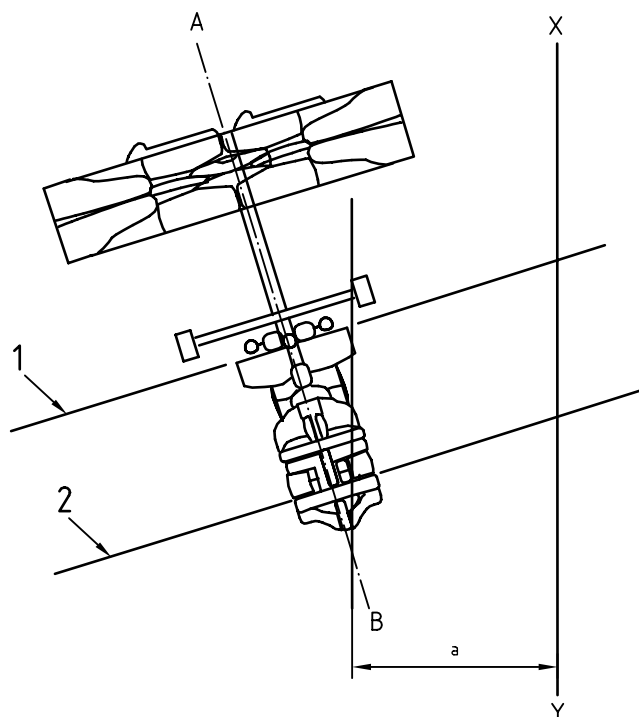
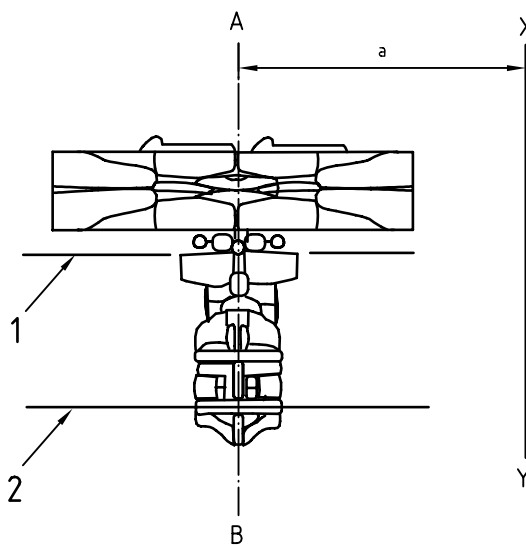


Figure 10 — Truck with stabilizers



Key

- 1 Load axle
- 2 Steer axle
- XY is the tilt axis.
- ^a Parallel.

Figure 11 — Truck with axle locking

Bibliography

- [1] ISO 13562-1, *Industrial variable-reach trucks — Part 1: Stability tests*.
- [2] EN 1459:1998, *Safety of industrial trucks — Self-propelled variable reach trucks*.

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