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Rough terrain trucks — Stability tests

Chariots élévateurs tous terrains à fourches — Essais de stabillité

Foreword

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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.

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Rough terrain trucks — Stability tests

1 Scope

This International Standard specifies the basic tests to verify the stability of rough terrain lift trucks and rough terrain variable reach trucks.

It is applicable to the above trucks:

– with a seated operator;

– fitted with fork arms or attachments;

– with fixed or articulated chassis;

– which may have stabilizers, axle-locking or frame-levelling devices;

– with two- or four-wheel or articulated steering systems;

– with masts with or without tilt mechanisms;

– with non-slewing booms or having slewing movement not greater than 5° either side of the longitudinal centre-plane.

This International Standard is not applicable to trucks when handling suspended loads which may swing freely.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standard listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 5767:1992, *Industrial trucks operating in special conditions of stacking with mast tilted forward — Additional stability test*

ISO 10658:1996, *Industrial trucks operating in special conditions of stacking with load offset by powered devices — Additional stability test*

3 Purpose of tests

3.1 Normal operating conditions

The basic tests specified in this International Standard ensure that a rough terrain truck demonstrates satisfactory stability when reasonably and appropriately used under normal conditions, i.e.:

a) masted trucks, stacking with the mast approximately vertical and the fork arms reasonably horizontal, on substantially firm, smooth, level and prepared surfaces;

b) variable reach trucks, stacking with a combination of boom elevation/extension and the fork arms reasonably horizontal, on substantially firm, smooth, level and prepared surfaces;

c) 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; where applicable, any reaching/telescopic mechanism is to be fully retracted;

d) operating with the load centre of gravity approximately on the longitudinal centre plane of the truck.

e) masted trucks, 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;

f) variable reach trucks, manoeuvring an elevated load with the fork arms tilted rearwards.

3.2 Operating conditions — Other than normal

When the operating conditions differ from those stated in 3.1 use either:

a) a truck complying with other International Standard(s) covering the different conditions (e.g. ISO 5767), or

b) a truck whose stability performance is agreed upon between the interested parties. This performance shall not be less than that required by the test specified for normal operating conditions in 3.1.

4 Stability tests

4.1 Specification of tests

The stability of rough terrain trucks shall be verified by means of one of the procedures described in 4.2. The tilting platform test shall be used to verify stability in the event of a dispute.

4.2 Verification procedure

4.2.1 Tilting platform

A test platform which can be tilted about one side shall be used. The truck under test shall be placed on the platform, which is initially in the horizontal plane, sequentially in the positions described in table 1.

For each of the truck positions, the platform shall be tilted slowly and smoothly to the slope indicated in table 1. The truck is considered stable if it passes all the tests without overturning.

For the purposes of these tests, overturning is defined as the test platform slope value which, if increased, would cause overturning of the truck.

It is permissible in the lateral tests for one of the load wheels to lose contact with the test platform and it is acceptable for parts of the structure or other designed features to make contact with the test platform.

The momentum gained by a truck adopting a change in attitude is additive to that produced by the tilting platform and overturning of the truck caused by the added momentum is to be taken as evidence of instability at that slope angle.

4.2.2 Fixed slope

Fixed slopes, with inclinations equivalent to the prescribed test slopes, shall be used. The slope surface shall be smooth and capable of supporting the truck mass with no deformation likely to affect the test results.

The truck under test shall be driven onto the fixed slopes and positioned according to table 1. For each of the truck positions, the load shall be elevated slowly and smoothly to the height indicated in table 1.

4.2.3 Calculation

Calculation may be used to predict stability. Such calculations shall take into account structural and tyre deflections. Calculation methods shall be confirmed by test data.

Calculations are typically used to predict payloads for alternative attachments and/or alternative tyre options.

Calculations shall not be used to type test new models of trucks.

4.3 Test conditions

4.3.1 Condition of the truck

The tests shall be carried out on an operational truck.

The operator shall be represented by an object having a mass of 90 kg if the stability during a test is thereby decreased. 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 mid-point of the adjustments provided.

Fuel tanks of engined trucks shall be full if stability is thereby reduced; all other tanks shall be filled to their correct operating levels.

Tyres shall be inflated to their correct 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.

4.3.2 Position of the truck on the platform

For tests 1 and 2 (see table 1), the truck shall be placed on the test platform so that the load axle is parallel to the tilt axis, *XY*, of the test platform [see figures 1c), 2d) and 2e)].

Stabilizers or axle locking may only be used for tests 1 and 3.

For tests 3, 4 and 5 (see table 1), the truck shall be positioned on the test platform in a turning position with line MN parallel to the tilt axis, *XY*, of the test platform [see figures 2c) to 2f)].

Trucks positioned as shown in figure 2c), d), f) and g) shall have the steer wheel nearest to the tilt axis parallel with the tilt axis.

Lateral stability tests shall be conducted to the side of the truck which is the least stable.

Point N is the centre point of the area of contact between the test platform surface and the front wheel or the stabilizer contact pad nearest the tilting axis [see figures 2c) to 2g)].

Point M is defined as follows:

a) for trucks having an oscillating steering axle: the projection onto the test platform of the intersection of the longitudinal centre-plane AB of the truck with the axis of this axle [see figures 2c), 2d) and 2f)];

b) for trucks with articulated chassis: the projection onto the test platform of the intersection of the longitudinal centre plane EF of rear chassis module and the axis of the rear axle when fully articulated [see figure 2e)];

c) for trucks with axle locking: the centre point of the area of contact between the test platform and the rear wheel nearest the tilting axis [see figure 2g)].

4.3.3 Test load

The test load shall be a mass equivalent to the maximum load *Q*, as indicated on the information plate of the truck, which the truck can elevate to its maximum lift height acting through the centre of gravity, G, nominally positioned at the standard load centre distance, *D*, both horizontally from the front face of the fork arm shank and vertically from the upper face of the fork arm blade (see figure 3 and table 2).

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 International Standard for these additional ratings.

The centre of gravity, G, of the test load (see figure 3) shall be located in the longitudinal centre plane, AB, of the truck [see figures 1c), 1d) and 1e), 2c) to 2g), and 6c) and 6d)].

4.3.4 Location of the truck on the platform

The truck shall be positioned in accordance with table of tests, see table 1.

The initial position of the truck on the test platform shall be maintained during each test. This may be achieved by application of the parking or service brakes, which may be secured in the ‘on’ position, or by wedging the wheels against the truck frame, ensuring however that articulation is not affected.

Blocks (chocks) having a maximum height not exceeding the value indicated in table 3 may be used, if necessary, to maintain the initial position of the truck on the test platform. Blocks (chocks), if used, shall not artificially improve stability.

Stabilizers or axle locking may only be used for tests 1 and 3.

The coefficient of friction of the platform surface may be increased if necessary by an appropriate friction-increasing material.

4.3.5 Position of the front face of the fork arm shanks

4.3.5.1 For trucks fitted with masts

Test 1 shall be conducted with the horizontal position of a load datum point, E, unchanged when elevated from its lowered position [see figure 4c)].

By means of a plumb line or other suitable equipment, set the mast vertical, elevate the fork and the specified test load to approximately 500 mm above the test platform. With the front face of the fork arm shank vertical, establish a point E [see figure 4a)] on the fork or fork carrier, having a fixed relationship to the centre of gravity of the test load G (see figure 3). Point E shall be used to provide a reference datum F on the test platform [see figure 4a)]. When the mast is elevated, a new point F1 on the test platform may occur [see figure 4b)]. By the following adjustments, this new point F1 can be returned to the original location of F [see figure 4c)], as follows.

a) For trucks with tiltable masts, changes in the location of F1 shall be corrected by varying the tilt of the mast within the limits provided by the design of the truck.

b) For trucks with fixed masts, adjustments in the fork arms or fork carrier tilt (where provided) may be used to correct for changes in location of point F1 within the limits of tilt provided by the design of the truck.

c) For trucks having non-tiltable masts, fork arms, or fork carrier, adjustments cannot be made.

4.3.5.2 Trucks with variable reach mechanism

Tests 1 and 3 shall be conducted with the load in the least stable combination of lift and reach, as determined by the manufacturer [see figures 1b) and 2b)].

4.3.6 Trucks with selectable stabilizers and/or axle locking

Tests 1 and 3 shall be conducted both with stabilizers engaged and disengaged [see figures 1d) and 2f)].

4.3.7 Lift height for tests simulating travel

For tests simulating travel, i.e. tests 2 and 4, the upper face of the fork arms, measured at the heels of the fork arms when fully tilted rearward, shall be positioned approximately 500 mm from the test platform [see figures 5a), 5b), 6a) and 6b)].

4.3.8 Lateral test procedure

Lateral tests shall be conducted to the side to which the truck is least stable.

For trucks with operator-selectable stabilizers, or axle locking, test 3 shall be conducted both with stabilizers and axle lock engaged and disengaged.

For trucks fitted with operator-selectable stabilizers or chassis levelling, test 3 may be performed with a maximum of 7 % (4°) of lateral correction [see figures 2a), 2b) and 2f)].

4.3.9 Lateral stacking test (unladen)

The unladen lateral stacking tests for masted trucks shall be conducted at maximum backward tilt. For variable reach trucks, tests shall be conducted at maximum and minimum boom extension, at maximum boom angle.

4.3.10 Safety precautions

Precautions shall be taken to prevent the overturning of the truck or displacement of the test load during the course of the test. If the means for preventing the total overturning of the truck consist of rope lashing or chain, this shall be sufficiently slack to impose no appreciable restriction on the truck until the overturning is reached.

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

a) firmly securing the test load to the carrier or equivalent structure;

b) suspending the test load near the ground from an appropriate support placed on the fork so that the suspension point is at the point where the centre of gravity G (see figure 3) of the test load would be if the test load were to be placed on the fork.

5 Stability tests for trucks with attachments

Trucks fitted with attachments shall be subjected to the same stability tests, except where the attachment can bring the centre of gravity of the load out of the longitudinal centre plane AB of the truck [see figures 1c), 1d) and 1e)]. Refer to clause 6 for this case.

For verification of the vertical position of the mast, a reference point having a fixed relationship to the centre of gravity of the test load G (see figure 3) shall be chosen.

The test load shall be the nominal load at the nominal centre distance specified for the attachment when used on the truck being tested.

The lift heights required in the tests shall be measured between the surface of the tilting platform and the underside of the load or attachment whichever is the lower.

6 Stability tests for trucks with offset loads

Where the load or attachment offsets the centre of gravity of the load from the longitudinal centre plane of the truck, an additional stability test is required (see, for example, ISO 10658).

Table 1 — Stability tests

	Tests for longitudinal stability		Tests for lateral stability		
Test No.	1	2	3	4	5
Test of stability when	Stacking	Travelling	Stacking	Travelling	Stacking
Test load	WITH	WITH	WITH	WITH	WITHOUT
Lift height, variable reach	Least stable lifting and reach combination with fork arm in horizontal position	Lowered (see 4.3.7)	Least stable lifting and reach combination with fork arm in maximum backward tilt	Lowered (see 4.3.7)	Maximum and minimum boom extension at maximum boom angle
Lift height, inclination of mast	Maximum lift height with mast vertical (see 4.3.5.1)	Lowered and maximum backward tilt (see 4.3.7)	Maximum lift height and maximum backward tilt (see 4.3.9)	Lowered and maximum backward tilt (see 4.3.7)	Maximum lift height and maximum backward tilt (see 4.3.9)
Load centre distance	*D* of test load	*D* of test load	*D* of test load	—	—
Stabilizer device and/or axle locking	WITH and WITHOUT	WITHOUT	WITH and WITHOUT	WITHOUT	WITHOUT
Correction or lateral tilt	WITHOUT	WITHOUT	WITH	WITHOUT	WITHOUT
Truck position on test platform	Figures 1a) or 1b), and 1c), 1d) or 1e)	Figures 6a) or 6b), and 6c) or 6d)	Figures 2a) or 2b), and 2c), 2d), 2e), 2f) or 2g)	Figure 5a) or 5b), and figure 2c), 2d) or 2e)	Figure 5c) or 5d), and figure 2c), 2d) or 2e)
Slope of test platform	7 %	22 %	12 %	50 %	10 %