



# SLOVENSKI STANDARD

## SIST EN 16203:2014

01-september-2014

Nadomešča:  
SIST ISO 1074:1999

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**Vozila za talni transport - Dinamično preskušanje za preverjanje bočne stabilnosti - Čelni viličarji**

Safety of Industrial Trucks - Dynamic tests for verification of lateral stability - Counterbalanced Trucks

Sicherheit von Flurförderzeugen - Prüfung der dynamischen Standsicherheit - Gegengewichtsstapler

Sécurité des chariots de manutention - Essais dynamiques pour la vérification de la stabilité latérale - Chariots en porte-à-faux

**Ta slovenski standard je istoveten z: EN 16203:2014**

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53.060      Industrijski tovornjaki      Industrial trucks

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EUROPEAN STANDARD

EN 16203

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2014

ICS 53.060

English Version

## Safety of Industrial Trucks - Dynamic tests for verification of lateral stability - Counterbalanced Trucks

Sécurité des chariots de manutention - Essais dynamiques  
pour la vérification de la stabilité latérale - Chariots en  
porte-à-faux

Sicherheit von Flurförderzeugen - Prüfung der dynamischen  
Standsicherheit - Gegengewichtsstapler

This European Standard was approved by CEN on 28 February 2014.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
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## Foreword

This document (EN 16203:2014) 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of an identical text or by endorsement, at the latest by December 2014 and conflicting national standards shall be withdrawn at the latest by December 2014.

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 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, which is 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.

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## Introduction

This European Standard is a type C standard as stated in EN ISO 12100:2010. This standard has been prepared to be a harmonized standard to provide one means of conforming to the essential safety requirements of the Machinery Directive and associated EFTA regulations.

The extent to which hazards are covered is indicated in the scope of this standard.

NOTE 1 The requirement for a dynamic test is intended to be included in EN 16307-1, *Industrial trucks – Safety requirements and verification – Part 1: Supplementary requirements for self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*.

The purpose of this standard is to provide a procedure for verifying the lateral stability of the truck while travelling. The procedure can be used as a type test as well as an individual test.

The truck is designed so that when travelling, laden or unladen, it will remain stable while being operated on smooth level ground under conditions of use defined by the manufacturer, e.g. by controlling travelling velocity, steering rate of change, acceleration and deceleration, position of load handling device.

To reduce the risk of lateral instability for lifting, furthermore it is proposed to indicate this misuse of driving with elevated load by signals or by reduction of the driving velocity when exceeding a certain lift height. This requirement is intended to be included in the respective standard in its next revision.

NOTE 2 This standard is not intended to completely eliminate the possibility of a lateral tip over in all working conditions, i.e. it is possible to exceed the lateral stability limits if slightly uneven or sloping surfaces combine with unsafe driving practices.

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## 1 Scope

This European Standard specifies dynamic tests for the verification of lateral stability for counterbalanced lift trucks according to EN ISO 3691-1 that have a centre control, sit down, non-elevating operator, with a rated capacity up to and including 5 000 kg when travelling on smooth level ground with the forks in travelling position. The standard is not applicable for Rough Terrain forklift trucks.

NOTE 1 Experience shows that counterbalanced lift trucks with a rated capacity over 5 000 kg are not significantly affected by lateral instability.

The requirements are specific to the various drive systems (e.g. Electric-/Internal-Combustion-Engine trucks), taking account of their varying influence on dynamic stability performance.

This European Standard does not cover the risk of a lateral tip over associated with driving backwards.

NOTE 2 Research has shown that driving backwards in typical working operations, such as unloading of a lorry, does not cause lateral instability. For this reason, only driving forward needs to be tested.

Risks due to falling off a loading dock or turning on a ramp are not covered by this European Standard.

Risks due to lifting or manoeuvring operations are covered by the respective stability tests.

## 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 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)*

ISO 5053:1987, *Powered industrial trucks - Terminology*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5053:1987 and EN ISO 3691-1:2012 and the following apply.

### 3.1

#### **maximum velocity**

maximum designed truck velocity according to the manufacturer's specifications

Note 1 to entry: If the truck velocity is automatically reduced in certain load device positions (i.e. lift height dependent), this reduced velocity is the maximum velocity for that load condition.

### 3.2

#### **test velocity**

velocity greater than 90 % of the maximum velocity

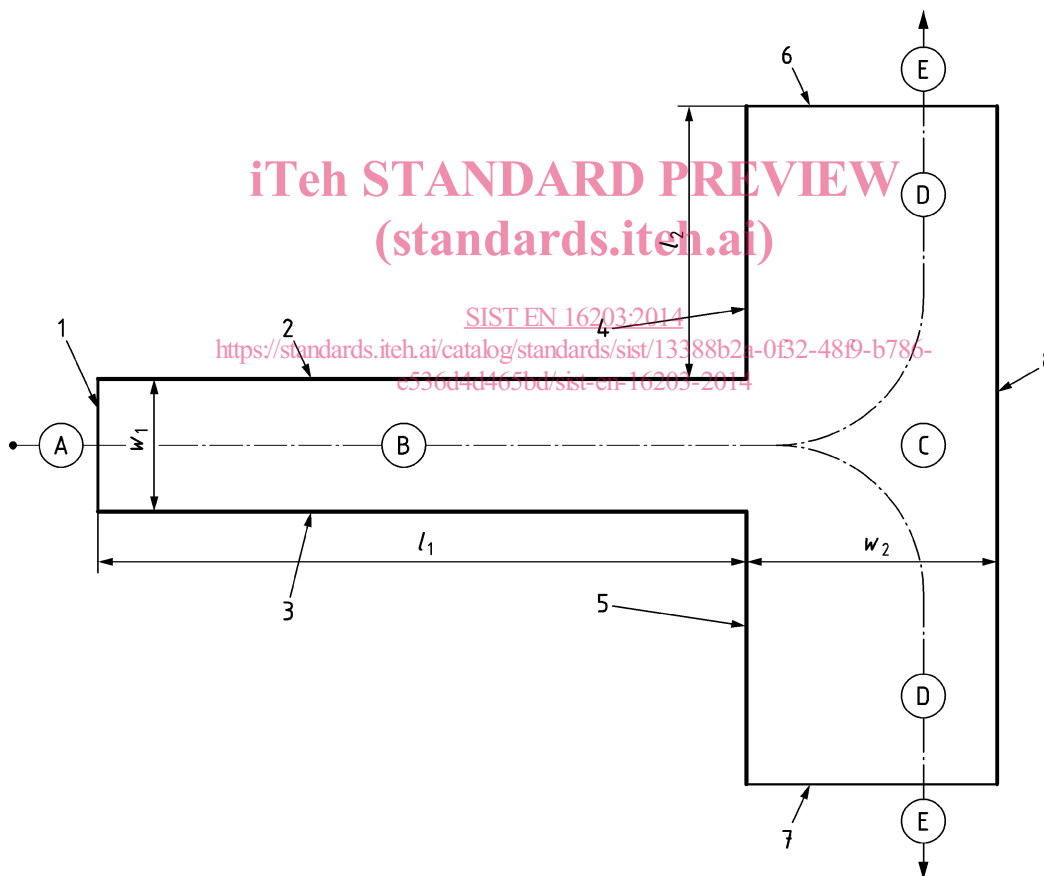
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## 4 Test equipment

## 4.1 Test area

The test area shall be a flat and smooth area with a hard, clean and dry surface made of concrete, asphalt or equivalent. The lanes shall have no more than 2 % slope in any direction of travel and the slip friction coefficient  $\mu$  of tyres and surface shall be between  $\mu = 0.6$  and  $\mu = 0.8$ . The slip friction coefficient can be measured as described in Annex B. The slip friction coefficient may change by environmental influences (temperature, moisture, intermediary medium) as well as by type and wear condition of tyres and road surface. Therefore, a friction measurement shall be carried out before each test series. The area shall be clear of all loose chippings, sand or anything similar.

The test track shall consist of two perpendicular crossing lanes (see Figure 1). The lanes are defined by lines 1 to 8, of which at least lines 2, 3, 4, 5 and 8 shall be continuously marked on the ground (e.g. by painted lines, adhesive tape, non-fixed wooden lathes, ropes or chains, etc.). The defining lines shall be marked so they are clearly visible to the operator whilst driving. Whilst the preferred test track will have a shape similar to those of Figure 1, alternative test tracks in accordance with Annex A may be used.



## Key

A	accelerating area	$w_1$	width of the entry lane
B	entry lane	$w_2$	width of the exit lane
C	manoeuvring area	$l_1$	length of the entry lane
D	exit lane	$l_2$	length of the exit lane
E	braking area		

lines 1 – 8 limiting the test track

Figure 1 — Layout of the test track



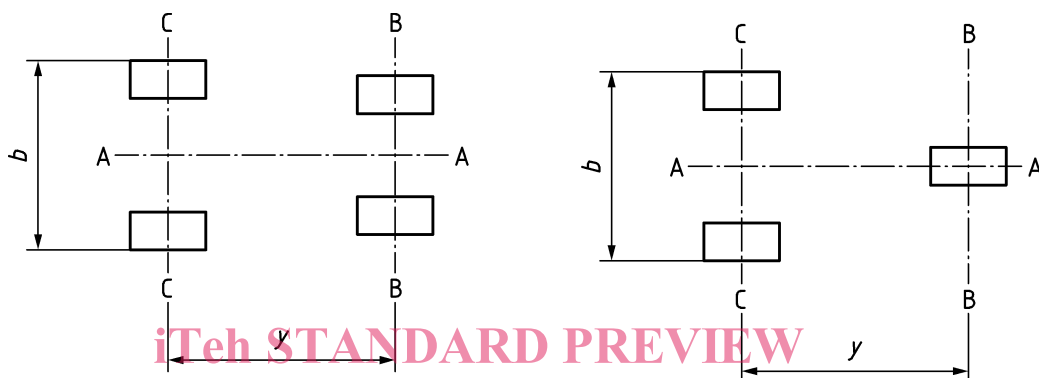
The overall dimensions of the test track shall include a sufficient area A to accelerate to reach the test velocity prior to the entry lane B and a sufficient area E for stopping. The dimensions depend on the type and size of the truck and are defined as follows:

$w_1 = 1,5 \cdot b$  [m] with the truck width  $b$  as shown in Figure 2

$l_1 = 3 \cdot y$  [m] with the wheelbase  $y$  as shown in Figure 2

$l_2 = 4 \cdot y$  [m] with the wheelbase  $y$  as shown in Figure 2

The dimension  $w_2$  is defined in 6.2.



#### Key

A-A longitudinal plane of truck

B-B steering axle

C-C load axle

$b$  truck width [m]

$y$  wheelbase [m]

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Figure 2 — measures of 3-wheel and 4-wheel trucks

## 4.2 Test set-up and test equipment

An appropriate sensor shall be used to measure the travel velocity during the test or, at least, when the forklift truck crosses line 1 (velocity sensor, velocity barrier, etc.). Additional appropriate measures shall be used to verify that the accelerator pedal is fully pressed while driving between line 1 and line 6 or line 7 (e.g. contact sensor under the accelerator pedal). Furthermore, appropriate sensors, a video camera or human observers are necessary to detect whether the test is valid.

## 4.3 Protective equipment and precautions

To enable tests with minimal risk to the driver the truck shall be fitted with:

- a) an operator restraint system, preferably a seat belt, which maintains the driver safety;
- b) outrigger type stabilizers as protective equipment to prevent the truck tip-over:
  - 1) The test truck shall be equipped with stabilizers on both sides of the truck.
  - 2) The clearance between the stabilizers and the ground shall be such that tip-over of the vehicle is prevented but a rear wheel lift-off is still possible. For trucks with articulating steer axles, full articulation shall be possible before the stabilizers make contact with the ground.

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- 3) The stabilizers shall be fixed rigidly and securely to the truck.
- 4) The total mass of the stabilizers shall be less than 10 % of the weight of the unladen truck.
- 5) The position of the centre of gravity of the truck shall not be lowered by attaching the stabilizers.

**4.4 Test Load**

Test shall be carried out with the unladen truck as defined in Clause 5.

**5 Test truck**

The truck to be tested shall be in a safe and functional state. All equipment attached shall be in accordance to the specification of the manufacturer of the truck. If the test is to be performed on a sample that is representative for a range of trucks, the test shall be carried out on the truck with the most disadvantageous stability values.

The fuel tanks of internal combustion engine trucks shall be filled if stability is thereby decreased.

All other tanks shall be filled to their correct operating levels, as applicable.

The test truck shall be fitted with new tyres (max. 10 % of tread wear) which shall comply with the specifications of the manufacturer of the truck. Pneumatic tyres shall be inflated to their correct pressure specified by the truck manufacturer.

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**6 Requirements**

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**6.1 General – Dynamic lateral stability**

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The dynamic lateral stability shall be verified by testing as defined in this standard.

Simulation as calculations, computer modelling or other equivalent simulating methods may be used, provided that the results are validated by testing as defined in this standard.

**6.2 Test Criteria**

The truck shall run the test according to Clause 7 for the measurement  $w_2$ .  $w_2$  is defined by the formula:

$$w_2 = w_3 + \frac{b}{2} \text{ [m]} \quad (1)$$

The measurement  $w_3$ , for electric driven trucks given in Figure 3 and for IC-driven trucks given in Figure 4, depends on the maximum velocity and the truck width  $b$  is shown in Figure 2.

**EXAMPLE** To determine the width of the exit lane,  $w_2$ , for an electric driven truck with a maximum velocity of 10 km/h: Find the maximum truck velocity along the x-axis and record the value of  $w_3$  on the y-axis where a vertical line from the maximum truck velocity crosses the graph curve: in this case  $w_3 = 5$  m. Substitute  $w_3$  in Formula (1) in 6.2 to determine  $w_2$  for this specific truck.

This requirement is fulfilled if three successful attempts are obtained within a maximum number of twenty attempts.

An attempt is successful in the case that it is:

- a) a valid attempt;

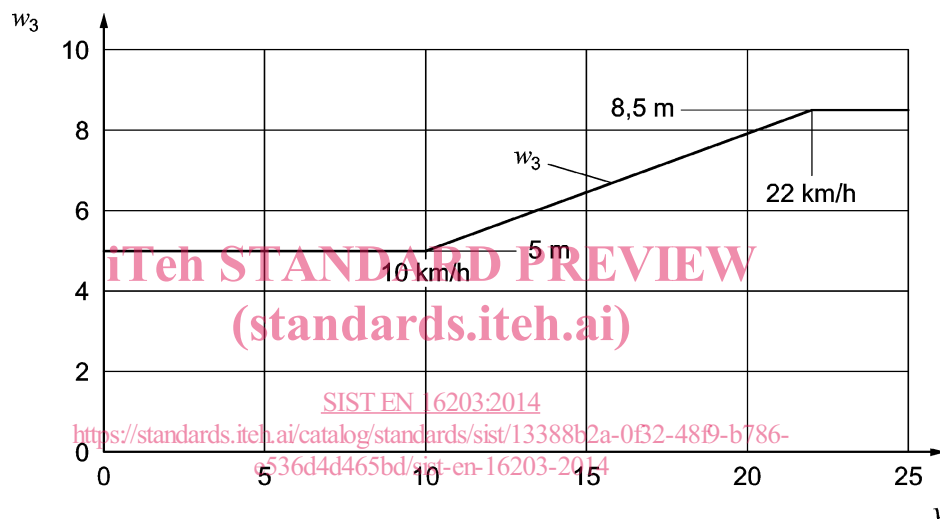
and

b) the subsequent relevant criteria are fulfilled:

- 1) for a three wheel truck with 1 wheel on the rear axle this rear wheel has contact to the ground; or
- 2) for a three wheel truck with twin centre rear wheels at least one of these two wheels has contact to the ground; or
- 3) for a four wheel truck with an articulating rear axle the inner rear wheel has contact to the ground.

A lift off of the inner front wheel is allowed.

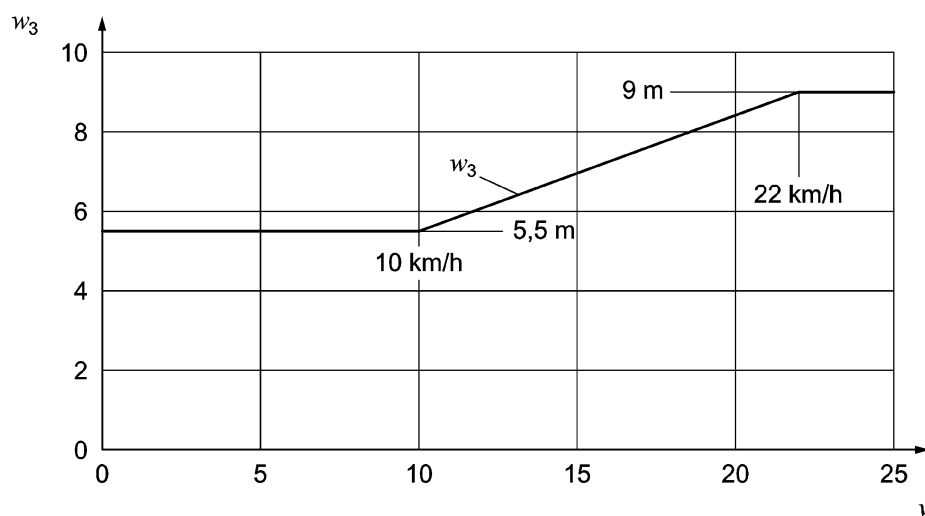
A valid attempt is obtained if no part of the truck touches the limiting lines 2, 3, 4, 5 and 8 (see Figure 1) of the test track or the ground beyond under the test conditions described in Clause 7.



**Key**

$v$  velocity in km/h

**Figure 3 — Required measure  $w_3$  for electric driven trucks**



**Key**

$v$  velocity in km/h

**Figure 4 — Required measure  $w_3$  for IC-driven trucks**