IEC 63281-3-2

Edition 1.0 2024-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

E-Transporters –
Part 3-2: Performance test methods for mobility of cargo e-Transporters

e-Transporteurs –
Partie 3-2: Méthodes d'essai de performances pour la mobilité des e-Transporteurs de marchandises

IEC 63281-3-2:2024-05(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 43.120

ISBN 978-2-8322-8832-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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E-TRANSPORTERS –

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The text of this International Standard is based on the following documents:

Draft	Report on voting
125/95/FDIS	125/100/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63281 series, published under the general title *e-Transporters*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn, or
- revised.

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INTRODUCTION

At the time of writing of this document, the global market scale of cargo e-Transporters is about US $ 30 billion, with a wide range of application scenarios, which can meet the needs for short-distance distribution, low-carbon and environmental protection.

However, there is currently no international standard for this kind of product. The mobility of cargo e-Transporters is the key index of their performance, including their maximum speed, maximum climbing angle, maximum climbing speed, turning characteristics, gap detection, narrowest passing width, specific object detection, and typical object detecting distance.

This document specifies the performance criteria and related test methods for cargo e-Transporters.

E-TRANSPORTERS –

Part 3-2: Performance test methods for mobility of cargo e-Transporters

1 Scope

This document is applicable to electrically powered transport devices for use on public roads or in public spaces and which are primarily designed for transporting cargo ("cargo e-Transporters"). The typical application environment of cargo e-Transporters includes the following: for the purposes of hotels, restaurants, office buildings, hospitals, industrial/recreational parks, public roads, etc.

This document specifies performance criteria and evaluation methods for the mobility of cargo e-Transporters.

This document does not include safety and performance requirements.

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.

IEC 63281-1:2023, *E-Transporters – Part 1: Terminology and classification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 63281-1 and the following apply.

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

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

3.1
cargo e-Transporter
CeT
e-Transporter that is primarily designed for transporting cargo or goods, or both

[SOURCE: IEC 63281-1:2023, 3.4]

3.2
rated speed
speed that the CeT can achieve in normal operating conditions with rated load without any degradation of performance according to the specification

3.3
rated load
maximum allowed weight of cargo(s) transported by the CeT, as defined by the manufacturer

[SOURCE: IEC 63281-1:2023, 3.14, modified – Replaced the term "e-Transporter" with "CeT" and deleted the content about the person.]

3.4
localization
process of identifying or distinguishing the position of the CeT on the environment map

[SOURCE: IEC 63281-1:2023, 3.21, modified – Replaced the term "e-Transporter" with "CeT".]

3.5
trial
single instance of a performance measurement that can be carried out under identical conditions and be repeated multiple times

4 Test conditions

4.1 Overview

Before testing, the CeT shall be set up and properly warmed up.

The CeT shall be in normal working condition to ensure intended operation during the whole test process.

Unless otherwise specified, the CeT shall be tested at rated speed under rated load.

NOTE "Normal working condition" means the operating condition intended by the manufacturer.

4.2 Environmental conditions

Unless otherwise specified by the manufacturer, all tests shall be performed under the following environmental conditions:

– Relative humidity: (20 to 60) %;
– Temperature: (10 to 30) °C;
– Atmospheric pressure: (86 to 106) kPa;
– Illumination: > 200 lx;
– Wind speed: The average wind speed measured 0,7 m above the ground shall be less than 3 m/s, and the maximum speed of gusts shall be less than 5 m/s.

For the repeatability and reproducibility of tests, avoid changing the environmental conditions during the test and record them in the test results.

4.3 Testing surface condition

In principle, select the severest test ground or slope surface according to the expected use scenario so that it can reflect the most unfavourable condition (such as wooden, ceramic tile floor, concrete or asphalt surface, etc.), and usually the kinetic friction coefficient should be 0,75 to 1,0, unless specified otherwise by the manufacturer.

NOTE The kinetic friction coefficient is in accordance with ISO 7176-13.

4.4 Test equipment

Relative to the specified value or actual value, the accuracy of all control values or measured values should be within the following tolerance range:

a) Voltage: ±0,2 %;
b) Current: ±1 %;
c) Temperature: ±2 °C;
d) Position resolution ≤ 1 cm;
e) Position accuracy ≤ 1 cm;
f) Angle resolution ≤ 3°;
g) Angle accuracy ≤ 5°;
h) Data sampling frequency ≥ 30 Hz;
i) Time resolution ≤ 0,01 s;
j) Time accuracy ≤ 0,02 s.

5 Preparation of CeT for testing

The testing of the CeT shall be as follows:

a) Adjust CeT to the typical configuration specified by the manufacturer;
b) Function inspection of the CeT shall be carried out before testing to ensure normal operation;
c) Before testing the CeT, the battery shall complete at least one charge-discharge cycle. The operation of discharge limit defined by the manufacturer shall be carried out under normal operation according to the manufacturer's instructions;
d) Before the test of the CeT, the battery shall be fully charged as specified by the manufacturer;
e) The rated load shall be reasonably and evenly distributed when tested under rated load conditions.

6 Maximum speed

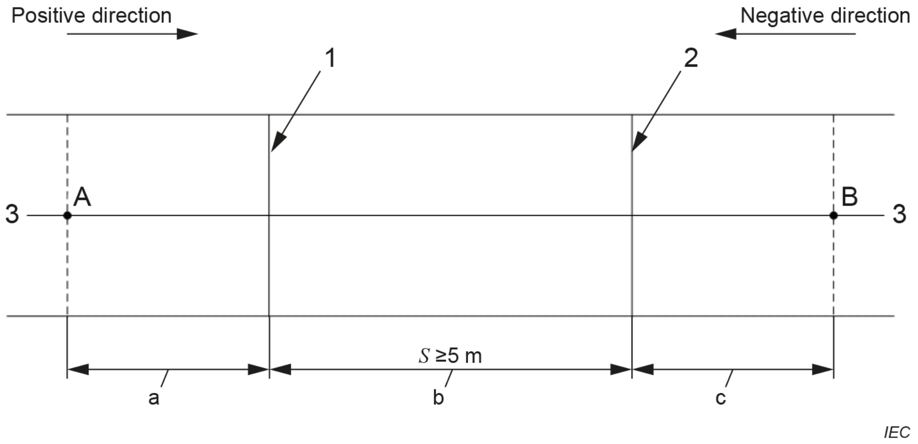
6.1 Test purposes

This test evaluates the maximum allowable driving speed of the CeT under the rated load.

6.2 Test facility

The test shall be conducted on a long straight flat concrete or asphalt surface.

The demonstration of maximum speed test is shown in Figure 1. The length of the measurement section is not less than 5 m, and the width of the measurement section should ensure that the CeT can pass normally. Sufficient space should be reserved at each end of the measurement section for acceleration and deceleration of the CeT.



Key:

A: initial start point (+)

B: initial start point (−)

1: measurement start line (+)/measurement stop line (−)

2: measurement stop line (−)/measurement start line (+)

3: central line

a: acceleration section (+)/deceleration section (−)

b: measurement section

c: deceleration section (+)/acceleration section (−)

Figure 1 – Maximum speed test

6.3 Test procedure

The test steps are as follows:

1) select an initial point in the positive direction and record the length of the measurement section;
2) place the CeT with rated load at the initial point;
3) the CeT moves from the initial point and shall accelerate to stable speed before reaching the start line;
4) the CeT moves along the central line from the start line to the stop line. Record the time of the CeT passing through the measurement section;
5) after passing through the stop line, the CeT decelerates to stop. The average speed is calculated according to Formula (1) and is then recorded:

$$V = \frac{S}{t} \tag{1}$$

where

V is the average speed for each trial, in metres per second (m/s);

S is the length of the measurement section, in metres (m);

t is the passing time for each trial, in seconds (s).

6) repeat steps 2) to 5) for three trials. A trial is regarded as a failure and is terminated in advance if the CeT does not reach the stop line or if it deviates from the central line by more than 10 % of the length of the measurement section;

7) after three successful trials, select an initial point in the negative direction and repeat the test procedure in steps 2) to 6).

8) after three successful trials, the test is terminated. Take the minimum value of average speed in both positive and negative directions as the maximum speed.

6.4 Result record

After the test, fill in the test result in Table 1. The test results shall include information such as the conditions of the concrete or asphalt surface (surface material, kinetic friction coefficient, etc.), and the loading weight of the CeT.

Table 1 – Maximum speed test record table

Length of the measurement section (m)			**Loading weight (kg)**			
Operating condition	☐ Operated by the human pilot ☐ Autonomous driving without human intervention					
Conditions of the concrete or surface						
Passing time (s)	T_{1+}	t_{2+}	t_{3+}	t_{1-}	t_{2-}	t_{3-}
Average speed (m/s)	V_{1+}	V_{2+}	V_{3+}	V_{1-}	V_{2-}	V_{3-}
Maximum speed (m/s)						

7 Maximum climbing angle

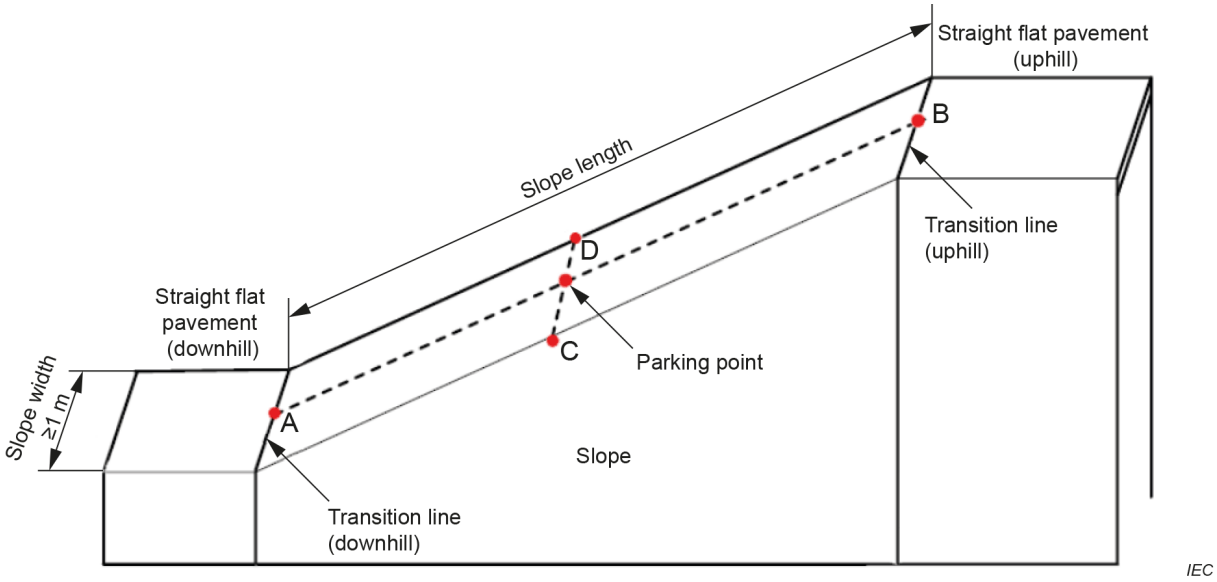
7.1 Test purposes

This test evaluates the maximum climbing angle of a CeT in a specific direction of movement under no load and at rated load.

7.2 Test facility

The test shall be conducted on a slope with adjustable slope angles.

The demonstration of maximum climbing angle test is shown in Figure 2. A straight flat concrete or asphalt surface shall be set before and after the slope. The accuracy of angle adjustment shall be within ±0,5°. The length of the slope is usually not less than 5 times the length of the CeT to ensure its normal travelling. The width of the slope shall be wide enough such that the CeT can travel laterally on the slope for more than 1 m. Safety guardrails or barriers shall be added on both sides of the slope to prevent the CeT from falling down the slope.



Key:

A to B: a linear path along the length of the slope, connecting the midpoints of the slope on the width of the slope.

C to D: a lateral path along the width of the slope, connecting the midpoints of the slope on the length of the slope.

Parking point: a location on the slope at which the CeT is to be parked during each trial. In principle, it is located at the centre of the slope. If a parking point other than the centre location is selected, its location relative to the slope shall be recorded in the test report.

Figure 2 – Maximum climbing angle test

7.3 Test procedure

The test steps are as follows:

1) select one of the test configurations as specified in Table 2. The initial angle of the test is usually the allowable climbing angle declared by the manufacturer. For test configuration 1, 2, 3 and 4, the initial point is selected on the straight flat concrete or asphalt surface (uphill or downhill, depending on the travelling path), and shall be close to the transition line such that the CeT will not rush uphill or downhill due to inertia. For test configurations 5 and 6, the initial point is selected on the lateral path;
2) place the CeT with evenly distributed rated load at the initial point;
3) according to the selected test configuration, the CeT moves from the initial point to the parking point following the travelling path and moving direction as in Figure 2;
4) after reaching the parking point, the CeT shall be able to park on the slope for at least 30 s;
5) the CeT moves along the same travelling path, moving from the parking point to the target point;
6) repeat steps 2) to 5) for three trials. In each trial, the CeT shall be able to stop stably after reaching the target point. A trial is regarded as a failure and terminated in advance if the CeT becomes physically unstable (e.g. toppling, tipping over, sliding) or deviates from the travelling path by more than 20 % of the length of the travelling path;
7) place the CeT with no load at the initial point and repeat test procedure in steps 3) to 5);
8) if the first three trials for the selected slope angle under no load and rated load are all successful, record the selected slope angle. Then increase the slope angle by 1° and repeat the test procedure in steps 2) to 7). Otherwise, decrease the slope angle by 1° and repeat test procedure in steps 2) to 7).
9) if the slope angle after adjustment is covered by previous trials, the test under the selected test configuration is terminated. Record the maximum angle under the selected test configuration. Select another test configuration in Table 2 and repeat the test procedure in steps 2) to 8).