
**Energy efficiency of industrial
trucks — Test methods —**

Part 2:
**Operator controlled self propelled
trucks, towing and burden carrier
trucks**

*Efficacité énergétique des chariots de manutention — Méthodes
d'essai —*

*Partie 2: Chariots automoteurs commandés par l'opérateur, tracteurs
et chariots transporteurs de charge*

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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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 5, *Sustainability*.

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.

This document is intended to be used in conjunction with ISO 23308-1.

A list of all parts in the ISO 23308 series can be found on the ISO website.

Introduction

The ISO 23308 series deals with the energy efficiency of industrial trucks including batteries and battery chargers.

ISO 23308-1 contains the procedures to determine the efficiency of trucks, traction batteries and battery chargers. The other parts provide a specific test cycle for different truck types.

NOTE The test cycles are based on the VDI 2198 guideline. This guideline is widely accepted by industry and is used to measure the energy consumption of electric industrial trucks and internal combustion (IC) industrial trucks. The guideline has been in place since 1996 and it is used broadly. This approach allows the evaluation of the energy efficiency of trucks by comparison.

The content of this document is of relevance for the following stakeholder groups:

- machine manufacturers (small, medium and large enterprises);
- market surveillance authorities;
- machine users (small, medium and large enterprises);
- service providers, e.g. for consulting activities.

The stakeholder groups above have been given the opportunity to participate at the drafting process of this document. The machines concerned are indicated in the scope of this document.

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Energy efficiency of industrial trucks — Test methods —

Part 2:

Operator controlled self propelled trucks, towing and burden carrier trucks

1 Scope

This document specifies the method of energy consumption measurement for the following types of industrial trucks as defined in ISO 5053-1:

- counterbalance lift truck;
- articulated counterbalance lift truck;
- reach truck (with retractable mast or fork arm carriage);
- straddle truck;
- pallet-stacking truck;
- pallet truck;
- platform and stillage truck;
- pallet truck end controlled;
- order-picking truck;
- centre-controlled order-picking truck;
- towing, pushing tractor and burden carrier;
- towing and stacking tractor;
- side-loading truck (one side only);
- lateral-stacking truck (both sides);
- lateral-stacking truck (three sides);
- multi-directional lift truck.

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 23308-1:2020, *Energy efficiency of Industrial trucks — Test methods — Part 1: General*

ISO 3691-1:2011, *Industrial trucks — Safety requirements and verification — Part 1: Self-propelled industrial trucks, other than driverless trucks, variable-reach trucks and burden-carrier trucks*

ISO 5053-1, *Industrial trucks — Terminology and classification — Part 1: Types of industrial trucks*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5053-1 and ISO 23308-1 apply.

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

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

4 Test conditions

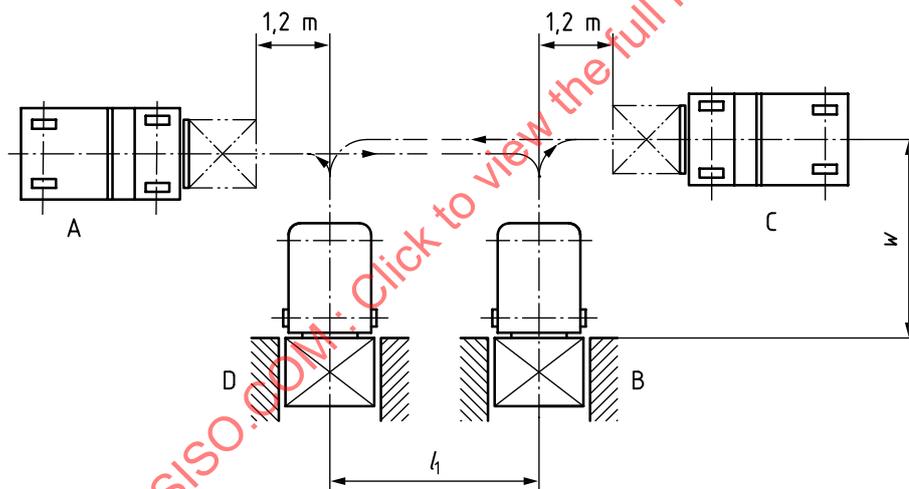
The test conditions are given in ISO 23308-1:2020, Clause 4.

5 Measurement procedure

5.1 General

ISO 23308-1 applies together with 5.2, 5.3 and 5.4, which describe specific information for the respective truck type.

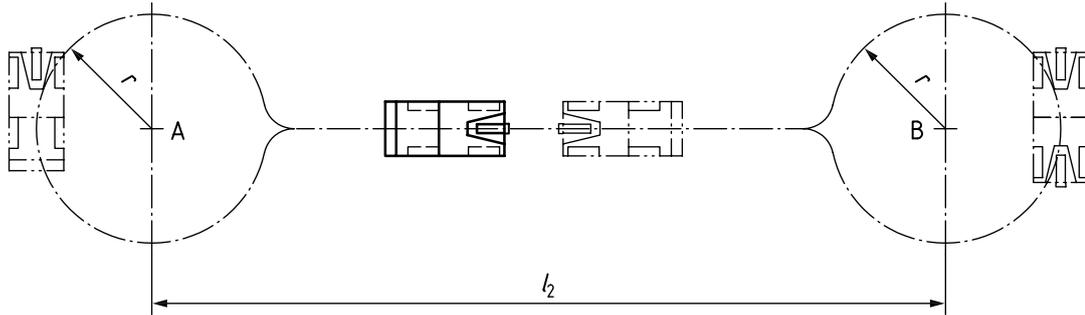
5.2 Test layout



Key

- w distance between the longitudinal centre plane of the truck and the simulated leading edge of the rack
- l_1 distance between the load lifting positions

Figure 1 — Cycle for energy consumption test of self-propelled trucks

**Key**

- r minimum turning radius
 A, B midpoint r
 l_2 distance

Figure 2 — Cycle for energy consumption test of towing tractors and burden carriers

5.3 Operating requirements and sequence for counterbalance lift trucks and comparable truck designs

For counterbalance trucks, lorry-mounted trucks, multi-directional forklift trucks and articulated counterbalance lift trucks the cycle shall be performed according to [Figure 1](#) and [Table 1](#) and shall start at position “A”.

While travelling, the load shall be at a lift height defined by the manufacturer, typically 300 mm. The mast or the fork carriage shall be tilted to the maximum backwards tilt.

Simultaneous operation is not permissible, travelling is not permitted while lift/lowering, or tilt operations.

The test duration shall be 1 h and the speed shall be adapted to reach the number of cycles per hour as defined in [Table 1](#). If the truck is not capable to achieve the number of cycles as specified within 1 h, the test shall be continued at maximum performance until the specified number is achieved. The time needed shall be reported in the declaration as defined in ISO 23308-1:2020, 6.2.1.

At position “B” and “D” the load shall be lifted and lowered without depositing the load.

The sequence of the cycle shall be carried out with the following actions:

- start at position “A”;
- travel in forward direction to position “B” by turning through 90°;
- return the backward tilt to the vertical position;
- lift the load with the lift as specified in [Table 1](#);
- lower to the lift height for travelling (300 mm);
- tilt back to maximum;
- drive backwards to position “C”;
- drive forward to position “D”;
- repeat the procedure as on position “B”;
- drive backwards to position “A”;

— end of cycle.

Table 1 — Test specification for counterbalanced trucks

Rated capacity Q , rated voltage, U , and type	$Q \leq 5$ t and $U \leq 36$ V (electric)	$Q \leq 5$ t (all other)	$Q = 5$ t ^a	5 t < $Q \leq 10$ t	10 t < $Q \leq 18$ t	$Q > 18$ t
Test load	$0,7 Q$	$0,7 Q$	$0,7 Q$	$0,7 Q$	$0,7 Q$	$0,7 Q$
Number of cycles (1/h)	45	60	60 or 45 ^a	45	40	25
Distance, l_1 (m)	30	30	30	30	50	100
Distance, w (m)	3	3	3 or 4 ^a	4	5	8
Lift at B and D (m)	2	2	2	2	3	3

^a The truck manufacturer may decide to test according to the test for trucks with $Q \leq 5$ t or $Q > 5$ t. For this capacity, the selected number of cycles and distance, w , shall be documented and published.

5.4 Operating requirements for other types of self-propelled trucks

5.4.1 General

For other truck types within the scope of this document, the cycle shall be performed according to [Figure 1](#) and [Table 2](#).

NOTE For types of trucks not covered by this document or other parts of the ISO 23308 series, one of the specific measurement procedures can be chosen and used as a guideline.

At position “B” and “D”, the load shall be lifted and lowered without depositing the load.

The test duration shall be 1 h and the speed shall be adapted to reach the number of cycles per hour as defined in [Table 2](#).

Simultaneous operation is not permissible, travelling is not permitted while lift/lowering, reach or tilt operations.

While travelling, the load shall be at a lift height defined by the manufacturer, typically 300 mm.

Table 2 — Test specification for other types of trucks

Type	Reach truck	Straddle trucks, pallet stacking trucks	Pallet and stillage trucks, pallet trucks end controlled, centre controlled order picking trucks	Towing tractors and burden carriers	
				Rated voltage $U < 80$ V	Rated voltage $U \geq 80$ V and IC-trucks
Test load	$0,7 Q$	$0,7 Q$	$0,7 Q$	$0,7 Q$	$0,7 Q$
No. of cycles (1/h)	35	20	20	40	60
Distance, l_1/l_2 (m)	30	30	30	50	50
Distance, w / Radius, r (m)	3	3	3	r_{\min}	r_{\min}
Lift at B and D (m)	4	2	0,15 or maximum ^a	—	—

^a Whichever is lower.

5.4.2 Operating sequence for reach trucks

For reach trucks, the cycle shall be performed according to [Figure 1](#) and [Table 2](#) and shall start at position "D".

The mast or the fork carriage shall be tilted 6° backwards or to the maximum backwards tilt, whichever is lower. The reach mechanism shall be retracted.

At position "B" and "D", the load shall be lifted, lowered and shifted without depositing the load.

The sequence of the cycle shall be carried out with the following actions:

- start at position "D", load at 300 mm, mast or the fork carriage tilted to the backwards tilt, reach mechanism in travelling position;
- move the backward tilt to the vertical position;
- extend the reach mechanism until maximum reach;
- lift the load as specified in [Table 2](#);
- lower to the lift height for travelling (300 mm);
- retract the reach mechanism in travelling position;
- tilt to the backwards tilt;
- drive forward to position "C";
- drive backwards to position "B" by turning through 90°;
- repeat the procedure as on position "D";
- drive forward to position "A";
- drive backwards to position "D";
- end of cycle.

5.4.3 Operating sequence of straddle trucks and pallet stacking trucks

For straddle trucks and pallet stacking trucks, the cycle shall be performed according to [Figure 1](#) and [Table 2](#) and shall start at position "D".

The sequence of the cycle shall be carried out with the following actions:

- start at position "D", load at 300 mm;
- lift the load as specified in [Table 2](#);
- lower to the lift height for travelling (300 mm);
- drive forward to position "C";
- drive backwards to position "B" by turning through 90°;
- repeat the procedure as on position "D";
- drive forward to position "A";
- drive backwards to position "D";
- end of cycle.

Double stackers and stacking tractors should be tested according to [5.4.3](#).