
Earth-moving machinery — Safety —
Part 4:
Requirements for backhoe loaders

Engins de terrassement — Sécurité —

Partie 4: Exigences applicables aux chargeuses-pelleteuses

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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 on 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 the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety, ergonomics and general requirements*.

This second edition cancels and replaces the first edition (ISO 20474-4:2008), which has been technically revised with the following changes:

- normative references have been updated;
- references to national and regional provisions in the withdrawn ISO/TS 20474-14 have been deleted;
- new safety requirements and protective measures have been added.

It is intended to be used in conjunction with ISO 20474-1.

A list of all parts in the ISO 20474 series, published under the general title, *Earth-moving machinery — Safety*, can be found on the ISO website.

Introduction

This document is a type-C standard as stated in ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

ISO 20474 provides acceptable safety requirements for earth-moving machinery. This standard does not necessarily provide requirements to meet all national and regional regulatory provisions, e.g. Japan does not allow object handling with earth-moving machinery.

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Earth-moving machinery — Safety —

Part 4: Requirements for backhoe loaders

1 Scope

This document gives the safety requirements specific to wheeled and crawler backhoe loaders as defined in ISO 6165. It is intended to be used in conjunction with ISO 20474-1, which specifies general safety requirements common to two or more earth-moving machine families. The specific requirements given in this document take precedence over the general requirements of ISO 20474-1.

This document deals with all significant hazards, hazardous situations and events relevant to the earth-moving machinery within its scope (see ISO 20474-1:2017, Annex A) when used as intended or under conditions of misuse reasonably foreseeable by the manufacturer. It specifies the appropriate technical measures for eliminating or reducing risks arising from relevant hazards, hazardous situations or events during commissioning, operation and maintenance.

This document is not applicable to machines manufactured before the date of its publication.

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 2330, *Fork-lift trucks — Fork arms — Technical characteristics and testing*

ISO 6016, *Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components*

ISO 6165, *Earth-moving machinery — Basic types — Identification and terms and definitions*

ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls*

ISO 7096:2000, *Earth-moving machinery — Laboratory evaluation of operator seat vibration*

ISO 7451, *Earth-moving machinery — Volumetric ratings for hoe-type and grab-type buckets of hydraulic excavators and backhoe loaders*

ISO 7546, *Earth-moving machinery — Loader and front loading excavator buckets — Volumetric ratings*

ISO 8643, *Earth-moving machinery — Hydraulic excavator and backhoe loader boom-lowering control device — Requirements and tests*

ISO 9248, *Earth-moving machinery — Units for dimensions, performance and capacities, and their measurement accuracies*

ISO 14397-1:2007, *Earth-moving machinery — Loaders and backhoe loaders — Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load*

ISO 14397-2, *Earth-moving machinery — Loaders and backhoe loaders — Part 2: Test method for measuring breakout forces and lift capacity to maximum lift height*

ISO 20474-1:2017, *Earth-moving machinery — Safety — Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20474-1, ISO 6165 and the following apply.

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

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

3.1 backhoe loader
self-propelled crawler or wheeled machine having a main frame designed to carry both front-mounted equipment and rear-mounted backhoe equipment (normally with outriggers or stabilizers)

Note 1 to entry: When used in the backhoe mode, the machine is stationary and normally digs below ground level.

Note 2 to entry: When used in the loader mode (bucket use), the machine loads through forward motion.

Note 3 to entry: A backhoe work cycle normally comprises excavating, elevating, swinging and discharging of material. A loader work cycle normally comprises filling, elevating, transporting and discharging of material.

[SOURCE: ISO 6165:2012, 4.3]

3.2 compact backhoe loader
backhoe loader (3.1) with an operating mass in accordance with ISO 6016 of 4 500 kg or less, designed to work in limited spaces with the associated needs for greater manoeuvrability

3.3 hydraulic lift capacity
maximum mass that can be lifted in any arm position with the fork in horizontal position limited by the hydraulic circuit working pressure as defined in ISO 14397-2

3.4 anchorage point
vertical point below the lifting device where the load force is applied or transposed

3.5 hydraulic holding circuit pressure load
maximum static pressure in a specific circuit, limited by a relief valve at a flow no greater than 10 % of rated circuit flow

3.6 tipping load
static load at the balance point

3.7 hydraulic lift capacity
maximum load that can be lifted at the bucket hinge pin with any hydraulic circuit activated, limited by the working circuit hydraulic pressure

3.8 lift point radius
horizontal distance between the bucket hinge pin and the swing pivot centre

3.9 balance point
point at which the moment acting to overturn the machine with a specific load and lift point radius is equal to the moment of the machine available to resist overturning

3.10**overturning moment**

moment when the balance point is reached

3.11**test force**

force applied to the load cell either by the test weight or by applying hydraulic means

4 Safety requirements and protective measures**4.1 General**

Backhoe loaders shall comply with the safety requirements and protective measures of ISO 20474-1, in as far as those are not modified by the specific requirements of this clause.

4.2 Operator's station**4.2.1 Minimum space envelope**

On backhoe loaders with a retractable rear window, the cab height above the SIP (seat index point) shall not be less than 920 mm, measured with the window retracted into the cab.

4.2.2 Operator's controls

ISO 20474-1:2017, 4.5 applies with the following additions.

- On backhoe loaders equipped with outriggers, an acoustic and visual warning device shall warn the operator when the travel control is engaged and the outriggers are not in the transport position as defined by the manufacturer. An acoustic and visual warning device shall warn the operator that the transmission is engaged when the operator's seat is not facing in the direction of the controls used to propel, e.g. braking, steering. The operator shall be able to determine if the outriggers are in the transport position as defined by the manufacturer prior to engaging the travel control.
- If the backhoe loader is provided with an alternative operator position with alternative travel controls, there shall also be control devices for braking and steering at this alternative position, which meet the performance requirements for the primary functions.

4.2.3 Operator's seat

ISO 20474-1:2017, 4.4.1, shall apply; in addition, the seat shall be in accordance with ISO 7096:2000, input spectral class EM 5, and EM 8 for compact backhoe loaders.

4.3 Warning devices

ISO 20474-1:2017, 4.9, first indent, applies with the addition that the sound level shall also be greater than or equal to 93 dB(A) at 7 m distance from backhoe swing centre to the rear. The operator shall be able to activate the warning device also from the backhoe operation position.

4.4 Stability**4.4.1 General**

ISO 20474-1:2017, 4.11, shall apply, with the additions given in [4.4.2](#) and [4.4.3](#) below.

NOTE All rated capacities as defined hereafter are based on tests, calculations, or both, of machines on a level and firm supporting surface.

The mass of the load, its density and the location of its centre of gravity, as well as the mass of the attachment and the quick coupler, if fitted, shall be included in the determination of the rated operating load and the size/capacity of the attachment.

In order to provide sufficient stability, the rated operating load in intended operations shall be determined as specified in [4.4.2](#) and [4.4.3](#).

4.4.2 Loader portion

4.4.2.1 General

The rated capacities of the backhoe loader used in loader applications shall be determined as follows, with the backhoe in its transport position as specified by the manufacturer.

The loader portion of the backhoe loader does not require a boom-lowering control device as defined in ISO 8643.

4.4.2.2 Bucket application

The rated operating capacity shall be determined according to ISO 14397-1.

The volumetric rating of bucket shall be determined according to ISO 7546.

NOTE The mass, volumetric rating of bucket and density of the material are taken into account when the bucket capacity is selected for a specific application.

4.4.2.3 Fork application

4.4.2.3.1 General

The rated operating capacity is based on the use of forks and shall be determined by the criteria specified in [4.4.2.3.2](#) and [4.4.2.3.3](#).

4.4.2.3.2 Stability assessments

The tipping load shall be determined according to ISO 14397-1 and ISO 14397-2, with the fork in a horizontal position. The rated load, as a percentage of tipping load, shall not exceed the applicable value as specified in [Table 1](#).

Table 1 — Stability factors in fork application

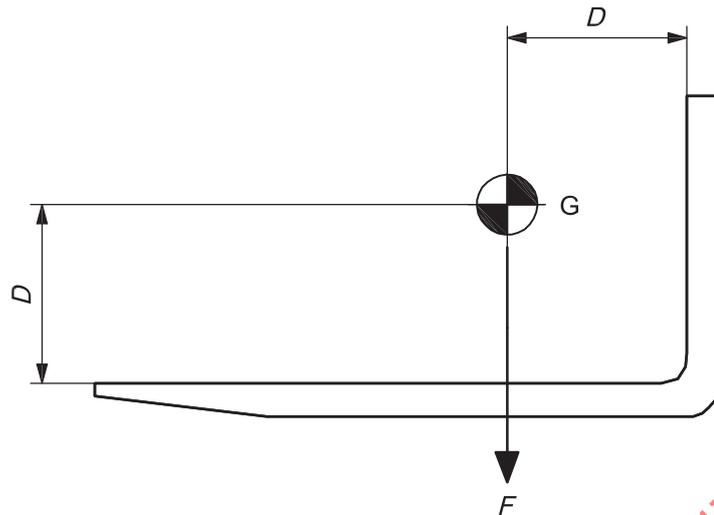
Rated load capacity as a percentage of tipping load for loader portion	
Ground condition	Percentage of tipping force
Rough terrain	60
Firm and level ground	80

Stability factors used to determine the rated operating load of the crawler backhoe loader shall not exceed 35 % of the tipping load.

4.4.2.3.3 Fork load centre of gravity

Fork arms shall meet the performance requirements stated in ISO 2330.

The load centre of gravity distance, D , is determined as a point on the longitudinal centreline of the machine at half the distance from the most rearward point of the load opening to the tip of the fork (see [Figure 1](#)).

**Key**

- D distance, mm
 F load, N
 G centre of gravity

Figure 1 — Load centre of gravity with fork arms**4.4.2.4 Log-handling application****4.4.2.4.1 General**

The rated operating capacity is based on a log grapple application and shall be determined according to ISO 14397-1 (except for stability factor stated in ISO 14397-1:2007, 5.1 with the log grapple fitted. The rated load as percentage of tipping load shall not exceed the applicable value specified in [Table 2](#).

Table 2 — Stability factors in log handling

Ground condition	Rated operating load capacity as percentage of tipping load	
	Wheeled backhoe loaders	Crawler backhoe loaders
Rough terrain	75	50
Firm and level ground	85	60

4.4.2.5 Object-handling application

The rated operating capacity is based on use of a lifting accessory or accessories and the attachment and shall be determined according to ISO 14397-1.

4.4.2.6 Other applications

The rated load of derivative machinery shall be determined by the manufacturer according to the load specification given in [4.4.2.2](#) to [4.4.2.5](#), considering the comparable hazard.

4.4.3 Backhoe portion

4.4.3.1 General

ISO 20474-1:2017, 4.11, shall apply, with the following exceptions.

- If the loader bucket is intended to increase the stability of the machine, the hydraulic circuits of the loader portion do not require locking devices.
- The rated capacities of a backhoe loader used in backhoe applications shall be determined with the loader bucket and the outriggers placed on the ground (see [Annex A](#)). The hydraulic circuits of the loader portion do not require locking devices.

4.4.3.2 Bucket and shovel application

The rated lift capacity for a backhoe loader used in backhoe application with a bucket or shovel shall be determined in accordance with [Annex A](#) as the value according to [A.5](#).

The volumetric rating of the bucket shall be determined according to ISO 7451 or ISO 7546.

NOTE The mass, the volumetric rating of the bucket and the density of the material are taken into account when a bucket is selected for a specific application.

4.4.3.3 Object-handling application

4.4.3.3.1 General

The rated lift capacity of a backhoe portion used for object handling application shall be determined according to [4.4.3.3.2](#) to [4.4.3.3.4](#).

4.4.3.3.2 Rated lift capacity in object handling

The rated lift capacity in object handling of the backhoe portion is defined in [A.6](#).

4.4.3.3.3 Rated lift capacity table in object handling

A table of the rated lift capacity in object handling, established by the manufacturer, shall be provided.

The rated lift capacity table in object handling shall be generated with the rated lift capacity in object handling on different lift point radii, minus the mass of the attachment if necessary (see [A.8](#)). There shall be at least five different lift point radii. Minimum and maximum lift point radius shall always be included.

The tables shall be available at the operator's station for each object-handling configuration specified in the operator's manual.

4.4.3.3.4 Load safety devices

The backhoe portion used in object handling operations with a maximum rated lift capacity of $\geq 1\,000$ kg, according to [Annex A](#), or an overturning moment of $\geq 40\,000$ N · m, shall have provisions for the following.

- An acoustic or visual warning device which indicates to the operator when the rated lift capacity/ corresponding load moment is reached and continues as long as the lift capacity or load moment is exceeded. The rated lift capacity is defined in [4.4.3.3.3](#).

This device may be deactivated while the backhoe equipment is performing operations other than object handling. The activation shall be clearly indicated. The control device for activation and

deactivation shall be within the operator's zone of comfort according to ISO 6682. A warning sign shall be placed close to the control device indicating the need for activation during object handling.

- A lowering control device on each raising boom and arm cylinder. For each arm cylinder the device shall be installed at the end which is pressurized to raise the arm away from the base machine. The lowering control device for each boom and arm cylinder shall be tested in accordance with ISO 8643.

4.4.3.4 Other applications

The rated lift capacity of derivative machinery shall be determined by the manufacturer according to the load specification given in [4.4.3.2](#) and [4.4.3.3](#), whereby the comparable hazard has to be considered for the special application.

4.5 Travelling and transportation

ISO 20474-1:2017, 4.15.6, shall apply with the addition that the backhoe portion shall be equipped with a device that securely locks the backhoe in transport position.

5 Information for use

ISO 20474-1:2017, 6.2, shall apply, with the following additions to the operator's manual.

The manufacturer shall provide information on the rated operating load or bucket volume whenever applicable to

- bucket applications according to [4.4.2.2](#), for loader applications,
- fork handling according to [4.4.2.3](#), for loader applications,
- log-handling applications according to [4.4.2.4](#), for loader applications,
- object-handling applications according to [4.4.2.5](#), for loader applications,
- other handling applications according to [4.4.2.6](#), for loader applications,
- backhoe bucket applications according to [4.4.3.2](#),
- backhoe object handling application according to [4.4.3.3](#),
- backhoe other application according to [4.4.3.4](#),
- instructions on how to securely lock the backhoe in the transport position,
- backhoe rated object handling capacity table, e.g. in accordance with [4.4.3.3.3](#).

Annex A (normative)

Test method for backhoe loader lift capacity at the backhoe portion

A.1 General

[Annex A](#) specifies a test method to be used for determining the backhoe loader capacity when in backhoe applications.

NOTE 1 A terminology specific to backhoe loaders is provided by ISO 8812; the most common backhoe loaders are illustrated in [Annex B](#) of this part of ISO 20474.

NOTE 2 The terms and definitions used in the International Standards referenced in this part of ISO 20474 are also applicable to this part of ISO 20474.

A.2 Apparatus

A.2.1 Load cell or force transducer, appropriate to the magnitude of the load to be measured.

A.2.2 Wire ropes and shackles, pulley, safety chains and adjustable anchor point (e.g. slide rail).

A.2.3 Pressure gauge.

A.2.4 Means for measuring linear dimensions.

Tolerances shall be in accordance with ISO 9248.

A.3 Test site

The test site shall consist of a substantially level (± 2 % inclination), hard surface — preferably of concrete — with an anchor point and sufficient space for the load cell.

A.4 Preparation for testing

A.4.1 General

The machine shall be clean and equipped according to the manufacturer's specifications.

It shall be equipped with a quick coupler, if applicable, but without attachment. Tyre inflation and tyre ballast shall be as specified by the manufacturer. The fuel tank shall be filled to 50 % capacity.

Prior to testing, the engine and hydraulic system shall be at the normal working temperature, and the hydraulic system pressures shall then be checked for compliance with the manufacturer's recommended hydraulic pressure settings.

A.4.2 Position

The machine shall be positioned on the test site as follows:

- a) in the least stable position (e.g. fully side-shifted or fully articulated);

- b) with the oscillation of the articulated steering joint (if any) locked;
- c) if it can be articulated horizontally, with the arm in the straight position;
- d) with stabilization devices engaged according to the manufacturer's specifications.

Outriggers and loader bucket shall be in a position such that the wheels are just clear of ground.

A.5 Capacity test

A.5.1 Load cell

The load cell ([A.2.1](#)) shall be installed between the excavator bucket hinge pin and the anchorage points, vertically below the hinge pin.

A.5.2 Position of boom and arm

The boom and arm shall be so positioned that the line between the boom hinge pin and the bucket hinge pin is horizontal when the force is applied.

A.5.3 Test procedure

A.5.3.1 Step one

The test force shall be progressively applied until either

- a) the tipping load is reached, or
- b) the hydraulic holding circuit pressure load is reached.

A.5.3.2 Step two

After completion of step one of the test, the hydraulic lift capacity shall be measured.

A.5.4 Verification

The following shall be measured and recorded:

- a) the lift point radius;
- b) the tipping load;
- c) the hydraulic holding circuit pressure load;
- d) the hydraulic lift capacity.

A.6 Rated lift capacity in bucket or shovel applications

The capacity for a backhoe loader used in a bucket or shovel application shall be either

- 75 % of maximum load according to [A.5.3.1](#) a), or
- the hydraulic lift capacity according to [A.5.3.2](#),

whichever is the lesser of the two.

A.7 Rated lift capacity in handling capacity

The rated object-handling capacity shall be either

- 75 % of maximum tipping load according to [A.5.3.1](#) a), or
- 87 % of hydraulic lift capacity according to [A.5.3.2](#),

whichever is the lesser of the two.

A.8 Rated lift capacity with attachment

The rated lift capacity shall be determined with the backhoe in the centre position at maximum lift point radius, minus the mass of the attachment.

Backhoe loaders with side shift shall be measured both with the backhoe in the centre position and fully side-shifted.

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