
**Earth-moving machinery — Loaders and
backhoe loaders —**

Part 2:

**Test method for measuring breakout
forces and lift capacity to maximum lift
height**

*Engins de terrassement — Chargeuses et chargeuses-pelleteuses —
Partie 2: Méthode d'essai pour mesurer les forces d'arrachement et la
capacité de levage à la hauteur de levage maximale*



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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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.

ISO 14397-2 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 1, *Test methods relating to machine performance*.

This second edition cancels and replaces the first edition (ISO 14397-2:2002), which has been technically revised.

ISO 14397 consists of the following parts, under the general title *Earth-moving machinery — Loaders and backhoe loaders*:

- *Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load*
- *Part 2: Test method for measuring breakout forces and lift capacity to maximum lift height*

Earth-moving machinery — Loaders and backhoe loaders —

Part 2:

Test method for measuring breakout forces and lift capacity to maximum lift height

1 Scope

This part of ISO 14397 specifies a test method for measuring the breakout forces and lift capacity to maximum lift height of wheeled or crawler loaders, or of the loader portion of backhoe loaders, as these machine types are defined in ISO 6165.

2 Normative references

The following referenced documents are indispensable for the application 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 6016:1998, *Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components*

ISO 6165:2006, *Earth-moving machinery — Basic types — Identification and terms and definitions*

ISO 6746-1:2003, *Earth-moving machinery — Definitions of dimensions and codes — Part 1: Base machine*

ISO 7546:1983, *Earth-moving machinery — Loader and front loading excavator buckets — Volumetric ratings*

ISO 9248:1992, *Earth-moving machinery — Units for dimensions, performance and capacities, and their measurement accuracies*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6165, ISO 6746-1 and ISO 14397-1, and the following apply.

3.1

breakout force

maximum sustained upward vertical force, in newtons, generated at a point 100 mm behind the leading edge of the bucket of a loader, or behind the foremost point of the cutting edge for a loader having a bucket with an irregular (pointed, curved, etc.) cutting-edge shape, by a lift or tilt cylinder, with the bottom of the bucket's cutting edge parallel to, and not more than 20 mm above, the ground reference plane (GRP)

NOTE Typical test arrangements are shown in Figures 1 and 2.

3.2 hydraulic circuit working pressure
pressure applied to the specific hydraulic lifting circuit by the hydraulic pump(s)

3.3 hydraulic circuit holding pressure
maximum static pressure in a specific circuit limited by a relief valve at a flow not exceeding 10 % of the rated circuit flow

3.4 hydraulic limiting condition
condition in which the breakout force or lift capacity is limited by the hydraulic circuit working or holding pressure

3.5 lift capacity to maximum height
 m_{lift}
<bucket application> mass, in kilograms, which can be lifted from the ground to maximum height using the lift cylinder or cylinders at hydraulic circuit working pressure, with the bucket positioned to hold the maximum load, and with the resultant force acting vertically through the centroid of the rated bucket volume as specified in ISO 7546

NOTE A typical test arrangement is shown in Figure 3.

3.6 lift capacity to maximum height
 m_{lift}
<fork application> mass, in kilograms, which can be lifted from the ground to maximum height using the lift cylinder or cylinders at hydraulic circuit working pressure, with the forks positioned horizontally and the fork load centre as specified in ISO 14397-1

4 Apparatus

4.1 Load cell or force transducer, appropriate to the magnitude of the tool force to be measured and having an accuracy in accordance with ISO 9248.

4.2 Hydraulic oil pressure gauge or transducer, appropriate to the magnitude of the hydraulic circuit working and holding pressure to be measured and having an accuracy in accordance with ISO 9248.

5 Test conditions

5.1 Test site

The test site shall consist of a hard, substantially level surface, preferably of concrete, which shall have anchor points and sufficient space for a scale or load-measuring device.

5.2 Preparation

5.2.1 General

The loader under test shall be clean and generally equipped in accordance with ISO 6016. It shall be of a standard configuration as specified by the manufacturer. During testing, the loader's transmission shall be in neutral and its brakes released.

Backhoe loaders shall have their loader portion in the standard configuration and their backhoe in the transport position, as specified by the manufacturer.

5.2.2 Specific conditions

If breakout force and lift capacity are determined under specific conditions, such as with additional counterweight, ripper, backhoe, or tyre ballast, then these conditions shall be specified in the operator's manual and in advertising literature, with the stable operating conditions according to ISO 14397-1 clearly described.

5.2.3 Bucket

The bucket shall be empty and in the positions shown in Figures 1, 2 and 3, as applicable.

5.2.4 Test equipment

Typical arrangements of the test equipment which shall be positioned on the test site, are shown in Figures 1, 2 and 3.

Safety chains shall be fitted to prevent the machine from overturning during tests where tipping limits will be reached or exceeded. These chains shall be loose enough to allow the machine to reach a tipping limit condition while at the same time preventing it from overturning.

6 Test method

6.1 General

The breakout force and lift capacities shall be measured in accordance with the general requirements of 6.2 and, as applicable, in accordance with the specific requirements of 6.3 and 6.4 and as shown in Figures 1, 2 or 3.

The tests shall be conducted with the machine running in accordance with the manufacturer's operating instructions and all safety rules.

6.2 Test procedure

6.2.1 With the drive system in neutral and the brakes released, position the loader on the test area with its bucket empty and suitably attached to the load cell as shown in Figures 1, 2 or 3.

6.2.2 With the engine running at the manufacturer's recommended speed, operate the cylinder or cylinders independently and record the breakout forces and lift capacities.

6.2.3 Note and record the limiting conditions for each test in the test report. In the case of hydraulic limiting conditions, the holding pressure of that circuit being tested shall not be exceeded. If the tipping limit condition (see ISO 14397-1) is reached in a circuit, the force obtained with that hydraulic circuit is the breakout force or lift capacity.

6.2.4 Conduct each test three times and note the maximum values for each test. Record an arithmetic mean of these three values in the test report.

6.3 Breakout force

Test the breakout force exerted by the lift cylinders (see Figure 1) and tilt cylinder (see Figure 2) as follows. Operate the corresponding cylinder or cylinders at working pressure while applying to the load cell a reactive force by means of a wire rope or other device acting vertically through a point 100 mm behind the leading

edge of the bucket or behind the foremost point of the cutting edge for a loader having a bucket with an irregular cutting-edge shape.

For tilt cylinders, in order to prevent linkage movement, the bucket shall be supported by a steel block beneath the bucket pivot (see Figure 2).

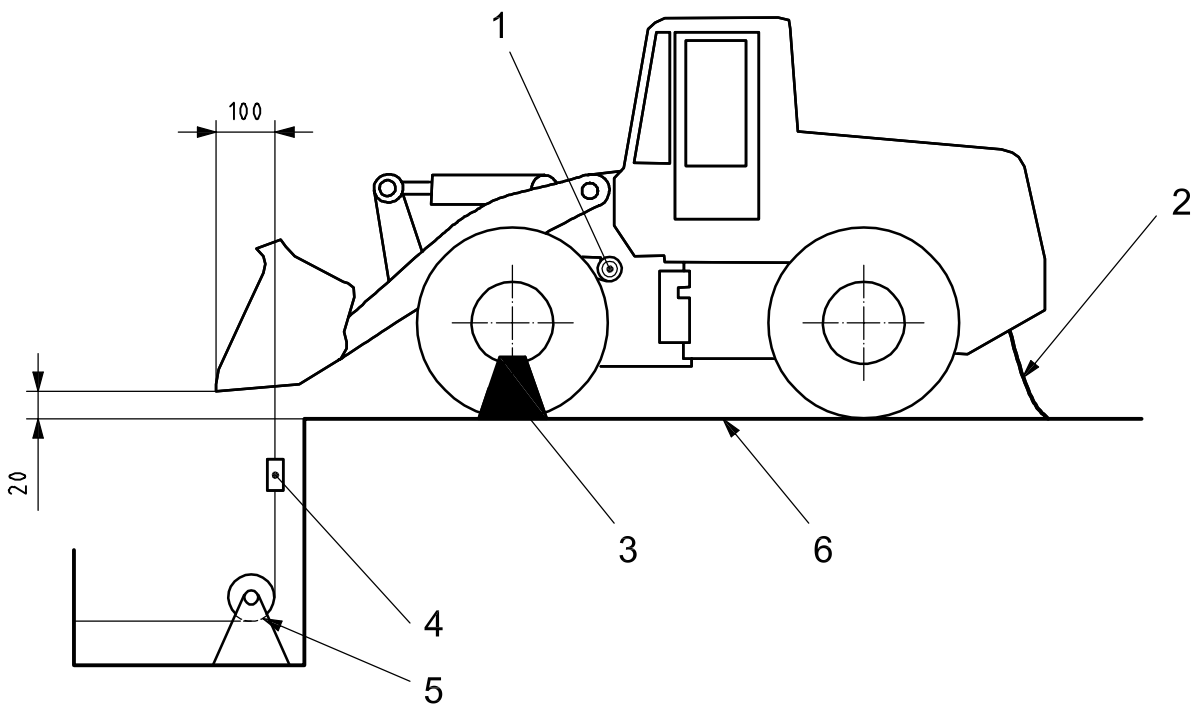
For lift cylinders on wheeled loaders only, in order to prevent tyre deflection, the front axle shall be supported by a steel block (see Figure 1).

6.4 Lift capacity to maximum height, m_{lift}

6.4.1 Position the bucket to achieve a strike plane in accordance with ISO 7546 at the maximum lift height.

6.4.2 While operating the lift cylinder or cylinders at working pressure, apply a reactive force by means of a wire rope or other device acting vertically through the bucket centroid or fork load centre to the load cell. Measure the lift force taken from the bucket or fork on the ground to the lift cylinder or cylinders extended to within 10 mm of full stroke (see Figure 3). The lift capacity to maximum height is the minimum measured lift capacity force measured.

Dimensions in millimetres

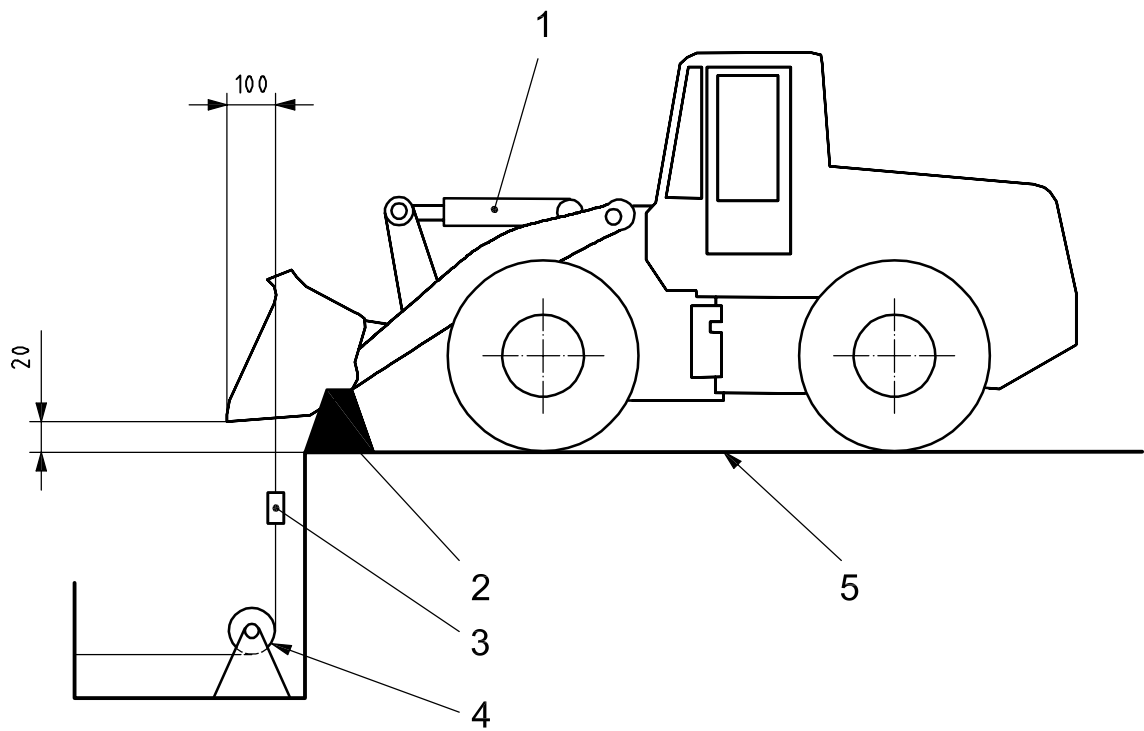


Key

- | | |
|------------------------------|-------------|
| 1 lift cylinder | 4 load cell |
| 2 loose safety chain | 5 pulley |
| 3 support at axle centreline | 6 GRP |

Figure 1 — Typical test arrangement — Breakout force — Lift cylinders

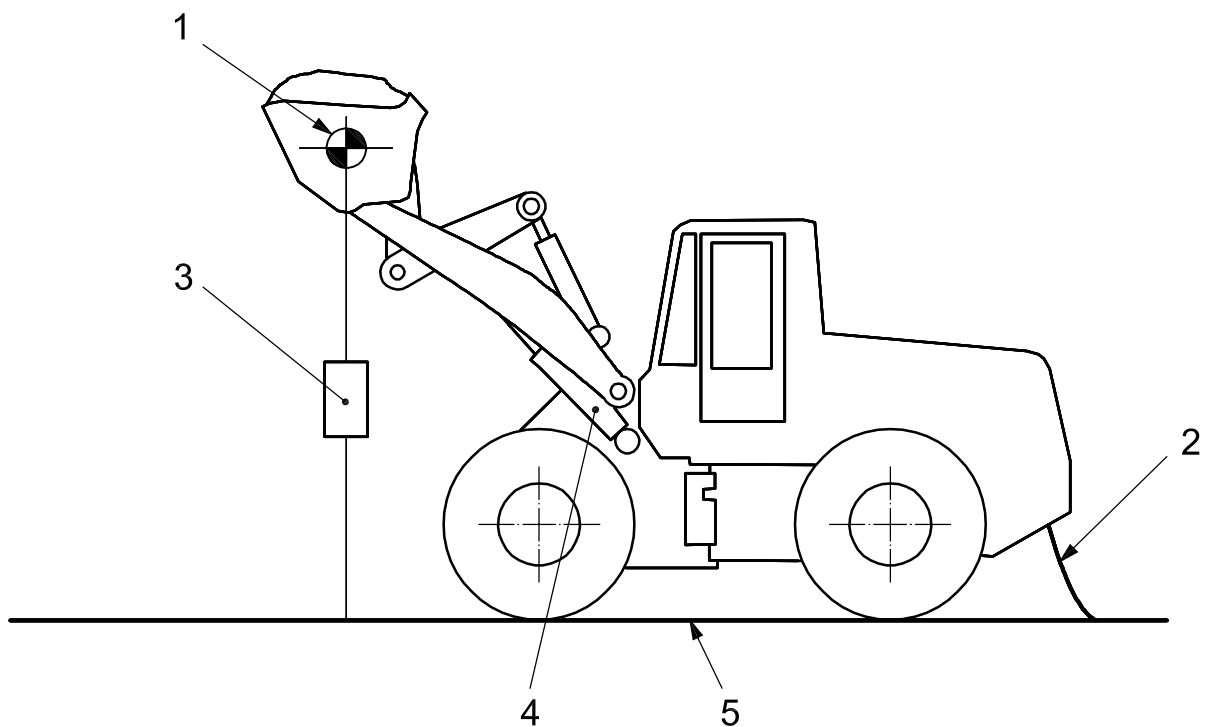
Dimensions in millimetres



Key

- | | | | |
|---|-----------------------------|---|--------|
| 1 | tilt cylinder | 4 | pulley |
| 2 | support at pivot centreline | 5 | GRP |
| 3 | load cell | | |

Figure 2 — Typical test arrangement — Breakout force — Tilt cylinders



Key

- 1 centre of gravity of load ^a
- 2 loose safety chain
- 3 load cell

- 4 lift cylinder
- 5 GRP

^a Positioned through centroid of rated bucket volume.

Figure 3 — Typical test arrangement — Lift capacity to maximum height

7 Test report

7.1 General

The following information shall be reported for all machines:

- a) manufacturer;
- b) model;
- c) type;
- d) test machine product identification number;
- e) operating mass of machine as tested, in kilograms;
- f) working or holding hydraulic circuit pressure setting(s), in kilopascals;
- g) type of undercarriage (crawler or wheeled machine).

7.2 Crawler machines

Additionally, for crawler machines only, the following information shall be reported:

- a) type of track shoe;
- b) maximum width (over tracks), $W1$, in metres;
- c) track gauge, $W2$, in metres;
- d) track shoe width, $W4$, in metres;
- e) crawler base, $L2$, in metres;
- f) counterweights (if specified), in kilograms.

7.3 Wheeled machines

Additionally, for wheeled machines only, the following information shall be reported:

- a) tread, $W3$ (specify front and rear separately if different), in metres;
- b) wheel base, $L3$, in metres;
- c) tyre size(s);
- d) tyre pressure(s), in kilopascals;
- e) ballast (if specified), in kilograms;
- f) counterweights (if specified), in kilograms.

7.4 Bucket fitted for each test

Specific buckets available for machines may be tested. They shall be listed as follows:

- type;
- rated volume (in accordance with ISO 7546);
- mass, in kilograms.

7.5 Results

The test results shall be recorded in accordance with Table 1.

Table 1 — Test results

Test	Force, F N	Limiting conditions
Breakout force	Lift cylinder(s)	
	Tilt cylinder(s)	
Lift capacity with bucket		
Lift capacity with forks		

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