BS ISO 6016:2008

BSI Standards Publication

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

National foreword

This British Standard is the UK implementation of ISO 6016:2008. It supersedes BS 6911-13:1998, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/513/1, Earth moving machinery (International).

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 56294 5

ICS 53.100

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2011.

Amendments issued since publication

Date	Text affected

BS ISO 6016:2008

INTERNATIONAL STANDARD

ISO 6016

Third edition
2008-12-01

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

Engins de terrassement — Méthodes de mesure des masses des engins de terrassement complets, de leurs équipements et de leurs organes constitutifs

Reference number
ISO 6016:2008(E)

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Foreword

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ISO 6016 was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 1, *Test methods relating to safety and machine performance*.

This third edition cancels and replaces the second edition (ISO 6016:1998), which has been technically revised.

INTERNATIONAL STANDARD ISO 6016:2008(E)

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

1 Scope

This International Standard specifies methods for measuring the masses of whole earth-moving machines, their equipment, attachments or components, using weighbridges or force transducers. It also defines the terms related to these masses.

It is applicable to earth-moving machinery as 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 6165:2006, *Earth-moving machinery — Basic types — Identification and terms and definitions*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 General definitions

3.1.1
base machine
machine with a cab or canopy and operator-protective structures if required, without equipment or attachments but possessing the necessary mounting for such equipment and attachments

NOTE For an example, see Figure 1.

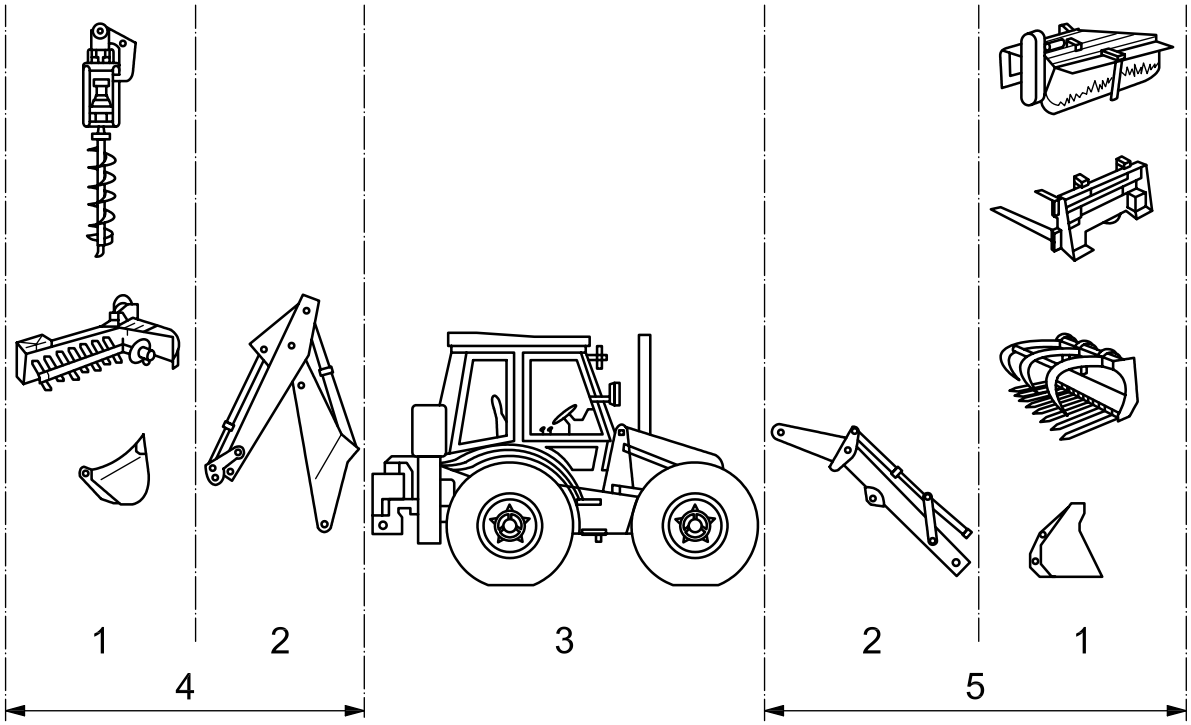
3.1.2
equipment
set of components mounted onto the base machine that allows an attachment to perform the primary design function of the machine

NOTE For examples, see Figure 1.

3.1.3
optional equipment
optional components mounted onto the base machine or equipment to increase, for example, capacity, flexibility, or enhance comfort

3.1.4
attachment
assembly of components that can be mounted onto the base machine or equipment for specific use

NOTE For examples, see Figure 1.



Key

1 attachment
2 equipment
3 base machine
4 backhoe portion
5 loader portion

NOTE This illustration of a loader, its equipment and attachments, is given by way of example only. Equipment and attachments can differ from one machine to another and between machine types. Some base machines can be fitted directly with an attachment (e.g. a grader with a dozer blade).

Figure 1 — Base machine, equipment and attachments

3.1.5
component
part, or assembly of parts, of a base machine, equipment or attachment

3.1.6
ballast
removable weight added to the base machine or equipment as specified by the manufacturer, which is used to increase machine performance, e.g. stability, traction or compaction

NOTE Ballast can be added through the use of weights on wheels, frames or axles, counterweights, liquid-filled tyres, or compartments to be filled with water, sand or iron parts.

3.1.7
left-hand [right-hand] side
side defined when the machine is oriented towards its primary direction of travel

3.1.8
front axle [rear axle] of machine
axle defined for the primary direction of travel

3.2 Masses

3.2.1
operating mass
OM
mass of the base machine, with equipment and empty attachment in the most usual configuration as specified by the manufacturer, and with the operator (75 kg), full fuel tank and all fluid systems (i.e. hydraulic oil, transmission oil, engine oil, engine coolant) at the levels specified by the manufacturer and, when applicable, with sprinkler water tank(s) half full

NOTE 1 The mass of an operator is not included for non-riding machines.

NOTE 2 Ballast mass at delivery can be included if specified by the manufacturer.

3.2.2
rated payload
PL
paymass
mass that can be carried by the machine, as specified by the manufacturer

3.2.3
rated ballast mass
BM
maximum mass of ballast that can be added to the machine, as specified by the manufacturer

3.2.4
gross machinery mass
GMM
maximum machine mass as approved by the manufacturer, which combines the operating mass (OM) of the machine with the heaviest combination of equipment and attachments, the heaviest combination of optional equipment, the rated payload (PL), as specified by the manufacturer, the rated ballast mass (BM) and, when applicable, full sprinkler water tank(s)

3.2.5 Axle distribution of masses of wheeled machines

3.2.5.1
axle load
mass on each axle at the **operating mass** (3.2.1)

3.2.5.2
maximum axle load
maximum mass allowable on each axle, as specified by the manufacturer

3.2.6
shipping mass
SM
mass of the base machine without an operator, with the fuel level at 10 % of tank capacity or with the minimum fuel level needed for machine shipping purposes as specified by the manufacturer, whichever is higher, with all fluid systems at the levels specified by the manufacturer and with empty sprinkler tank(s), when applicable, and with or without equipment, ballast, attachment, cab, canopy, operator-protective structures, wheels and counterweights as stated by the manufacturer

NOTE If the manufacturer intends that the machine be partially disassembled for shipping purposes, the masses of the disassembled items will also be stated.

3.3 Measurements

3.3.1
single measurement
measurement whose result is obtained as the indication of one measuring device or as a sum of the indications of several measuring devices acting simultaneously

3.3.2
cumulative measurement
measurement whose result is obtained as a sum of the indications of a single measuring device or that of several measuring devices acting successively

3.3.3
axis of support
line(s) through the centerline(s) of the axles or the centre of the left-hand-side and right-hand-side wheels or track about which the machine rotates

3.4 Apparatus

3.4.1
general
complete set of equipment and devices required to determine the mass of a machine or its equipment or attachment or component

3.4.2
weighbridge
device with a platform, normally flush with the adjacent surfaces, used to determine mass

NOTE Force transducers can be used within the weighbridge to determine the mass.

3.4.3
force transducer
device used to determine mass by measuring the force applied either by tension or pressure

3.4.4
knife edge
device with an angled edge used to support and transfer the load at the axis of support of the machine

3.4.5
decking
material of suitable size and strength for distributing machine mass over weighbridges

4 Preparation for testing

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

In the case of a cumulative measurement, the same fixed position of the equipment and attachment in relation to the base machine shall be ensured for all measurements.

Articulated machines should normally be tested in a straight line.

Wheeled machines shall be tested with the brakes released. Where necessary, crawler machines shall be manoeuvered until the contact-grousers are level on each side.

IMPORTANT — It is essential to ensure that the ground reactions in the horizontal plane are zero.

5 Methods for measuring mass

5.1 General

The single measurement method should be used whenever possible. The cumulative measurement method may be used when the mass or the physical size of the base machine, equipment and attachment exceeds the capabilities of the measurement apparatus available.

5.2 Precision of measurement apparatus

The precision of apparatus used to determine masses of whole earth-moving machinery, equipment or attachments shall be such that the total measurement procedure provides a result of an accuracy within the tolerances specified in ISO 9248. It is recommended that weighbridges, force transducers and other measurement equipment used be subjected to a calibration procedure.

5.3 Single-measurement method

5.3.1 Principle

This method involves measuring the ground reaction forces acting simultaneously on the machine at its axes of support as in Figure 2 and Figure 3 a) or 3 b), or, alternatively, the force acting on a tensile force transducer or transducers when the machine is suspended over the ground as in Figure 4.

5.3.2 Procedure

When a single weighbridge or force transducer is used, the machine shall be placed centrally on it, as shown in Figure 2.

When several weighbridges or a pressure force transducer or transducers are used, the wheels or tracks of the machine shall be placed as close as possible to the centre of the platforms of these weighbridges or force transducer(s), as shown in Figure 3 a). Decking and knife edges shall be used for crawler machines to ensure the correct transfer of load exerted by machine mass to the weighbridges or force transducer(s), as shown in Figure 3 b).

When one or more tensile force transducers are used, one end of the slinging apparatus (steel cables, chains, ropes, etc.) shall be attached to the lifting points on the machine, with the machine in the manufacturer's recommended position for lifting, and the other end shall be attached to the suspended force transducer(s). The machine shall then be lifted or the machine supports lowered as shown in Figure 4. If more than one force transducer is used, the vertical position for each transducer shall be ensured.

5.3.3 Measurement results

The result of each measurement shall be reduced by the mass of any decking, knife edge or slinging apparatus used.

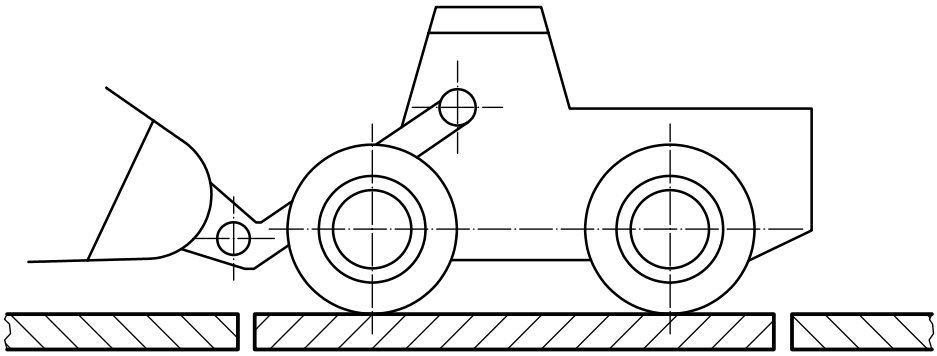
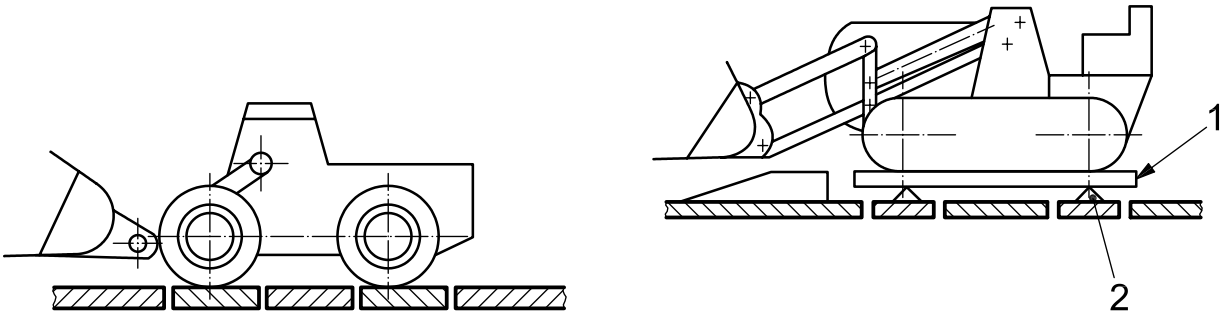


Figure 2 — Weighbridge



a) Wheeled machines **b) Crawler machines**

Key

1 decking
2 knife edge

Figure 3 — Weighbridges or force transducers

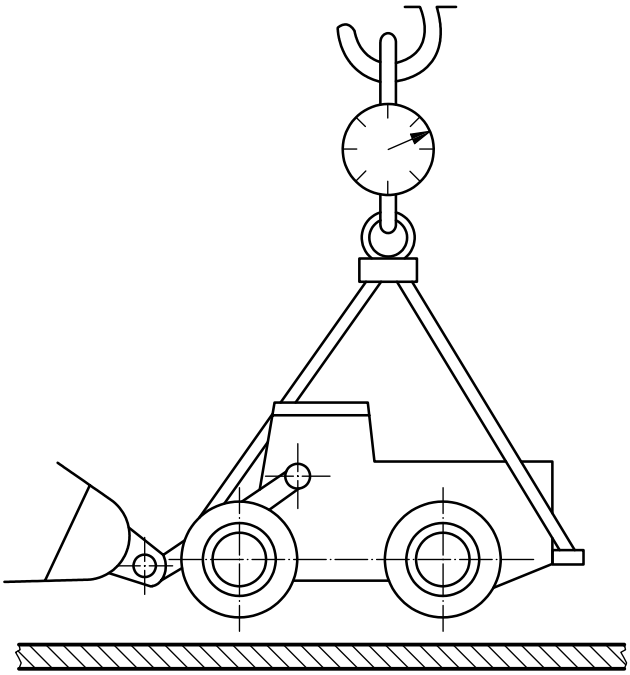


Figure 4 — Crane hook — Force transducer

5.4 Cumulative measurement method

5.4.1 Principle

This method involves successive measuring of the ground reaction forces acting on the machine at its axes of support when it is placed as shown in Figure 5 and 6.

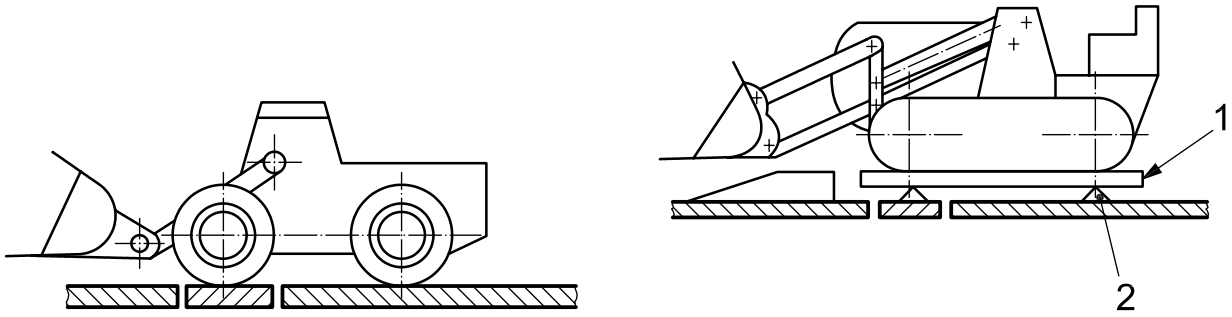
5.4.2 Procedure

When a single weighbridge or force transducer is used, the machine shall be placed with one wheel or one axis of support (as shown in Figures 5 and 6) on the platform, while the other axis is supported on a hard surface adjacent to the weighbridge. The partial mass shall be measured with the machine always in a level position. The machine shall then be placed with the other axis of support on the single weighbridge or force transducer. If measuring each wheel individually, the partial mass of each wheel shall be measured. The partial masses shall be combined to determine the total mass.

When several weighbridges or pressure force transducers are used, they shall be placed successively under each axis of support while keeping the machine in a level position.

5.4.3 Measurement results

The result of each measurement shall be reduced by the mass of any decking or knife edges used.

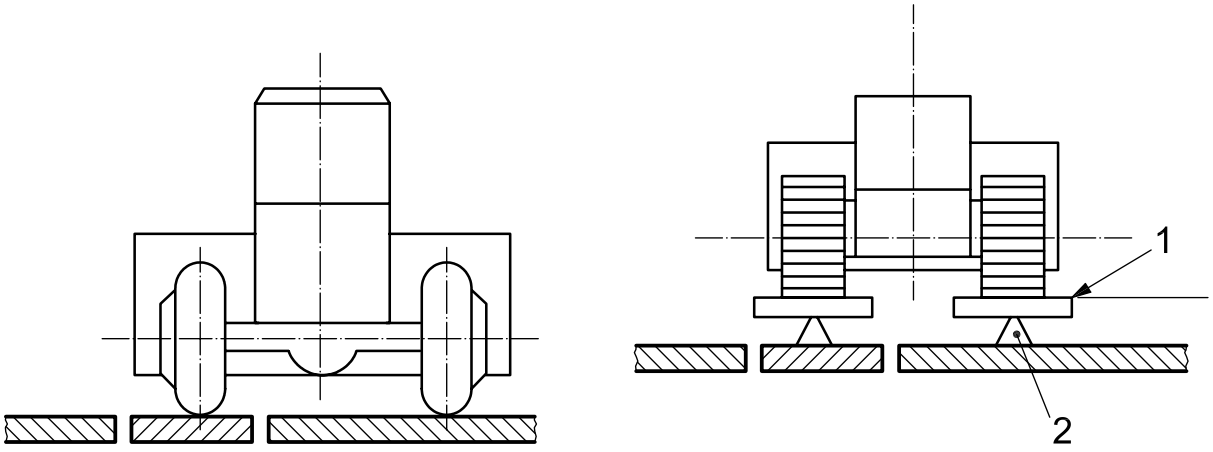


a) Wheeled machines **b) Crawler machines**

Key

1 decking
2 knife edge

Figure 5 — Weighbridge or force transducer — Axes of support — Front and rear axles of machine



a) Wheeled machines **b) Crawler machines**

Key

1 decking
2 knife edge

Figure 6 — Weighbridge or force transducer — Axes of support — Left-hand and right-hand sides

5.5 Measurement of axle load

Axle load shall be determined with the machine in a level position. Either method may be used to determine the axle load, but measurement using the front and rear axles as shown in Figure 5 is recommended.

5.6 Determination of mass of equipment, attachment or components

Either method may be used to determine the mass of equipment, attachment or components, but the single-measurement method is recommended.

6 Reporting measurement results

The test report shall contain at least the following information:

a) machine under measurement:

   1) manufacturer's name;

   2) type;

   3) model;

   4) PIN, or serial number;

   5) description of the machine complete at measurement (e.g. equipment/attachment fitted, components, counterweight, tools, spare parts, tyre pressure);

   6) place and date of measurement;

   7) person responsible for measurement;

b) apparatus and measurement method: description of weighing apparatus applied and measurement method used;

c) results:

   1) actual measured mass of the machine, including a tabulation of the partial masses if the cumulative measurement method was used, as shown in Table 1;

   2) operating mass of the machine;

   3) other machine masses in specified conditions, recorded in the same manner.

It is advisable to measure or calculate and list the masses defined in 3.2, as these definitions are used in other standards or legislation. OM is frequently used for machine classification and is often to be found on machine PIN plates. GMM can be used in ROPS, and brake standards and axle loads are often a restriction for road use. SM is used for cargo calculations and fees related to shipping.

Table 1 — Example of measurements

Values in kilograms

Measurement position	Measurement
Front axle of machine	
Intermediate axle	
Rear axle of machine	
Total	
or	
Left-hand side	
Right-hand side	
Total	

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