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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 complets, de leurs équipments et de leurs organes constitutifs

Reference number
ISO 6016:1998(E)

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.

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.

International Standard ISO 6016 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 6016:1982), which has been technically revised.

Annex A of this International Standard for information only.

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

1 Scope

This International Standard specifies methods for determining the masses of whole machines, their equipment, attachments or components, using weighbridges, pressure dynamometers (load cells) or extension dynamometers.

It is applicable to earth-moving machinery as defined in ISO 6165.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6165: 1997, *Earth-moving machinery — Basic types — Vocabulary.*

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

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 General definitions

3.1.1 base machine: Machine with, if required, cab or canopy and operator-protective structures, without equipment or attachment, but including the mountings necessary to connect equipment or attachment. (See figure 1.)

3.1.2 equipment: Set of components mounted onto the base machine which allow an attachment to perform its primary design function. (See figure 1.)

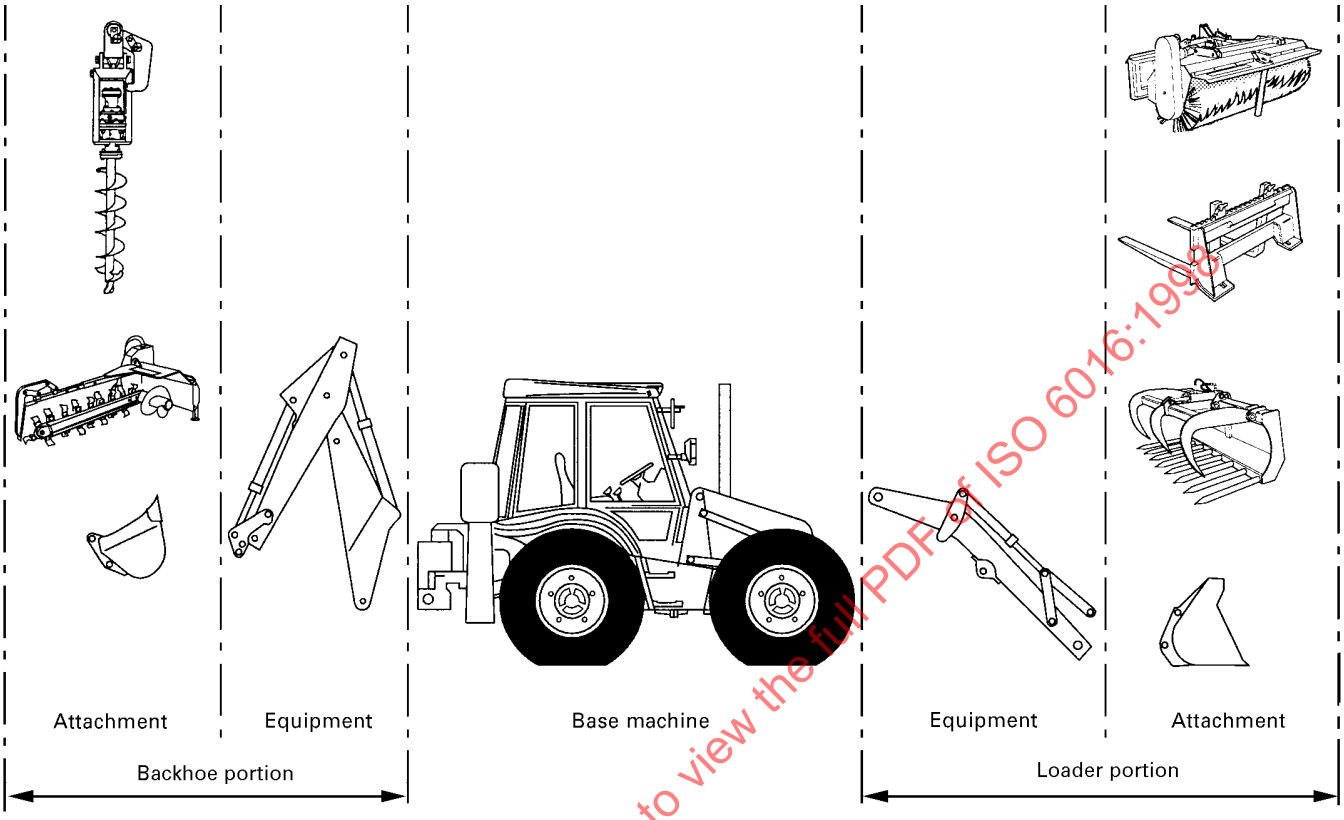
3.1.3 optional equipment: Optional items of equipment mounted onto the base machine to increase, for example, capacity, flexibility, comfort and safety.

3.1.4 attachment (tool): Assembly of components that can be mounted onto the base machine or equipment for specific use. (See figure 1.)

3.1.5 component: Part, or an assembly of parts, of a base machine, equipment or attachment.

3.1.6 “left-hand” and “right-hand” side of a machine: Side defined when facing the primary direction of travel.

3.1.7 “front axle” and “rear axle” of a machine: Axle defined for the primary direction of travel.



NOTE — This is an example. The equipment and attachment differ from one machine to another. Some base machines can be fitted directly with an attachment, for example, a grader with a dozer blade.

Figure 1 — Illustration of the definitions of base machine, equipment and attachment

3.2 Masses

3.2.1 operating mass (OM): Mass of the base machine with equipment and empty attachment as specified by the manufacturer, and with the operator (75 kg), full fuel tank and all fluid systems at the levels specified by the manufacturer.

3.2.2 rated paymass (payload) (PM): Manufacturer’s rated mass that can be carried by the machine.

3.2.3 gross machinery mass (GMM): Combined mass of the operating mass (OM) of the machine and the rated paymass (PM).

3.2.4 Axle distribution of masses of wheeled machines

3.2.4.1 axle load: Load on each axle at operating mass. (See 3.2.1.)

NOTE — It is expressed in kilograms.

3.2.4.2 maximum permissible axle load: Maximum load on each axle specified by the manufacturer.

NOTE — It is expressed in kilograms.

3.2.5 shipping mass (SM): Mass of the base machine without an operator, and with fuel level at 10 % of tank capacity, all fluid systems at their levels specified by the manufacturer and with or without equipment, attachment, cab, canopy, ROPS and/or FOPS, wheels and counterweights as stated by the manufacturer.

NOTE — If the machine has to be disassembled for shipping purposes, the masses of these dismounted components should be stated by the manufacturer.

3.2.6 cab, canopy, ROPS and/or FOPS mass: Mass of a cab, canopy, ROPS or FOPS with all their components, and the mountings required to secure these to the base machine.

3.3 Measurements

3.3.1 simple measurement: Measurement when the 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 complex measurement: Measurement when the result is obtained as a sum of the indications of several measuring devices acting successively.

3.3.3 apparatus: Complete set of equipment and devices required to determine the mass of a machine or its equipment or components.

4 Preparation for testing

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

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

Articulated machines should normally be tested in a straight line.

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

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

5 Methods of determination of masses

5.1 General

Two methods of measurement are specified in this International Standard: a simple method and a complex one. The simple measurement method is considered to be the basic and preferred one. Under unavoidable circumstances, that is, when a large mass or a machine of large dimensions, or when the equipment, attachment or component render the application of the simple measurement method impossible with the apparatus that is available, the complex measurement method may be used.

5.2 Measurement apparatus

5.2.1 For simple measurement

For the simple measurement method, the following apparatus is required:

– weighbridge(s);
– pressure or extension dynamometers;
– knife edges (conveniently sized rolled steel angle);
– decking;

– crane or support structure;
– steel cables (or chains or ropes).

5.2.2 For complex measurement

For the complex measurement method, the following apparatus is required:

– weighbridge(s);
– pressure dynamometer(s);
– knife edges (conveniently sized rolled steel angle);
– decking;
– level.

5.2.3 Accuracy

For both 5.2.1 and 5.2.2, the weighbridge, pressure dynamometer or extension dynamometer shall be accurate to within the tolerances specified in ISO 9248.

5.3 Simple measurement method

This method involves measuring the ground reaction forces acting simultaneously on the machine at its axes of support as in figure 2, 3a) or 3b), or the force acting on the extension dynamometer when the machine is suspended over the ground as in figure 4.

5.3.1 Procedure

When a single weighbridge or pressure dynamometer is used, the machine shall be placed centrally on it (see figure 2).

When several weighbridges or pressure dynamometers 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 pressure dynamometers [see figure 3a)]. Decking and knife edges shall be used for tracked machines to ensure the correct transfer of load exerted by machine mass to the weighbridges or pressure dynamometers [see figure 3b)].

When an extension dynamometer is used, one end of the steel cables shall be attached to the slinging points on the machine and the other end to the suspended dynamometer. The machine shall then be lifted or the machine supports lowered (see figure 4).

The measurement shall be made not less than three times.

5.3.2 Measurement results

The result of each measurement shall be reduced by the mass of any decking, knife edges or steel cables, depending on the measurement method used.

The final result shall be calculated as the arithmetical mean value of not less than three measurements.

5.4 Complex measurement method

5.4.1 General

This method involves successive measuring of the ground reaction forces acting on the machine at its axes of support (that is, either the front axle or rear axle axes, or the left-hand side or right-hand side wheel or track axes) when it is placed as in figure 5a), 5b), 6a) or 6b).

Weighbridges or pressure dynamometers shall be used.

The use of an extension dynamometer is not recommended but, when employed, use the method given in annex A.

5.4.2 Procedure

When a single weighbridge or pressure dynamometer is used, the machine shall be placed on the platform axle after axle [see figures 5a) and 5b)] or side after side (left-hand and right-hand) [see figures 6a) and 6b)] successively, while the other axle (side) is supported on the hard surface adjacent to the weighbridge; the partial masses shall be measured.

When several pressure dynamometers are used, they shall be placed successively under each supporting axle axis (front, intermediate or rear) or under the wheel or track axis of the left-hand/right-hand side, while keeping the machine in a horizontal position.

The measurement shall be made not less than three times.

5.4.3 Measurement results

The result of measurement shall be reduced by the mass of any deckings, knife edges or steel cables. The final result shall be calculated as the arithmetical mean value of three successive measurements.

It will usually be the case that the total of the front and rear, or the right-hand and left-hand side masses do not equal the operating mass due to small differences in level between the weighbridge platform and the surrounding ground or due to the limited accuracy of the measuring apparatus. Therefore:

a) it is preferable to use the sum of the front and rear masses to determine the total mass of a wheeled machine;

b) it is preferable to use the sum of the right-hand and left-hand side masses to determine the total mass of a tracked machine.

5.5 Determination of mass of equipment, attachment or components

Either method may be used to determine the mass of equipment, attachment or components but the simple measurement method should preferably be used. For this purpose, any measuring apparatus specified in 5.2 may be used depending on mass and dimensions of the equipment, attachment or component.

6 Reporting measurement results

The test report shall contain at least the following information.

a) Machine under measurement:

(i) manufacturer's name,

(ii) type,

(iii) model,

(iv) PIN, or serial number,

(v) description of the machine and its completeness at measurement (e.g. equipment/attachment fitted, components, counterweight, tools, spare parts, tyre pressure),

(vi) place and date of measurement,

(vii) person responsible for measurement.

b) Apparatus and measurement method used:

(i) description of weighing apparatus applied and measurement method used.

c) Results:

(i) operating mass of the machine, tabulated as shown in table 1;

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

Table 1

Values in kilograms

Measurement position	**Measurement** 1	2	3	**Mean value**
Front axle				
Intermediate axle				
Rear axle				
Total				
or Left-hand side				
Right-hand side				
Total				

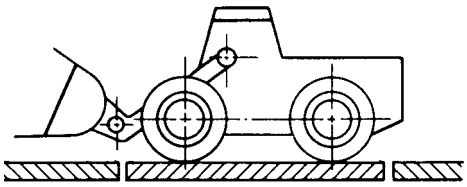
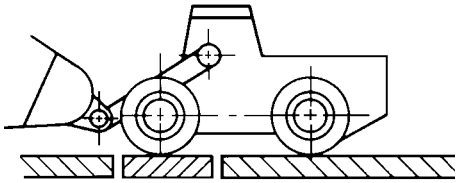
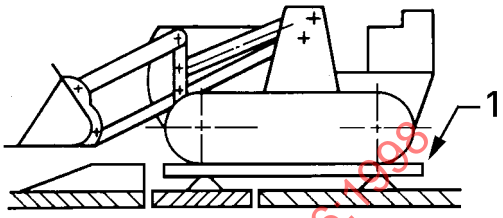


Figure 2 — Weighbridge



a) Wheeled vehicles

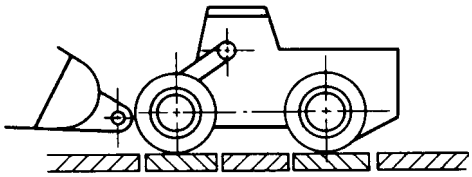


Key:

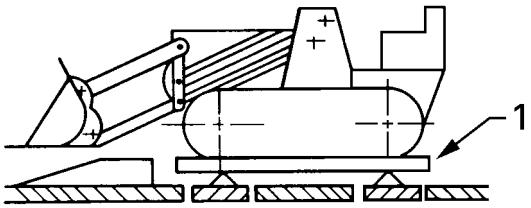
1 Decking

b) Tracked vehicles

Figure 5 — Weighbridge or pressure dynamometer — Weighing by axle



a) Wheeled vehicles

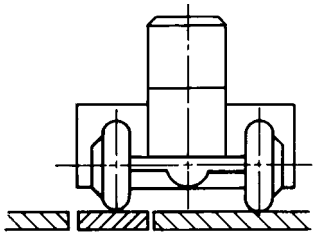


Key:

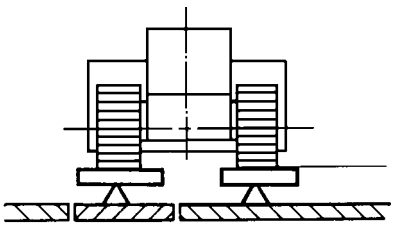
1 Decking

b) Tracked vehicles

Figure 3 — Weighbridges or pressure dynamometers



a) Wheeled vehicles



b) Tracked vehicles

Figure 6 — Weighbridge or pressure dynamometer — Weighing by side

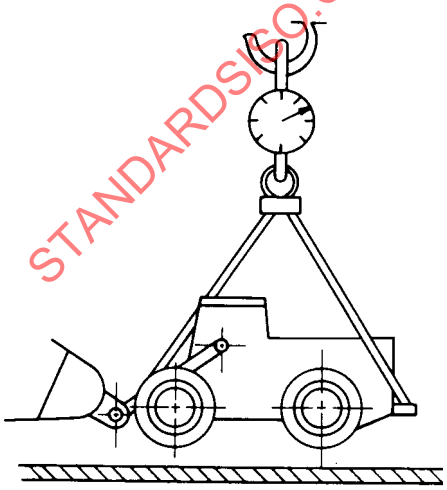
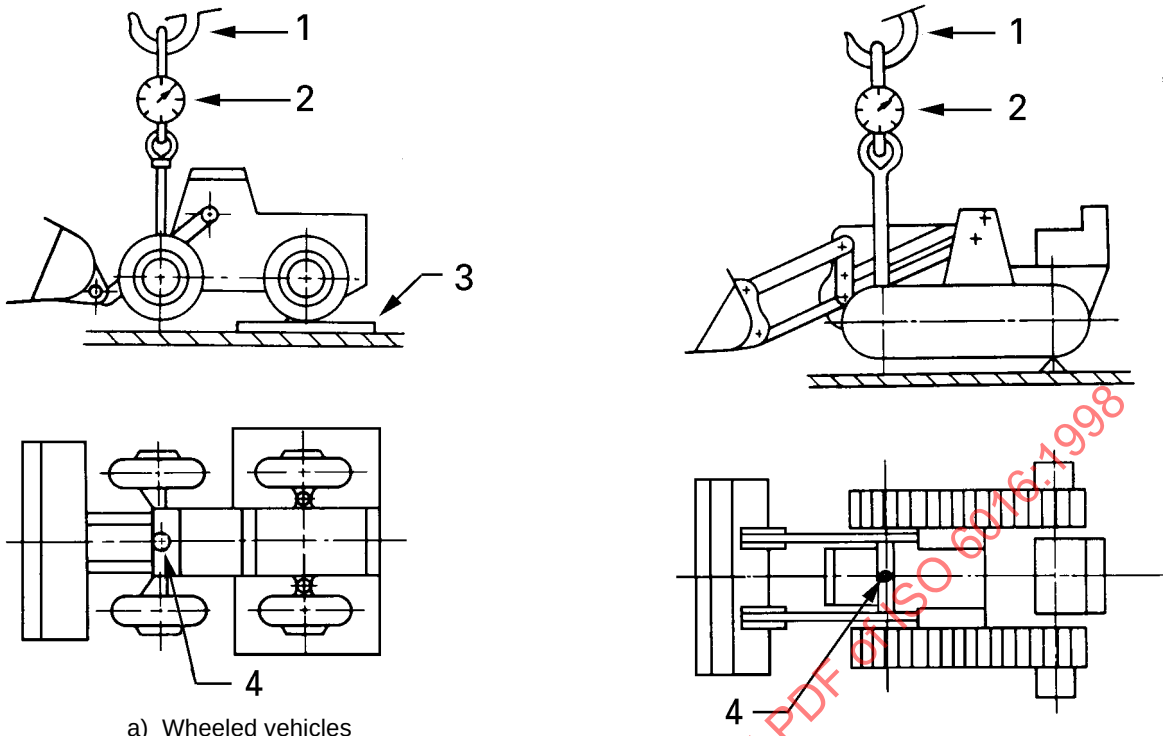


Figure 4 — Crane hook — Tension dynamometer



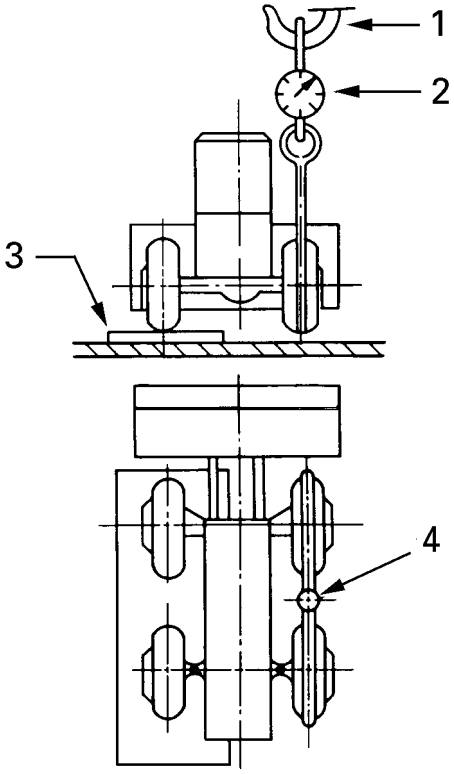
a) Wheeled vehicles

b) Tracked vehicles

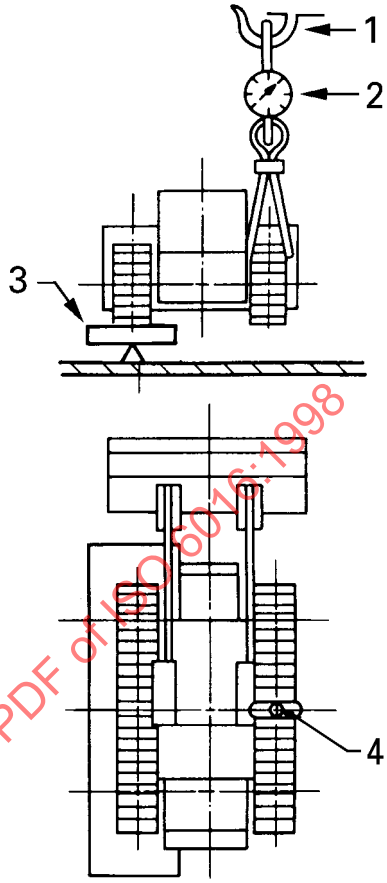
Key:

1 Crane hook
2 Tension dynamometer
3 Decking
4 Steel cable to the dynamometer

Figure 7 — Weighing the front or rear of the machine by crane hook/tension dynamometer



a) Wheeled vehicles



b) Tracked vehicles

Key:

1 Crane hook
2 Tension dynamometer
3 Decking
4 Steel cable to the dynamometer

Figure 8 — Weighing one side of the machine by crane hook/tension dynamometer