International Standard 6016

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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 équipements et de leurs organes constitutifs

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6016 was developed by Technical Committee ISO/TC 127, *Earth moving machinery*, and was circulated to the member bodies in January 1981.

It has been approved by the member bodies of the following countries :

Australia	Germany, F.R.	South Africa, Rep. of
Austria	India	Sweden
Belgium	Italy	United Kingdom
Brazil	Japan	USA
Czechoslovakia	Mexico	USSR
Finland	Poland	
France	Romania	

No member body expressed disapproval of the document.

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

1 Scope and field of application

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

It applies to wheeled and tracked earth-moving machinery.

2 Definitions

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

2.1 machine : The wheeled or tracked machine, the mass of which is to be measured.

2.2 equipment : The complete set of assemblies and elements ready to be mounted to the base machine (for example, working tool, arms, hydraulic cylinders or sheave block cables, put together depending on machine application).

2.3 components : Major items that make up the whole base machine and which, from time to time, may be removed for repair or replacement, such as gearbox, axles, fuel tanks, cab.

2.4 operating mass of the machine : The mass of the base machine with all standard equipments, operator (75 ± 3 kg), full fuel tank, full lubricating, hydraulic and cooling systems; and where provided, with empty bucket, body or bowl.

NOTES

1 Empty means a machine without any payload.

2 Machine mass at different specific conditions and with different outfits may be measured as necessary, one of the measurements always being that of the operating mass of the machine.

3 Definitions 2.2 and 2.3 are under review by ISO/TC 127/SC4, and are included here for information.

2.5 simple measurement : The 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.

2.6 complex measurement : The measurement when the result is obtained as a sum of the indications of several measuring devices acting successively.

2.7 apparatus : The complete set of equipment and devices required to determine the mass of a machine or its equipment or components.

2.8 'left-hand' and 'right-hand' side of a machine : Defined accordingly, when facing the primary direction of travel.

2.9 'Front axle' and 'rear axle' of a machine : Defined accordingly, for the primary direction of travel.

3 Preparation for testing

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

In case of a complex measurement, the same fixed position of the equipment 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 till the contact-grousers are level on each side.

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

4 Methods of determination of masses

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, i.e. when a great mass or large dimensions of a machine or of its equipment or component render the application of this simple measurement method impossible with the apparatus at disposal, the complex measurement method may be used.

4.1 The following apparatus is required :

Weighbridge(s)

Pressure or extension dynamometers

Knife edges (conveniently sized rolled steel angle)

Decking

Level

Crane or support structure

Steel cables (or chains or ropes).

The weighbridge, pressure dynamometer or extension dynamometer shall be accurate to within ± 2 % of the mass being measured.

4.2 Simple measurement method

This method involves measuring the ground reaction forces acting simultaneously on the machine at its axes of support as in figures 1, 2a) or 2b) or the force acting on the extension dynamometer, when the machine is suspended over the ground as in figure 3.

4.2.1 Procedure

When a single weighbridge or pressure dynamometer is used, the machine shall be placed centrally on it (see figure 1).

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 2a)]. 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 2b)].

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 3).

The measurement shall be made not less than three times.

4.2.2 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 successive measurements.

4.3 Complex measurement method

This method involves successive measuring of the ground reaction forces acting on the machine at its axes of support (i.e. front axle or rear axle axes, left-hand side or right-hand side wheel or track axes) when it is placed as in figures 4a), 4b), 5a) or 5b).

Weighbridges or pressure dynamometers shall be used.

The use of an extension dynamometer is not recommended.

4.3.1 Procedure

When a single weighbridge or pressure dynamometer is used, the machine shall be placed on the platform axle after axle [see figures 4a) and 4b)] or side after side (left-hand and right-hand) [see figures 5a) and 5b)] 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 or rear) or under wheel or track axis of the left-hand/right-hand side, while keeping the machine in a horizontal position.

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

The measurement shall be made not less than three times.

4.3.2 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.

4.4 Determination of mass of equipment or components

Either method may be used to determine the mass of equipment or components but the simple measurement method should preferably be used. For this purpose, any measuring apparatus specified in 4.1 may be used depending on mass and dimensions of the equipment or component.

5 Reporting measurement results

The test report shall contain at least the following information :

5.1 Machine under measurement :

a) Manufacturer's name

b) Type

c) Model

d) Serial number

e) Description of the machine and its completeness at measurement (equipment fitted, components, counterweight, tools, spare parts, tyre pressure etc.)

f) Date of measurement

g) Person responsible for measurement.

5.2 Apparatus and measurement method used

Description of weighing apparatus applied and measurement method used.

5.3 Results

Operating mass of the machine.

Values in kilograms

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

NOTE — Other masses of machine in specified conditions shall be recorded in the same manner.

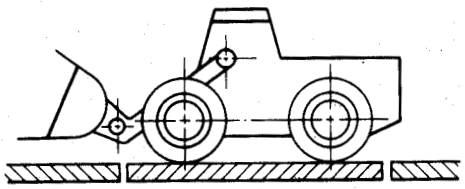
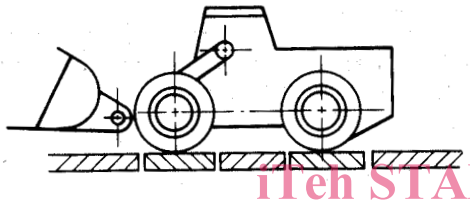


Figure 1 — Weighbridge



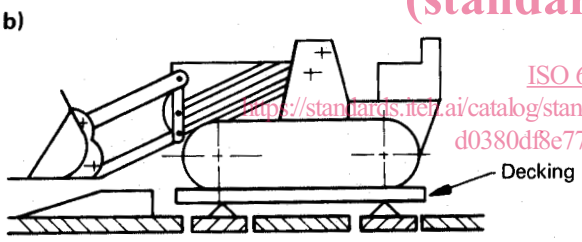


Figure 2 — Weighbridges or pressure dynamometers

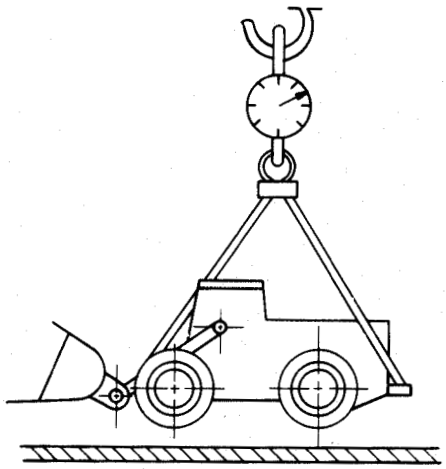
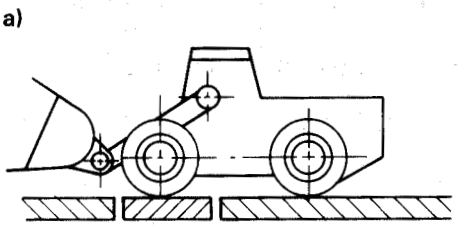


Figure 3 — Crane hook Tension dynamometer



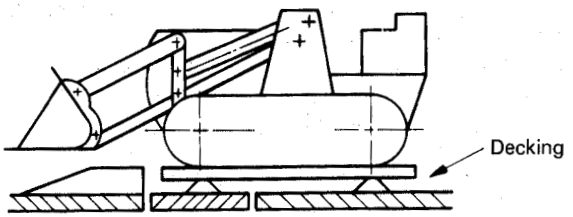
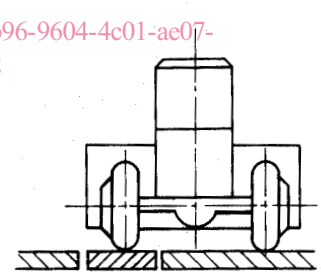


Figure 4 — Weighbridge or pressure dynamometer



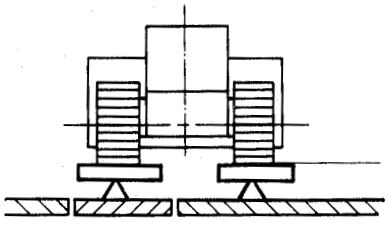


Figure 5 — Weighbridge or pressure dynamometer

Annex A

Extension dynamometer — Method of measurement

(For information, see clause 4.3.1)

The use of an extension dynamometer is not recommended but, when employed, the method shall be as follows :

a) when weighing the front or rear of the machine, the suspension point of the dynamometer shall be placed exactly at the intersection line of the vertical planes determined by the given front or rear axle and by the main longitudinal axis of the whole machine [see figures 6a) and 6b)];

b) when weighing one side of the machine, the suspension point of the dynamometer shall be placed at the intersection line of the vertical planes determined by the longitudinal axis of respectively left-hand or right-hand wheels or track and by the main lateral axis of the whole machine [see figures 7a) and 7b)].

In both cases the machine shall be kept in a horizontal position.

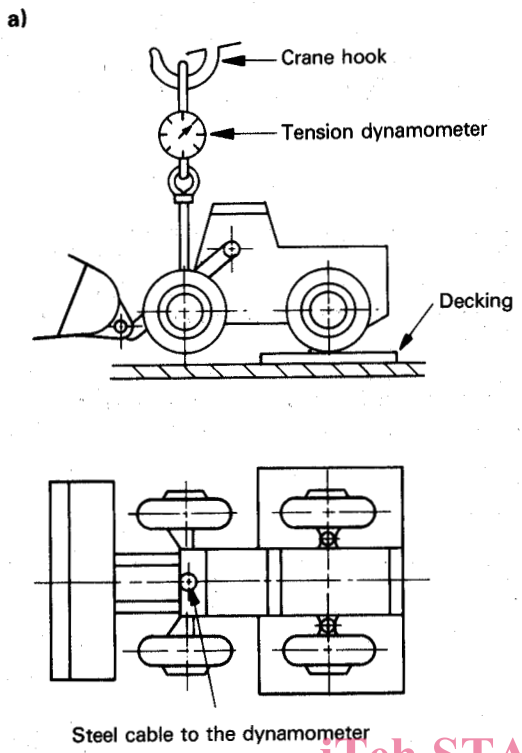


Figure 6 — Weighing the front or rear of the machine

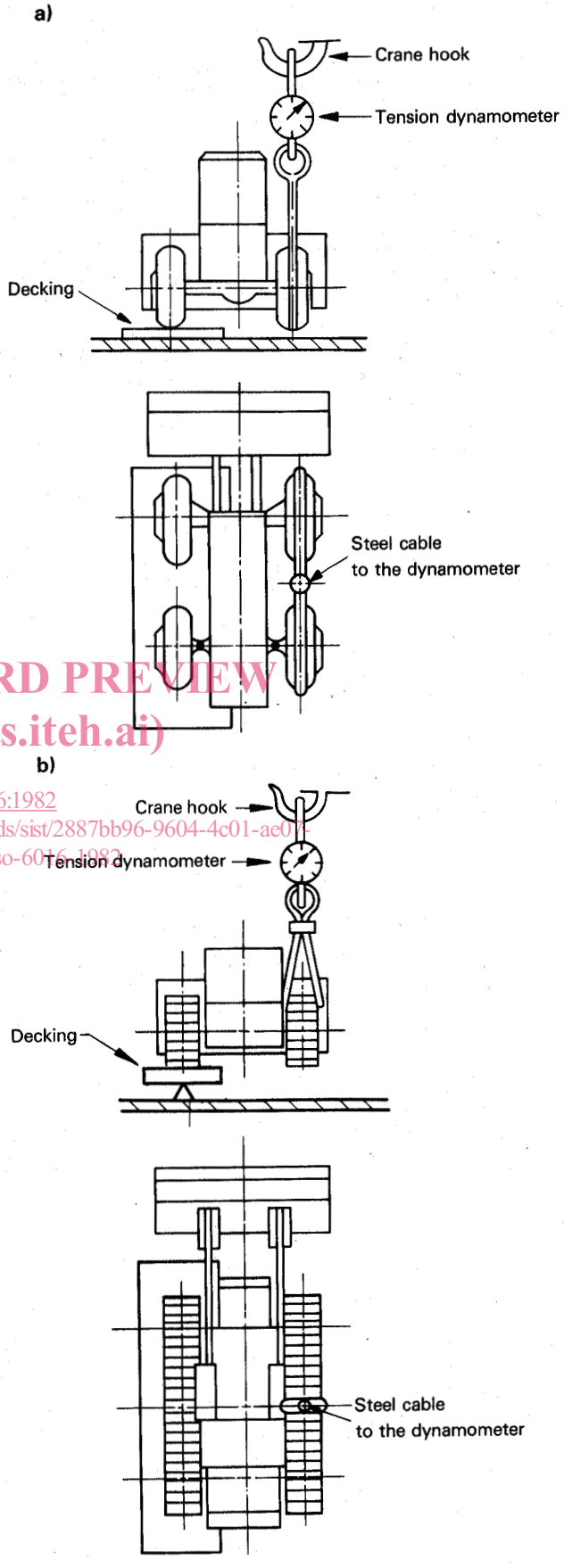


Figure 7 — Weighing one side of the machine