International Standard 5004

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Earth-moving machinery — Method of test for the measurement of tool movement time

Engins de terrassement — Méthode d'essai pour le mesurage du temps de mouvement des outils

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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.

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

Australia	Finland	Pakistan
Austria	France	Poland
Belgium	Germany, F.R.	Romania
Brazil	India	Sweden
Bulgaria	Italy	United Kingdom
Egypt, Arab Rep. of	Japan	USSR

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Czechoslovakia
USA

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Earth-moving machinery — Method of test for the measurement of tool movement time

1 Scope and field of application

This International Standard specifies a method of determining the movement time of hydraulically-operated tools and components of wheeled and track-laying earth-moving machines, for example, raising, lowering or slewing. The test method is applicable to tools both laden and unladen.

2 Reference

ISO 5998, *Earth-moving machinery — Rated operating load for crawler and wheel loaders.*

3 Terms and definitions

For the purpose of this International Standard, the following terms and definitions apply :

3.1 tool : Component of a machine designed to perform a specified function and whose time of movement is to be determined.

3.2 upper structure : Part of the machine which is able to slew or rotate about a vertical axis relative to the undercarriage of the machine and to which a tool is attached.

3.3 tool movement : Path through which the tool is moved. This is usually the maximum possible movement permitted by the operating cylinders, for example, from cylinder "fully extended" (open) to cylinder "fully retracted" (closed).

3.4 rotational movement of the superstructure : Angle through which the superstructure slews or rotates.

3.5 tool movement time : Time taken for the tool to complete its movement. The movement is usually the maximum allowed by the operating cylinders.

3.6 rotational movement time : Time taken for the upper structure to rotate through a measured angle.

3.7 operating pressures : Operating pressures of the hydraulic system, as recommended by the manufacturer.

3.8 engine speed : Manufacturer's specified maximum governed speed (with the operating lever at the maximum position).

3.9 rated operating load : Nominal value of the load applied to the bucket or tool and which represents normal loading under typical conditions as specified and determined in accordance with the appropriate International Standard for example, ISO 5998.

4 Apparatus

The following apparatus is required :

a) Stop watch accurate to ± 0,1 s

b) Protractor accurate to ± 1°

c) Pressure gauge for hydraulic system accurate to ± 5 %

d) Engine tachometer accurate to ± 5 %

e) Tyre pressure gauge.

5 Preparation for the test

5.1 The test shall be carried out on a hard level surface with no obstruction to tool movement. In the case of tools which operate below ground level, such as a ripper or excavator bucket, the machine shall be positioned so that the tool projects into an open pit at one edge of the hard surface.

5.2 The machine, together with its tool, shall be in its normal working condition set with the engine to run at the engine speed as specified in 3.8. The operating pressures shall be checked to ensure that they are in accordance with the manufacturer's recommendations (see 3.7). The tyres shall be inflated to the manufacturer's recommended normal pressures.

5.3 Immediately prior to the test, the machine shall be run for a period sufficient to ensure that the engine, transmission, oils, coolant and hydraulic components are at their normal working temperatures.

6 Procedure

6.1 The machine, prepared as above, shall be located on the test site on its normal working position, which is to be shown in a drawing in the test report. The tool under examination shall be operated in the manner normally employed when operating the machine in accordance with the manufacturer's instructions.

6.2 Before conducting any test, it is advisable that the operator familiarizes himself with the movement of the tool or component by operating it several times in the manner required in the actual test.

6.3 a) Normally measurement shall be observed over the complete travel of the hydraulic cylinder or other means of actuation required to bring about the particular tool movement, that is, from fully extended to fully retracted, or vice versa.

b) Additionally, where specific measurements are required (for example, ground line to maximum lift height), the time shall be recorded together with the specific conditions of the test.

6.4 When a movement can be made using more than one cylinder or motor system (for example, in a hydraulic excavator the bucket can be moved by using the boom lift and/or dipper and/or bucket cylinder separately or in combination), only one cylinder or motor system shall be used for the test and the one used shall be stated in the results.

6.5 When satisfied that the machine and its tools are prepared as the test requires, the tester shall then time the specified movement not less than three times to obtain a reliable mean value for the time of movement.

6.6 a) The measurement to determine the time of movement of a laden tool shall be made with the tool carrying the ISO rated operating load (see 3.9).

b) Where the tool normally discharges its load during the movement, the load shall be retained throughout the test to ensure that uniform repeatable conditions are maintained.

c) The measurements to determine the lifting time of a bucket shall be taken in two modes :

i) with a bucket empty, and

ii) with the bucket filled with material to the ISO rated operating load (see 3.9).

d) The measurements to determine the lowering time of a tool shall be taken with the tool in the unladen condition. The lowering time shall be the minimum time in either the power-down or float-down mode. The manner in which the tool is lowered shall be stated in the results. (See table 1.)

6.7 The speed of slewing or rotating shall be measured for continuous slewing with attachments fully extended at maximum working radius and without any load by measuring the time taken for a specific angle of rotation and then calculating the rotational frequency or measuring the rotational frequency. The rotational frequency in both directions shall be measured, and reported unless it is the same in both directions when only one figure needs to be reported. (See table 2.)

7 Accuracy of measurements

The following measuring accuracies shall be adhered to :

a) Time :

The variation between three or more consecutive measurements shall not exceed ± 0,2 s.

b) Angle of rotation ± 5°.

8 Test report

The following information shall be recorded :

a) Type of machine

b) Make of machine

c) Model of machine

d) Machine number

e) Details of equipment fitted

f) Hydraulic working pressure

g) Manufacturer's specified governed engine speed

h) Tool movement time

j) Specific test conditions in accordance with clause 6.3, 6.6 and 6.7

k) A drawing showing the working position.

Table 1 — Tool movement time

Tool observed, for example, bucket raising

State load in bucket

Hydraulic cylinder or motor used, for example, lift arm(s) cylinder(s)

Test No.	Time s
1	t_1
2	t_2
3	t_3
4	t_4
:	:
n	t_n

Tool movement time : $\dfrac{t_1 + t_2 + t_3 + \ldots t_n}{n}$

Table 2 — Rotational frequency

Test No.	Rotational frequency min^{-1}	Time for α degrees of movement s
1	N_1	t_1
2	N_2	t_2
3	N_3	t_3
:	:	:
n	N_n	t_n

Rotational frequency : $\dfrac{N_1 + N_2 + N_3 + \ldots n_n}{n}$ min^{-1}

or

$$= \frac{60 \times n}{t_1 + t_2 + t_3 + \ldots t_n} \times \frac{\alpha}{360} \text{ min}^{-1}$$