



Agricultural wheeled tractors — Operator seat — Measurement of transmitted vibration

Tracteurs agricoles à roues — Siège du conducteur — Mesurage des vibrations transmises

Technical Report 5007 was drawn up by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, and approved by the majority of its members. The reasons which led to the decision to publish the document in the form of a Technical Report are given in the introduction.

In July 1980, this document was submitted to the ISO Council, which approved its publication as a Technical report.

0 Introduction

This document is issued as a Technical Report owing to lack of national support for the procedure as an International Standard as well as an identification of several areas where more knowledge and experience are essential.

The parts where more information is needed before this document can be published as an International Standard are particularly :

- vibration rig excitation data;
- the effect of rig geometry on measured seat performance;
- dynamic range of accelerometers and associated instrumentation;
- rideometer filter tolerances;
- the importance of vibration above 10 Hz frequency;
- application means for lateral stability test force;
- characteristics for the classification of tractors.

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1 Scope

This Technical Report specifies methods for the measurement of the effectiveness of the seat in reducing the vertical whole-body vibration transmitted to the operator of an agricultural tractor, and methods for the measurement of other seat characteristics.

The measurements specified relate to :

- a) vertical vibration of the seat suspension system and weighted acceleration of the vibration on the seat;
- b) load/deflection characteristic of the seat suspension system;
- c) lateral stability of the seat;
- d) dimension of the seat and its vertical and horizontal adjustment.

NOTES

- 1 Vibration which reaches the operator other than through his seat, for example that sensed by the feet through the platform or controls, is not covered.
- 2 The important characteristics of seat construction include the dimensions of the seat cushion and supporting parts such as back and arm rest, and the range of operator mass for which isolation from vibration is measured.
- 3 The measurement of whole-body vibration along the three principal axes is covered by ISO 5008.

2 Field of application

This Technical Report applies to seats which may be fitted either to specified models of agricultural wheeled tractors or to a group of models which have similar vibration characteristics. It is recognized that there may be designs of tractors, for example, stilt-tractors, tricycle tractors, hillside tractors or vineyard tractors, etc., for which this Technical Report is not appropriate.

3 References

ISO 2041, *Vibration and shock — Vocabulary*.

ISO 2631, *Guide for the evaluation of human exposure to whole-body vibration*.

ISO 3411, *Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope*.

ISO 3462, *Agricultural tractors and machinery — Seat reference point*.¹⁾

ISO 4253, *Agricultural tractors — Operator's seating accommodation*.

ISO 5008, *Agricultural wheeled tractors and field machinery — Measurement of whole-body vibration of the operator*.

IEC Publication 225, *Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations*.

1) At present at the stage of draft.

4 General

4.1 The specification of instruments, test facility characteristics and vibration assessment should allow measurements to be made and reported with acceptable precision.

4.2 Methods are defined for classifying tractors into groups which have similar vibration characteristics and for choosing reference tractors to be representative of such groups.

4.3 Two alternative methods are given for measuring the vertical vibration of the seat suspension system : either

- a) using a vibration test sand (for all classified tractors), or
- b) using a test track (as an alternative for tests for seats on non-classified tractors).

4.4 The vibration is evaluated in accordance with ISO 2631. The procedure includes means of weighting the vibration level at different frequencies to take account of agreed approximations to the frequency sensitivity of the human operator.

5 Definitions

For the purposes of this Technical Report, the following definitions shall supplement those of ISO 2041.

5.1 ride vibration : Vertical vibration in the frequency range covered by 1/3 octave bands centred from 1 to 80 Hz transmitted through the driver's seat.

5.2 weighted vibration : Measured vibration acceleration modified by the frequency-weighting.

5.3 vibration transmission factor : Ratio of weighted vertical acceleration vibration measured on the seat to that measured at the point of the seat attachment.

5.4 vibration class : Class or group of tractors which show the same vibration characteristics at the seat attachment point.

5.5 classified tractor : Tractor, the vibration behaviour of which is classified in a vibration class because of similar ride vibration features.

5.6 non-classified tractor : Tractor which has not been classified in a defined vibration class.

5.7 reference tractor : Tractor, the vibration behaviour of which is characterised by the output spectra of the vibration rig when testing a seat for a given vibration class of tractors.

5.8 unladen tractor : Tractor in working order with full tanks and radiators, but less the mass of the operator and without removable ballast weights, special equipment or loads.

6 Tolerances

Unless otherwise stated, the following tolerances shall apply :

- for all specified values : $\pm 5 \%$

Linear dimensions shall be recorded to the nearest integral unit.

The measuring accuracy of the instruments used shall be within the following limits :

- for linear measurements : $\pm 0,5 \%$
- for angular measurements : $\pm 0,25^\circ$
- for determination of tractor mass : $\pm 0,5 \%$
- for measurement of tyre pressure : $\pm 10 \text{ kPa}$

7 Vibration measurements

7.1 Vibration transducers and amplifiers

The vibration shall be sensed by acceleration transducers (accelerometers), one of which shall be attached to the rigid part of a disc of 250 ± 50 mm diameter of which the centre part shall be rigid to a diameter of 75 ± 5 mm (a typical arrangement is shown in figure 1). The transducer should preferably be protected by a rigid cover. The disc, which may be covered with 20 mm thick resilient material, shall be placed between the operator and the centre of the seat.

A second transducer shall be mounted on the seat attachment, where it is mounted on the tractor or cab, at a point not more than 100 mm from the longitudinal centreline of the seat, if possible, not outside the vertical projection of the seat cushion, and in any event neither outside the rear of this projection nor more than 50 mm outside the front edge of this projection.

The transducers together with their associated amplifiers shall be sensitive to vibration levels of $0,05 \text{ m/s}^2$ and shall be capable of measuring vibrations of 5 m/s^2 r.m.s. with a crest factor (ratio of peak to r.m.s. value) of 3 without distortion and with an accuracy of $\pm 2,5 \%$ of the actual r.m.s. reading.

In the range 1 to 80 Hz the frequency response shall not vary by more than 5 %.

7.2 Magnetic tape recorder

The electrical signals generated by the transducers may be recorded for later analysis on magnetic tape.

The magnetic tape recorder shall have a replay accuracy of better than $\pm 3,5 \%$ over the frequency range 1 to 80 Hz including any change of tape speed made during replay for the purpose of analysis.

7.3 Frequency weighting

Frequency weighting shall be achieved by direct use of electrical filters in a frequency weighting "ride-meter". Where more detailed information is required, analysis of the acceleration into 1/3 octave band levels and weighting of the levels may be carried out.

NOTE — Vibration above 10 Hz may be disregarded. When a vibration meter is used, it may be connected with a low-pass filter with a cut-off frequency of 10 Hz and a high-frequency attenuation increasing by 12 dB/octave.

7.3.1 Frequency-weighting "ride-meter"

The "ride-meter" shall consist of an electronic weighting network incorporated between the transducer and a time integration stage. The weighting network shall have an insertion loss according to the curve in figure 2. The loss shall not deviate from the curve by more than $\pm 0,5$ dB from 2 to 4 Hz and ± 2 dB at all other frequencies.

The integration stage shall be capable of indicating the integral (I) of the square of weighted vibration acceleration (a_w^2) for the time period of the test run (T), or its square root (I'), that is :

$$I = \int_{t=0}^T a_w^2 dt \text{ or } I' = \sqrt{\int_{t=0}^T a_w^2 dt}$$

or directly the r.m.s. value ($A_{w \text{ eff}}$) of the weighted vibration acceleration, that is :

$$A_{w \text{ eff}} = \sqrt{\frac{I}{T}} = \frac{\sqrt{I}}{\sqrt{T}}$$

The overall accuracy of the r.m.s. value of the weighted vibration acceleration thus determined shall lie within $\pm 5 \%$.

7.3.2 Frequency analysis method

7.3.2.1 Analyse each vibration recording into 1/3 octave component accelerations over the frequency range 1 to 80 Hz, the 1/3 octave centre frequencies being in compliance with IEC Publication 225, which shall, however, be extrapolated for the lower frequencies.

7.3.2.2 Average the root mean square (r.m.s) value of each component (b_f) over the duration specified for the measurement.

7.3.2.3 Multiply 1/3 octave values by weighting factors (w_f) listed in table 1, and calculate a weighted acceleration (B_w) value for each recording as the square root of the sum of the squares of the weighted 1/3 octave values, that is :

$$B_w = \sqrt{\sum_{f=1}^{80} w_f^2 b_f^2}$$

Table 1 — Weighting factors relative to the frequency range of maximum acceleration sensitivity

Frequency, f (centre frequency of 1/3 octave band) Hz	Weighting factor, w_f
1,0	0,50 = - 6 dB
1,25	0,56 = - 5 dB
1,6	0,63 = - 4 dB
2,0	0,71 = - 3 dB
2,5	0,80 = - 2 dB
3,15	0,90 = - 1 dB
4,00	1,00 = 0 dB
5,00	1,00 = 0 dB
6,3	1,00 = 0 dB
8,00	1,00 = 0 dB
10,00	0,80 = - 2 dB
12,5	0,63 = - 4 dB
16,0	0,50 = - 6 dB
20,0	0,40 = - 8 dB
25,0	0,315 = - 10 dB
31,5	0,25 = - 12 dB
40,0	0,20 = - 14 dB
50,0	0,16 = - 16 dB
63,0	0,125 = - 18 dB
80,0	0,10 = - 20 dB

7.4 Calibration

The entire measurement and analysis equipment shall be regularly calibrated, where possible in accordance with existing standards or recommendations.

8 Operators

Two operators shall be used in each test; one a light operator with a mass of 55 kg $\pm$ 10 %, of which not more than 5 kg may be contributed by ballast carried in a belt; the other a heavy operator with a mass of 98 kg $\pm$ 10 %, with not more than 8 kg of this mass carried in a belt (see ISO 3411).

9 Classification of tractors

9.1 General

For the purpose of measuring the vibration performance of seats, the vibration behaviour of a classified tractor (see 5.5) may be represented by a single reference vibration spectrum which is typical of the spectral power density of the vertical acceleration recorded at the seat attachment point of the reference tractor (see 5.7).

9.2 Classifiable tractors (category A)

9.2.1 A classifiable 2-axle tractor shall have the following characteristics :

Axle load distribution :	Front : 30 to 45 % of unladen mass Rear : 70 to 55 % of unladen mass
Tyres :	Front smaller than rear (radius of front $\leq$ 0,8 times radius of rear)
Track width :	Smallest adjustable track width greater than 1 150 mm
Suspension :	Rear axle unsprung
Longitudinal position of seat reference point :	Between axis of rear wheels and centre of gravity of tractor

9.2.2 Category A 2-axle tractors are divided into the following classes :

- Class 1 : 1 400 to 3 600 kg unladen tractor mass;
- Class 2 : 3 601 to 5 000 kg unladen tractor mass.

9.3 Reference tractor

9.3.1 General

The reference tractor is defined by the spectral power density of the vertical acceleration (figures 3 and 4) recorded at the point of seat attachment of the reference tractor during a run on the standard test track (see 11.2.1) at a speed of $12 \pm 0,5$ km/h.

The technical data of the reference tractors will probably correspond with the approximate values of table 2.

Table 2 — Technical data of reference tractors

Technical data	Class 1	Class 2
Unladen mass, kg	3 040	4 750
Front axle load, kg	1 300	1 830
Rear axle load, kg	1 740	2 920
Front tyres	7,50-18	12,4/11-28
Rear tyres	16,9/14-34	16,9/14-38
Front tyre pressure, kPa	200	150
Rear tyre pressure, kPa	110	130
Wheelbase, mm	2 125	2 590

9.3.2 Class 1

The spectral power density (ϕ) of the vertical vibration acceleration at the seat attachment of the Class 1 reference tractor (figure 3) can be approximately expressed by the following equation :

$$\phi = \phi_{\max} \exp - \frac{(f - f_m)^2}{2 b^2}$$

where the constants have the values :

$$\phi_{\max} = 6,0 \text{ (m/s}^2\text{)}^2/\text{Hz}$$

$$f_m = 3,25 \text{ Hz}$$

$$b = 0,33 \text{ Hz}$$

The permitted tolerances are :

$$\phi_{\max} = \pm 10 \%$$

$$f_m = \pm 5 \%$$

The tolerance on b is determined by the fact that the weighted vibration acceleration at the seat attachment must be within the limits :

$$a_{wB} = 1,9 \text{ to } 2,2 \text{ m/s}^2$$

9.3.3 Class 2

The spectral power density (ϕ) of the vertical vibration acceleration at the seat attachment of the Class 2 reference tractor (see figure 4) can be approximately expressed by the following equation :

$$\phi = \phi_{\max} \exp - \frac{(f - f_m)^2}{2 b^2}$$

where the constants have the values :

$$\phi_{\max} = 5,5 \text{ (m/s}^2\text{)}^2/\text{Hz}$$

$$f_m = 2,65 \text{ Hz}$$

$$b = 0,3 \text{ Hz}$$

The permitted tolerances are :

$$\phi_{\max} = \pm 10 \%$$

$$f_m = \pm 5 \%$$

The tolerance with respect to b is determined by the fact that the weighted vibration acceleration at the seat attachment must be within the limits :

$$a_{wB} = 1,6 \text{ to } 1,8 \text{ m/s}^2$$

9.4 Non-classifiable tractors (category B)

A non-classifiable tractor has characteristics such that it cannot be included in a class in category A.

10 Test methods

10.1 Selection of test method

10.1.1 A seat intended for use on a class or classes of category A tractors shall be tested on a vibration test stand using the appropriate control signals.

Seats tested for Class 2 tractors are to be deemed suitable also for Class 1 tractors.

10.1.2 A seat intended for use on a category B tractor shall be tested on the model of tractor on which it will be used, either on the standard test track or on the vibration test stand using as control signal an input corresponding to the acceleration curve determined during a test on the standard track with the model of tractor on which the seat will be used.

10.2 Test procedure

10.2.1 Tests shall be carried out on the same seat and in the following sequence :

- a) measurement of dimensions (see clause 14);
- b) determination of load/deflection characteristics of the suspension system (see clause 12);

- c) lateral stability (see clause 13);
- d) vibration tests (see clause 11).

10.2.2 The seat (and tractor, if applicable) submitted for test shall conform in respect of construction and fittings, insofar as these are related to the characteristics to be tested, with seats or tractors supplied in series production.

10.2.3 Before the tests are carried out, the seat shall be run in as specified by the seat manufacturer, to bring it to a normal operating condition.

10.2.4 The seat reference point shall be determined in accordance with ISO 3462.

11 Vibration tests

11.1 General

11.1.1 Condition of tractor

11.1.1.1 The tractor shall be fitted with a protective frame and/or cab unless it is of a type for which this equipment is not required. It shall not carry any auxiliary equipment and there shall be no ballast or liquid in the tyres.

11.1.1.2 The tyres shall be the standard size for the tractor, as specified by the manufacturer. The depth of tread shall be not less than 65 % of the depth of a new tread and the tyre walls shall not be damaged.

11.1.1.3 Except for reference tractors, the tyre pressures shall be the arithmetic mean of the ranges recommended by the tractor manufacturer.

11.1.1.4 The track setting shall be that which is usual for normal field work, as recommended by the manufacturer.

11.1.2 Condition of seat

11.1.2.1 The seat shall be set for the mass of the operator in accordance with the manufacturer's instructions.

11.1.2.2 The seat position shall be set horizontally and vertically to suit the operator's stature.

11.1.3 Values to be reported

11.1.3.1 During each test, the weighted vibration acceleration for the whole test time shall be determined with the direct-reading vibration meter specified in 7.3.1 or by 1/3 octave analysis of the recorded acceleration signals. The arithmetic mean values of the corrected seat vibration acceleration for the light operator and for the heavy operator shall be reported.

11.1.3.2 The report shall also contain the ratio of the weighted vibration acceleration on the operator's seat to the weighted vibration acceleration at the point of seat attachment. This ratio shall be given to two decimal places.

11.1.3.3 The ambient temperature range during the tests shall be measured and included in the report.

11.2 Test on vibration stand

11.2.1 Test stand

11.2.1.1 Physical characteristics

The moving part of the vibration test stand shall consist of a platform the dimensions of which corresponds approximately with those of the operator platform of a tractor and on which there is an attachment for the seat to be tested, a steering wheel, and a toe-stop. The general arrangement and main dimensions shall be as shown in figure 5.

The stand shall be flexurally and torsionally stiff and the bearings and guides shall not provide unnecessary freedom.

The stand shall be constrained to travel in an essentially vertical direction and be free from resonances and non-linearities which would distort the output vibration beyond the correction capability of signal compensation.

If the platform is carried on an arm, as shown in figure 5, the radius from the arm pivot to the centre of the seat attachment shall be at least 2 000 mm.

The stand shall be capable of simulating sinusoidal vibrations in accordance with figure 6 when loaded with a mass of 150 kg.

11.2.1.2 Signal generation

The vibrations shall be generated by means of a servo-controlled electro-hydraulic actuator. The system shall have dynamic response capable of driving the mounting base of the loaded seat in accordance with the defined test spectra.

The transfer function characteristics of the equipment may be compensated for during the synthesis of the command input signal in order that the vertical output power spectral density and probability density distribution of acceleration amplitudes requirements are satisfied at the seat mounting base. Any appropriate digital or analogue method may be used to generate the command signal provided that the output power spectral density and probability density distribution of acceleration amplitudes requirements are satisfied at the seat mounting base. For tests on category A tractors, the probability density distribution of the total input vibration shall be approximately Gaussian.

The test input vibration shall produce the appropriate spectrum of vertical vibration at the seat attachment point according to the class of category A tractor for which the operator seat is intended, or it shall be the double-integrated acceleration signals recorded, at the point of seat attachment, on the model of category B tractor on which the operator seat is to be used whilst travelling on the standard test track at $12 \pm 0,5$ km/h.

One method of synthesising the input signal for category A class 1 and class 2 tractors is given in the annex.

11.2.1.3 Safety requirements

The vibration test stand shall have failsafe provisions capable of automatic shutdown when the seat mounting base acceleration exceeds 15 m/s^2 for any reason. It is preferred that this provision be a hydraulic means, such as a supply pressure relief valve and/or a load-limiting valve across the piston of the actuator cylinder.

The pump and/or servo-valves shall be sized to limit the test stand velocity to $1,3 \text{ m/s}$, and the accumulator shall be of the minimum size required to provide the proper system response.

Failsafe shutdown switches shall be provided for both the operator in the test seat and the operator of the test facility. The shutdown switches shall shut down the hydraulic power supply and actuate a valve to release the system hydraulic pressure.

11.2.2 Procedure

11.2.2.1 Mount the seat to be tested on the vibration test stand in accordance with the arrangement in figure 5.

Operate the vibration test stand to produce the appropriate input signals to the seat, as given in 11.2.1.2, and measure the weighted vibration acceleration on the seat over a period of 28 s.

11.2.2.2 The vibration test stand shall be so adjusted that there is a weighted acceleration (a_{WB}) at the point of seat attachment within the following ranges :

Category A, class 1 tractor : $a_{WB} = 1,9 \text{ to } 2,2 \text{ m/s}^2$

Category A, class 2 tractor : $a_{WB} = 1,6 \text{ to } 1,8 \text{ m/s}^2$

The value a_{WB} actually present at the seat attachment point during the test shall be determined. If this deviates from the reference value :

$a_{WB}^* = 2,05 \text{ m/s}^2$ for category A, class 1

$a_{WB}^* = 1,7 \text{ m/s}^2$ for category A, class 2

the acceleration a_{WS} measured on the operator seat shall be corrected by use of the equation :

$$a_{WS}^* = a_{WS} \times \frac{a_{WB}^*}{a_{WB}}$$

11.2.2.3 At least two test runs shall be made for each operator. If the results differ by more than $\pm 5\%$ from the arithmetic mean, resolve the discrepancies by further repeat measurements.

11.3 Test on standard test track

11.3.1 Standard test track

The standard test track shall be an artificial track consisting of two parallel strips adapted to match the wheel track width of the tractor. The surface of each track strip is defined by ordinates of elevation with respect to an arbitrary base line as given in table 3.

The length of the standard test track shall be 100 m.

11.3.2 Procedure

11.3.2.1 With the tractor travelling at a speed of $12 \pm 0,5$ km/h, maintained without using the brakes, measure the vertical vibration on the seat and at the point of seat attachment on the tractor, beginning when the axis of the tractor rear wheels is over point $D = 0$ in table 3 and ending when the axis of the front wheels is over point $D = 100$ in table 3.

11.3.2.2 At least two test runs shall be made for each operator. If the results differ by more than $\pm 5\%$ from the arithmetic mean, resolve the discrepancies by further repeat measurements.

12 Determination of suspension system load/deflection characteristics

12.1 The maximum and minimum values for the adjustment of the seat for the operator's mass shall be calculated from the suspension characteristic curve measured in a static test. This determination of the suspension characteristic shall be undertaken at the extremes of adjustment for operator mass. If the design of the seat allows the suspension travel to be influenced by the vertical adjustment of the seat, the characteristic shall be determined at both extremes of this adjustment.

12.2 To determine the static characteristic, the seat shall be mounted in a test stand and a force shall be applied either directly or through a mechanism. The suspension system depression shall be measured with an accuracy of 1 % of the maximum deflection.

12.3 A complete characteristic curve shall be taken from zero force to maximum and back to zero. The force steps at which the suspension system depression is measured shall not be greater than 100 N; at least eight points shall be plotted at approximately equal intervals of the movement of the suspension. The maximum force shall be taken either as that at which no further suspension system depression can be measured, or as 1 500 N, whichever is the lesser.

After application or removal of the force, the vertical depression of the suspension system shall be measured 200 mm in front of the seat reference point. After application or removal of the force, sufficient time shall be allowed to ensure that the seat is at rest.

12.4 In seats without fixed limits for the operator mass adjustment, the settings shall be so chosen that :

- a) for minimum operator mass, the seat just returns to the top limit of free suspension travel (see explanation below) when the force is removed ;
- b) for maximum operator mass, the force of 1 500 N just depresses the seat to the lower limit of free suspension travel (see explanation below).

In this case, it shall be reported that the operator mass adjustment range is greater than that measured.

12.5 Full travel of the suspension shall be taken as the movement from the highest limiting position, defined as the position taken up by the suspension adjusted for the maximum operator mass with no external force applied, to the lowest limiting position, defined as the position taken up by the suspension adjusted for the minimum operator mass with a vertical force of 1 000 N applied.

Free travel of the suspension shall be taken as the movement from the position taken up by the suspension when just touching the upper limit stop to the position when the suspension just touches the lower limit stop.

12.6 The maximum range of adjustment for the operator's mass shall be determined by multiplying by 1,3 the values for the load adjustment range determined as below. In addition, the free suspension travel determined, where necessary, at the two extremes of vertical adjustment shall be reported.

By "load adjustment range" is meant the range between the two loads corresponding to the mean position in the suspension system load/deflection characteristic between the settings for the maximum and minimum operator masses. Since the spring characteristics are, in general, hysteresis loops, a central line shall be drawn through the loop (see figure 7, points A and B) for the determination of the load application.

By "mean position" is meant that position which the seat assumes when it is depressed by half the full travel of the suspension.

13 Determination of lateral stability

13.1 Condition of seat

The seat shall be adjusted, as far as possible, to the maximum permissible operator mass setting and fixed to a stand so that its base plate or structure is clamped against a rigid plate not smaller than the seat itself.

13.2 Procedure

13.2.1 Apply a force of 1 000 N to the surface or cushion of the seat or to the cushion supporting structure at a point 200 mm in front of the seat reference point and 150 mm on one side of the longitudinal plane of symmetry through the seat, making provision to accommodate the angular deflection of the seat at the point of application.

13.2.2 Measure the lateral angles of inclination of the cushion supporting structure at the end settings of horizontal and vertical seat adjustments.

13.2.3 Repeat the procedure given in 13.2.1 and 13.2.2 with the force applied on the other side of the longitudinal plane of symmetry through the seat.

14 Measurement of dimensions

The following dimensions shall be measured :

14.1 Depth of seat surface.

The horizontal distance between the seat reference point and the front limit of the padded part of the seat measured parallel to and 150 mm from the longitudinal mid-plane of the seat.

14.2 Width of seat surface.

The horizontal distance across the seat measured 150 mm in front of the seat reference point and not more than 80 mm vertically above it.

14.3 Height of backrest.

The vertical distance of the upper limit of the padded part of the backrest (not its supporting structure) above the seat reference point.

If the supporting structure protrudes above this upper limit, this shall be reported.

14.4 Range of horizontal adjustment.

14.5 Range of vertical adjustment.

14.6 Angle of seat surface to the horizontal.

The angle, measured in a longitudinal plane, made by the surface of the loaded measuring device used in ISO 3462.

15 Specimen report form

1 Name and address of manufacturer

2 Model of seat

3 Test details

a) Standardized track/vibration stand

b) Category

c) Class

4 Tractor details (category B tractor only)

a) Make and model

b) Mass (total) kg (front) kg (rear) kg

c) Whether protective cab or frame fitted

d) Tyres fitted :

— Front : Type and size Pressure kPa

— Rear : Type and size Pressure kPa

e) Operator position (for example, rear, mid-mounted or front)

f) Track setting mm

5 Dimensions

a) Depth of seat mm

b) Width of seat mm

c) Height of backrest mm

d) Range of horizontal adjustment mm

e) Range of vertical adjustment mm

f) Angle of seat surface to the horizontal degrees

6 Suspension system characteristics

a) Range of adjustment for operator's mass kg to kg

b) Free suspension travel mm

c) Full suspension travel mm

7 Lateral stability

Maximum lateral angle of inclination degrees

8 Vibration characteristics

	Tractor vibration	Seat vibration	Ratio
a) Light operator	 m/s ²	 m/s ²	
b) Heavy operator	 m/s ²	 m/s ²	
c) Ambient temperature range	 °C		

9 Special remarks

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10 Test carried out by : **Date of test :**

Annex**Method for synthesising the input control signals to the vibration test stand**

This is one method for generating an input signal corresponding to the power spectral density functions given in figures 3 and 4 for category A class 1 and 2 tractors respectively.

A total of 701 ordinates of signal amplitude are tabulated at intervals of 0,04 second, in tables 4 and 5.

They may be stored numerically and, after passing through a low-pass filter with a cut-off frequency of about 10 Hz and high-frequency attenuation of 12 dB/octave, they give approximately the required deflection signal for the electro-hydraulically operated vibration test stand.

The control signals shall be repeated without interruption. The vibration test stand shall be so adjusted that there is a weighted acceleration at the seat attachment within the following ranges :

Category A, class 1 tractor : $a_{WB} = 1,9$ to $2,2$ m/s²

Category A, class 2 tractor : $a_{WB} = 1,6$ to $1,8$ m/s²

The value a_{WB} actually present at the seat attachment point during the measurement shall be determined. If this deviates from the reference value :

$a_{WB}^* = 2,05$ m/s² for category A, class 1

$a_{WB}^* = 1,7$ m/s² for category, A, class 2

the acceleration a_{WS} measured on the operator seat shall be corrected by use of the equation

$$a_{WS}^* = a_{WS} \times \frac{a_{WB}^*}{a_{WB}}$$

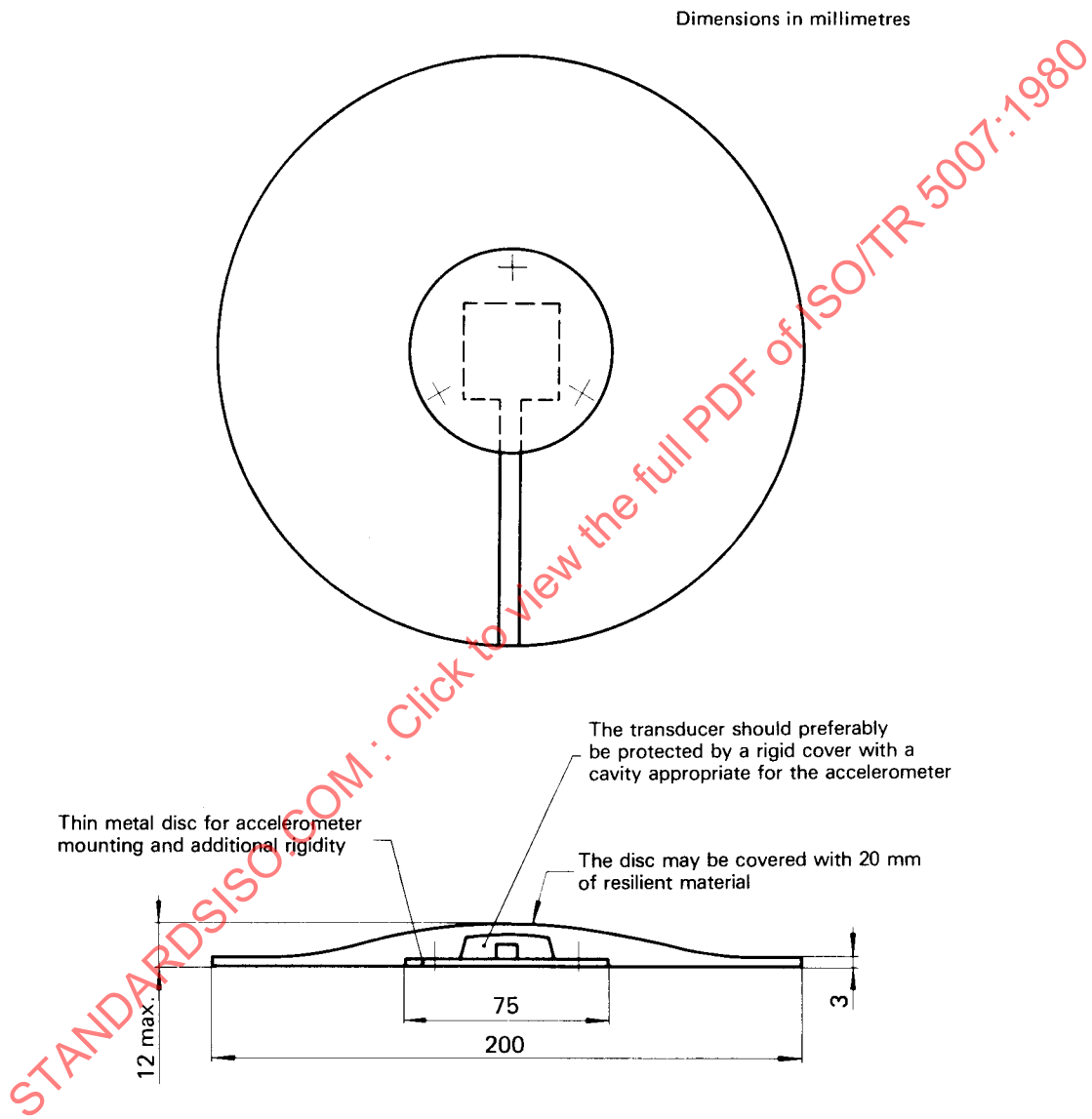


Figure 1 — Suggested design for a semi-rigid disc for accelerometer mounting

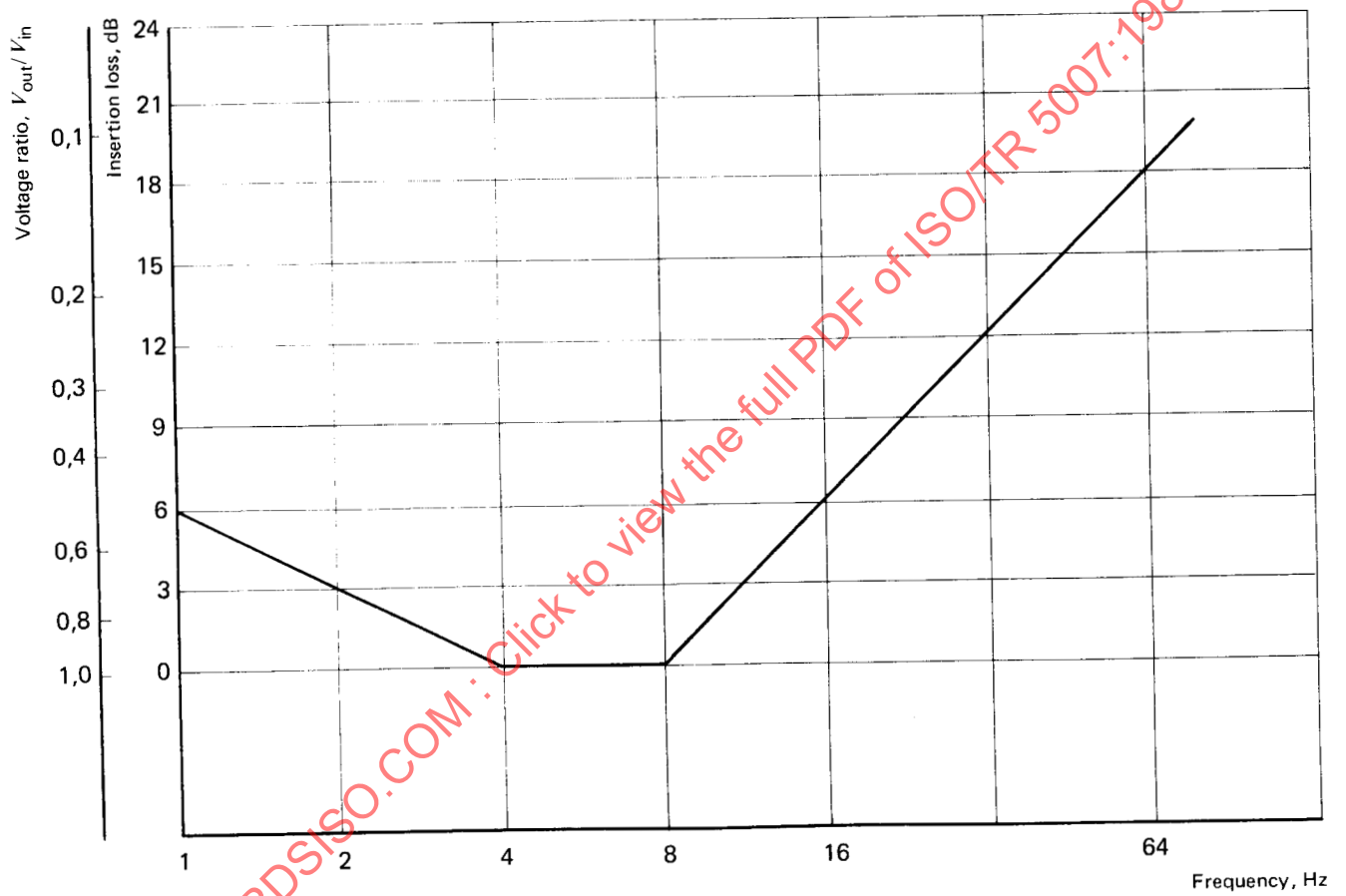


Figure 2 — Frequency-weighting filter characteristics of "ride-meter" — Vertical direction

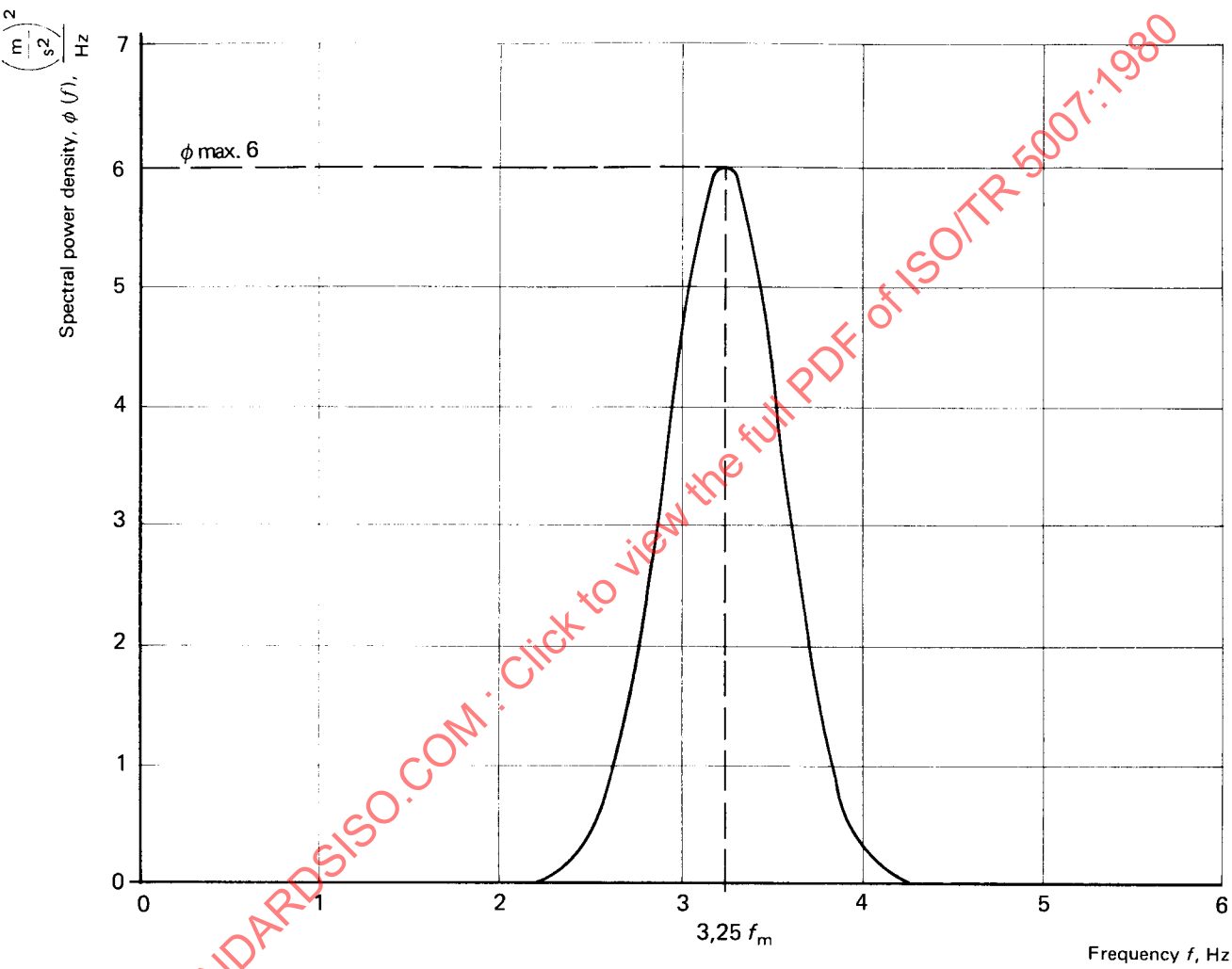


Figure 3 — Approximate function for the spectral power density of the vertical vibration acceleration at the seat attachment of the reference tractor for class 1

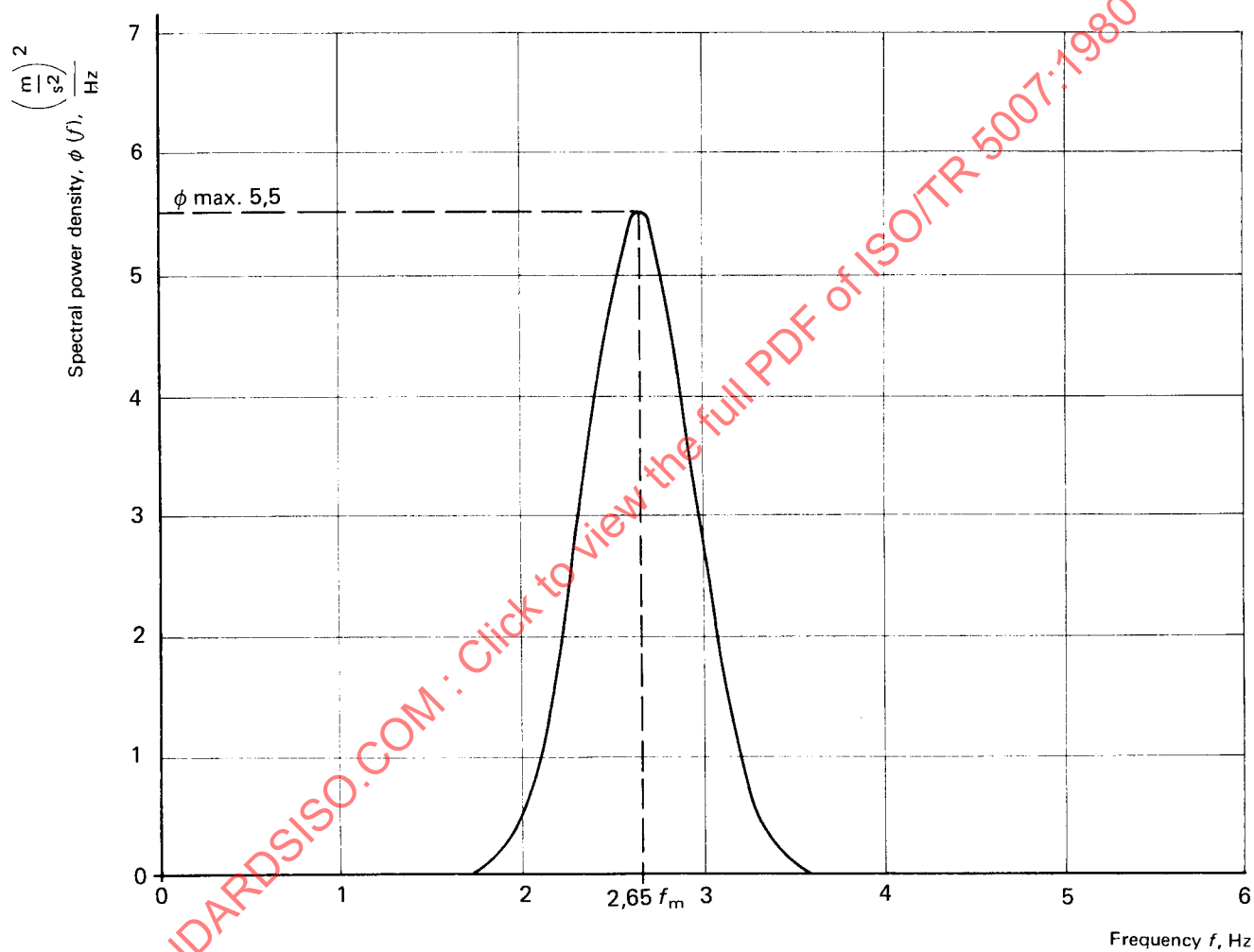
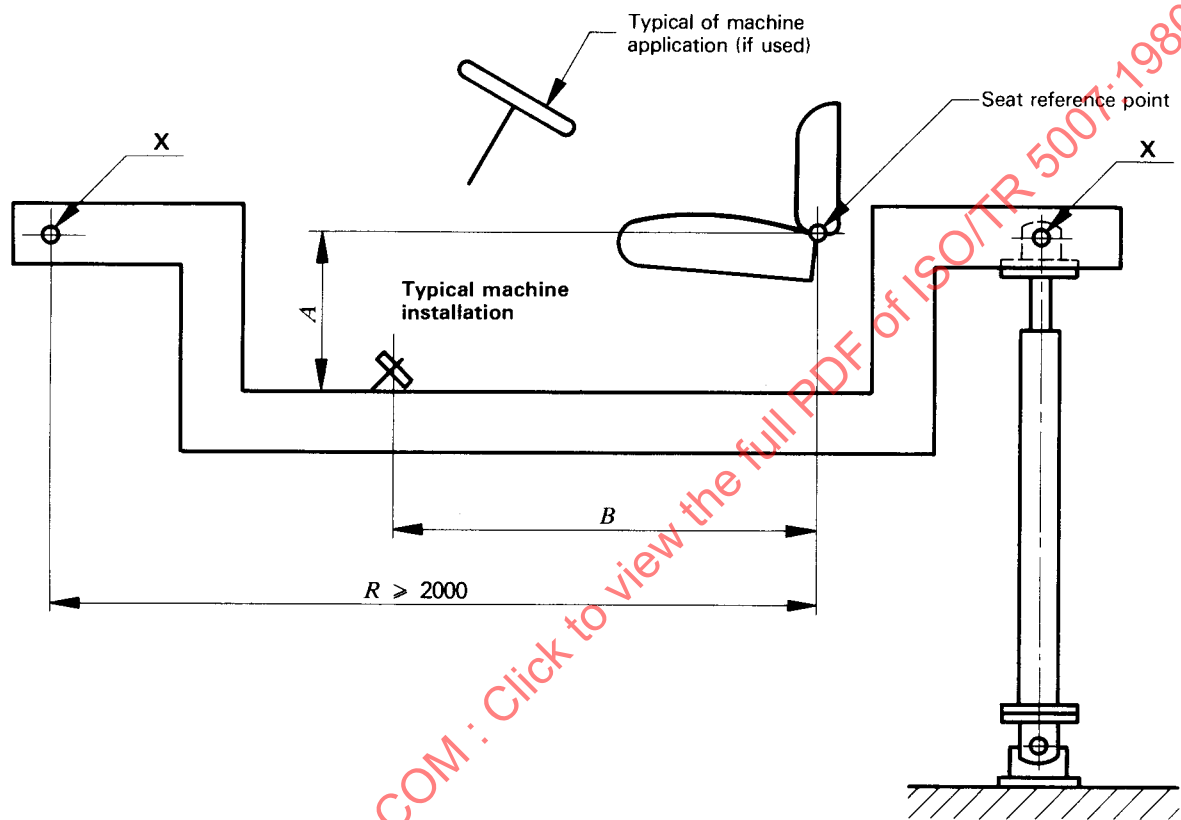


Figure 4 — Approximate function for the spectral power density of the vertical vibration acceleration at the seat attachment of the reference tractor for class 2



Seat location (*A* and *B*) shall be in accordance with ISO 4253.

The vertical distance between the seat reference point and the axis *X-X* of the test stand shall not exceed ± 200 mm.

NOTE — This diagram is illustrative only and does not limit the construction of the test stand to the type shown.

Figure 5 — Vibration test stand

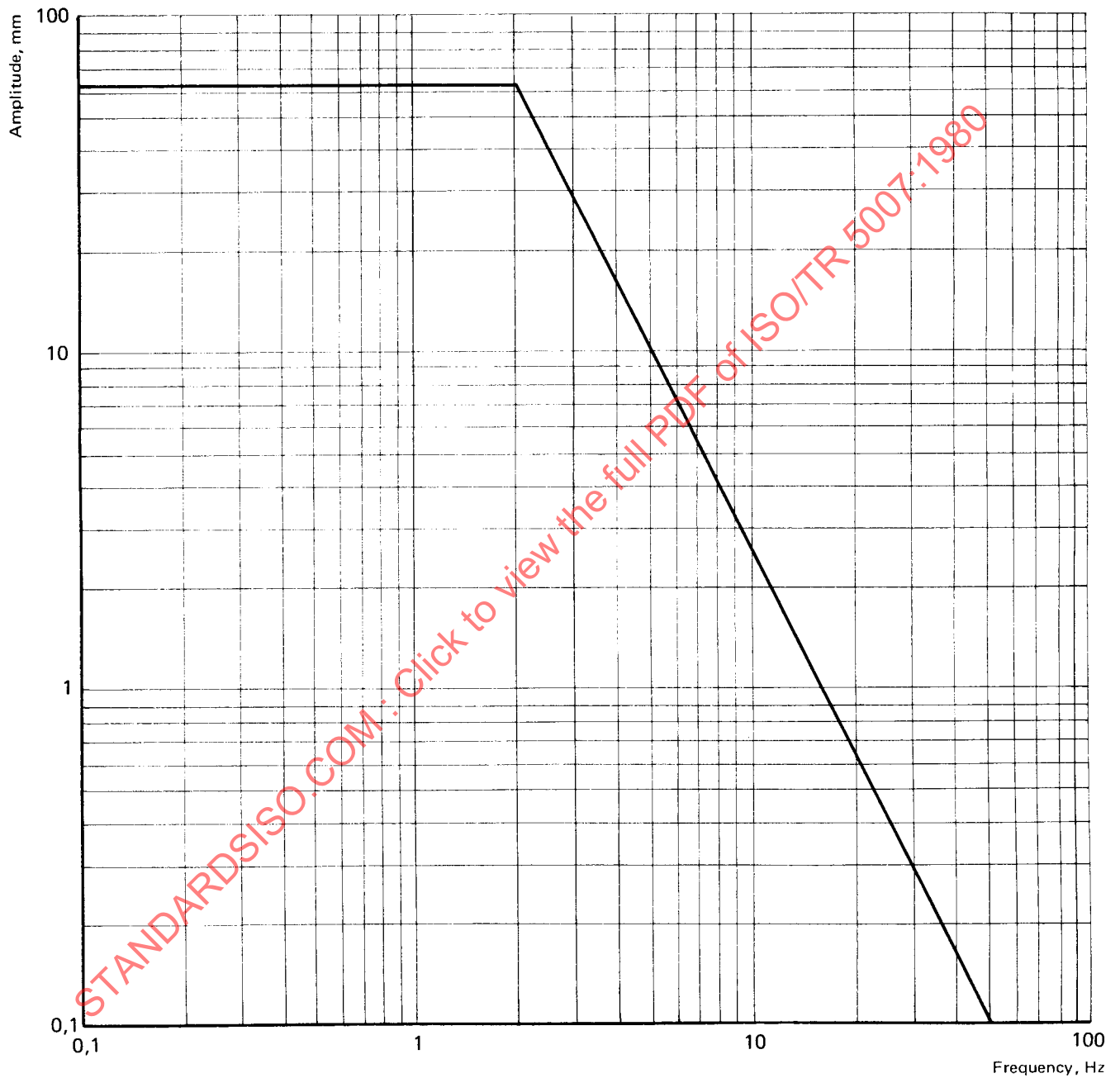


Figure 6 — Amplitude characteristic curve for the vibration test stand

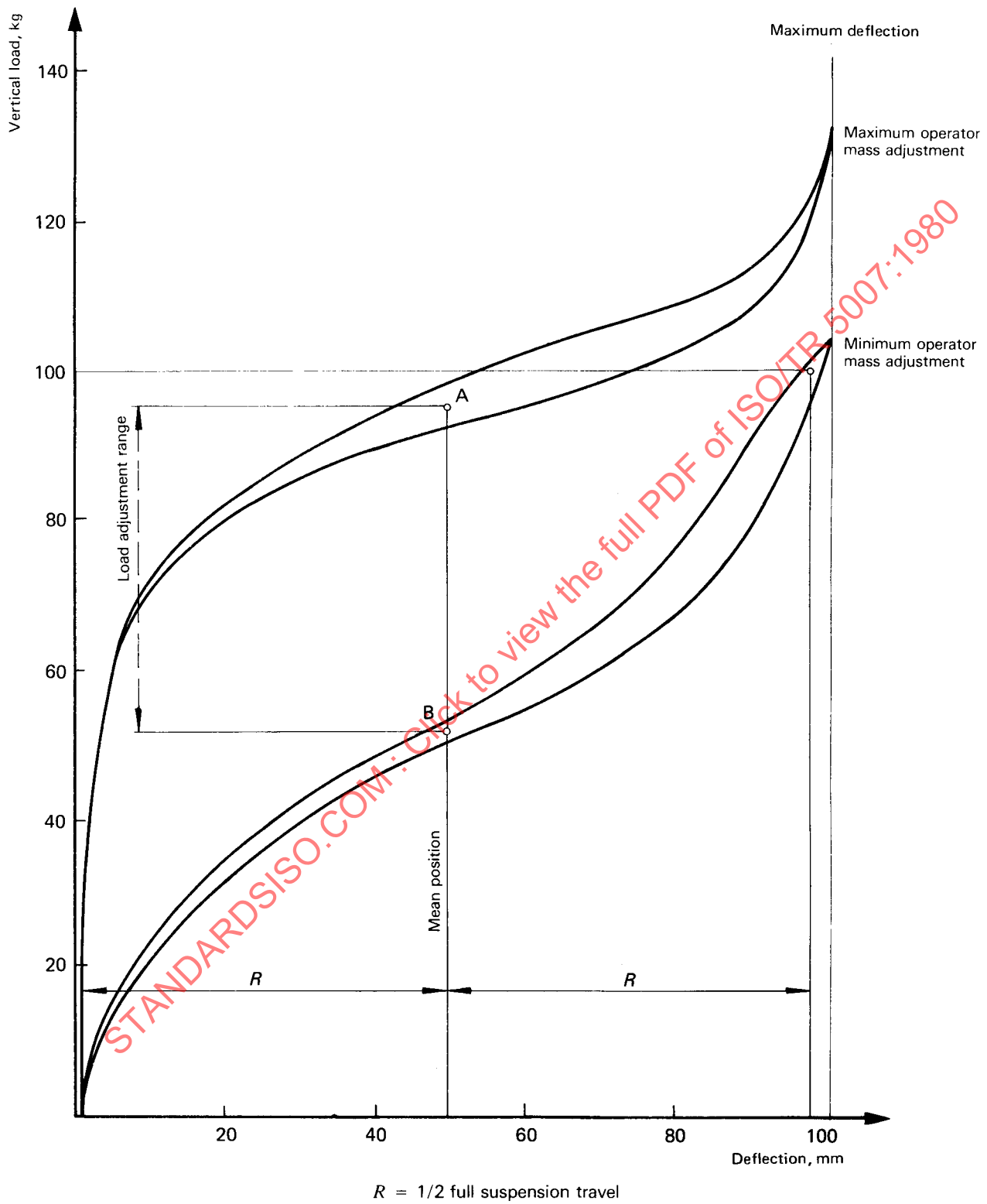


Figure 7 — Example of suspension system characteristic curves

Table 3 — Standard test track — Ordinates of elevation with respect to an arbitrary baseline

 D = distance from start (m); L = ordinate of left-hand strip (mm); R = ordinate of right-hand strip (mm)

D	L	R	D	L	R	D	L	R	D	L	R
0	115	140	9,60	135	95	19,20	95	70	28,80	90	75
0,16	110	125	9,76	120	95	19,36	85	70	28,96	75	90
0,32	110	140	9,92	120	95	19,52	85	75	29,12	75	75
0,48	115	135	10,08	120	95	19,68	75	85	29,28	75	75
0,64	120	135	10,24	115	85	19,84	85	85	29,44	70	75
0,80	120	125	10,40	115	90	20,00	75	90	29,60	75	75
0,96	125	135	10,56	115	85	20,16	85	85	29,76	75	85
1,12	120	125	10,72	115	90	20,32	75	70	29,92	85	75
1,28	120	115	10,88	120	90	20,48	70	75	30,08	75	75
1,44	115	110	11,04	110	75	20,64	65	75	30,24	85	75
1,60	110	100	11,20	110	75	20,80	70	75	30,40	75	75
1,76	110	110	11,36	100	85	20,96	65	75	30,56	70	75
1,92	110	110	11,52	110	85	21,12	70	75	30,72	75	75
2,08	115	115	11,68	95	90	21,28	70	85	30,88	85	75
2,24	110	110	11,84	95	90	21,44	70	85	31,04	90	75
2,40	100	110	12,00	95	85	21,60	70	90	31,20	90	85
2,56	100	100	12,16	100	95	21,76	75	95	31,36	100	75
2,72	95	110	12,32	100	90	21,92	75	95	31,52	100	75
2,88	95	95	12,48	95	85	22,08	75	90	31,68	120	85
3,04	90	95	12,64	95	85	22,24	85	90	31,84	115	75
3,20	90	100	12,80	95	90	22,40	85	95	32,00	120	85
3,36	85	100	12,96	85	90	22,56	90	85	32,16	120	85
3,52	90	100	13,12	85	85	22,72	90	85	32,32	135	90
3,68	90	115	13,28	75	90	22,88	95	85	32,48	145	95
3,84	95	110	13,44	75	95	23,04	95	85	32,64	160	95
4,00	90	110	13,60	75	90	23,20	100	85	32,80	165	90
4,16	90	95	13,76	70	75	23,36	100	75	32,96	155	90
4,32	95	100	13,92	70	90	23,52	110	85	33,12	145	90
4,48	100	100	14,08	70	100	23,68	110	85	33,28	140	95
4,64	100	90	14,24	70	110	23,84	110	85	33,44	140	85
4,80	90	90	14,40	65	95	24,00	100	75	33,60	140	85
4,96	90	90	14,56	65	100	24,16	100	75	33,76	125	75
5,12	95	90	14,72	65	90	24,32	95	70	33,92	125	75
5,28	95	70	14,88	65	90	24,48	100	70	34,08	115	85
5,44	95	65	15,04	65	85	24,64	100	70	34,24	120	75
5,60	90	50	15,20	55	85	24,80	115	75	34,40	125	75
5,76	95	50	15,36	65	85	24,96	110	75	34,56	115	85
5,92	85	50	15,52	65	85	25,12	110	85	34,72	115	75
6,08	85	55	15,68	55	75	25,28	100	75	34,88	115	90
6,24	75	55	15,84	55	85	25,44	110	95	35,04	115	100
6,40	75	55	16,00	65	75	25,60	100	95	35,20	120	100
6,56	70	65	16,16	55	85	25,76	115	100	35,36	120	100
6,72	75	75	16,32	50	75	25,92	115	100	35,52	135	95
6,88	65	75	16,48	55	75	26,08	110	95	35,68	135	95
7,04	65	85	16,64	65	75	26,24	115	95	35,84	135	95
7,20	65	90	16,80	65	75	26,40	110	95	36,00	135	90
7,36	75	95	16,96	65	85	26,56	100	95	36,16	120	75
7,52	75	100	17,12	65	70	26,72	100	95	36,32	115	75
7,68	95	95	17,28	65	65	26,88	100	100	36,48	110	70
7,84	115	110	17,44	65	75	27,04	100	95	36,64	100	65
8,00	115	100	17,60	65	75	27,20	100	95	36,80	110	55
8,16	125	110	17,76	50	75	27,36	110	90	36,96	115	55
8,32	110	100	17,92	55	85	27,52	115	90	37,12	100	50
8,48	110	100	18,08	55	85	27,68	115	85	37,28	115	50
8,64	110	95	18,24	65	85	27,84	110	90	37,44	110	50
8,80	110	95	18,40	70	75	28,00	110	85	37,60	100	65
8,96	110	95	18,56	75	75	28,16	110	85	37,76	90	55
9,12	110	100	18,72	95	75	28,32	100	85	37,92	95	55
9,28	125	90	18,88	90	75	28,48	100	90	38,08	90	35
9,44	120	100	19,04	90	70	28,64	90	85	38,24	90	35

Table 3 (continued)

D	L	R	D	L	R	D	L	R	D	L	R
38,40	110	35	48,00	75	85	57,60	95	115	67,20	55	100
38,56	100	35	48,16	90	95	57,76	85	110	67,36	65	100
38,72	115	35	48,32	95	95	57,92	90	115	67,52	50	100
38,88	100	35	48,48	100	120	58,08	90	110	67,68	50	85
39,04	100	35	48,64	110	100	58,24	90	100	67,84	50	90
39,20	110	30	48,30	115	100	58,40	85	95	68,00	50	100
39,36	110	45	48,96	115	115	58,56	90	95	68,16	55	100
39,52	110	50	49,12	120	115	58,72	85	90	68,32	55	95
39,68	100	55	49,28	120	110	58,88	90	90	68,48	65	90
39,84	110	50	49,44	115	95	59,04	90	95	68,64	50	85
40,00	90	55	49,60	115	90	59,20	90	115	68,80	50	70
40,16	85	55	49,76	115	90	59,36	90	115	68,96	50	70
40,32	90	65	49,92	110	95	59,52	90	115	69,12	50	65
40,48	90	65	50,08	110	100	59,68	85	110	69,28	50	55
40,64	90	70	50,24	100	110	59,84	75	110	69,44	45	50
40,80	95	75	50,40	100	120	60,00	90	115	69,60	35	50
40,96	95	75	50,56	95	120	60,16	90	120	69,76	35	55
41,12	95	75	50,72	95	115	60,32	90	120	69,92	35	65
41,28	90	90	50,88	95	120	60,48	90	120	70,08	35	65
41,44	90	95	51,04	95	120	60,64	95	120	70,24	35	65
41,60	85	95	51,20	90	135	60,80	95	120	70,40	35	55
41,76	85	100	51,36	95	125	60,96	90	120	70,56	45	55
41,92	90	100	51,52	95	120	61,12	90	115	70,72	50	55
42,08	90	95	51,68	100	120	61,28	95	110	70,88	50	50
42,24	85	100	51,84	100	120	61,44	95	110	71,04	50	45
42,40	85	110	52,00	100	120	61,60	100	100	71,20	50	45
42,56	95	110	52,16	100	125	61,76	110	100	71,36	50	50
42,72	95	115	52,32	110	125	61,92	100	100	71,52	45	45
42,88	95	115	52,48	110	125	62,08	100	100	71,68	45	55
43,04	100	100	52,64	100	125	62,24	95	100	71,84	55	65
43,20	100	95	52,80	100	120	62,40	95	100	72,00	55	65
43,36	100	95	52,96	100	120	62,56	95	100	72,16	70	65
43,52	100	90	53,12	110	115	62,72	90	100	72,32	70	75
43,68	110	95	53,28	100	110	62,88	90	100	72,48	75	85
43,84	100	100	53,44	110	110	63,04	90	100	72,64	75	85
44,00	110	90	53,60	95	110	63,20	90	90	72,80	75	90
44,16	100	85	53,76	95	110	63,36	90	90	72,96	85	95
44,32	110	90	53,92	100	110	63,52	85	90	73,12	90	100
44,48	110	85	54,08	95	100	63,68	85	90	73,28	90	110
44,64	100	85	54,24	100	100	63,84	75	85	73,44	90	115
44,80	100	90	54,40	100	100	64,00	75	85	73,60	90	120
44,96	95	90	54,56	100	100	64,16	75	75	73,76	90	115
45,12	90	95	54,72	95	100	64,32	75	75	73,92	90	115
45,28	90	100	54,88	100	100	64,48	70	75	74,08	110	115
45,44	95	100	55,04	100	115	64,64	70	70	74,24	100	110
45,60	90	90	55,20	110	115	64,80	70	55	74,40	100	110
45,76	85	90	55,36	100	110	64,96	70	45	74,56	100	110
45,92	75	90	55,52	110	100	65,12	65	55	74,72	95	115
46,08	85	90	55,68	100	110	65,28	65	55	74,88	95	120
46,24	75	90	55,84	100	110	65,44	65	65	75,04	95	125
46,40	75	90	56,00	100	110	65,60	55	70	75,20	95	135
46,56	75	90	56,16	95	115	65,76	55	75	75,36	100	135
46,72	85	90	56,32	90	110	65,92	55	75	75,52	100	140
46,88	85	85	56,48	95	110	66,08	55	75	75,68	100	140
47,04	90	85	56,64	95	110	66,24	55	85	75,84	100	140
47,20	75	85	56,80	90	100	66,46	55	85	76,00	110	135
47,36	65	75	56,96	100	100	66,56	65	90	76,16	100	125
47,52	70	70	57,12	100	95	66,72	70	90	76,32	100	125
47,68	70	75	57,28	95	100	66,88	70	110	76,48	100	125
47,84	70	75	57,44	100	100	67,04	65	100	76,64	110	125

Table 3 (concluded)

D	L	R	D	L	R	D	L	R	D	L	R
76,80	115	125	83,20	100	120	89,60	100	120	96,00	100	125
76,96	120	125	83,36	100	125	89,76	100	135	96,16	95	125
77,12	120	125	83,52	100	120	89,92	110	140	96,32	95	125
77,28	120	135	83,68	100	135	90,08	110	135	96,48	95	125
77,44	110	125	83,84	95	140	90,24	110	140	96,64	110	125
77,60	100	125	84,00	100	135	90,40	100	145	96,80	95	120
77,76	120	135	84,16	110	140	90,56	100	155	96,96	95	120
77,92	120	125	84,32	110	140	90,72	110	155	97,12	95	120
78,03	120	125	84,48	110	140	90,88	110	155	97,28	95	110
78,24	115	125	84,64	110	140	91,04	100	155	97,44	100	115
78,40	115	120	84,80	120	155	91,20	110	155	97,60	110	120
78,56	115	120	84,96	115	145	91,36	110	160	97,76	110	115
78,72	110	120	85,12	115	155	91,52	115	160	97,92	100	115
78,88	100	120	85,28	120	160	91,68	110	155	98,08	95	115
79,04	100	120	85,44	120	165	91,84	115	155	98,24	100	115
79,20	95	120	85,60	120	160	92,00	115	140	98,40	95	115
79,36	95	120	85,76	125	165	92,16	115	155	98,52	100	115
79,52	95	125	85,92	135	160	92,32	120	155	98,72	100	110
79,68	95	125	86,08	135	160	92,48	125	145	98,88	110	100
79,84	100	120	86,24	125	155	92,64	125	155	99,04	95	95
80,00	95	125	86,40	125	155	92,80	125	155	99,20	90	100
80,16	95	125	86,56	120	145	92,96	120	155	99,36	90	100
80,32	95	125	86,72	120	145	93,12	120	145	99,52	75	110
80,48	100	120	86,98	110	140	93,28	120	145	99,68	75	115
80,64	100	125	87,04	110	140	93,44	115	145	99,84	75	115
80,80	100	125	87,20	110	140	93,60	120	145	100,00	75	110
80,96	110	125	87,36	110	140	93,76	115	140			
81,12	115	135	87,52	110	140	93,92	115	140			
81,28	110	140	87,68	100	135	94,08	115	140			
81,44	115	140	87,84	100	135	94,24	115	140			
81,60	110	140	88,00	100	135	94,40	115	140			
81,76	115	140	88,16	100	125	94,56	115	140			
81,92	110	140	88,32	110	120	94,72	115	135			
82,08	110	140	88,48	115	120	94,88	115	135			
82,24	110	135	88,64	110	120	95,04	110	135			
82,40	110	135	88,80	110	125	95,20	110	135			
82,56	100	125	88,96	100	125	95,36	110	135			
82,72	110	125	89,12	100	125	95,52	115	135			
82,88	110	125	89,28	95	125	95,68	100	140			
83,04	100	125	89,44	95	125	95,84	95	135			

Table 4 — Vibration test stand — Control signal ordinates for class 1 tractors

PS = set point (number); a = amplitude of the required value signal (10^{-4} m); t = measurement time (s)

PS	a	t	PS	a	t	PS	a	t	PS	a	t
0	0 000	0	65	— 0 211		129	0 025		193	0 342	
1	0 344	0	66	— 0 180		130	0 074		194	0 330	
2	0 333	0,04	67	— 0 182		131	0 106		195	0 265	
3	0 272	0,08	68	— 0 210		132	0 115		196	0 184	
4	0 192		69	— 0 222		133	0 090		197	0 118	
5	0 127		70	— 0 210		134	0 048		198	0 105	
6	0 115		71	— 0 186		135	0 038		199	0 128	
7	0 169		72	— 0 141		136	0 066		200	0 174	
8	0 243		73	— 0 088		137	0 116		201	0 215	8,0
9	0 298		74	— 0 033		138	0 180		202	0 229	
10	0 320		75	0 000	3,0	139	0 229		203	0 221	
11	0 270		76	0 001		140	0 212		204	0 199	
12	0 191		77	— 0 040		141	0 157		205	0 164	
13	0 124		78	— 0 098		142	0 097		206	0 162	
14	0 057		79	— 0 130		143	0 055		207	0 174	
15	0 027		80	— 0 115		144	0 073		208	0 210	
16	0 004		81	— 0 068		145	0 175		209	0 242	
17	— 0 013		82	— 0 036		146	0 287		210	0 270	
18	— 0 039		83	— 0 032		147	0 380		211	0 285	
19	— 0 055		84	— 0 050		148	0 406		212	0 285	
20	— 0 056		85	— 0 052		149	0 338		213	0 258	
21	— 0 059		86	— 0 039		150	0 238		214	0 223	
22	— 0 068		87	— 0 011		151	0 151	6,0	215	0 194	
23	— 0 104		88	0 014		152	0 080		216	0 165	
24	— 0 134		89	0 041		153	0 090		217	0 132	
25	— 0 147	1,0	90	0 054		154	0 146		218	0 106	
26	— 0 144		91	0 040		155	0 196		219	0 077	
27	— 0 143		92	0 006		156	0 230		220	0 065	
28	— 0 155		93	— 0 000		157	0 222		221	0 073	
29	— 0 179		94	0 025		158	0 184		222	0 099	
30	— 0 181		95	0 065		159	0 147		223	0 114	
31	— 0 155		96	0 076		160	0 115		224	0 111	
32	— 0 139		97	0 054		161	0 114		225	0 083	
33	— 0 141		98	— 0 016		162	0 140		226	0 026	9,0
34	— 0 170		99	— 0 066		163	0 198		227	— 0 028	
35	— 0 221		100	— 0 048		164	0 257		228	— 0 052	
36	— 0 259		101	— 0 011	4,0	165	0 281		229	— 0 069	
37	— 0 281		102	0 061		166	0 276		230	— 0 077	
38	— 0 268		103	0 131		167	0 236		231	— 0 067	
39	— 0 258		104	0 168		168	0 201		232	— 0 095	
40	— 0 285		105	0 161		169	0 167		233	— 0 128	
41	— 0 346		106	0 131		170	0 145		234	— 0 137	
42	— 0 437		107	0 086		171	0 135		235	— 0 144	
43	— 0 509		108	0 067		172	0 165		236	— 0 131	
44	— 0 547		109	0 088		173	0 242		237	— 0 155	
45	— 0 562		110	0 110		174	0 321		238	— 0 208	
46	— 0 550		111	0 148		175	0 399		239	— 0 266	
47	— 0 576		112	0 153		176	0 411	7,0	240	— 0 285	
48	— 0 622		113	0 139		177	0 373		241	— 0 276	
49	— 0 669		114	0 119		178	0 281		242	— 0 205	
50	— 0 689	2,0	115	0 099		179	0 179		243	— 0 110	
51	— 0 634		116	0 091		180	0 109		244	— 0 020	
52	— 0 542		117	0 078		181	0 094		245	0 041	
53	— 0 429		118	0 059		182	0 136		246	0 053	
54	— 0 314		119	0 062		183	0 206		247	0 020	
55	— 0 282		120	0 072		184	0 271		248	0 016	
56	— 0 308		121	0 122		185	0 267		249	0 041	
57	— 0 373		122	0 155		186	0 203		250	0 090	
58	— 0 446		123	0 191		187	0 091		251	0 136	10,0
59	— 0 469		124	0 184		188	0 009		252	0 151	
60	— 0 465		125	0 143		189	0 006		253	0 123	
61	— 0 417		126	0 087	5,0	190	0 074		254	0 070	
62	— 0 352		127	0 029		191	0 186		255	0 034	
63	— 0 262		128	0 010		192	0 280		256	— 0 001	

Table 4 (continued)

PS	<i>a</i>	<i>t</i>	PS	<i>a</i>	<i>t</i>	PS	<i>a</i>	<i>t</i>	PS	<i>a</i>	<i>t</i>
257	-0 010	11,0	321	-0 181	13,0	385	0 012	16,0	449	-0 031	18,0
258	-0 031		322	-0 045		386	0 103		450	-0 108	
259	-0 061		323	0 013		387	0 164		451	-0 157	
260	-0 086		324	-0 037		388	0 129		452	-0 155	
261	-0 104		325	-0 160		389	0 047		453	-0 081	
262	-0 103		326	-0 247		390	-0 055		454	-0 012	
263	-0 093		327	-0 258		391	-0 097		455	0 053	
264	-0 074		328	-0 187		392	-0 056		456	0 085	
265	-0 056		329	-0 069		393	0 043		457	0 054	
266	-0 039		330	0 044		394	0 162		458	0 002	
267	-0 000		331	0 078	14,0	395	0 220	17,0	459	0 026	19,0
268	0 033		332	0 061		396	0 205		460	-0 034	
269	0 067		333	-0 012		397	0 129		461	-0 014	
270	0 097		334	-0 102		398	0 053		462	0 031	
271	0 085		335	-0 127		399	0 022		463	0 061	
272	0 034		336	-0 103		400	0 052		464	0 098	
273	0 002		337	-0 045		401	0 114		465	0 123	
274	-0 050		338	0 039		402	0 175		466	0 103	
275	-0 080		339	0 094		403	0 191		467	0 078	
276	-0 096		340	0 107		404	0 172		468	0 046	
277	-0 121	12,0	341	0 058	15,0	405	0 138		469	0 042	
278	-0 116		342	-0 011		406	0 092		470	0 044	
279	-0 092		343	-0 078		407	0 052		471	0 072	
280	-0 060		344	-0 093		408	0 051		472	0 109	
281	-0 018		345	-0 068		409	0 025		473	0 133	
282	-0 011		346	-0 025		410	0 001		474	0 138	
283	-0 052		347	0 021		411	-0 026		475	0 125	
284	-0 143		348	0 008		412	-0 065		476	0 095	
285	-0 241		349	-0 016		413	-0 073		477	0 105	
286	-0 330		350	-0 038		414	-0 038		478	0 129	
287	-0 343	10,0	351	-0 024	14,0	415	-0 001	17,0	479	0 181	20,0
288	-0 298		352	0 041		416	0 029		480	0 206	
289	-0 235		353	0 135		417	0 030		481	0 200	
290	-0 203		354	0 196		418	-0 005		482	0 168	
291	-0 249		355	0 171		419	-0 045		483	0 140	
292	-0 356		356	0 053		420	-0 068		484	0 149	
293	-0 448		357	-0 111		421	-0 093		485	0 186	
294	-0 486		358	-0 265		422	-0 075		486	0 237	
295	-0 444		359	-0 348		423	-0 067		487	0 242	
296	-0 343		360	-0 336		424	-0 051		488	0 207	
297	-0 240	12,0	361	-0 258	15,0	425	-0 049		489	0 130	
298	-0 215		362	-0 155		426	-0 059		490	0 055	
299	-0 277		363	-0 059		427	-0 077		491	0 015	
300	-0 399		364	-0 056		428	-0 107		492	0 014	
301	-0 527		365	-0 123		429	-0 143		493	0 036	
302	-0 585		366	-0 187		430	-0 141		494	0 054	
303	-0 569		367	-0 218		431	-0 142		495	0 056	
304	-0 479		368	-0 136		432	-0 106		496	0 022	
305	-0 363		369	0 012		433	-0 080		497	-0 032	
306	-0 296		370	0 149		434	-0 050		498	-0 076	
307	-0 299	10,0	371	0 212	15,0	435	-0 030	17,0	499	-0 108	20,0
308	-0 374		372	0 153		436	-0 014		500	-0 099	
309	-0 466		373	0 021		437	-0 017		501	-0 029	
310	-0 528		374	-0 104		438	-0 031		502	0 051	
311	-0 520		375	-0 160		439	-0 037		503	0 138	
312	-0 432		376	-0 142		440	-0 068		504	0 199	
313	-0 320		377	-0 027		441	-0 113		505	0 213	
314	-0 244		378	0 099		442	-0 167		506	0 184	
315	-0 237		379	0 186		443	-0 203		507	0 139	
316	-0 310		380	0 174		444	-0 191		508	0 062	
317	-0 413	10,0	381	0 085	15,0	445	-0 135	17,0	509	0 027	20,0
318	-0 462		382	-0 031		446	-0 047		510	0 030	
319	-0 456		383	-0 086		447	0 028		511	0 067	
320	-0 351		384	-0 069		448	0 032		512	0 146	