
**Earth-moving machinery — Determination
of turning dimensions of wheeled machines**

*Engins de terrassement — Détermination des dimensions de braquage des
engins sur roues*



Foreword

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International Standard ISO 7457 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 7457:1983), which has been technically revised.

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Earth-moving machinery — Determination of turning dimensions of wheeled machines

1 Scope

This International Standard specifies methods for determining the turning radius, turning diameter, machine clearance diameter, and inside and outside tyre clearance diameters, described in the horizontal plan by a wheeled earth-moving machine with its equipment and attachments when executing a turn.

This International Standard is applicable to all types of steerable wheeled earth-moving machinery. It is applicable irrespective of the type of steering used.

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 5010:1992, *Earth-moving machinery — Rubber-tyred machines — Steering requirements*.

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 definitions given in ISO 6165 and the following apply.

3.1 turning centre: Point about which all turns of constant radius are made. (See figure 1.)

3.2 turning diameter: Diameter of the circular path described by the centre of tyre contact with the surface of the test site of the wheel describing the largest circle when the machine is executing its sharpest practicable turn under the test conditions described in clause 7, or by calculation for skid steer loaders. (See figure 1.)

3.3 turning radius: Half the turning diameter (as defined in 3.2). (See figure 1.)

3.4 machine clearance diameter: Diameter of the smallest circle which will enclose the outermost points of projection of the machine and its equipment and attachments when it executes its sharpest practical turn, under the conditions described in clause 7, or by calculation for skid steer loaders. (See figure 1.)

NOTE — As the machine clearance diameter is affected by the type of equipment and attachments fitted, the latter should be stated in the test report.

3.5 outer and inner tyre clearance diameter: Diameter of the circular path described by the outermost point of the loaded (lower) section of the tyre located on the vertical diameter of the outermost wheel and also that of the innermost point of the innermost wheel when the machine is executing its sharpest practical turn under the conditions described in clause 7. (See figures 1 and 2.)

See clause 6 for the state of loading of the machine.

3.6 non-stop 180° turn width: Minimum road width required for the tyre paths of the machine as it makes a 180° turn without stopping. (See figure 3.)

4 Test area

The test area shall be a compacted or paved surface affording good tyre adhesion, capable of displaying legible markings and resistant to defacement by turning machines. The test surface shall be visually flat, with no more than 3 % grade in any direction. The test area shall be large enough to accommodate the test machine as it negotiates the appropriate tests.

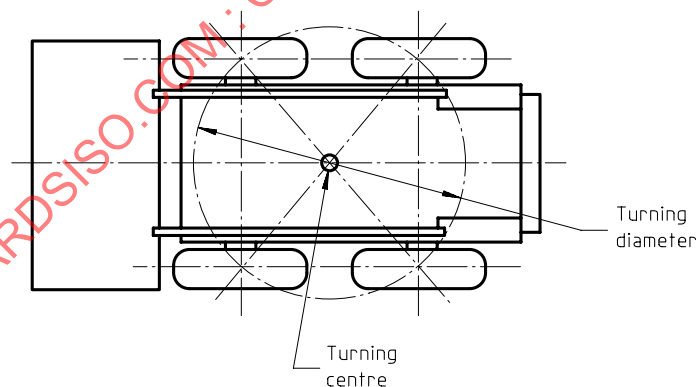
5 Test equipment

The following equipment or its equivalent shall be provided.

5.1 Steel tape, readable to 1 cm and of greater length than the diameter (or radii) to be measured.

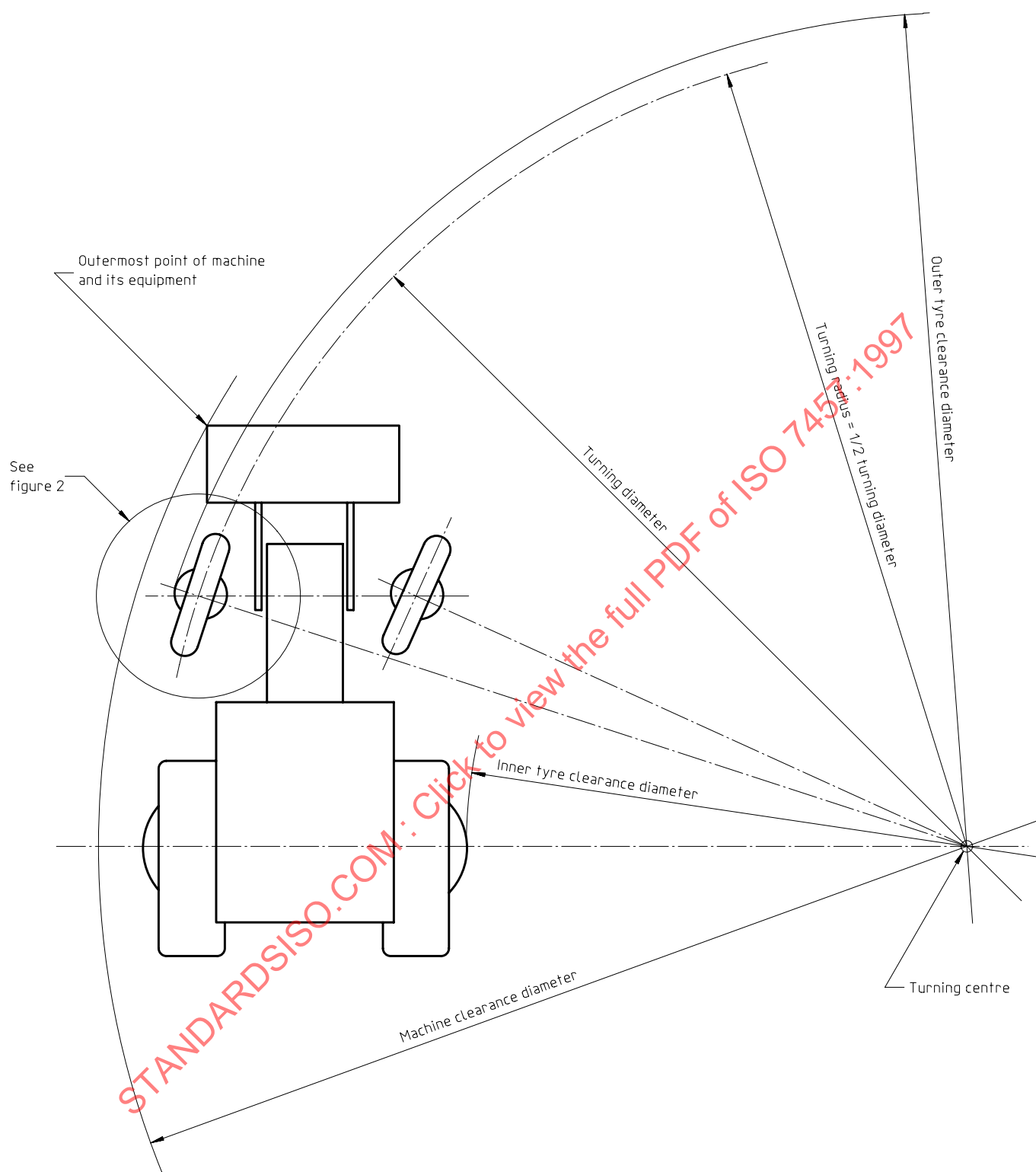
5.2 Plumb line, as required in the measurement of clearance diameter (or radii).

5.3 Apparatus for the measurement of pedal effort, as required for the execution of the test.



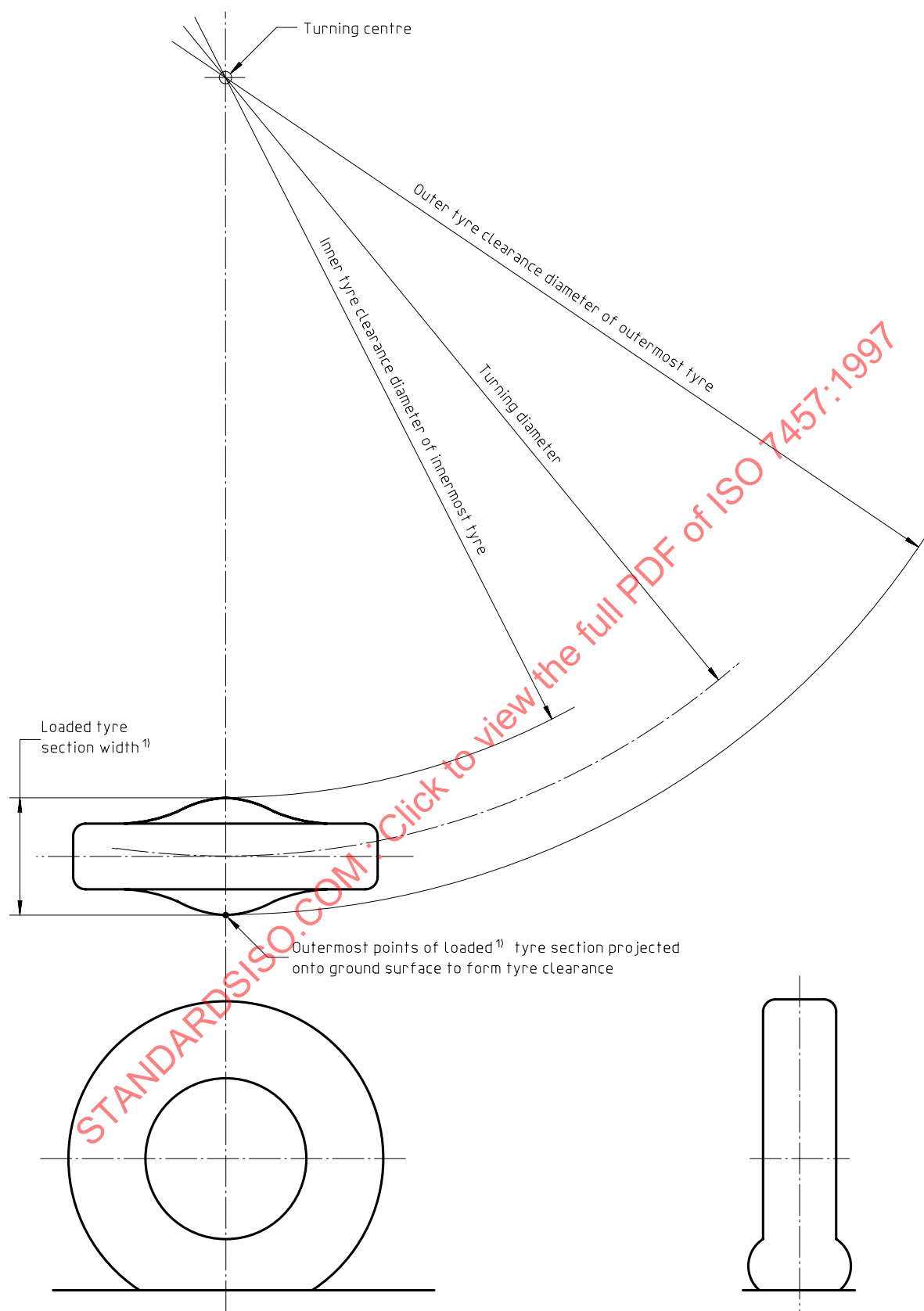
a) Skid steer machine

Figure 1 — Turning and related diameters



b) Other wheeled machines

Figure 1 — Turning and related diameters (*concluded*)



1) For state of loading refer to clause 6.

Figure 2 — Tyre clearance diameter

6 Preparation for test

6.1 The track of machines having adjustable track axes shall be measured and recorded. The tyre pressures shall be adjusted to those recommended by the manufacturer of the machine. If the manufacturer specifies various pressures or ballast according to ground conditions then those specified for a hard surface shall be used. The tyre sizes and pressures used shall be recorded.

6.2 The machine to be tested shall be in its operating condition, and the equipment and the attachments with which it is equipped and their positions shall be noted.

6.3 Movable equipment shall be in its recommended transport position.

6.4 Load-carrying equipment shall be laden or empty as specified in 6.4.1 to 6.4.3 (see ISO 5010).

6.4.1 Tractor-scrappers and dumpers shall be at the manufacturer's rated maximum gross mass and axle distribution, including the mass of the heaviest combination of equipment and attachments approved by the manufacturer, an operator of 75 kg and a full fuel tank.

6.4.2 Wheel loaders, wheel tractors, excavators and graders shall be at the manufacturer's empty machine mass, including the mass of the heaviest combination of equipment and attachments approved by the manufacturer which produce the greatest load on the steered axle(s), an operator of 75 kg and a full fuel tank.

6.4.3 All component parameters related to steering capability shall be within the manufacturer's specifications; i.e. tyre size and pressure, hydraulic fluid pressure and flow, warning device actuation point, etc.

7 Test procedure

See ISO 9248 for units and tolerances.

7.1 Right turn: Wheeled and articulated steer

7.1.1 Drive the machine forwards, at as low a speed as possible, on full right lock, that is, with the steering control element (e.g. steering wheel) turned to the right to its fullest extent, until the minimum diameter is being described.

7.1.2 Then continue to drive the machine forward, at as low a speed as possible, with the position of the steering control element unchanged, for a further complete turn but stopping at regular short intervals.

At appropriate stops, make projections to the surface of the test site with the plumb line and mark the test surface appropriately. The projections shall be made, as required, from the following.

- a) The outermost point of the loaded (lower) section of the tyre on the vertical diameter of the outermost wheel: this point shall be used to determine the outer tyre clearance diameter.

NOTE — Should the wheel at which the measurement is being made lean outwards to a significant extent it may be advisable to determine, in addition, the outer tyre clearance diameter or radius by projecting down from the upper section of the tyre on the vertical diameter of the outermost wheel.

- b) The innermost point of the loaded (lower) section of the tyre on the vertical diameter of the innermost wheel: this point shall be used to determine the inner tyre clearance diameter.

NOTE — Any inward wheel lean should again be taken into account.

- c) The outermost point, that is, the point describing the largest circle of the machine and its equipment: this point shall be used to determine the machine clearance diameter.

7.1.3 Measure the outer tyre clearance diameter at not less than three points spaced approximately equally around the circle. The average of the three or more measurements shall be calculated and noted, and the width of the outermost tyre, measured across the loaded section of the tyre shall be recorded as the turning diameter - right. Alternatively and optionally the resulting dimension may be halved and recorded as turning radius - right.

7.1.4 Measure the inner tyre clearance diameter at not less than three points spaced approximately equally around the circle. The average of the three or more measurements shall be calculated and noted.

7.1.5 Measure the diameter of the machine clearance circle at not less than three points spaced approximately equally around the circle. The average of the three or more measurements shall be calculated and noted.

The machine clearance diameter may also be determined by adding twice the radial distance between the point projected for the machine clearance diameter and the outer tyre clearance circle.

7.1.6 As an alternative to the above method of measurement of the diameters, the latter may be determined by calculation, using the distances between three approximately equally spaced points; see figure 4, using the relationship shown.

7.1.7 For the right non-stop 180° turn width (see figure 3), proceed as follows.

- a) The machine shall be in a non-articulated or non-steered position. Mark a line to the left of the machine parallel to the centreline of the machine.
- b) Turn the steering wheel to the full right turn angle while the machine is in a stationary position. Then drive the machine forward while still steering full right. A 270° turn shall be completed, while stopping at regular intervals to mark the tyre clearance circle as in 7.1.2. At the beginning of the turn, the tyre clearance circle shall be marked for whichever tyre is closest to the line described in a).
- c) Measure the perpendicular distances from the line described in a) to the near side and the far side of the tyre clearance circle. The difference between the two measurements shall be the right non-stop 180° turn width.

7.1.8 Any other methods for determining the turning diameters which give equal accuracy may be employed.

7.1.9 Each test shall be conducted three times and the average of the turning dimensions obtained shall be recorded in the test results.

7.2 Left turn: Wheeled and articulated steer

Repeat the procedure described in 7.1 but with the machine driven on full left lock instead of on full right lock and record the results as left turn results instead of right turn.

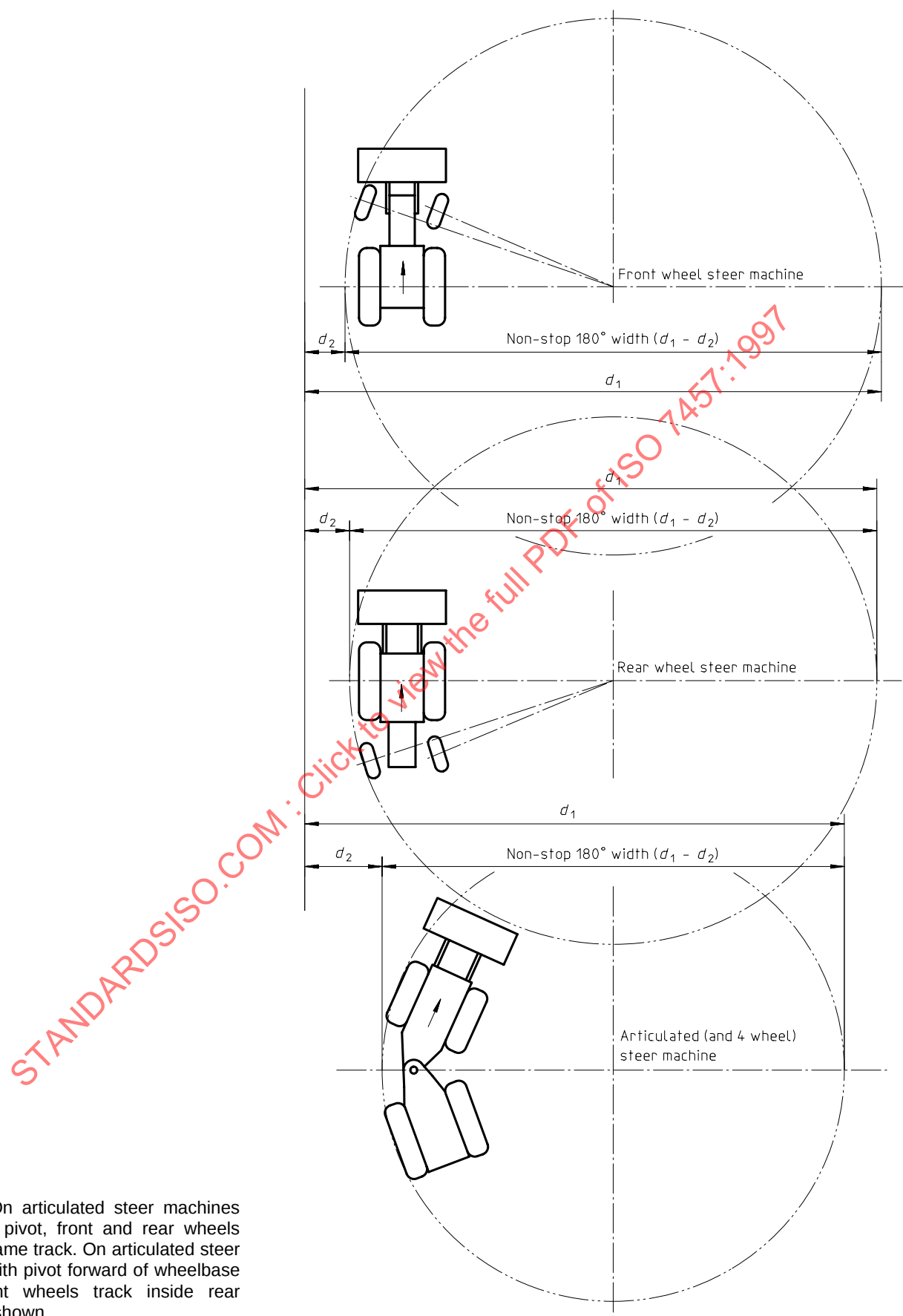
7.3 Skid steer

Turning centre, machine clearance diameter and outer tyre clearance diameter are determined by calculation from machine drawings (see figure 1). Definitions 3.5 and 3.6 are not applicable.

8 Additional optional test procedure for machines whose left- and right-hand brakes on the non-steered wheels can be applied separately

Repeat the test procedure described in clause 7 with the inside non-steered wheel brake applied with a pedal effort of 450 N or with the effort necessary to lock the wheel if this is less than 450 N.

The results obtained shall be reported as "with brakes". The results from the test procedure described in clause 7 shall be reported as "without brakes".



NOTE — On articulated steer machines with centre pivot, front and rear wheels follow the same track. On articulated steer machines with pivot forward of wheelbase centre, front wheels track inside rear wheels, as shown.

Figure 3 — Non-stop 180° turn width

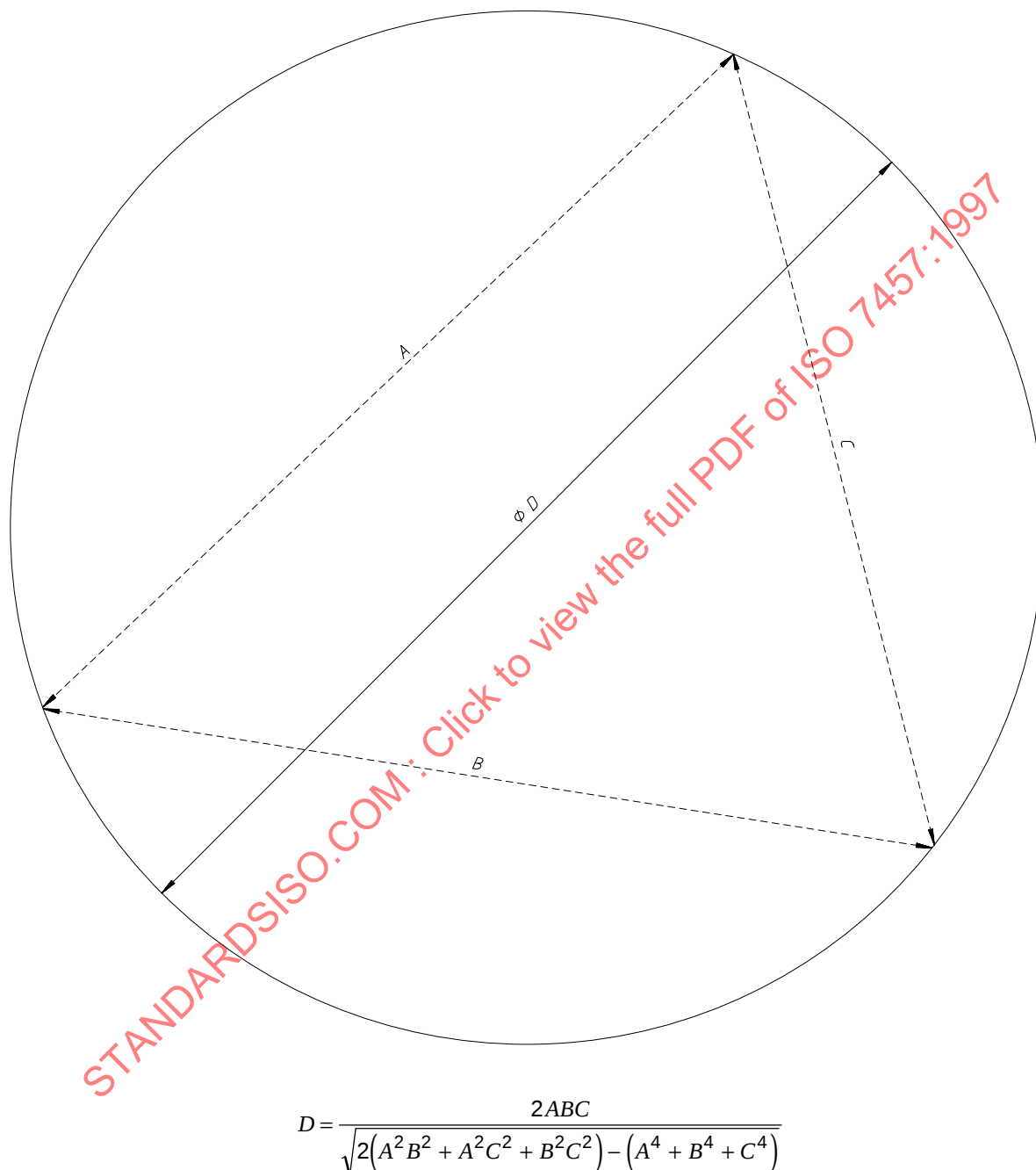


Figure 4 — Calculation of diameters from measurements between three approximately equally spaced circumference points

9 Test results

The following information shall be recorded in the test report:

- a) name of manufacturer;
- b) type of machine;
- c) model, serial number;
- d) equipment fitted and its position;
- e) tyre sizes:
 - front left..... front right
 - rear left..... rear right
- f) tyre pressure, in kilopascals:
 - front left..... front right
 - rear left..... rear right

- g) the track width, in metres, of all axles;
- h) outer tyre clearance diameter, in metres:
 - 1) right turn without brakes;
 - 2) left turn without brakes;

and, where applicable:

- 3) right turn with brakes;
- 4) left turn with brakes;
- i) inner tyre clearance diameter, in metres:
 - 1) right turn without brakes;
 - 2) left turn without brakes;

and, where applicable:

- 3) right turn with brakes;
- 4) left turn with brakes;
- j) turning diameter, in metres:
 - 1) right turn without brakes;
 - 2) left turn without brakes;

and, where applicable:

- 3) right turn with brakes;
- 4) left turn with brakes;