
International Standard



7457

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

Engins de terrassement — Mesurage des dimensions de braquage des engins à roues

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

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 7457 was developed by Technical Committee ISO/TC 127, *Earth-moving machinery*, and was circulated to the member bodies in December 1981.

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

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

No member body expressed disapproval of the document.

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

1 Scope

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

2 Field of application

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

3 References

ISO 5010, *Earth-moving machinery — Steering capability — Rubber-tyred machines*.¹⁾

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

4 Definitions

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

4.1 turning centre: The point about which all turns of constant radius are made. (See figure 1.)

4.2 turning diameter: The 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 8. (See figure 1.)

4.3 turning radius: Turning radius = $1/2 \times$ turning diameter (as defined in 4.2). (See figure 1.)

4.4 machine clearance diameter: The diameter of the smallest circle which will enclose the outermost points of pro-

jection of the machine and its equipment when it executes its sharpest practical turn, under the conditions described in clause 8. (See figure 1.)

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

4.5 outer and inner tyre clearance diameter: The 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 8. (See figure 2.)

NOTE — The criteria for the state of loading of the machine as given in clause 7 shall be observed.

4.6 non-stop 180° turn width: The minimum road width required for the tyre paths of the machine as it makes a 180° turn without stopping.

5 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.

6 Test equipment

The following equipment or its equivalent shall be provided.

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

6.2 A plumb line, as required in the measurement of clearance diameter (or radii).

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

1) At present at the stage of draft.

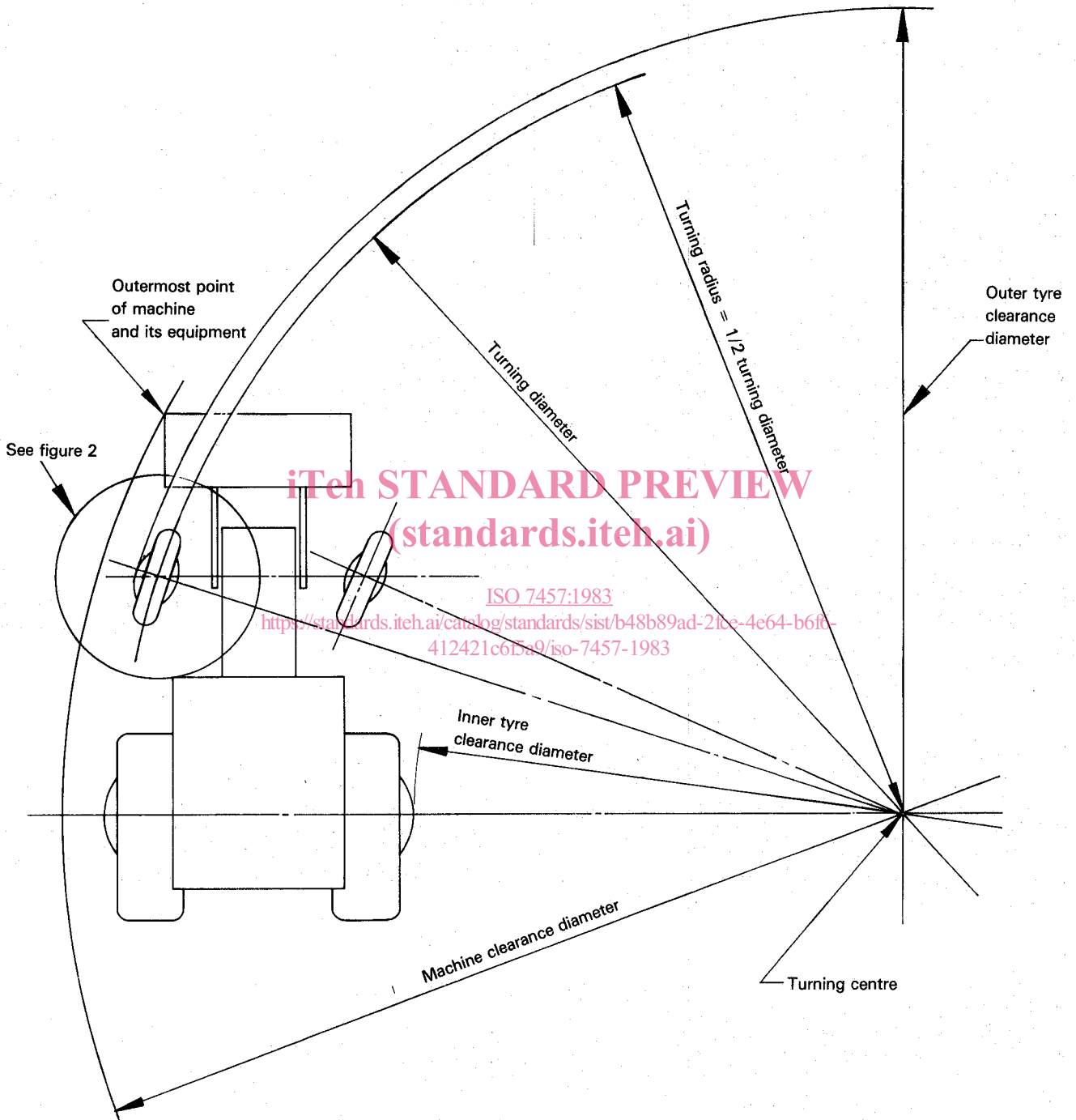
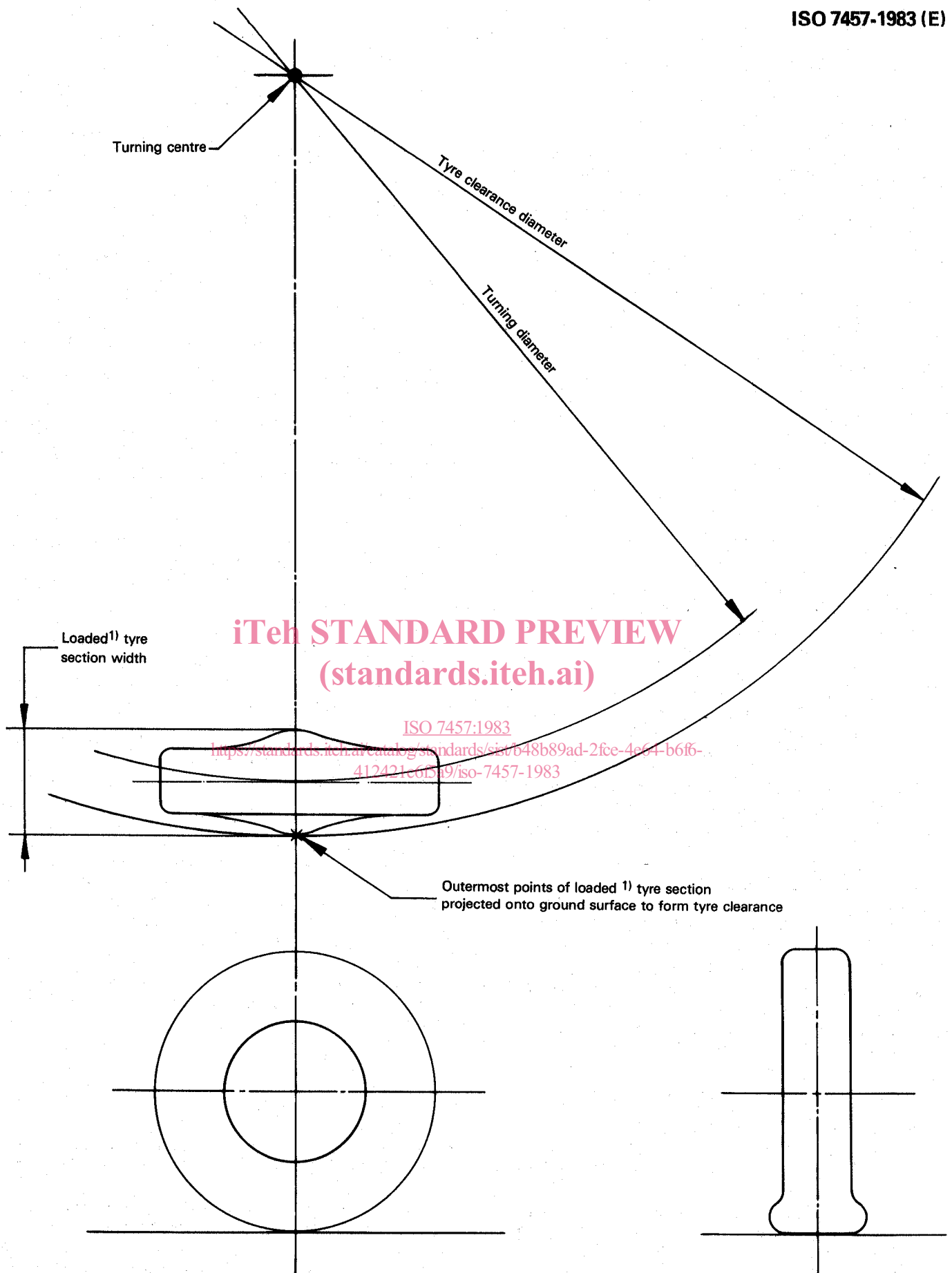


Figure 1 — Turning and related diameters



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Figure 2 – Tyre clearance diameter

1) For state of loading refer to clause 7.

7 Preparation for test

The track of machines having adjustable track axles 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.

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

Movable equipment shall be in its recommended transport position.

Load-carrying equipment shall be laden or empty as specified in clause 9 of ISO 5010.¹⁾

8 Test procedure

8.1 Right turn

8.1.1 The machine shall be driven forwards, at as low a speed as possible, on full right lock, that is, with the steering control element (for example, steering wheel) turned to the right to its fullest extent, until the minimum diameter is being described.

8.1.2 The machine shall then continue to be driven 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 projections to the surface of the test site shall be made with the plumb line and the test surface appropriately marked. The projections shall be made, as required, from :

- 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.

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.

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.

8.1.3 The outer tyre clearance diameter shall be measured 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 subtracted from it. The resulting dimension shall be recorded as the turning diameter—right. Alternatively and optionally, the resulting dimension shall be halved and recorded as turning radius—right.

8.1.4 The inner tyre clearance diameter shall be measured 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.

8.1.5 The diameter of the machine clearance circle shall be measured 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 can also be determined by adding twice the radial distance between the point projected for the machine clearance diameter and the outer tyre clearance circle.

8.1.6 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.

8.1.7 Right non-stop 180° turn width (see figure 3)

- a) The machine shall be in a non-articulated or non-steered position. A line shall be marked to the left of the machine parallel to the centreline of the machine.

1) For information, clause 9 of ISO 5010 is repeated here :

9 Machine specifications for test

9.1 Tractor-scrappers and dumpers that will not travel on public roads are to 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.

9.2 Tractor-scrappers and dumpers that will travel on public roads are to be at the manufacturer's rated maximum gross mass and axle distribution as noted in 9.1 unless that exceeds the legal limit for the public road, in which case the tests shall be concluded at the maximum allowable mass and axle loadings for the public road.

9.3 Wheel loaders, wheel tractors, excavators and graders that will or will not travel on public roads are to 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.

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

- b) The steering wheel shall be turned to the full right turn angle while in a stationary position. The machine shall then be driven 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 8.1.2. 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) The perpendicular distances from the line described in a) to the near side and the far side of the tyre clearance circle shall be measured. The difference between the two measurements shall be the right non-stop 180° turn width.

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

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

8.2 Left turn

The procedure described in 8.1 shall be repeated but with the machine driven on full left lock instead of on full right lock and the results recorded as left turn results instead of right turn.

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

The test procedure described in clause 8 shall be repeated 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 8 shall be reported as "without brakes".

10 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 megapascals :

front left	front right
rear left	rear right

- g) the track width, in millimetres, 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;

- j) 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;

- k) 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;

- m) machine 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;

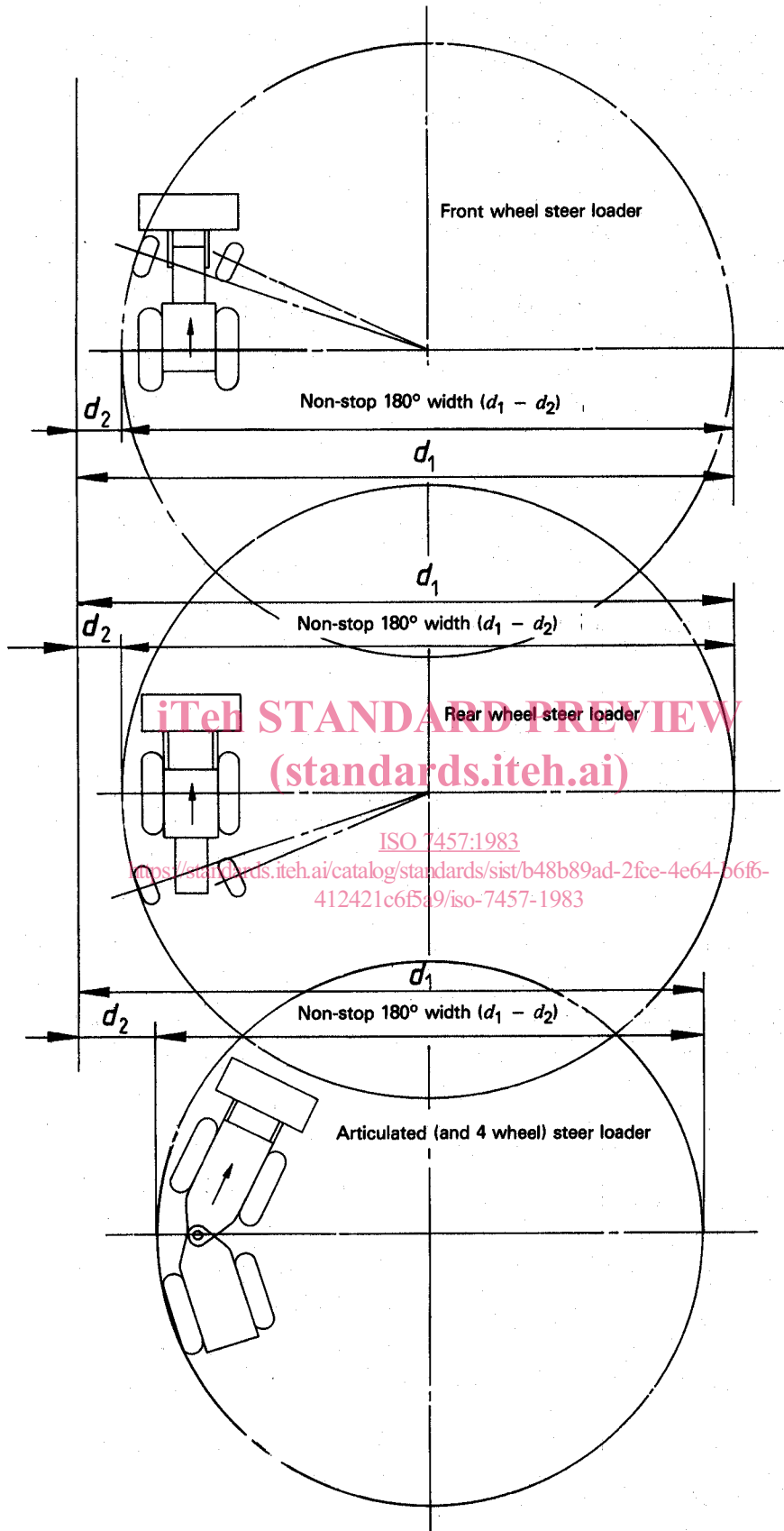
- n) non-stop 180° turn width, in metres :

- 1) right turn without brakes;
- 2) left turn without brakes;

and where applicable :

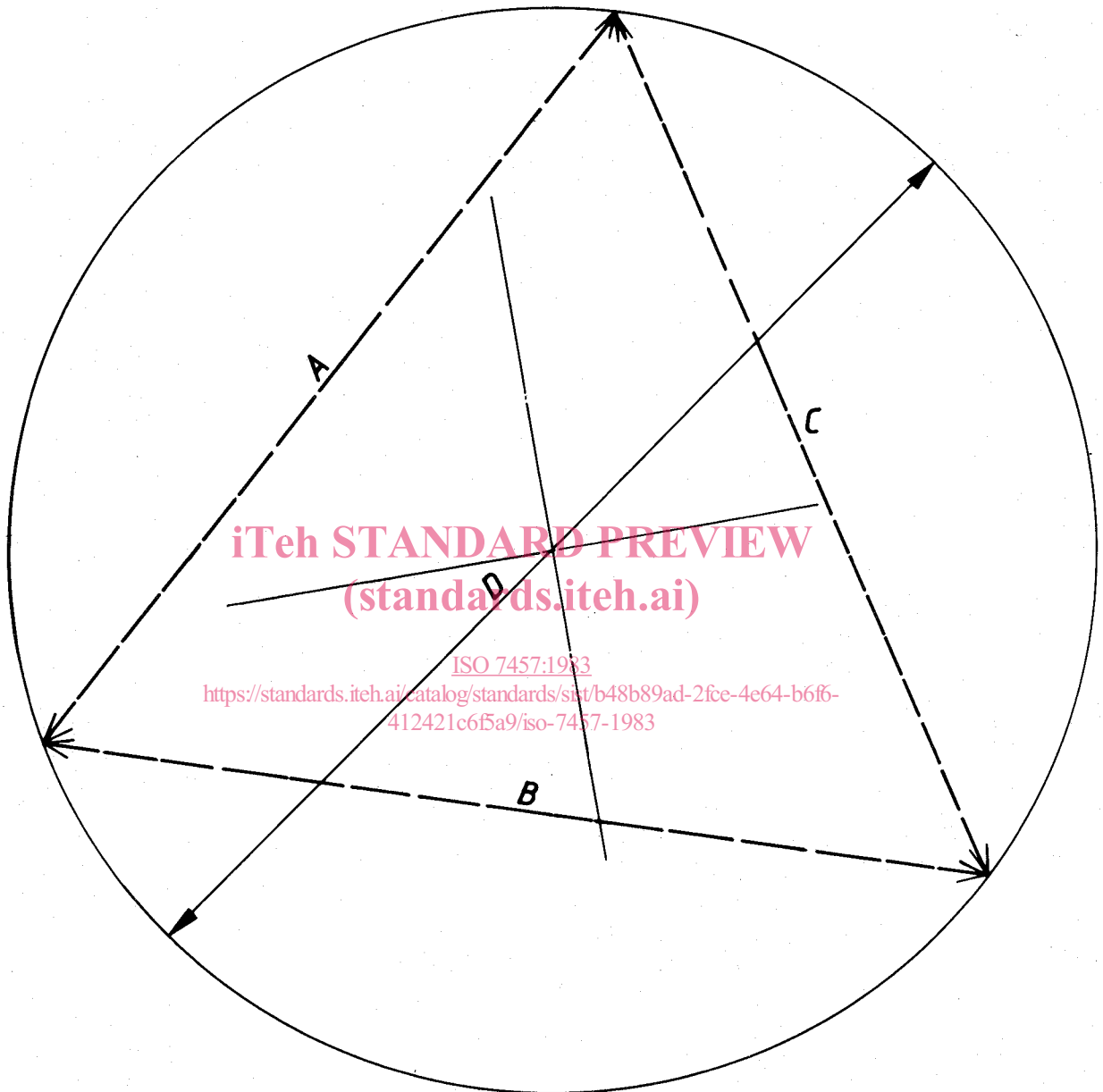
- 3) right turn with brakes;
- 4) left turn with brakes.

NOTE — All linear dimensions shall be reported in metres, correct to two decimal places.



NOTE — On articulated steer loaders with centre pivot, front and rear wheels follow the same track.
On articulated steer loaders with pivot forward of wheel base centre, front wheels track inside rear wheels (as shown).

Figure 3 — Non-stop 180° turn width



$$D = \frac{2ABC}{\sqrt{2(A^2B^2 + A^2C^2 + B^2C^2) - (A^4 + B^4 + C^4)}}$$

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