

Indian Standard

AGRICULTURAL TRACTORS — BRAKING PERFORMANCE — METHOD OF TEST

(First Revision)

1 SCOPE

This standard specifies method for measuring the performance for service brakes and parking brakes of agricultural tractors.

2 TERMINOLOGY

2.1 Agricultural Tractor

A self-propelled wheeled vehicle having two axles, of a track-laying or semi-track-laying machines, more particularly designed to pull, push, carry and operate implements and machines used for agricultural work.

2.2 Ballasted Tractor

2.2.1 Ballasted Tractor (for Stopping Test)

A tractor so ballasted as to attain its maximum mass as recommended by the manufacturer for road work.

2.2.2 Ballasted Tractor (for Brake Holding Capacity Tests)

A tractor so ballasted as to attain its maximum mass as recommended by the manufacturer for developing maximum drawbar pull during drawbar performance tests.

2.3 Braking Device

A combination of parts, the function of which is to reduce the speed of moving tractor or to bring it to a stop, or to keep it stationary, if already stopped. The braking device consists of the braking device control, the braking device transmission and the brakes themselves.

2.3.1 Braking Device Control

The part of the braking device actuated directly by the operator to supply to the braking device transmission the energy required for operating the brakes.

2.3.2 Braking Device Transmission

The combination of components connecting the braking device control and the brakes.

2.3.3 Brake

The element of the braking device in which the forces opposed to the motion or tendency to motion are produced.

2.4 Service Braking Device

A device, the function of which is to reduce the speed of a moving tractor or to bring it to a stop.

2.5 Parking Braking Device

Assembly of parts by means of which the tractor can be maintained at rest even on a slope and in the absence of the driver.

2.6 Spring Brake

A braking device in which the energy required for braking is supplied by one or more springs acting at an energy accumulator.

2.7 Brake Control Input Force

The sum of all forces applied by the operator to the braking device control, measured at the point of load application, in a line from the point of application through the operator's hip joint for foot pedal controls, or through the arm to shoulder joint for hand-operated controls.

2.8 Maximum Axle Load

Technically permissible axle load for each axle stated by the manufacturer as in the case for the road work for stopping distance tests or as ballasted during the drawbar tests for brake holding capability tests.

2.9 Maximum Mass

Technically permissible maximum mass of the tractor stated by the manufacturer as in the case for the road work for stopping distance tests or as ballasted during the drawbar tests for brake holding capability tests.

2.10 Maximum Design Speed

The maximum attainable speed of unballasted tractor, where the engine speed governor has been set at the maximum high idle speed rating recommended by the manufacturer.

NOTE — Maximum design speed and maximum mass should correlate to the maximum permissible tyre speed as approved by Tyre and Rim Manufacturers' Association.

2.11 Mean Deceleration

The average deceleration calculated from initial speed and stopping distance as defined by the following formula:

$$F = \frac{V^2}{2S}$$

where

- F* = mean deceleration, m/s/s;
- V* = initial speed, m/s; and
- S* = stopping distance, m.

2.12 Measured Deceleration

The mean of the sustained deceleration recorded, for example on a decelerometer.

2.13 Stopping Distance

The distance travelled by a tractor between the point at which the first movement of the braking device control is made, and the point at which the tractor comes to a stop.

2.14 Unballasted Mass

Mass of unballasted tractor.

2.15 Unballasted Tractor

A tractor in running order fitted with all standard accessories and complete with fuel, coolant and lubricant and carrying a 75 kg mass on the driver's seat but without any optional accessory or load.

2.16 Ballasted Mass (for Stopping Tests)

Mass of tractor with appropriate ballast weights suggested by the manufacturer for transport work.

2.17 Ballasted Mass (for Brake Holding Capability Tests)

Maximum permissible weight recommended by the manufacturer for conducting maximum drawbar pull tests on the tractor.

3 GENERAL REQUIREMENTS

3.1 The performance of service braking devices shall be based on the mean deceleration calculated over the stopping distance.

3.2 The performance of parking braking devices shall be based on the ability to hold the tractor stationary on up and down slopes.

3.3 The tests shall be carried out on an horizontal concrete track giving a good grip for tyres; the surface shall be dry and clean. The test surface shall not have a longitudinal slope exceeding one percent, nor a side slope exceeding 3 percent.

3.4 The settings and condition of the brake components shall conform to the manufacturer's specifications.

3.5 The inflation pressure shall be the pressure recommended by the manufacturer for the road work.

3.6 The tractor's weight shall be as prescribed for each type of test and be specified in the test report.

3.7 The test shall be performed when the wind velocity is less than 5 m/s.

3.8 The performance of service braking device shall be measured without locking of the braked wheels until the tractor has come to stop.

3.9 The braked axle(s) shall be equipped with the largest diameter tyres specified by the manufacturer for normal agricultural work.

3.10 The measuring accuracy shall be such that the following items shall have the tolerances within the limits shown against each:

	Percent
a) Travel speed	± 3
b) Tractor mass	± 3
c) Deceleration	± 3
d) Stopping distance	± 1
e) Brake control input force	± 5
f) Tyre inflation pressure	± 5
g) Brake system fluid (gas) pressure	± 5

4 DETERMINATION OF SERVICE BRAKING DEVICE PERFORMANCE

4.1 Cold Test

4.1.1 Test Conditions

4.1.1.1 The brakes shall be cold at the beginning of the test. A brake is deemed to be cold, if any, of the following conditions are met:

- a) The temperature measured on the disc or on the outside of drum is below 100°C;
- b) In case of totally enclosed brakes, including oil immersed brakes, the temperature measured on the outside of the housing is below 50°C; and
- c) The brakes have not been actuated in previous one hour.

4.1.1.2 During the braking test, an unbraked axle, when capable of being declutched, shall not be connected with a braked axle.

4.1.2 Procedure

With the tractor travelling at its maximum attainable speed or 35 km/h, whichever is less, a measured force shall be applied to the control of

the service braking device and the resulting stopping distance measured. Where possible, the engine shall be declutched from the driven axles when applying the brakes. If it is not possible to declutch the engine from the driven axles, the engine speed control shall be moved to the minimum engine speed position when applying the brakes.

4.1.2.1 The stopping distances for a series of values of force applied to the control of the braking device shall be recorded and the corresponding values of mean deceleration shall be calculated from the formula given under 2.11. Stopping distances for initial speeds faster than 25 km/h are to be corrected by the formula:

$$S_{25} = \frac{48.2 S}{V^2}$$

where S_{25} is the corrected stopping distance in m, S is the observed stopping distance in m, and V is the measured initial speed in m/s.

4.1.2.2 Sufficient values to establish the relationship between mean deceleration and force applied to the control of the braking device from zero force to, if possible, the force at which the braked wheels lock, but at least up to a force of 600 N, if the braked wheels do not lock, shall be obtained.

4.1.2.3 The relationship between mean deceleration and force applied to the control of the braking device, and the corrected stopping distance shall be reported either in the form of a graph or a table of corresponding values.

4.1.2.4 Deviation of the tractor from its original course and any abnormal vibration during braking shall also be reported.

4.2 Brake Fade Test (Hot Test)

4.2.1 Procedure for Heating the Brakes

The ballasted tractor shall be towed for 1 km at 80 ± 5 percent of the speed specified under 4.1.2 or 20 km/h whichever is less with, if possible, the engine disengaged from the driving axles and the service brake applied such that the towing force is 10 percent of the maximum tractor weight.

4.2.2 If the maximum attainable speed of the tractor is such that a towing vehicle of sufficient capacity is not available to carry out the test as described above, the tractor shall be driven at 80 ± 5 percent of its maximum attainable speed. Without disengaging the engine from the driving

axles, the engine speed control shall be moved to the minimum engine speed position and the service brake applied so that the tractor decelerates at 60 percent of the maximum deceleration measured in the cold brake test until its speed has fallen to half the initial speed. It shall then be accelerated as rapidly as possible to the initial speed and this speed allowed to stabilize for at least 10 seconds. At the end of this period or 60 seconds after the initial brake application, whichever is the longer, the brake shall be reapplied with the same force. The cycle shall be repeated until the brakes have been applied a total of 20 times.

4.2.3 Immediately after heating the brakes by whichever of the above two procedures are appropriate, the test under 4.1.2 shall be repeated without allowing the brakes to cool and committing measurements with the tractor unballasted.

4.2.4 The report shall state which method of heating the brakes was used.

5 PARKING BRAKING DEVICE TEST

5.1 The force which is necessary to apply at the control of the parking braking device to hold the tractor stationary when facing up and down at 18 percent gradient, when ballasted to its maximum weight, as in case of drawbar performance test, shall be measured.

5.2 The force which is necessary to apply at the control of the parking braking device to hold a vehicle combination comprising the unballasted tractor and an unbraked trailer of the same mass as of tractor or 3 tonnes whichever is less, stationary when facing up and down a 12 percent gradient shall also be measured.

5.3 The measurements may be made either on a sloping road or by applying a pull to the tractor on a level road/track with the equivalent gravitational force applied constantly and continuously for both forward and reverse directions.

5.4 If it is necessary to actuate the parking braking device control several times in order to hold the tractor stationary, the maximum force applied shall be recorded.

6 TEST REPORT

6.1 The data shall be recorded in accordance with the proforma given in Annex A.

ANNEX A
(Clause 6.1)

SPECIMEN TEST REPORT

- | | |
|---|---|
| <p>1. Tractor manufacturer's name and address</p> <p>2. Tractor specification:</p> <p>a) Make</p> <p>b) Model</p> <p>c) Type</p> <p>d) Serial No.</p> <p>e) Unballasted mass, kg</p> <p>f) Maximum mass for stopping distance test, kg</p> <p>g) Mass borne by each axle (as tested), kg</p> <p>h) Maximum mass technically permissible on each axle, kg</p> <p>j) Maximum design speed, km/h</p> | <p>3. Size and ply rating of tyres</p> <p>4. Inflation pressure</p> <p>a) Front, kPa</p> <p>b) Rear, kPa</p> <p>5. Braking device specification</p> <p>a) Make</p> <p>b) Type</p> <p>6. Service brake test result</p> <p>a) Ambient temperature Deg C</p> <p>b) Cold test results</p> <p>1) Speed before application of brake, km/h</p> <p>2) Test data</p> |
|---|---|

	Braking device control force, N
Ballasted	Mean deceleration, m/s/s
	Stopping distance, m*
	Braking device control force, N
Unballasted	Mean deceleration m/s/s
	Stopping distance, m*

* Corrected values as per formula given in 4.1.2.1.

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|--|---|
| <p>c) Brake fade test (hot test) results</p> <p>1) Speed before application of brake, m/s</p> <p>2) Braking device control force, N</p> <p>3) Mean deceleration m/s/s</p> <p>4) Measured deceleration m/s/s</p> <p>5) Stopping distance, m</p> <p>6) Stopping distance (corrected value), m</p> <p>d) Maximum deviation of tractor from its original course, m</p> | <p>e) Abnormal variation</p> <p>f) The brakes were heated by (state method)</p> <p>7. Brake Holding Test</p> <p>Total Tractor Mass, kg</p> <p>Mass at Front Axle, kg</p> <p>Mass at Rear Axle, kg</p> |
|--|---|

18 percent slope	12 percent slope with trailer of tonnes				
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Braking device Control force, N					