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भारतीय मानक *मसौदा*

कृषि ट्रैक्टर — परीक्षण प्रक्रियाएँ — विद्युत परीक्षण ड्रॉबार के लिए -

(आइ एस 12226 *का दूसरा पुनरीक्षण*)

Draft **Indian Standard**

AGRICULTURAL TRACTORS — TEST PROCEDURES — POWER TESTS FOR DRAWBAR

(*Second Revision of* IS 12226)

ICS 65.060.10

Agricultural Machinery and Equipment Sectional Committee, FAD 11	Last date for Comments: **27 October 2025**

FOREWORD

(*Formal clause will be added later*)

Drawbar is one of the important power outlet in agricultural tractors. It is the amount of useful power available at the drawbar for pulling implements, trailers, or other loads. In order to have a uniform practice in evaluating the drawbar power a need was felt to formulate this standard. This standard was first published in 1987. Subsequently, the standard was revised in 1995 deriving assistance from ISO 789-9: 1990 'Agricultural tractor — Test procedures — Power test for drawbar'.

The second revision of the standard incorporates the following modifications:

a) Definitions of wheelbase, rated engine speed, specific fuel consumption, and dynamic radius index have been incorporated directly into the standard, which were earlier referenced from IS 5994 : 1987 'Test code for agriculture tractors'.
b) Following test requirements have been included:
    i) Throttle lever shall be fully open during all tests unless specified otherwise.
    ii) In case advance gearbox technology used, the tests shall be conducted in consultation with manufacturer.
    iii) Upper limit of atmospheric temperature of 35 °C has been provided rather than range (25 ± 10 °C) for conducting tests.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft **Indian Standard**

AGRICULTURAL TRACTORS — TEST PROCEDURES — POWER TESTS FOR DRAWBAR

(*Second Revision of* IS 12226)

1 SCOPE

1.1 This standard specifies test procedures for determining the power available at the drawbar on agricultural tractors of the wheeled, track-laying or semi-track-laying type.

1.1.1 The statement of power rating of the drawbar is specified in **6.5**.

2 REFERENCES

The standards given in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMS & DEFINITIONS

For the purpose of this standard, the following definitions shall apply.

3.1 Wheelbase — Distance at ground level between two vertical planes passing through the centres of the front wheels and the rear wheels with tractor and wheels in the same straight ahead position.

3.2 Tractor Mass

3.2.1 *Basic Tractor Mass* (*Unladen Tractor)* — Mass of the tractor in working order with full tanks and radiators. Optional front and rear weights (ballast), tyre ballast, tractor operator, mounted implements, mounted equipment or any specialized components are not included.

3.2.2 *Ballasted Tractor Mass* (*Laden Tractor)* — Mass of the tractor ballasted according to **5.7** for the performance test given in **6**.

3.3 Rated Engine Speed — The speed of the engine in rev/min, specified by the manufacturer for continuous operation at full load.

3.4 Drawbar Power

Power measured at the drawbar, which can be sustained for at least 20s, or the time needed to cover a distance of at least 20m, whichever is longer.

3.5 Maximum Drawbar Pull

Maximum horizontal drawbar pull at a drawbar hitch point recommended by the manufacturer and complying with the limitations set forth in **5.7**, **6.1** and **6.2** which a tractor can sustain in its longitudinal axis.

3.6 Specific Fuel Consumption — The mass of the fuel consumed per unit of work.

3.7 Dynamic Radius Index/Type Roiling Radius — The effective radius corresponding to the average distance travelled by the tractor in one rotation of wheels (that is, this distance divided by 2л). When the tractor is driven without drawbar load at a speed of approximately 2 km/h.

4 MEASUREMENT UNITS AND PERMISSIBLE TOLERANCES

For the purpose of this standard, the measurement units and permissible tolerances as given in **5** of IS 5994 shall apply.

5 GENERAL REQUIREMENTS

5.1 Specification

The tractor tested shall conform to the specification in the test report (*see* Annex B) and shall be used in accordance with the manufacturer's recommendations for normal operation.

5.2 Running-in and Preliminary Adjustments

The tractor shall be run-in prior to the test. For spark-ignition engines fitted with a means for the operator to vary the ratio of the fuel/air mixture, the tests shall be carried out with the settings recommended for normal operation. The adjustment of the carburettor or the injection pump shall be the same as used in the PTO power tests (*see* IS 12036). Run-in shall be done with the governor set at full throttle and with the engine operating at rated speed.

Where the same tractor is used for the drawbar and PTO (*see* IS 12036), the fuel settings shall not be changed.

5.3 Fuels and Lubricants

The compression-ignition (diesel) fuel used for the test shall be the CEC reference fuel CEC RP-03-A-84 (*see* Annex C).

The lubricants used for the test shall comply with the manufacturer's specification and be identified by trade-name, type and viscosity class. If different lubricants are used, precise information shall be given as to where they are used (engine, transmission, etc).

If the lubricant conforms to other national or International Standards, a specific reference to these shall be given.

> NOTE — In case reference fuel as specified is not available the testing authority should indicate in the test report the corresponding characteristics of the fuel used in testing.

5.4 Ancillary Equipment

5.4.1 For all tests, accessories such as the hydraulic lift pump or air compressor may only be disconnected if it is practicable for the operator to do so as normal practice in work, in accordance with the operator's manual and without using tools, except as otherwise specified for a particular test. If not, they shall remain connected and operate at minimum load.

5.4.2 If the tractor is equipped with devices that create variable parasitic power losses such as a variable speed cooling fan, intermittent hydraulic or electrical demands, etc, the device shall not be disconnected or altered for test purposes. If it is practical for the operator to disconnect the device as outlined by the operator's manual, it may be disconnected for test purposes, in which case this shall be recorded in the test report.

5.4.3 Power variations during tests caused by these devices exceeding ± 5 percent shall be recorded in the test report in terms of percent variation from the mean.

5.5 Operating Conditions

No corrections to the measured values of torque or power shall be made for atmospheric conditions or other factors. Atmospheric pressure shall not be less than 96.6 kPa. If this is not possible because of altitude, a modified carburettor or fuel pump setting may have to be used, details of which shall be included in the report.

Stable operating conditions shall have been attained at each load setting before beginning test measurements.

5.6 Fuel Consumption

Arrange the fuel measurement apparatus so that the fuel pressure at the carburettor or the fuel injection pump is equivalent to that which exists when the tractor fuel tank is half full. The fuel temperature shall be comparable to that which occurs during full load operation for 2 h of the tractor when fuel is taken from the tractor fuel tank. Efforts shall be made to limit the temperature variations throughout the tests. The fuel consumption shall be measured when the tractor traverses a straight track for a minimum distance of 100 m,

When consumption is measured by volume, calculate the mass of fuel per unit of work using the density corresponding to the appropriate fuel temperature. This value shall then be used to calculate the volumetric data using the fuel density at 15°C.

Alternatively, when the consumption is measured by mass, calculate volumetric data using the fuel density value at 15°C.

5.7 Ballasting and Tyre Pressure

Ballast (weight) which is commercially available and approved by the manufacturer for use in agriculture may also be fitted for wheeled tractors; liquid ballast in the tyre may also be used.

The overall static load on each tyre (including liquid ballast in the tyres and a 75 kg mass added to the tractor to represent the driver) and the inflation pressure shall be within the limits specified by the tyre manufacturer. Measure inflation pressure with the tyre valve in the lowest position.

6 TEST PROCEDURE

6.1 General

6.1.1 Measure the drawbar performance of the tractor on one of the following surfaces:

a) *For wheeled or rubber track tractors* — a clean, horizontal and dry concrete or tarmacadam surface containing a minimum number of joints;

b) *For steel track-laying tractors* — flat, dry and horizontal mown or grazed grassland or in a horizontal surface having equally good adhesion characteristics; and

c) A moving surface (rotating drum or treadmill), providing results are comparable to those obtained on the above surfaces.

6.1.2 State the type of surface in the report, if a rotating drum is used, report the diameter of the drum.

6.1.3 During all tests, the throttle lever shall be set fully open unless specified otherwise.

6.1.4 If a tractor is equipped with advanced gearbox technologies, such as fully or partially non-mechanical and/or hybrid stepless transmission systems (e.g. hydrostatic, hydrokinetic, CVT, etc.), the performance test shall be conducted in consultation with the manufacturer and the testing authority.

6.1.5 Do not make the test in gears in which the forward speed exceeds the safety limits of the test equipment.

6.1.6 The line of pull shall be horizontal. The height of the drawbar shall remain fixed in relation to the tractor and shall be such that the tractor can be controlled at all times during the test. For wheeled tractors, the following formula applies.

$$H_{Max} \leq \frac{0.8 \times W \times Z}{F}$$

Where,

W is the static load exerted by the front wheels on the ground, in newtons

Z is the wheelbase, in millimetres,

F is the maximum drawbar pull, in N, and

H is the static height of the line of pull above the ground, in millimetres

6.1.7 At the beginning of the drawbar test, the weight of tyre or rubber track tread bards, measured at the centreline of the tyres or tracks, shall be at least 65 percent of their height when new. This height shall be measured using the technique and equipment specified in Annex D.

6.1.8 The atmospheric temperature at the test track shall not be exceeding 35ºC.

6.1.9 In the case of tractors having driving wheels not mechanically locked together, the revolutions of each wheel should be separately recorded, and the slip to be calculated for each wheel. If the results for each wheel differ by more than 5 percent, they should be checked and separately reported.

6.1.10 Slip of the driving wheels or tracks shall be determined by the following formula.

$$\frac{100\ (N_1 - N_0)}{N_1}$$

where

N_1 is the sum of the revolutions of all driving wheels or tracks for a given distance, and

N_0 is the sum of the revolutions of all driving wheels or tracks for the same distance when the tractor is driven without drawbar load at a speed of approximately 3.5 km/h.

6.1.11 The slip of wheels or rubber tracks shall not exceed 15 percent and that of steel tracks shall not exceed 7 percent.

6.2 Transmission Characteristic Test

6.2.1 Measure the maximum drawbar power in, if possible, at least six gears between that in which maximum pull can be developed, without exceeding the slip limits in **6.1.11**, and that in which maximum power can be produced up to the gear closest to, but not exceeding, 12 km/h. The results shall include drawbar power, pull, speed, slip, fuel consumption and atmospheric conditions Any noticeable wheel hop should be noted in the report with corresponding slip values at which it occurred. For steel track laying tractors, report the maximum drawbar pull as a foot note beneath the table giving drawbar performance figures if the maximum pull occurs above 7 percent slip.

6.2.2 If the tractor has a hydrokinetic torque converter which can be locked out by the driver, carry out the test both with the torque converter in operation and with it locked out.

6.2.3 If the tractor has a stepless variable transmission, carry out the test at six transmission ratios approximately equally spaced but including that at which maximum power is obtained produce tables showing drawbar power, speed, wheel or track slip and fuel consumption as a function of drawbar pull.

6.3 Varying Drawbar Pull and Speed at Full Load

6.3.1 If the tractor is not fitted with a power take-off capable of transmitting full engine power, the drawbar power and speed shall be measured as a function of drawbar pull at full load. Operate the tractor, ballasted as for the tests in **6.2**, at the speed ratio giving maximum drawbar power. Increase the drawbar pull until maximum drawbar power is generated, and then increase the drawbar pull further, to reduce the engine speed in approximately 10 percent intervals using the speed at maximum power as 100 percent until either the drawbar pull reaches its maximum value, or the slip limits in **6.1.11** or some other limiting condition as specified by the manufacturer is reached. For each increment of drawbar pull, record speed, drawbar power, wheel or track slip, engine speed and atmospheric conditions.

6.3.2 If the tractor has a hydrometric torque converter which can be locked out by the driver, carry out the test both with the torque converter in operation and with it locked out.

6.3.3 If the tractor changes the gear ratio setting automatically with increasing drawbar pull, end the test at the first automatic ratio change.

6.4 Ten-Hour Test

For wheeled tractors, ballasted in accordance with **5.7**, five-hour test given in **6.4.1** shall be conducted followed by another five-hour test given in **6.4.2** with a minimum of time interval for track laying tractors, the test given at **6.4.1** shall be conducted for 10 hours instead of 5 hours.

6.4.1 *Five-hour Test at 75 percent of the Pull at Maximum Power*

The ballasted wheeled tractor shall be operated for 5 hours in a gear normally used for agricultural work, such as ploughing. The drawbar pull shall be 75 percent of the pull at maximum power in that gear. Values of the power, speed, slip, fuel consumption, and temperature of fuel, coolant and lubricating oil, and atmospheric conditions (temperature, pressure and relative humidity) shall be reported.

6.4.1.1 If the tractor is fitted with hydrokinetic torque converter which can be 'locked out' by the driver, the test shall be carried out with the torque converter in operation, within the limitations specified by the manufacturer in his/her published instructions. If the limiting conditions for operation of the torque converter are reached, the test shall be completed with the torque converter 'locked out'. The respective durations of the two parts of the test shall be noted in the test report and the corresponding fuel consumption shall be separately reported. For four-wheel drive tractors, test with four-wheel drive engaged shall be carried out.

6.4.2 *Five-hour Test at the Drawbar Pull Coinciding with* 15 *percent Wheel Slip*

The ballasted wheeled tractor shall be operated for 5 hours at the drawbar pull giving 15 per cent wheel slip measured during the test specified in **6.2**. The gear used shall be the fastest gear in which the required pull can be obtained when the engine is operating under the control of the governor. If necessary, supplementary ballast may be added to reduce the wear of the tyres and to facilitate control of the tractor. The drawbar pull, speed and atmospheric conditions (temperature, pressure and relative humidity) shall be reported.

6.4.2.1 If the tractor is fitted with hydrokinetic torque converter which can be 'locked out', by the driver, the test shall be carried out with the torque converter in operation, within the limitations specified by the manufacturer in his/her published instructions. If the limiting conditions for operation of the torque converter are reached, the test shall be completed with the torque converter, 'locked out'. The respective durations of the two parts of the test shall be noted in the test report. For four-wheel drive tractors, test with four-wheel drive engaged shall be carried out.

> NOTE — If the tractor does not develop sufficient power to reach the drawbar pull coinciding with 15 percent wheel slip measured during the test specified in **6.2** the test shall be carried out at the maximum drawbar pull.

6.5 Statement or Power Rating

The power rating of the tractor is usually stated as PTO power (*see* IS 12036). If the tractor is not fitted with a PTO capable of transmitting the full power of the engine, the power rating of the tractor shall be stated as the power measured at the drawbar.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	***Title***
FAD 11 (27972)	Agricultural tractors — Test procedures — Power tests tor power take-off (*first revision of IS 12036*)
IS 5994 : 2022	Agriculture tractors — Test code (*fourth revision*)
IS 1448 (Part 2): 2007	Methods of test for petroleum and its products [P:2] Petroleum products and lubricants — Neutralization number — Potentiometric titration method (*second revision*)
IS 1448 (Part 4/Sec 1):2021	Methods of Test for Petroleum and its Products - Part 4/Section 1 Determination of Ash (*fourth revision*)
IS 1448 (Part 8) : 2012 ISO 4262:1993	Methods of test for petroleum and its products [P:8] Determination of carbon residue — Ramsbottom method (*second revision*)
IS 1448 (Part 9) : 2023 ISO 5165 : 2020	Petroleum and its products — Methods of test Part 9 Determination of the ignition quality of diesel fuels — Cetane engine method (*third revision*)
IS 1448 (Part 10/Sec 1) : 2021 ISO 3015 : 2019	Methods of test for petroleum and its products Part 10 Petroleum and related products from natural or synthetic sources Section 1 Determination of cloud point (*third revision*)
IS 1448 [Part 15] : 2004 ISO 2160 : 1998	Methods of test for petroleum and its products [P:15] Petroleum products — Corrosiveness to copper — Copper strip test (*third revision*)
IS 1448 (Part 18) : 2020	Methods of test for petroleum and its products Part 18 Distillation of petroleum products (*third revision*)
IS 1448 (Part 20) : 2024 ISO 13736 : 2021	Petroleum and its products — Methods of test Part 20 Determination of flash point — Abel closed-cup method (*fourth revision*)

IS 1448 (Part 21) : 2019/ ISO 2719 : 2016	Methods of test for petroleum and its products [P:21] Determination of flash point — Pensky-martens closed cup method (*fourth revision*)
IS 1448 [P : 25/Sec 1] : 2018/ISO 3104 : 1994	Methods of test for petroleum and its products [P:25] Transparent and opaque liquids Section 1 Determination of kinematic viscosity and calculation of dynamic viscosity (*second revision*)
IS 1448 [P : 32] : 2019/ ISO 3838 : 2004	Methods of test for petroleum and its products [P:32] Crude petroleum and liquid or solid petroleum products — Determination of density or relative density — Capillary stoppered pyknometer and graduated bicapillary pyknometer methods (*third revision*)
IS 1448 (Part 33) : 2021	Methods of test for petroleum and its products Part 33 Sulphur by high pressure decomposition device method (*third revision*)
IS 1448 [Part 40] : 2015/ ISO 3733 : 1999	Methods of test for petroleum and its products Part 40 Petroleum products and bituminous materials — determination of water — Distillation method (*fourth revision*)

ANNEX B

(*Clause* 5.1)

SPECIMEN TEST REPORT FOR DRAWBAR

B-1 LOCATIONS

Tractor manufacturer's name and address:_____

Place of running in : _____

Duration of running in : _____

B-2 SPECIFICATION OF TRACTOR

Tractor

Model : _____ Serial No._____

Engine

Make : _____ Model : _____

Type : _____ Serial No._____

Rated speed : _____,min^{-1}

Cylinders

Number : _____ Bore : _____ mm

Stroke : _____, mm Capacity : _____, 1

Fuel and Injection system

Capacity of fuel tank : _____,1

Make, type and model of injection pump : _____

Manufacturer's production setting : _____, 1/h

Make, type and model of injectors : _____

Make, type and model of magneto, coil and distributor : _____

Make, type and model of carburettor : _____

Ignition or injection timing (manual or automatic) : _____

Air cleaner

Make and model : _____ Type : _____

Precleaner (*if fitted*)

Make and model : _____ Type : _____

Transmission

Clutch

Type ; _____Diameter of discs : _____ mm

Gear						
Nominal travelling speed at rated engine speed with dynamic radius index (*see* **3.7**), km/h						

Drawbar

Type : _____

Height above ground, *Max* : _____mm, *Min* : _____mm

Position relative to PTO : _____mm

Steering

Type : _____
(for example, manual, power or power-assisted)

Wheels

Location of steering wheels : _____

Steering

Make of tyres : _____Type : _____
(for example, radial or cross ply)

Size : _____

Maximum permissible load : _____kg Ply rating_____

Track (tread) *Max* : _____mm' *Min* : _____mm

Inflation Pressure : _____kPa

Driving

Location of driving wheels : _____

Make of Tyres : _____ Type : _____
(for example, radial or cross ply)

Size : _____

Maximum permissible load : _____ kg Ply rating : _____

Track (treated) *Max.* : _____mm ; *Min* : _____mm

Inflation pressure : _____kPa

Wheelbase : _____mm

Tracks

Type : _____ Number of track plates : _____

Width of track plates : _____ mm

Masses (with tanks full but without driver)

Mass	*Front*	*Rear*	*Total*
Without ballast			
With ballast			

B-3 FUEL AND LUBRICANT SPECIFICATIONS

Fuel

Trade-name : _____ Octane (RON[1)]) No. _____

Octane number or cetane number : _____Density at 15ºC:_____

Type : _____

Engine oil

Trade-name : _____ Type : _____

Viscosity class : _____

Transmission oil

Trade-name : _____ Type : _____

Viscosity class : _____

B-4 VARYING DRAWBAR PULL AND SPEED

Drawbar pull, kN						
Speed, km/h						
Drawbar power, kW						
Engine speed, Min^{-1}						
Wheel or track slip						

Maximum drawbar pull (track-laying tractor only)

Maximum : _____kN Track slip : _____%

[1)] Ron : Research Octane Number.

B-5 DRAWBAR TEST

Date of test: _____

Type of surface (or drum diameter) : _____

Height of drawbar above ground : _____

Gear	*Speed* km/h	*Power* kW	*Drawbar Pull* kN	*Engine Speed* Min-1	*Wheel or Track Slip %*	*Noticeable Wheel Hop (yes/no)*	*SFC (optional)*		*Atm Conditions*		
							kg/kWh	kWh/1	Temp °C	R.H. %	Pressure kPa
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Maximum power at rated engine speed											
1											
2											
3											
Etc											
Maximum power at rated engine speed (optional)											
1											
2											
3											
Etc											

ANNEX C

(*Clause* 5.3)

REFERENCE FUEL CERF-03-A-84 FOR COMPRESSION-IGNITION ENGINES-SPECIFICATIONS

S.No.	Characteristic	Limit and Units	Test Method, Ref to Part of IS
(1)	(2)	(3)	(4)
i)	Relative density 15ºC/4ºC (specific gravity)	0.84 ± 0.005	IS 1448 [Part 32]
ii)	Distillation		IS 1448 [Part 18]
	50% (volume)	245º C Min	
	90% (volume)	330º C ± 10º C	
	Final boiling point	370ºC Max	
iii)	Cetane index	51 ± 2	IS 1448 [Part 9]
iv)	Kinematic viscosity at 40ºC	3 cSt ± 0.5 cSt	IS 1448 [Part 25]
v)	Sulphur content	Min to be reported	IS 1448 [Part 33]
		Max 0.3% (m/m)	
vi)	Flash point	55º C Min	IS 1448 [Part 20 & 21]
vii)	Cloud point	– 5º C Max	IS 1448 [Part 10/Sec 1]
viii)	Conradson carbon residue on 10% bottoms	0.2% (m/m) Max	IS 1448 [Part 8]
ix)	Ash content	0.01% (m/m) Max	IS 1448 [Part 4/Sec 1]
x)	Water content	0.05% (m/m) Max	IS 1448 [Part 40]
xi)	Copper corrosion	1 Max	IS 1448 [Part 15]

xii)	Strong acid number	0.2 mg KOH/g Max	IS 1448 [Part 2]
xiii)	Oxidation stability	2.5 mg/100 ml	
	NOTE — The CEC RF-03-A-8 reference fuel shall be based only on straight run distillates, hydro-desulfurized or not, and contain no additives.		

ANNEX D

(*Clause* 6.1)

DRAWBAR TESTS — MEASUREMENT OF TYRE TREAD AND TRACK

The height of the tyre or rubber track tread bars (*see* **6.1**) shall be measured by use of a 3-point gauge. Each gauge leg shall terminate in a hemispherical tip of radius 5 mm. The guage shall be placed astride the tread bar and perpendicular to the direction of the tread bar as close to the centreline of the tyre or rubber track as possible. Two legs of the gauge shall be positioned at the base of the tread bar (at the point of tangency between the tyre carcass and the radius joining the tread bar to the carcass). The third point of the gauge shall be in the centre of the tread bar.

The tread bar eight shall be the difference in elevation between the two outside legs of the gauge and the centre point. The tread bar height measured in this manner shall be taken and averaged for a minimum of four equally spaced locations round the periphery or the tyre. It shall be compared to similar data on a new tyre of the same make, size, type, and inflation pressure.