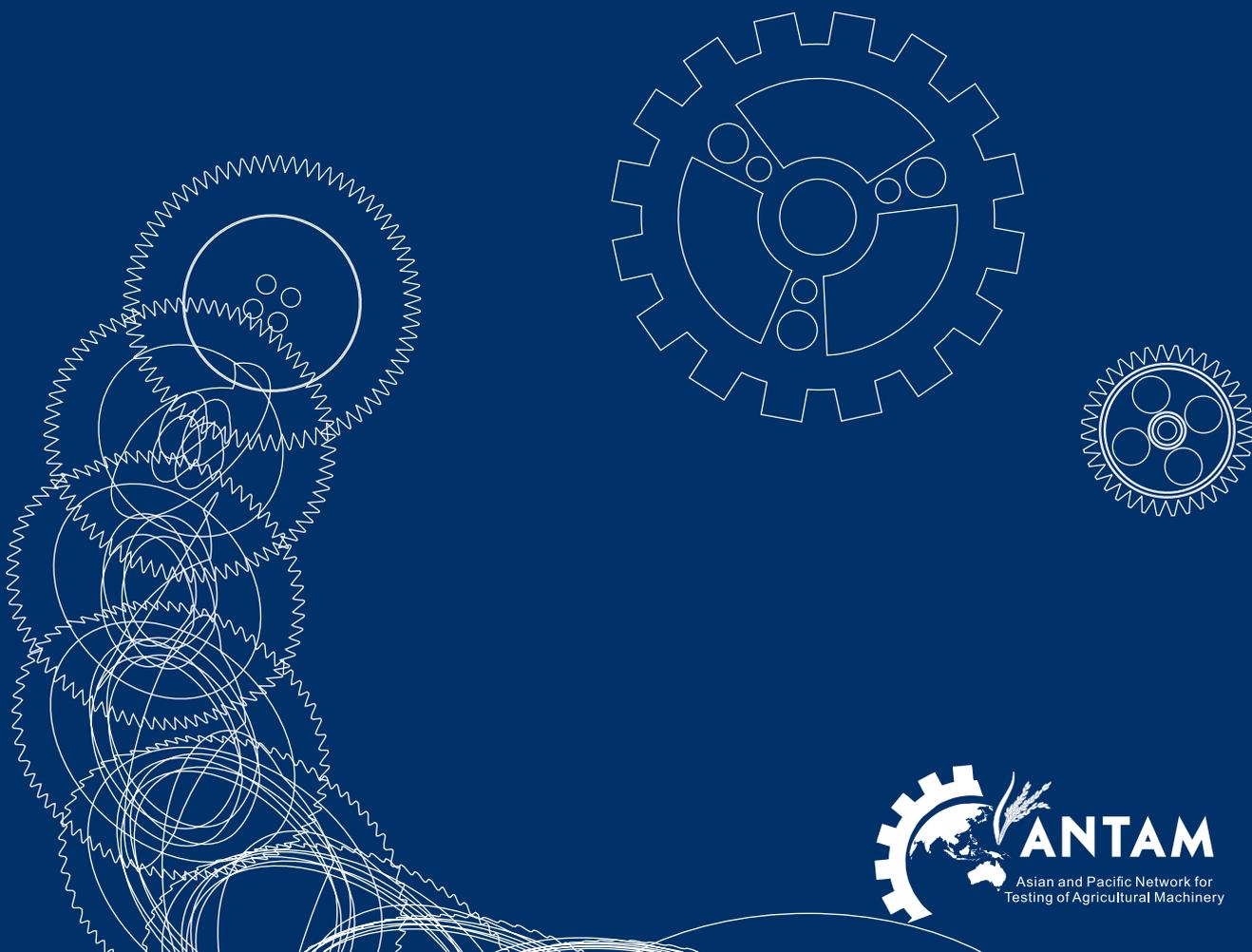


ANTAM STANDARD CODE FOR TESTING OF POWER TILLERS

001-2017



The Centre for Sustainable Agricultural Mechanization (CSAM), is a regional institution of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), based in Beijing, China. CSAM started operations in 2004, building on the achievements of the Regional Network for Agricultural Machinery (RNAM) and the United Nations Asian and Pacific Centre for Agricultural Engineering and Machinery (UNAPCAEM). CSAM serves the 62 members and associate members of UNESCAP.

The vision of CSAM is to achieve production gains, improved rural livelihood and poverty alleviation through sustainable agricultural mechanization for a more resilient, inclusive and sustainable Asia and the Pacific.

The Secretariat of the Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM) is based at CSAM. CSAM is the executing agency of ANTAM. The ANTAM Secretariat assists and coordinates the operation of the network, and provides necessary logistical and administrative support.



The shaded areas of the map indicate ESCAP members and associate members

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ANTAM STANDARD CODE FOR TESTING OF POWER TILLERS

**Centre for Sustainable Agricultural Mechanization
United Nations Economic and Social Commission for Asia and the Pacific**

001-2017*

August 2017

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The Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM) Standard Code for Testing of Power Tillers was prepared under the supervision of the Centre for Sustainable Agricultural Mechanization of the United Nations Economic and Social Commission for Asia and the Pacific (CSAM-ESCAP). The current version of the Code is based on the first edition published in August 2015, initially drafted by Dr. Chan Chee Wan and modified based on technical negotiations conducted with designated national counterparts in 2015, 2016 and 2017.

The consultation process in 2017 started in March and was concluded at the 3rd Meeting of ANTAM Technical Working Groups held on May 24-27, 2017 in Dhaka, Bangladesh. The Code has been developed with contributions from: Israil Hossain; Sinh Chao; Chang Xiongbo; Champat Raj Mehta; Angit Sasmito; Takashi Fujimori; Mohd Khusairy Khadzir; Darwin Aranguren; Vadim Pronin; Pavel Ishikin; Anuchit Chamsing; and Le Huy Phuong. The ANTAM Test Code on Power Tillers was formulated by referring to standards developed by the International Electrotechnical Commission (IEC), International Standard Organization (ISO), and Organisation for Economic Co-operation and Development (OECD), and by merging relevant national standards from China, India, Indonesia, Philippines, and Thailand to reflect unique regional conditions.

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At CSAM, the process of development of the Code was coordinated by Camilla Stelitano under the supervision of Anshuman Varma, Programme Officer and the overall guidance of Li Yutong, Head of CSAM. Chan Chee Wan provided final reviews and editing of the Code and Wei Zhen contributed to the layout and design of the publication.

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I. Foreword

The Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM) is an initiative led by the Centre for Sustainable Agricultural Mechanization (CSAM) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The network develops regional standards to promote the use of safe, efficient and environmentally sound agricultural machinery in the Asia-Pacific region. In support of the 2030 Agenda for Sustainable Development, the ANTAM project aims to tackle cross-sectoral issues to impact economic, social and environmental aspects that affect the agricultural output of ESCAP member countries.

Over the past few decades the Asia-Pacific region has been an important engine for growth and poverty reduction. Between 2010 and 2013 the poverty rate fell to 10.3 percent of the total population in the region and the total number of people who are poor fell to 400 million¹. In this context, the increase in productivity of the agricultural work force has played a crucial role and it has been estimated that greater labour productivity in agriculture has the potential to lift an additional 110 million people from poverty between 2016 and 2030².

In the coming years, modernization of production systems that can empower the agricultural workforce is expected to play a central role in enabling the required increases in productivity in the agricultural sector. However, substantive progress in the modernization of agricultural production in the Asia-Pacific region, of which sustainable agricultural mechanization is undoubtedly an important component, continues to be restrained by uneven manufacturing capacity and the lack of regional integration mechanisms. The adoption of mutually recognized testing Codes for agricultural machinery can significantly reduce the need to conduct national testing when importing foreign machinery, and set minimum regional standards on the requirements pertinent to safety and efficiency. The integration of the agricultural machinery market through mutually recognized testing Codes can also unleash the full potential of the agricultural mechanization sub-sector by facilitating technology and knowledge exchange while at the same time helping protect end users from the use of unsafe and inefficient inputs.

Furthermore, a shared commitment to combat climate change and support the sustainable intensification of agricultural production calls for simultaneously addressing production gains and environmental protection. In this context, it is crucial to support the adoption of mechanization technologies and products that can increase yields, reduce the excessive use of chemical fertilizers and pesticides, and minimize the related environmental footprint. The regional standards being developed through ANTAM can guide manufacturers and end users towards this objective.

The ANTAM Codes for testing of agricultural machinery are developed through a collaborative process engaging designated members of Technical Working Groups (Appendix 2) and draw upon national standards of ESCAP member countries and major international requirements for agricultural machinery testing. The third version of the ANTAM Code for Testing of Power Tillers that we are presenting in 2017, builds upon the work conducted in 2016 and is enriched with enhanced safety standards to assure end users with efficient, durable and safe equipment.

Li Yutong
Head

Centre for Sustainable Agricultural Mechanization

¹ United Nations, Asian Development Bank, United Nations Development Programme (March 2017) Asia-Pacific Sustainable Development Goals Outlook. Bangkok, Thailand. Available at: <http://www.unescap.org/publications/asia-pacific-sustainable-development-goals-outlook>

² United Nations (2016) Economic and Social Survey of Asia and The Pacific 2016- Nurturing productivity for inclusive growth and sustainable development. Bangkok, Thailand. Available at: http://www.unescap.org/sites/default/files/publications/Economic%20and%20Social%20Survey%20of%20Asia%20and%20the%20Pacific%202016_0.pdf

II. Method of Operation³

The Annual Meeting shall adopt the Test Codes by consensus amongst ANTAM participating countries.

The Technical Working Groups (TWGs) of ANTAM develop, review and revise ANTAM Codes based on the decisions adopted at the Annual Meeting of ANTAM.

The ANTAM Test Codes are updated by the TWGs through technical negotiations led by CSAM. The content of the Codes is finalized and agreed upon by consensus amongst all TWGs members at the annual meetings of the TWGs.

The ANTAM Test Code on Power Tillers was formulated by referring to relevant International Electrotechnical Commission (IEC), International Standard Organization (ISO), and Organisation for Economic Co-operation and Development (OECD) standards and merging relevant national standards from China, India, Indonesia, Philippines, and Thailand. As specified in the Terms of Reference of the TWGs, members are responsible for selecting and providing relevant references to national and international standards. All selected standards are subject to revision and considered the most updated edition as per documents provided by TWGs members. All documents provided by national standards agencies are copyrighted.

Implementation of ANTAM Test Codes is voluntary. Member countries can use ANTAM Test Codes in their entirety or refer to parts of the Code to integrate them with procedures applied in national testing stations. ANTAM Test Codes apply only to the equipment described in the Codes. Thus, any testing station from an ANTAM member country is welcome to use the test Codes assuming it has adapted testing equipment, facilities and skilled personnel.

Participating national testing stations are responsible for using the Codes to carry out the tests and complete the test report. Each testing station shall certify that ANTAM Codes are followed and that the test report complies with ANTAM Test Codes and procedures. ANTAM strongly encourages the implementation of round robin tests⁴ among testing stations in order to ensure that test reports are supported by a quality assurance process.

The test report shall be verified by the ANTAM Secretariat prior to its release. The ANTAM Secretariat shall work with the Technical Reference Unit (TRU), an independent third party elected by member countries at the Annual Meeting, to check the technical contents of the report to ensure strict compliance with ANTAM testing methodologies.

Upon approval and validation of the test report by the ANTAM Secretariat, the ANTAM logo may be used on the tested machinery. The ANTAM Secretariat will then release the test report on its website.

The ANTAM Test Codes are designed to guide member countries in the application of standards for testing of agricultural machinery. The Codes provide information only and do not constitute formal legal advice. The ANTAM Secretariat assumes no liability for actions undertaken in reliance on the information contained in the Codes.

³ In reference to the Terms of Reference of ANTAM and the Terms of Reference of ANTAM Technical Working Groups adopted by the Annual Meeting on December 9, 2016.

⁴ Measurement system analysis technique, where independent technicians perform the tests in different stations. Such interlaboratory activity is encouraged to compare discrepancies in results, if any, and determine the reproducibility of test methods.

* The current Code is subject to revision and adoption by the 4th Annual Meeting of ANTAM to be held in Manila, the Philippines, on November 22-24, 2017.

III. General Text

1.0 SCOPE

This Test Code covers the terminology, general guidelines and tests to be conducted on power tillers with diesel engine excluding mini tillers. It also covers methodology for checking on machine specifications, engine performance, rotary shaft performance, vibration level, drawbar performance, turning ability, parking brake ability, noise measurement, waterproof ability and safety requirements.

The tests are conducted for establishing performance characteristics of power tillers that are ready for commercial production or already in production. The manufacturer has to specify whether the test is confidential or for commercial purpose.

This publication supersedes the previous ANTAM Standard Code for testing of Power Tillers (ANTAM 001-2016).

2.0 REFERENCES

The complete list of references to existing international standards that have been incorporated to this text is provided in **Annex A**. The list includes international standards developed by the International Standard Organization (ISO), Organisation for Economic Co-operation and Development (OECD) and national standards practiced by China, India, Indonesia, Philippines and Thailand. The selection of publications and the editions indicated were provided by the various national representatives. All selected standards are considered recent as per documents provided. All documents provided from the various national standards agencies are copyrighted.

3.0 TERMINOLOGY

3.1 Power Tiller

Power tiller is a single axle, self-powered and self-propelled tractor, which can pull and power various farm implements such as rotary tiller, cultivator, harrow, plough, seeder, harvester, and trailer.

3.1.1 General Purpose Type

The power tiller which can be used for a number of farm operations, including the types defined under pull type and tilling type.

3.1.1.1 Pull Type

The power tiller which pulls various kind of implements.

3.1.1.2 Tilling Type

The power tiller which uses an engine power driven tilling device, such as rotary and crank or screw blades.

3.2 Maximum Engine Power

Maximum sustainable engine power available at the crankshaft.

3.3 Operational Mass

The mass of the power tiller without operator in normal working condition with fuel tank and radiator (if fitted) full and lubricants filled to the specified levels.

Note: Any accessory fitted and its mass should be stated.

3.4 Rated Engine Power

The power available at the crankshaft or its equivalent at the rated speed specified by the manufacturer.

3.5 Tyre Rolling Radius

The effective tyre rolling radius is the average distance travelled by the power tiller in one rotation of the driving wheels divided by 2π , when the power tiller is driven without drawbar load at a speed of approximately 2 km/h. The weight of operator shall be reported when the power tiller is tested with operator seat.

3.6 Wheel Slip (for dry land operation)

This shall be determined by the following formula:

$$\text{Slip, percent} = \frac{100 (N_1 - N_2)}{N_1}$$

Where

N_1 = Sum of revolutions of driving wheels for a given distance (at least 20 m) when the power tiller is driven under load, and

N_2 = Sum of revolutions of driving wheels for the same distance when the power tiller is driven without load at a speed approximately 2.0 km/h

4.0 GENERAL GUIDELINES

4.1 Conditions for Checking of Dimensions

4.1.1 The power tiller shall be without ballast, any wear on tyres and placed on a firm horizontal surface (4.2.1 IS 9935-2002). The height of the tyre tread bars shall not be less than 65 percent of their height when new. The main frame shall be in horizontal position (9.2.6 GB/T 6229-2007).

4.1.2 Unless otherwise stated by the manufacturer/applicant, the power tiller shall be stationary with its wheels and standard components in the positions they would be, if the power tiller was travelling in a straight line (4.2.2 IS 9935-2002).

4.1.3 The pressure in pneumatic tyres shall be adjusted to the value recommended by the power tiller manufacturer for field work (4.2.3 IS 9935-2002). If a range of value is indicated the mean tyre pressure shall be used (3.3.3 GB/T 6229-2007).

4.2 Running-in

The manufacturer/applicant shall run-in the power tiller before the test, under his responsibility and in accordance with his usual instructions. The running-in shall be carried out in collaboration with the testing authority. If this procedure is impracticable due to the power tiller being an imported model, the testing authority may itself run-in the power tiller in accordance with the procedure prescribed or agreed to with the manufacturer/applicant.

4.2.1 The place and duration of the running-in shall be reported in the proforma given in **Annex B**.

4.3 Servicing and Preliminary Setting after Running-in

4.3.1 After completion of running-in, servicing and preliminary settings should be done according to the printed literature supplied by the manufacturer/applicant. The following may be carried out, wherever applicable:

- a) Change of the engine oil;
- b) Change of air cleaner oil (if provided with an oil bath type air cleaner);
- c) Change of transmission oil;
- d) Change of oil and fuel filters (if required);
- e) Greasing/oiling of all the lubricating points;
- f) Adjustment of valve clearance and injection pressure (if required);
- g) Tightening the nuts and bolts;
- h) Checking and adjusting the tension of belts and chains;
- i) Checking and adjustment of safety devices, if any;
- j) Any other checking or adjustment recommended by the manufacturer after the running-in period, and included in the printed literature of the power tiller.

4.3.2 The manufacturer/applicant may make adjustments in fuel injection pump, governor, fuel injector during the period the power tiller is prepared for tests. These adjustments should conform to the values specified by the manufacturer/applicant for agricultural use in the printed literature/specification sheet. No other adjustment shall be made, unless it is recommended in the literature. All the parts replaced shall be reported in the test report.

Note: Adjustment of fuel injection pumps except for low/high idling speed shall not be permitted under test.

4.4 Ballasting

The ballast mass, which are commercially available and approved by the manufacturer for use in agriculture, shall be within the limits specified by the manufacturer or load limit of axle. For wheeled power tillers, ballast on each tyre including liquid ballast in the tyres, and the inflation pressures shall be within the limits specified by the tyre manufacturer or load limit of axle, whichever is lower. Measure inflation pressure with the tyre/tube valve in the lowest position.

4.5 Repairs and Adjustments During Tests

All repairs and adjustments made during the tests shall be reported, together with comments on any practical defects or shortcomings in **Annex B**. This shall not include those maintenance jobs and adjustments which are performed in conformity with the manufacturer's recommendations.

4.6 Fuel and Lubricants

Fuels and lubricants shall be selected from the range of products commercially available in the country where the equipment is tested and shall conform to the minimum standards approved by the power tiller manufacturer. If the fuel or lubricant conforms to a national or international standard, it shall be mentioned and the standard stated (OECD Code 2-2017).

4.7 Auxiliary Equipment

For all power tests, accessories/ auxiliary drives (if any) may be disconnected only if it is practicable to do so as a normal practice during work in accordance with the operator's manual without using any tool. If not, they shall remain connected and operate at minimum load.

4.8 Fuel Consumption

The fuel measurement apparatus shall be so arranged that the fuel pressure at the fuel transfer pump is equivalent to that which exists when the power tiller fuel tank is half full. The fuel temperature shall be comparable to that in the normal operation of the power tiller when fuel is taken from the power tiller fuel tank.

4.8.1 To obtain hourly fuel consumption by volume and the work performed per unit volume of fuel, conversion of unit of mass to unit of volume shall be made using the density value at 15°C (IS 9935:2002).

4.8.2 When the fuel consumption is measured by volume, the specific fuel consumption shall be calculated using the density corresponding to the appropriate fuel temperature.

4.9 Atmospheric Conditions

4.9.1 Atmospheric Pressure

The atmospheric pressure shall not be less than 96.6 kPa during laboratory tests (5.2.3 GB/T 6229-2007). The pressure shall be noted at the start, middle and end of the test.

4.9.2 Temperature

For power tests, the normal ambient temperature shall be $27 \pm 7^\circ\text{C}$ (5.2.3 GB/T 6229-2007). Ambient air temperature at a representative point shall be measured as follows: Approximately 2 m in front or side depending upon the location of suction or blower device of power tiller and approximately 1.5 m above the ground (IS 9935:2002).

Note: No correction shall be made to the test results for atmospheric conditions.

5.0 Measuring Tolerances

The measuring apparatus shall be such that the following items shall have the tolerances within the limits shown against each (4.1.2 GB/T 6229-2007, IS):

Table IIIa. Accuracy requirements of measurement

Parameters	Tolerances
a) Rotational speeds, rpm	± 0.5 percent
b) Time, s	± 0.2 s
c) Distance, m or mm	± 0.5 percent
d) Force, N and torque, N·m	± 1.0 percent
e) Acceleration, m/s^2	+ 1.0 percent
f) Mass, kg	± 0.5 percent
g) Atmospheric pressure, kPa	± 0.2 kPa
h) Tyre pressure, kPa	± 5 percent
i) Temperature of fuels etc, °C	± 2 °C
j) Wet and dry bulb temperature, °C	± 0.5 °C
k) Fuel consumption (overall for the apparatus used): 1) Engine test, kg 2) Rotary shaft test, kg 3) Drawbar test, kg	± 1.0 percent ± 1.0 percent ± 2.0 percent
l) Angle, degree	± 0.5 degree

IV. Code

Tests to be conducted on a power tiller are given below:

Compulsory tests:

- Checking of specifications
- Engine performance
- Drawbar performance
- Rotary shaft performance
- Turning ability
- Parking brake
- Noise measurement
- Vibration measurement
- Waterproofing
- Safety check

Optional test:

- Engine test at high ambient temperature.

1.0 CHECKING OF SPECIFICATIONS

1.1 Specification Sheet

1.1.1 The power tiller manufacturer/applicant shall supply the specifications of the power tiller consisting of the items listed in the specimen report given in **Annex C**, as well as any other information required by the testing authority to carry out the tests. The manufacturer/ applicant shall also supply technical literature such as operation, maintenance and service manuals, and parts catalogue (4.1 IS 9935: 2002).

1.1.2 The information given by the manufacturer/applicant in the specification sheet (Clause 1.1.1) shall be verified by the testing authority and reported. Details of the components and assemblies which do not conform to the relevant ANTAM Codes shall also be reported. The adequacy or otherwise of the literature shall be indicated (7.1 IS 9935: 2002).

1.2 Conditions for Checking of Dimensions

1.2.1 While checking the dimensions of the power tiller, the conditions laid down in 4.1 of the general guidelines shall be followed.

2.0 ENGINE PERFORMANCE TEST

2.1 General

The various tests shall normally be carried out continuously.

The angle of the connection of the shaft connecting the crankshaft to the dynamometer shall not exceed 2° (5.2.2 GB/T 6229-2007).

If an exhaust gas discharge device for the test area is used, it shall not change the engine performance.

The governor control shall be set for maximum power.

2.2 Natural Ambient Test

Make no corrections to the measured values of torque or power for atmospheric conditions or other factors. The atmospheric pressure shall not be less than 96.6 kPa. If this is not possible because of altitude, a modified carburetor or fuel pump setting may have to be used, the details of which shall be included in the report. The surrounding temperature shall be 27 ± 7 °C (5.2.3 GB/T 6229-2007).

The following tests on the engine shall be conducted:

2.2.1 Maximum Power Test

Operate the engine at the speed where maximum power occurs for a period of 2 hours subsequent to a warming-up period to reach stabilized running conditions. Measure the power, torque and fuel consumption (6.1.2 IS 12036: 1995 and 5.3.1 GB/T 6229-2007).

The maximum power quoted in the test report shall be the average of at least six readings made at regular intervals during two-hour period. If the power varies by more than ± 2 percent from the average, repeat the test. If the variation continues, report the deviation (5.3.1 GB/T 6229-2007).

2.2.2 Power at Rated Engine Speed

If maximum power does not occur at rated engine speed, an additional 1 hour test shall be carried out using the procedure stated in 2.2.1.

2.2.3 Varying Speed Test at Full Load

Measure the power, torque and fuel consumption as a function of speed at full load. Minimum 6 readings shall be taken between rated rpm and speed at maximum torque. The minimum speeds at which measurements are made shall be at the speed of maximum torque and, if possible, 15 percent below that speed (6.1.3 IS 12036: 1995 and 5.3.2 GB/T 6229-2007).

2.2.4 Varying Load Tests

Measure the power, speed and fuel consumption at the values listed below of torque with the governor control set for maximum power at the rated engine speed (5.3.3 GB/T 6229-2007).

- a) The torque corresponding to maximum power available at rated engine speed;
- b) 85 percent of the torque obtained in (a);
- c) 75 percent of the torque obtained in (b);
- d) 50 percent of the torque obtained in (b);
- e) 25 percent of the torque obtained in (b);
- f) Unloaded [with the dynamometer disconnected if the residual torque is greater than 5 percent of the torque defined in (b)].

2.2.5 Five Hours Engine Rating Test

The engine shall be run continuously for 5 hours. For the first 4 hours, the engine shall be run at 90 percent of load (torque) corresponding to maximum power (IS 12036: 1995). During the 5th hour, the engine shall be run at a load corresponding to maximum power. During the test, all the parameters specified in 2.2.1 of this standard shall be recorded after every half-an-hour during the first 4 hours and after every 15 minutes during the 5th hour (6.1.7 IS 12036: 1995).

Report the following:

- Ambient air temperature at a representative point: this is taken to be approximately 2 m in front or to the side of the power tiller, depending upon the location of the suction or blower device on the power tiller and approximately 1.5 m above the ground;
- Atmospheric pressure;
- Relative air humidity;
- Air temperature at the engine air intake;
- Maximum coolant temperature (no need to report coolant temperature in case of an air-cooled engine);
- The fuel temperature at the inlet to the injection pump;
- Engine oil temperature;
- Exhaust gas temperature.

2.2.6 Presentation of Results

The observed data in 2.2.1 to 2.2.5 shall be reported in tabular form for each test condition (**Annex D-6**). If also presented in graphical form (which is optional), the following, covering the full range of engine speeds tested, shall be included:

- a) Power as a function of speed;
- b) Torque as a function of speed;
- c) Fuel consumption (mass) and specific fuel consumption (mass) as a function of speed;
- d) Specific fuel consumption (mass) as a function of power;
- e) Report the no-load maximum engine speed.

2.3 High Ambient Test (Optional)

The following tests on the engine shall be conducted under high ambient temperature (43 ± 2 °C) (IS 9935:2002).

2.3.1 Maximum power test

2.3.1.1 Maximum power absolute

Operate the power tiller at the engine speed where maximum power occurs for a period of two-hour subsequent to a warming-up period to reach stabilized running conditions. Measure the power, torque, fuel consumption and speed. The maximum power quoted in the test report shall be the average of at least six readings made at regular intervals during two-hour period. If the power varies by more than ± 2 percent from the average, repeat the test. If the variation continues, report the deviation.

If power tiller is not capable of transmitting the full power of the engine, operate it for two-hour at a power specified by the manufacturer. If possible, a 20 percent increase in power shall be applied every 5 minutes for a period of one minute. If the engine cannot develop the 20 percent increase in power, carry out the intermittent test at full engine power.

2.3.1.2 Maximum power at rated engine speed

If maximum power does not occur at rated engine speed, additional one hour test shall be carried out using the procedure stated in 2.3.1.1.

The coolant and lubricating oil consumption shall be recorded as under:

- a) Coolant consumption – liter/kWh
- b) Lubricating oil – g/kWh.

2.3.2 Varying speed test at Full Load (section 6.1.3 of IS 12036: 1995)

Measure the power, torque and fuel consumption as a function of speed at full load. Minimum 6 readings shall be taken between rated rpm and speed at maximum torque. The minimum speeds at which measurements are made shall be at the speed of maximum torque and, if possible, 15 percent below that speed (6.1.3 IS 12036: 1995 and 5.3.2 GB/T 6229-2007).

2.3.3 Presentation of Results

The observed data in 2.3.1 to 2.3.3 shall be reported in tabular form for each test condition (**Annex D-6**). If also presented in graphical form (which is optional), the following, covering the full range of engine speeds tested, shall be included:

- a) Power as a function of speed;
- b) Torque as a function of speed;
- c) Fuel consumption (mass) and specific fuel consumption (mass) as a function of speed;
- d) Specific fuel consumption (mass) as a function of power;
- e) Report the no-load maximum engine speed.

3. ROTARY SHAFT PERFORMANCE TEST

3.1 General

This test is applicable for tilling type power tiller.

The following tests will be conducted on rotary shaft at the lowest rotary shaft speed if there are more than one rotary shaft speeds available.

3.2 Natural Ambient Temperature Test

During the test, the surrounding temperature will be within the range of 27 ± 7 °C.

3.2.1 Varying Speed Test

Measure the power, torque and fuel consumption as a function of speed at full governor at approximately 1-2 percent speed increments. Readings shall be taken between no load rpm and speed at maximum torque (maximum power, rated power, maximum torque readings shall be taken). The minimum speeds at which measurements are made will be at the speed of maximum torque and, if possible, 15 percent below that speed (IS 9935:2002).

3.2.2 Five Hour Test at Rated Power of Rotary Shaft

The rotary shaft shall be run at 90 percent of load (torque) corresponding to maximum power continuously for 4 hours. During the 5th hour, the engine shall be run at a load corresponding to maximum power. During the test the power, torque and fuel consumption will be reported after every half-an-hour during the first 4 hours and after every 15 minutes during the 5th hour (IS 9935:2002).

Report the following:

- Ambient air temperature at a representative point: this is taken to be approximately 2 m in front or to the side of the power tiller, depending upon the location of the suction or blower device on the power tiller and approximately 1.5 m above the ground;
- Atmospheric pressure;
- Relative air humidity;
- Air temperature at the engine air intake;
- Maximum coolant temperature (no need to report coolant temperature in case of an air-cooled engine);
- The fuel temperature at the inlet to the injection pump;
- Engine oil temperature;
- Exhaust gas temperature.

NOTE - If the engine speed recommended for field tests is different from rated engine speed, then tests at the recommended speed setting shall also be conducted.

The data will be recorded in **Annex D-7**.

4. VIBRATION MEASUREMENT TEST

4.1 The power tiller shall be parked on a level concrete surface and tyres inflated according to off field pressure recommended for road work. The power tiller and its rotary tiller attachment (if recommended by manufacturer) shall be operated at rated engine speed at no-load (IS 9935:2002).

4.2 The acceleration of mechanical vibration of components/assemblies of the power tiller shall be measured with the help of suitable vibration measuring device on the components listed in Annex D-8.

4.3 The data shall be recorded in accordance with **Annex D-8**.

5.0 DRAWBAR PERFORMANCE TEST

5.1 General

5.1.1 The power tiller shall be fitted with pneumatic wheels and the test shall be conducted on a clean, horizontal and dry concrete test track containing a minimum number of joints under natural ambient condition.

The test shall be conducted in running state corresponding to the manufacturer's recommendations.

5.1.2 At the beginning of the test, the height of the tyre tread bars shall not be less than 65 percent of their height when new. The measurement shall be made at the centre line of the standard tyres (9.2.6 GB/T 6229-2007).

5.1.3 During the test at drawbar, the governor control shall be set for rated engine speed recommended by the manufacturer of engine.

5.1.4 The test shall not be conducted in the gear for which the forward speed exceeds the safety limit of the testing equipment.

5.1.5 The test shall be made at least in the speeds, from one giving a travel speed immediately faster than in the gear in which the greatest maximum power is developed down to one immediately slower than the gear setting allowing maximum pull to be developed (4.4.1.7 OECD Code 2-2014).

5.1.6 During the test, the line of pull shall be maintained horizontal. The height of the drawbar shall remain fixed in relation to the power tiller.

5.1.7 The measurement of drawbar pull, speed and slip shall be started only after the operational conditions are stabilized.

5.1.8 The test shall be conducted for at least 20 m run continuously without varying atmospheric or track conditions significantly (9.2.8 GB/T 6229-2007).

5.2 Test for Maximum Power and Pull

The test shall be conducted until the maximum power and pull are found in different forward speed gears. Measurement of engine speed, drawbar pull, fuel consumption, forward speed and wheel slip shall be recorded (9.3.1 GB/T 6229-2007).

The maximum drawbar pull and drawbar power shall be recorded at power tiller wheel slippage only up to 15 percent. As the no-slip distance will vary according to the degree of wear of the tyres, it will be necessary to check this regularly, particularly before determining maximum drawbar power (9.3.1 GB/T 6229-2007).

If the manufacturer/applicant recommends ballasting of the power tiller, the test shall be conducted both at ballasted and un-ballasted condition of the power tiller and the results shall be reported separately.

5.3 The data shall be recorded in **Annex D-3** and **Annex D-9**.

6.0 TURNING ABILITY (GB/T 6229-2007 and IS 9935: 2002)

6.1 General

6.1.1 The test area shall be a horizontal compact or paved surface having good tyre adhesion and capable of displaying legible marking.

6.1.2 The power tiller shall be tested with all liquid reservoirs filled to the specified level but without ballast, mounted implements and any other specified components.

6.1.3 At the beginning of the test, the height of the tyre tread bars shall not be less than 65 percent of their height when new. The inflation pressure in the tyres shall be maintained as recommended for the road work by the manufacturer.

6.1.4 The test shall be conducted with the power tiller without tail wheel at the minimum attainable speed. The measurement of radius of turning circle and turning space are referred in figure IIIa.

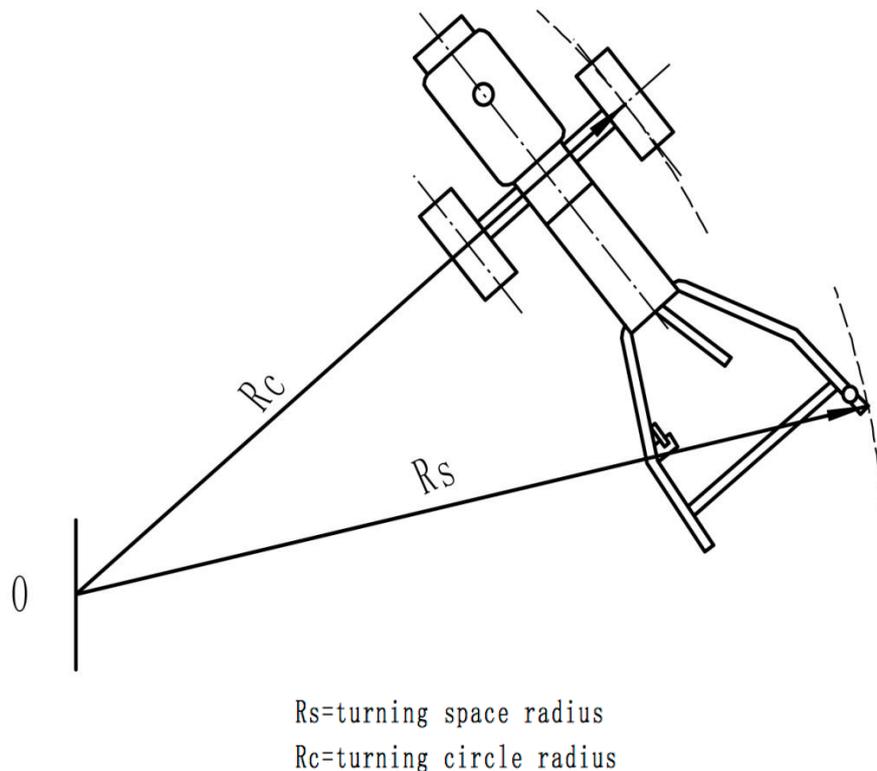


Figure IIIa: The measurement of radius of turning circle and turning space
(6.3.1 GB/T 6229-2007)

6.2 Procedure

The test shall be carried out, at minimum travel speed of the power tiller by turning it to the right and the left sides by the use of steering clutch until a 360-degree turn is completed. During the test, the following shall be recorded:

- a) Diameter of the minimum turning circle, and
- b) Diameter of the minimum turning space required.

6.3 The data shall be recorded in **Annex D-4**.

7.0 PARKING BRAKE TEST

7.1 General

7.1.1 The performance of the parking brake shall be based on the ability to hold the power tiller stationary, facing up and down on slopes.

7.1.2 The power tiller without ballast shall be attached with any matching implement e.g. rotary, plough etc.

7.1.3 The test shall be conducted on a clean, flat and dry concrete test track.

7.2 Procedure

7.2.1 The power tiller shall be placed out of gear on a slope of not less than 18 percent with the brakes applied. The power tiller shall be placed first facing up and then down the slope, the rotation of the braked wheel shall be observed. The observation along with the factors allowing the rotation of the wheels shall be stated in the test report (IS 9935: 2002).

The force, necessary to apply at the control of the parking braking device to hold the power tiller stationary when facing up and down on slopes shall be measured.

7.2.2 The data shall be recorded in **Annex D-5**.

8.0 NOISE MEASUREMENT TEST

8.1 General

8.1.1 Sound level meter which meets the requirements of IEC 60651-1979 for a type 1 instrument shall be used.

8.1.2 The test area shall be a flat open space and shall be within at least 20 m of the test machine. There shall be no obstacle likely to reflect significant sound, such as building, solid fence, tree or other vehicle.

8.1.3 The air temperature shall be in the range from -5 °C to 35 °C and the wind velocity at 1.2 m above ground level shall not exceed 5 m/s (9.2.4 GB/T 6229-2007).

8.1.4 The A-weighted sound pressure level of the background noise, including wind noise, shall be at least 10 dB(A) below that produced by the power tiller being tested.

8.2 Measurement at By-stander Position (IS 12180-2:2000)

8.2.1 The noise shall be measured with instrument of A weighted expressed in decibels set on fast level.

8.2.2 The measurement shall be made with the power tiller stationary on a short grass or soil surface.

8.2.3 The engine of the power tiller shall be operating at the manufacturer's rated speed and all related components shall be functioning as in normal field work. Tillage or moving components shall not engage with the soil or crop.

8.2.4 The microphone positions shall be located at 7.5 m away from the centerline on each side of the power tiller. The microphone shall be 1.2 m above ground level. The microphone shall be oriented in a direction normal to the centerline of the path of travel of power tiller on the track.

8.2.5 The octave band sound pressure level may be optionally measured and reported.

8.2.6 At least 3 measurements shall be made at each position for each operating condition. The reading of the 3 consecutive measurements shall be within 3 dB(A).

8.2.7 The data shall be recorded in **Annex D-10**.

8.3 Measurement at Operator Ear Level (IS 12180-1:2000)

8.3.1 The noise measurement test shall be conducted at the operator's ear level during the drawbar pull test.

8.3.2 The noise shall be measured with instrument of A weighted expressed in decibels set on slow level.

8.3.3 The test shall be conducted at different drawbar loads in different forward speed gears. The drawbar loads shall be applied by the loading device remotely positioned to eliminate interference with the sound fields caused by the power tiller.

8.3.4 During the measurement, the microphone shall be horizontal and facing forward. It shall be 50 mm to the side of the operator's forehead and in line with his eyebrows. It shall be mounted on an open frame helmet.

8.3.5 For seated operators, the microphone shall be located at $250 \text{ mm} \pm 20 \text{ mm}$ to the side of the center plane of the seat, the side being that on which the higher sound pressure level is encountered. The center of the microphone shall be $700 \text{ mm} \pm 20 \text{ mm}$ above the seat index point and $100 \text{ mm} \pm 20 \text{ mm}$ forward of that point. Excessive vibration of the microphone shall be avoided. The seat index point shall be determined in accordance with ISO 5131: 1996.

8.3.6 The sound level measurements shall be made in all forward speed gears under safety test condition. The results shall be reported in the gear giving the nearest forward speed of 2 km/h and also under any gear for which a sound level of at least 1 dB (A) above that of the above-mentioned gear was recorded.

8.3.7 The data shall be recorded in **Annex D-10**.

9.0 WATERPROOF TEST

9.1 General

9.1.1 The waterproof test is conducted to determine the effectiveness of the seals of the power tiller when operated under lowland condition.

9.1.2 The power tiller shall be fitted with puddling wheels as per recommendation of manufacturer and with no implement attached.

9.1.3 The power tiller is classed as “waterproof power tiller,” if after the test described below, there is no soil and water penetration into axle, brake and clutch system (4.9.1 OECD Code 2-2014).

9.2 Test Conditions

9.2.1 Test Bed

9.2.1.1 The test shall be conducted in a testing water bath/soil bin filled with a mixture of soil and water with a ratio of 1:3 by volume (TIS 1350-1996).

9.2.1.2 The soil shall contain 10-30% sand, 10-30% silt and 40-80% clay by weight while potable water shall be used (TIS 1350-1996).

9.2.2 Soil Mixture /Water Level

9.2.2.1 The soil mixture /water level shall be adjusted to the height of the centre line of the wheel axle with the power tiller in a horizontal position.

9.2.2.2 The power tiller shall be installed and fixed on a stand for free rotation of puddling wheels.

9.3 Test Procedures

9.3.1. General Provisions

9.3.1.1 The power tiller shall be in the gear giving the nominal forward speed nearest to 6 km/h (4.9.3.1 OECD Code 2-2014) and operated continuously at rated engine speed for 5 hours.

9.3.1.2 If there is leakage of oil from the axle shaft to the mixture of soil and water prior to the completion of test, then the test shall be terminated.

9.3.1.3 The power tiller shall then be removed from the testing bath and be cleaned.

9.3.1.4 The power tiller shall be left in a place free from rain or snow for at least 12 hours before being finally checked (4.9.3.1 OECD Code 2-2014).

9.3.1.5 The axle, clutch housing, the brake assembly shall then be disassembled and any evidence of soil and water solution penetration into them shall be stated in the test report.

9.3.2 Unsuccessful Test

If the test fails, the manufacturer may ask for a repeat test of the same power tiller but only once. The power tiller when re-tested shall be equipped with the same components after the seals have been changed and/or re-fixed in conformity with manufacturer’s specifications (4.9.3.1 OECD Code 2).

9.3.3 Checking Methods for Ingress of Water/Mud in the Oil

The oil in the housing (e. g. transmission box, engine sump) shall be checked using one or more of the following alternative methods (4.9.3.1 OECD Code 2).

9.3.3.1 Visual method: Distinct emulsification and/or colour change of the oil shall be regarded as proof of water ingress or;

9.3.3.2 Crackling method: When water ingress is not visually distinct, the presence of water in the lubricant shall be checked by putting a heated electric soldering iron into the oil. The presence of water crackling shall be regarded as waterproof failure; conversely, no crackling shall be regarded as waterproofing; or

9.3.3.3 Other methods: Other physical (e.g. centrifugation) or chemical (e.g. Karl-Fisher) standards to check if there is water in the oil.

9.3.4 The data shall be recorded in **Annex D-11**.

10.0 SAFETY REQUIREMENTS

10.1.1 Guards (IS 12239-3:1988)

All hot and dangerous parts shall be guarded or so located that they are safe enough.

10.1.2 Provision of the safety guard which shall not allow the operator's hand, feet and clothing to approach moving parts in normal working conditions, shall be made.

10.2 Controls (IS 12239-3:1988)

10.2.1 Moving parts, pinching points or sharp edge control surfaces are to be effectively shielded or covered with protective material to prevent injury to the operator/workers.

10.2.2 Relative location of hand controls which determine the position of the operator, relative to the power tiller, and location of working parts of tiller should be so designed to prevent accidental contact of operator with such dangerous parts.

10.2.3 All controls shall be identifiable by symbols and displays.

10.2.4 Provision shall be made to protect controls by means of locking device or by location, so as to prevent accidental operation which may cause dangerous movement. The rotary device shall not rotate when the power tiller is operated in reverse gear to protect the operator's feet from injury.

10.2.5 Engine of the power tiller shall be provided with a device to enable it to stop immediately. A clutch device may be provided to disengage the rotary device instantaneously. This should be easily accessible to the operator in his/her working position. These shall be so designed that they do not depend on sustained manual effort for their operation and that when they are in the stop position. Method of operation shall be clearly indicated on the power tiller.

10.3 Working Stability (IS 12239-3:1988)

10.3.1 A retractable ground stand shall be provided which could be easily deployed to arrest over-turning when parking the power tiller. Provision to prevent accidental retraction of the stand shall be made.

10.4 Lighting (IS 12239-3:1988)

10.4.1 For safe operation during night and on highway, effective lighting provision shall be made.

10.4.2 At least a single head-lamp shall be mounted on the front or above the engine of the power tiller.

10.5 Power Transmission (IS 12239-3:1988)

10.5.1 Power take-off shaft - If provided, it shall be protected by means of a non-rotating cover or casing which covers the PTO completely and is attached to the body of the tiller.

10.5.2 Rotary tiller - When rotary tiller or other power attachment with the power tiller is provided, it should be enclosed in a non-rotating casing. This should be so designed as to prevent accidental contact of any part of the operator's body with rotating/cutting parts. Casing so provided should be adjustable so that access is provided for assembly and maintenance of rotary device.

10.6 Other Requirements (IS 12239-3:1988)

10.6.1 The operator should be protected from effects of tillage device on the soil by means of a shield, wherever possible, including mudguards on wheels.

10.6.2 The outlet of the exhaust pipe shall be located and directed in such a way that the operator will not normally be exposed to harmful concentrations of noxious gases or fumes.

10.6.3 The power tiller is to be equipped with brakes which can stop the tiller under all manufacturer's recommended operating conditions.

10.7 Operational Safety Requirements (IS 12239-3:1988)

10.7.1 All routine checks and maintenance schedules as indicated by the manufacturer, are to be clearly understood by the operator before operating the power tiller.

10.8 The observations shall be recorded in **Annex E**.

V. Annexes

ANNEX A LIST OF CITED STANDARDS

Standards No.	Title
ANTAM 001-2016	Asian and Pacific Network for Testing of Agricultural Machinery Standard Code for Testing of Power Tillers
GB/T 6229-2007	Test Methods for Walking Tractors
IEC 60651-1979	Sound Level Meters
IS 12036:1995	Agricultural Tractors-Test Procedures-Power Test for Power Take-off
IS 12180-1:2000	Tractors and Machinery for Agriculture and Forestry-- Noise Measurement- Method of Test: Part: 1: Noise at the Operator's Position - Survey Method
IS 12180-2:2000	Tractors and Machinery for Agriculture and Forestry-- Noise Measurement- Method of Test: Part: 2: Noise Emitted when in motion
IS 12226:1995	Agricultural Tractors -- Power Tests for Drawbar -Test Procedure (First Revision)
IS 9935:2002	Power Tiller -- Test Codes
IS 12239-3:1988	Guide for Safety and Comfort of Operator of Agricultural Tractors and Power Tillers: Part 3: Requirements Relating to Power Tillers
ISO 4251-1:2005	Tyres (Ply Rating Marked Series) and Rims for Agricultural Tractors and Machines -- Part 1: Tyre Designation and Dimensions, and Approved Rim Contour
ISO 5353:1995	Earth-Moving Machinery and Tractors and Machinery for Agriculture and Forestry -- Seat Index Point
ISO 5131:1996	Tractors and Machinery for Agriculture and Forestry- Measurement of Noise at the Operator's Position- Survey Method
JB/T 7282-2004	Types and Specifications of Oils for Tractors
OECD Code 2-2014	OECD Standard Code for the Official Testing of Agricultural and Forestry Tractor Performance
OECD Code 2-2017	OECD Standard Code for the Official Testing of Agricultural and Forestry Tractor Performance
PNS/PAES 117:2000	Agricultural Machinery-- Small Engine- Method of Test
SNI 0738:2014	Quality Standard and Testing Method of Two-wheel Tractors
TIS 1350-1996	Walk-behind tractors
TIS 787-2008	Small size water cooled diesel engines

ANTAM = Asian and Pacific Network for Testing of Agricultural Machinery

IS = Indian Standards

GB/T and JB/T = Chinese Standards

IEC = International Electrotechnical Commission

ISO = International Standard Organization

OECD = Organization for Economic Co-operation and Development

PNS/PAES = Philippines National Standard/Philippines Agricultural Engineering Standard

SNI = Standard National Indonesia

TIS = Thai Industrial Standard

ANNEX B

(Clause 4.2.1 and 4.5)

PROFORMA FOR SELECTION, RUNNING-IN AND REPAIRS

B-1 NAME OF THE MANUFACTURER

B-2 ADDRESS

B-3 SUBMITTED FOR TEST BY

B-4 SELECTED BY

B-5 PLACE OF RUNNING-IN

B-6 DURATION AND SCHEDULE OF RUNNING-IN

B-7 REPAIRS AND ADJUSTMENTS MADE DURING RUNNING-IN

B-8 NUMBER OF SEALING

B-9 LOCATION OF SEALING

ANNEX C⁵*(Clause 1.1.1)***SPECIFICATION SHEET FOR POWER TILLERS**

<p>C-1 POWER TILLER</p> <p>a) Name and address of the manufacturer: b) Name and address of the applicant for test: c) Type: d) Make/Model: e) Serial number: f) Year of manufacture: g) Net mass, kg:</p>
<p>C-2 ENGINE</p> <p>a) Type/Make/Model: b) Name and address of the manufacturer: c) Serial number: d) Engine rated speed (recommended by manufacturer): e) Power at rated speed, kW: f) Net mass, kg:</p>
<p>C-3 CYLINDER AND CYLINDER HEAD</p> <p>a) Configuration (vertical or horizontal): b) Bore/stroke, mm: c) Capacity, cm³: d) Compression ratio: e) Type of combustion chamber:</p>
<p>C-4 FUEL SYSTEM</p> <p>a) Type of fuel b) Capacity of fuel tank, liters: c) Type of fuel filter: d) Manufacturer's production setting of fuel injectors (Valve opening pressure), kPa: e) Injection timing: f) Type of injection pump:</p>
<p>C-5 GOVERNOR</p> <p>a) Type: b) Governed range of engine speed, rpm: c) Rated engine speed, rpm:</p>
<p>C-6 AIR CLEANER</p> <p>a) Type (wet or dry): b) Location of air intake (in case of no pre-cleaner): c) Oil sump capacity, liter:</p>
<p>C-7 EXHAUST</p> <p>a) Type of silencer: b) Location:</p>

⁵ Annex B, C, D and E are developed in reference to IS 9935: 2002.

C-8 LUBRICATING SYSTEM

- a) Type:
- b) Oil sump capacity, litre:

C-9 COOLING SYSTEM

- a) Type:
- b) Details of pump and fan, if available:
- c) Coolant capacity, liter:

C-10 ELECTRICAL SYSTEM

- a) Voltage:
- b) Output power of generator, W:
- c) Details of headlights (number, Watt):

C-11 POWER TRANSMISSION SYSTEM

- a) Gearbox
 - 1) Oil capacity, liters:
 - 2) Grade of oil:
 - 3) Number of gears
 - i) Forward:
 - ii) Reverse:
 - 4) Nominal traveling speed at rated engine speed

	Gear number	Nominal traveling speed (*) at the rated engine speed of ... rpm (km/h)
Forward	L1	
	L2	
	L3	
	H1	
	H2	
	H3	
Reverse	L	
	H	

* Calculated with a pneumatic tyre dynamic radius index of mm
(ISO 4251-1:2005)

- b) Type of main clutch:
- c) Type of steering clutch:

C-12 ROTARY SHAFT (If applicable)

- a) Location:
- b) Number of splines:
- c) Speed, rpm:
- d) Diameter of shaft, mm:
- e) Height above ground, mm:
- f) Direction of rotation (viewed from driving end) :
- g) Rotary shaft speed at rated engine speed, rpm:
- h) Power transmission system
 - 1) Sprocket and chain:
 - 2) Any other:
- i) Arrangement for fitting of tines on the shaft:
- j) Number and type of tines:

C-13 MAIN PULLEY		
<ul style="list-style-type: none"> a) Type and number of belts: b) Diameter, mm: c) Location: d) Reduction ratio (from engine to clutch): e) Rotational speed at rated engine speed (rpm): 		
C-14 HITCH (If applicable)		
<ul style="list-style-type: none"> a) Type (pin or nut and bolt): b) Location: c) Height above ground level, mm <ul style="list-style-type: none"> 1) Maximum: 2) Minimum: 		
C-15 PARKING BRAKE		
<ul style="list-style-type: none"> a) Type: b) Method of operation: 		
C-16 WHEEL		
<ul style="list-style-type: none"> a) Tyres <ul style="list-style-type: none"> 1) Make: 2) Size: 3) Type of tyre: 4) Ply rating: 5) Recommended inflation pressure, kPa <ul style="list-style-type: none"> i) For fieldwork: ii) For transport: 6) Track width, mm: 7) Method of changing track width, range and number of steps: 8) Method of changing track width, if any, and range: b) Steel wheel for wet land <ul style="list-style-type: none"> 1) Track width, mm: 2) Type: 3) Size <ul style="list-style-type: none"> i) Diameter, mm: ii) Width, mm: 4) Total mass (2 wheels), kg: c) Tail wheel (if applicable) <ul style="list-style-type: none"> 1) Steel wheel <ul style="list-style-type: none"> i) Diameter, mm: ii) Width, mm: iii) Mass, kg: 2) Pneumatic tyre <ul style="list-style-type: none"> i) Type: ii) Tyre inflation, kPa: iii) Mass, kg: 		
C-17 OPERATOR'S SEAT FOR RIDING TYPE		
<ul style="list-style-type: none"> a) Type: b) Type of suspension: c) Range of adjustment (if any), mm: 		
C-18 MASS OF BALLAST		
<i>Ballast Mass as Used, kg</i>		
	<i>Water</i>	<i>Cast Iron Weight on -Wheel</i>

Optional ballast				
C-19 MASS OF POWER TILLER (WITHOUT DRIVER BUT WITH LUBRICANT, FUEL AND COOLANT FULL)				
	Ballast		Unballast	
Total				
C-20 OVERALL DIMENTIONS (mm)				
<i>Conditions</i>	<i>Length*</i>	<i>Width*</i>	<i>Height*</i>	<i>Ground Clearance</i>
<i>With ballast</i>				
<i>Without ballast</i>				
<i>* Measure the outermost points</i>				

ANNEX D

(Clause 2.2.1 to 2.2.5, 3, 4, 5, 6, 7, 8, 9)

DATA SHEET FOR LABORATORY AND TRACK TESTS OF POWER TILLER

D-1 POWER TEST				
a) Date and place of test:				
b) Type of dynamometer used:				
c) Fuel used				
1) Type:				
2) Density at 15°C:				
d) Engine oil used				
1) Type:				
2) Grade:				
e) Transmission oil used:				
f) No load maximum engine speed, rpm:				
g) Engine performance test data are given in D-6 :				
D-2 ROTARY SHAFT TEST				
a) Date and place of test:				
b) Type of dynamometer used:				
c) Fuel used				
1) Type:				
2) Density at 15°C:				
d) Engine oil used				
1) Type:				
2) Grade:				
e) Type of transmission oil used:				
f) No load maximum engine speed, rpm:				
g) Engine performance test data sheet given in D-6 :				
D-3 DRAWBAR PERFORMANCE TEST				
a) Date and location of tests:				
b) Type of track:				
c) Height of drawbar point above ground:				
d) Mass of power tiller, without ballast:				
e) Type and size of tyres:				
f) Tyre pressure, kPa:				
g) Details of fuel used (fuel number and standard):				
h) Test data (see D-8):				
D-4 TURNING ABILITY				
a) Details of wheels				
1) Wheel track, mm:				
2) Size of tyres:				
3) Pressure of tyres, kPa:				
b) Test data				
<i>Description</i>	<i>Minimum Turning Circle Diameter</i>		<i>Minimum Turning Space Diameter</i>	
	<i>Right Hand Side (m)</i>	<i>Left Hand Side (m)</i>	<i>Right Hand Side (m)</i>	<i>Left Hand Side (m)</i>

(1)	(2)	(3)	(4)	(5)
<i>With Steering Clutch</i>				
D-5 PARKING BRAKE TEST				
Power tiller mass, kg:				
Degree of slope ($^{\circ}$):				
<i>Observations</i>	<i>Parking Braking Device Facing up Slope</i>		<i>Parking Braking Device Facing down Slope</i>	
(1)	(2)		(3)	
<i>Parking device control force (N)</i>				
<i>Whether rolling of braking wheels noticed</i>	<i>Yes/No</i>		<i>Yes/No</i>	
<i>Efficacy of brakes</i>	<i>Yes/No</i>		<i>Yes/No</i>	

D-6 ENGINE PERFORMANCE TEST DATA SHEET														
Test	Power (kW)	Crank Shaft Torque (Nm)	Engine Speed (rpm)	Fuel Consumption		Specific Energy (kWh/l)	Temperature, °C					Atmospheric Conditions		
				Hourly (kg/h)	Specific (g/kWh)		Fuel	Intake air	Engine oil	Co olant	Exh aust air	Temp (°C)	Relative Humidity (%)	Pressure (kPa)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Natural Ambient														
i) Maximum power test														
ii) Power at rated engine speed														
Varying engine speed at full load i) ii) iii) iv) v) vi)														
Rated engine speed at varying load i) ii) iii) iv) v) vi)														

2. High Ambient (Optional)													
i) Maximum power test absolute i) ii) iii)													
ii) Maximum power at rated engine speed i) ii) iii)													
i) Varying speed at full load i) ii) iii) etc													

- a) Coolant consumption, liter/kWh:
- b) Specific consumption of lubricating oil, g/kWh:

FIVE HOURS TEST												
Test	Power (kW)	Crank Shaft Torque (Nm)	Engine Speed (rpm)	Fuel Consumption		Specific Energy (kWh/1)	Temperature (°C)			Atmospheric Conditions		
				Hourly (kg/h)	Specific (g/kWh)		Fuel	Engine oil	Coolant	Temp (°C)	Relative Humidity (%)	Pressure (kPa)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Five hours engine rating												

test a) At load corresponding to 90% of maximum power (4 hour) i) ii) iii) etc.														
At load corresponding to maximum power i) ii) iii)														

D-7 ROTARY SHAFT PERFORMANCE TEST DATA SHEET

Sl. No.	Test Condition	Tests	Rotary Shaft Power (kW)	Rotary Shaft Torque (N.m)	Engine Speed rpm	Fuel Consumption		Specific Energy (kWh/l)	Temperature (°C)					Pressure (kPa)			Atmospheric Conditions			Rotary Shaft Oil Temp (°C)	
						Hourly (g/h)	Specific (g/kWh)		Fuel	Engine Oil	Exhaust	Intake Air	Coolant	Intake Air	Exhaust Gas	Lub Oil	Temp (°C)	Relative Humidity (%)	Pressure (kPa)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(22)	
i)	Normal Ambient Test	Varying engine speed at full load i) ii) iii) etc																			
	same	Five hours test at rated power of rotary shaft a) At load corresponding to 90% of maximum power (4 hours): i) ii) iii) etc b) At load corresponding to maximum power i) ii) iii) etc																			

D-8 TEST DATA FOR VIBRATION MEASUREMENT

D-8.1 Date of test

D-8.2 Type of instrument

D-8.3 Location of test

D-8.4 Type of power tiller (tilling or pull)

S.No.	Measuring points		Acceleration (m/s ²)	
			HD	VD
			1	Steering handle
		Right arm grip		
2	Operator's seat (without operator)			
3	At main frame where engine is mounted			

* HD: Horizontal direction

VD: Vertical direction

D-9 TEST DATA FOR DRAWBAR PERFORMANCE

Test	Gear Number Used	Travel Speed (km/h)	Drawbar Pull (kN)	Drawbar Power (kW)	Wheel Slip (%)	Engine Speed (rpm)	Fuel Consumption		Specific Energy (kWh/1)	Atmospheric Conditions		
							kg/h	g/kWh		Temperature (°C)	Pressure (kPa)	Relative Humidity (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Maximum power test (power tiller un-ballasted)												
i)												
ii)												
iii)												

D-10 DATA SHEET FOR NOISE MEASUREMENT

MEASUREMENT POSITION				Operator Ear Level	By-stander	
D-10.1 Brief Description of the Silencing System						
D-10.2 Sound Level Meter 1) Type: 2) Make: 3) Model:						
D-10.3 Date of Test						
D-10.4 Background Noise Level, dB (A)						
D-10.5 Atmospheric Conditions a) Temperature, °C b) Wind velocity, m/s c) Pressure, kPa d) Relative humidity, %						
D-10.6 Test Data for Operator Ear Level						
No	Gear Used	Travelling Speed (km/h)	Engine Speed (rpm)	Slip (%)	Drawbar Pull (kN)	Sound Level dB (A)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1						
2						
3						
4						
5						
6						

D-10.7 Test Data for By-stander Position

S. No.	Gear Used	Engine Speed, rpm	Noise Level, dB (A)

D-10.8 Test Data for Octave Band Noise Level Measurement at By-stander Position

S. No.	Gear Used	Engine Speed (rpm)	Sound Pressure Level, dB(A)								
			Centre Frequency, Hz								
			31.5	63	125	250	500	1000	2000	4000	8000

D-11 DATA SHEET FOR WATERPROOF TEST

Sr No.	Components	Ingress of Mud/Water
1	Axle	Yes/No
2	Clutch housing	Yes/No
3	Brake assembly	Yes/No

ANNEX E
PROFORMA FOR SAFETY CHECK

E1-Guards

Sr No.	Moving Parts	Guarded or Safely Located
1	Main shaft of power tiller	Yes/No
2	Main pulleys	Yes/No
3	Flywheel	Yes/No
4	Rotary chains	Yes/No
5	Belts	Yes/No
6	Rotary tiller	Yes/No

Sr No.	Hot Parts	Guarded or Safely Located
1	Exhaust silencer	Yes/No
2	Exhaust manifold	Yes/No
3	Any others	Yes/No

E-2 Controls

Sr No.	Controls	Identifiable or Displayed
1	Clutch lever	Yes/No
2	Brake lever	Yes/No
3	Throttle lever	Yes/No
4	Lever to stop engine immediately	Yes/No
5	Main gear shifting lever	Yes/No
6	High/low gear shifting lever	Yes/No
7	Rotary engaging lever	Yes/No
8	Steering handle with side clutch lever	Yes/No
9	Tail wheel height adjusting lever	Yes/No

E-3 Working Stability

Is ground stand of power tiller retractable? Yes/No

E-4 Lighting

Is head light available in the power tiller? Yes/No

E-5 Power Transmission

Is power take-off (if provided) available with guard? Yes/No

Is rotary tiller available with guard or cover? Yes/No

E-6 Other Observations, if any

Appendix 1

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