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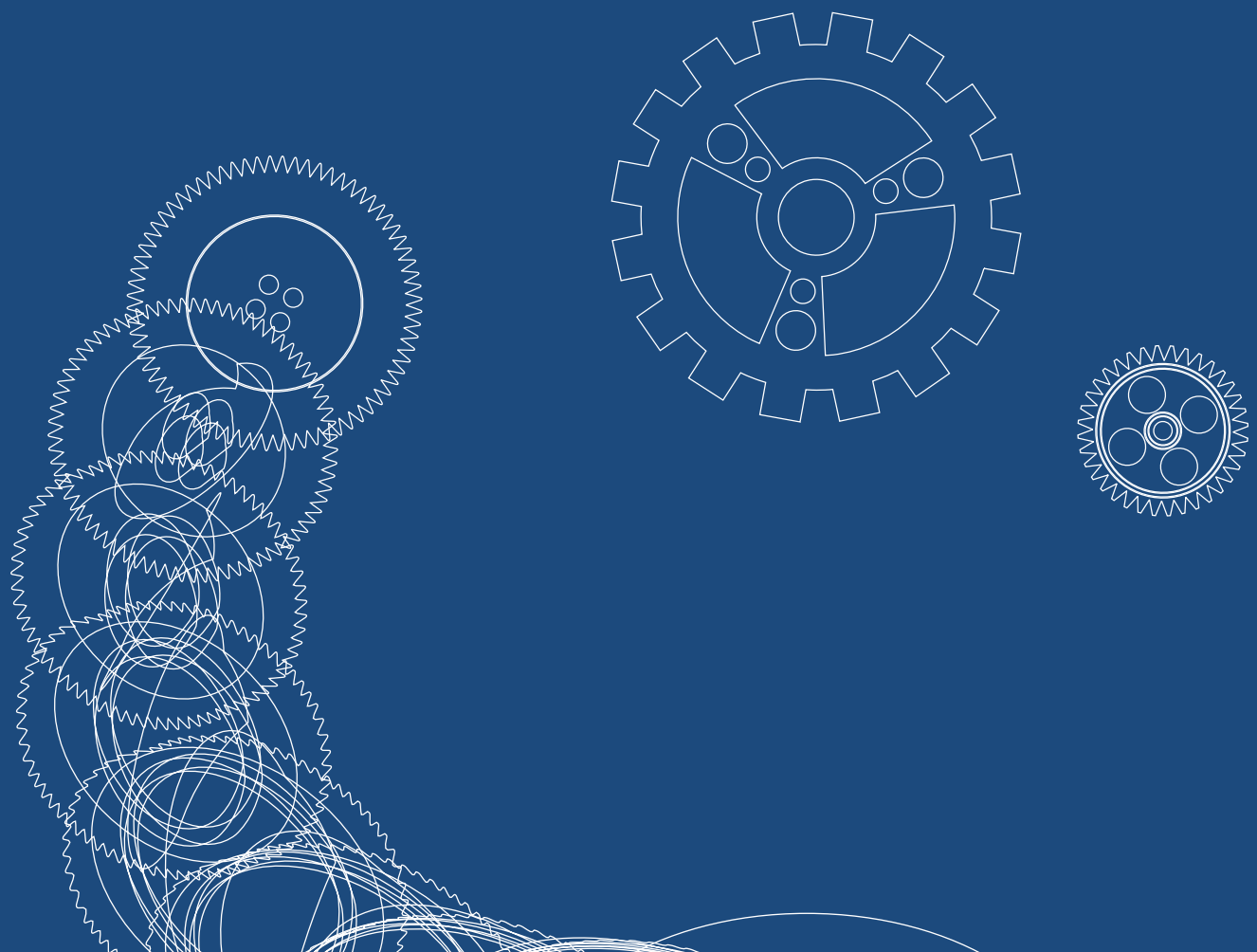
CSAM

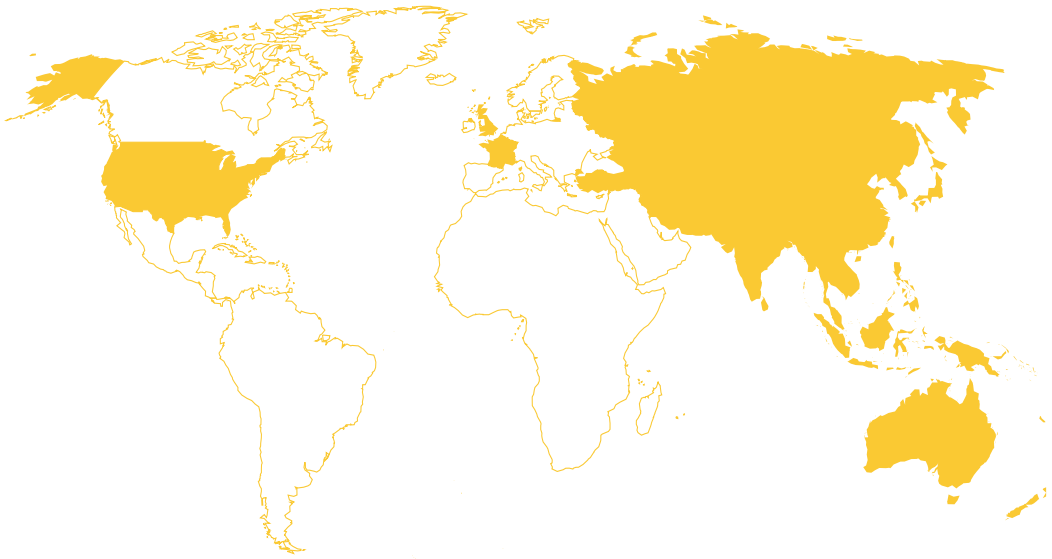
ANTAM STANDARD CODES FOR TESTING OF POWER TILLERS



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

ANTAM STANDARD CODES
FOR TESTING OF POWER TILLERS

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

July 2015

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I. FOREWORD

In the Asia-Pacific region, agricultural mechanization is playing an important role in increasing efficiency of agricultural production and enhancing rural economies propelled by population growth, increasing labour cost, shortage of agricultural labour force and feminization of agricultural production. Currently, countries across region are embracing agricultural mechanization to meet the growing demand for food.

According to the World Bank estimate in 2010, over the past two decades, the Asia-Pacific region has emerged as the largest market in the world in terms of sales of agricultural machinery, implements and equipment. In 2015, it is projected to have sales of US$ 49 billion as compared to US$ 27 billion in North America and US$ 20.5 billion in Western Europe. However, the use of unsafe and inefficient agricultural machinery not only results in potential loss of food production by farmers, but also exerts negative impact on the agro-ecosystem, and inflicts huge social costs as a result of absence of safety standards.

Sustainable intensification of agricultural production requires mechanization of farm operations to address both production gains and environmental protection. As part of their sustainable agricultural mechanization strategies, governments start laying emphasis on standardization and testing of agricultural machinery in order to reduce the economic, environmental and social cost inflicted by sub-standard machinery, and to increase farmers' access to safe, reliable and efficient machinery at affordable cost. However, countries are faced with common constraints of lack of technological know-how, inadequate infrastructure and shortage of trained technicians to conduct standard testing of agricultural machinery.

The on-going efforts made by governments to address the mechanization needs of farmers necessitate a region-wide mechanism to standardize and harmonize testing codes of agricultural machinery for the benefits of farmers, food production, environment and intra-regional trade.

The establishment of a regional network to promote trade in safe and reliable agricultural machinery through adoption of uniform regional testing codes and procedures was first proposed in 2006 at a regional roundtable of agricultural machinery manufacturers associations and distributors organized by the Centre for Sustainable Agricultural Mechanization (CSAM) in Seoul, Korea. In 2009, CSAM commissioned a feasibility study to review the status of agricultural mechanization in the Asia-Pacific region and gauge the needs of member countries for agricultural mechanization. The results of the study highlighted the demands of member countries to promote knowledge & technology sharing and capacity building through enhanced regional collaboration. The ensuing deliberations by member countries at the Centre's Technical Committee and the Governing Council meetings requested the Centre to spearhead an initiative to address their acute need for improving the testing capacity, training of technicians and building a regional institutional framework to promote sustainable agricultural mechanization.

The Asian and Pacific Network for Testing of Agricultural Machinery (ANTAM) was officially launched on 18 November 2013 in Bangkok, Thailand at a regional policymakers' roundtable, and the Terms or Reference of the Network was subsequently adopted by the Governing Council of CSAM at its ninth session in the same year.

ANTAM is a regional network composed of national testing stations of agricultural

machinery, research and extension institutes, associations and farmers organizations across the Asia-Pacific region. It is mandated to promote manufacture, adoption of and trade in safe, efficient and environmentally friendly agricultural machinery through harmonizing testing codes and procedures among participating countries for sustainable agricultural production.

To date, 16 member States and a region of ESCAP have designated focal points for ANTAM (Appendix I), and the 1st annual meeting of ANTAM was held from 16 to 19 September 2014 in Beijing, China (summary report of the meeting is attached in Appendix II). The Advisory Panel of ANTAM is comprised of CSAM, FAO, OECD, UNIDO and the European Network for Testing of Agricultural Machinery (ENTAM) represented by the Italian Agency for Agricultural Mechanization (ENAMA), China and India (Chair and Vice-Chair for ANTAM 2014-2015).

The Technical Working Group (TWG) of ANTAM (Appendix III) was set up in February 2015 upon nominations from ANTAM focal points in respective countries to provide technical advice and develop ANTAM testing codes. Based on the decision of the 1st annual meeting of ANTAM and consultations with the TWG members, it was agreed to first develop testing codes on power tillers and powered knapsack misters/cum dusters given their wide application across the region. Subsequently, a Sub-working Group on Power Tillers and a Sub-working Group on Powered Knapsack Misters-Cum-Dusters were set up.

ANTAM test codes on power tillers were formulated by referring to relevant ISO and OECD standards, and merging relevant national standards of China, India, Indonesia, Philippines, and Thailand where the machinery is popularly used so as to reflect the unique local conditions. The test codes are subject to regular review, update and revision. The implementation of the codes is voluntary.

The current ANTAM test codes were developed based on the draft prepared by Dr. Chan Chee-Wan, Lead Technical Expert of ANTAM, contracted by CSAM, who also provided invaluable technical support during the consultation process. The consultation process was culminated at the 1st TWG meeting held on 4-6 May in Serpong, Indonesia with contribution from Dr. Israil Hossain, Mr. Chao Sinh, Mr. CHANG Xiongbo, Mr. Jandool Khan, Mr. Darwin Aranguren, and Dr. Anuchit Chamsing. Comments were also received from Mr. C.R. Lohi, Dr. Vadim Pronin, and Mr. Chakradhar Chimote. Ms. AI Yuxin, Programme Officer of CSAM in charge of ANTAM project, worked on Part I and Part II, provided substantive editing and led the coordination process. Ms. Camilla Stelitano, individual contractor of CSAM, provided indispensible support to the editing and coordination. Mr. WEI Zhen, IT Assistant of CSAM, contributed layout design. Ms. WU Sheng, Research Assistant of CSAM, provided logistical support. Thanks to Dr. WANG Guanghui and Mr. TANG Dingchao for developing drawings of the codes, and Dr. YANG Minli for providing technical reference. Thanks also to ANTAM focal points in China and India, and Ms. HAN Xue, Mr. Vijaykumar Kale, Dr. Kanchan Kumar Singh in particular for their administrative support.

Special thanks to Mr. ZHAO Bing, Head of CSAM, for his staunch support and guidance. Deep gratitude goes to the Italian Agency for Agricultural Mechanization (ENAMA), the Technical Reference Unit of ANTAM, for providing technical peer review, and Dr. Sandro Liberatori for his unwavering support and commitment to ANTAM. Profound appreciations go to collaborating partners of ANTAM, including FAO, OECD, UNIDO and all ANTAM focal points in member countries for their support and contribution.

Appendix 1

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(As of February 2015)

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Appendix 2

SUMMARY REPORT OF THE 1ST ANNUAL MEETING OF ANTAM

1. The 1st Annual Meeting of ANTAM was held on 16-19 September in Beijing, China. Participants from 19 member States of UNESCAP, i.e. Bangladesh, China, Cambodia, France, Fiji, India, Indonesia, Japan, Malaysia, Mongolia, Nepal, Pakistan, Papua New Guinea, Republic of Korea, Russia, Sri Lanka, Thailand, The Philippines, Viet Nam, as well as representatives from relevant UN agencies and international organizations including ESCAP, FAO, OECD, UNIDO and ENAMA/ENTAM, and representatives of manufacturers, industry associations and farmers' organizations across the Asia-Pacific attended the meeting.

2. Dr. Kanchan Kumar Singh, Assistant Director General of the Indian Council of Agricultural Research, was elected the Chair of the 1st annual meeting.

3. China and India were elected Chair, Vice Chair of ANTAM for 2014-2015, and China Agricultural Machinery Testing Centre (CAMTC) was elected the Lead Focal Point for 2014-2015. China and India would join CSAM, ENAMA/ENTAM, FAO, OECD, UNIDO on the Advisory Panel of ANTAM.

4. Member countries the work report and work plan of ANTAM for 2014-2015 prepared by the Secretariat of ANTAM, and emphasized the importance of building a region-wide database of agricultural machinery test codes and procedures to enhance better understanding of the existing practices across the region, and to facilitate harmonization of test codes and procedures.

5. Member countries also requested CSAM to collaborate with relevant UN agencies (UNIDO, FAO and etc.) to jointly develop a project to assist member countries in upgrading the existing testing capacity.

6. Member countries agreed to nominate one or two experts for the Technical Working Group (TWG) of ANTAM by the end of October 2014. The Terms of Reference of the nomination would be circulated by CSAM after the meeting.

7. Member countries reviewed the operational structure of ANTAM outlined in the existing ToR, and discussed and agreed to rename the Steering Committee as "Advisory Panel", consisting of up to 10 members.

8. Member countries agreed with an interim arrangement of establishing an independent Technical Reference Unit (TRU) to provide technical support and third-party, objective check on the technical content of the reports performed by member countries in compliance with ANTAM codes and procedures, and provide a linkage with FAO and OECD on test codes and procedures during 2014-2016. The TRU during this period would be represented by ENAMA. Member countries would later consider necessary amendment to the existing ToR by incorporating the TRU with detailed functions, responsibilities and operation mechanism. CSAM would prepare a text and circulate it among member countries for prior consideration and following adoption when conditions were ripe.

9. Member countries decided that draft ANTAM test codes and procedures for tractors and knapsack mister cum dusters would be prepared by the TWG under the guidance of the Advisory Panel with technical support from TRU by April 2015. The Advisory Panel would review the draft test codes. Member countries agreed to conduct voluntary sample tests of the ANTAM codes and procedures, and produce reports before the 2nd Annual Meeting. The draft ANTAM test reports would be submitted to the 2nd Annual Meeting of ANTAM for review.

10. On financial arrangement, member countries agreed with the necessity to solicit funds to ensure the operation of ANTAM particularly during the initial operation stage, and suggested a minimum amount of voluntary contribution to finance the operation of ANTAM should be decided. A proper funding mechanism should be established.

11. Member countries requested CSAM to prepare a letter to help them lobby financial support from their respective authorities. Member countries further suggested that contribution to ANTAM be clubbed with their existing contributions to CSAM.

12. It was agreed that the 2nd Annual Meeting of ANTAM would be held in the second half of 2015. The date and venue of the meeting would be decided in consultation with member countries.

13. The summary report was adopted by consensus on 18 September 2014.

Appendix 3

Name List of ANTAM TWG Members

Sub-working Group on Power Tillers
(As of April 2015)

Name	**Country**
Dr. Israil Hossain	Bangladesh
Mr. Sinh Chao	Cambodia
Mr. CHANG Xiongbo	China
Mr. C. R. Lohi	India
Mr. Jandool Khan	Pakistan
Mr. Darwin Aranguren	Philippines
Dr. Vadim Pronin	Russia
Dr. Anuchit Chamsing	Thailand

Sub-working Group on Powered Knapsack Misters-Cum-Dusters
(As of April 2015)

Name	**Country**
Mr. ZHANG Xiaochen	China
Dr. Douzals Jean-Paul	France
Dr. K. N. Agrawal	India
Ms. Ayesha Herath	Sri Lanka
Mr. Ngo Van Phuong	Vietnam

II. Method of Operation

ANTAM test codes are aimed to establish specifications and basic performance criteria to increase safety, technical reliability of machinery and enhance market confidence. Based on mutual recognition of testing results through harmonized standards and procedures, ANTAM test codes will facilitate cross border trade of agricultural machinery by enabling both importing and exporting countries to accept with confidence the testing results conducted by another country.

ANTAM codes are a means to simplify trade procedures by avoiding repetition of tests, to provide market transparency through standardization, and to enhance the market competitiveness of the agricultural machinery industry by stimulating technology renovation.

ANTAM test codes shall be locally relevant, cost-effective, enforceable and sustainable, contributing to bringing the existing standards and testing procedures on par with international standards for health, safety and environmental protection.

Being progressive and dynamic in nature, ANTAM test codes are reviewed and updated by the Technical Working Group (TWG) of ANTAM at its annual meetings. The TWG is tasked to develop, review and revise ANTAM codes based on the decision adopted at the annual meeting of ANTAM. The annual meeting of ANTAM shall adopt the test codes by consensus of participating countries.

ANTAM test codes draw reference to the most relevant international standards and guidelines such as ISO and OECD standards and FAO guidelines. In addition, national standards have been taken into consideration when the machinery popularity reflects the unique local condition. ANTAM test codes can be used by member countries in their entirety or partially for national testing as well. ANTAM test codes apply only on designated equipments. Implementation of ANTAM test codes by participating countries is voluntary.

The participating national designated testing stations are responsible for using the codes to carry out the tests and issue test reports. They shall certify that ANTAM codes are followed and the corresponding test report complies with ANTAM test codes and procedures. ANTAM strongly encourages the implementation of round robin tests among testing stations in order to insure 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 responsibility of ANTAM shall not be engaged in case of legal or technical problem due to inappropriate testing method.

Any testing station from an ANTAM member country is welcome to use the test codes assuming it is provisioned with adapted testing equipments, facilities and skilled personnel. The ANTAM Secretariat shall work with the Technical Reference Unit (TRU), an independent, third party accredited by member countries at the annual meeting, to check the technical contents of the report to ensure strict compliance. Upon approval and validation by the ANTAM Secretariat, ANTAM logo shall be used on the tested machinery. The ANTAM Secretariat will then release the test report on its website.

III. GENERAL TEXTS

1.0 SCOPE

This standard covers the terminology, general guidelines and tests to be conducted on power tillers. The standard also covers methodology for checking on machine specifications, engine performance, drawbar performance, turning ability, parking brake and noise measurement at operator's ear level.

The tests conducted for establishing performance characteristics of power tillers that are ready for commercial production or already in production.

2.0 REFERENCES

The standards listed in **Annex A** contain provisions which through reference in this text, constitute provision of this standard incorporating existing national standards practiced by ISO, OECD, and China, India, Indonesia, Philippines and Thailand.

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.

3.0 TERMINOLOGY

3.1 Power Tiller

A prime mover having single axle in which the direction of travel and its control for field operation is performed by the operator walking behind it. It is also known as hand or walking type tractor. Some of these may have riding arrangement.

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.

3.1.2 Pull Type

The power tiller which pulls various kind of implements.

3.1.3 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 radius corresponding to the average distance travelled by the power tiller in one rotation of the driving wheels (that is, this distance divided by 2ð). When the power tiller is driven without drawbar, load at a speed of approximately 2 km/h.

3.6 Wheel Slip (for dry land operation)
This shall be determined by the following formula:

Where

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

N1 = Sum of revolutions of driving wheels for a given distance (at least 20 m) when the power tiller is driven under load, and
N2 = 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 any wear on tyres and placed on a firm horizontal surface (4.2.1 IS 9935-2002). A minimum tyre lug height of 65% versus new tire is not accepted (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 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 tire pressure will 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 pro-forma given in **Annex C**.

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, and
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 and any other adjustments 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 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, may be fitted. For wheeled power tillers, liquid 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 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 C**. This shall not include those maintenance jobs and adjustments which are performed in conformity with the manufacturer's recommendations.

4.6 Fuel and Lubricants

Fuel and lubricants for the tests shall conform to the printed literature supplied by the manufacturer (5.3 IS 12226: 1995 and JB/T 7282- 2004).

4.7 Auxiliary Equipments

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. Efforts shall be made to limit the temperature variations throughout the tests.

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 ℃ (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

Minimum 96.6 kPa during laboratory tests (5.2.3 GB/T 6229-2007). The pressure shall be noted at the beginning of the test.

4.9.2 Temperature

For power tests, the normal ambient temperature shall be 27$\pm$7 ℃ (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):

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

IV. CODES

Tests to be conducted on a power tiller are given below: checking of the specification, engine performance, drawbar performance, turning ability, parking brake and noise measurement at operator's ear level.

1.0 CHECKING OF SPECIFICATIONS

1.1 Specification Sheet

1.1.1 The power tiller manufacturer/applicant shall supply the specification of the power tiller consisting of the items listed in the specimen report given in **Annex B**, as well as any other information required by the testing authority to carry out the tests. The manufacturer/ applicant should also supply technical literature such as operational, 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 Standards 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 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 2^0 (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 $27 \pm 7\ ^0$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 the 2 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 optional additional 1 hour test should be carried out using the procedure stated in 2.2.1.

2.2.3 Varying Speed at Full Load

Measure the power, torque and fuel consumption as a function of speed at full power at approximately 10 percent speed increments. 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 Loads 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); and
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 80 percent of load (torque) corresponding to maximum power (7.6 SNI 0738: 2014, TIS 787-2008 and 5.2.3 PNS/PAES 117: 2000). 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).

2.2.6 Presentation of Results

The 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.

3.0 DRAWBAR PERFORMANCE TEST

3.1 General

3.1.1 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 (IS 993:2002).

The test shall be conducted without ballast.

3.1.2 During the test at drawbar, the governor control shall be set for maximum power at rated engine speed defined by the test (4.4.1.7 OECD Code 2-2014).

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

3.1.4 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).

3.1.5 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.

3.1.6 At the beginning of the test, the height of the tyre tread bars shall not be less than 65% 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).

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

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

3.2 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).

3.3 The data shall be recorded in D-3 and D-8.

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

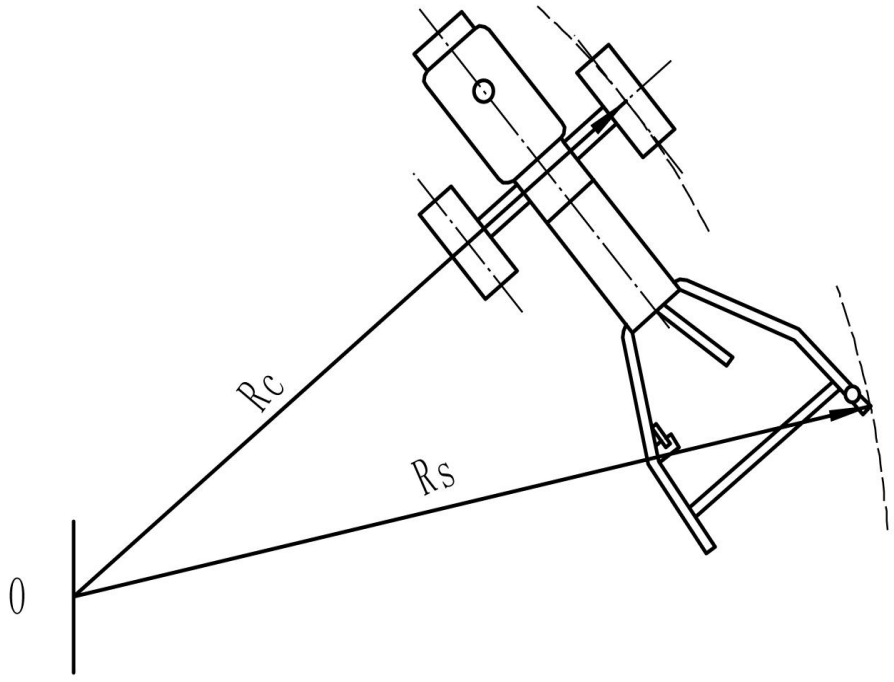
4.1 General

4.1.1 The test area shall be a horizontal compacted or paved surface having good tire adhesion and capable of displaying legible marking.

4.1.2 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.

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

4.1.4 The test shall be conducted with the power tiller without tailed wheel at the minimum attainable speed. The measurement of the turning circle and turning space are referred in figure 4a.



Rs=turning space radius
Rc=turning circle radius

Figure 4a: The measurement of radius of turning circle and turning space
(6.3.1 GB/T 6229-2007)

4.2 Procedure

The test shall be carried out, using minimum travel speed, on the power tiller by turning it to the right and the left side by the use of steering clutch till 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.

4.3 The data shall be recorded in D-4.

5.0 PARKING BRAKE TEST

5.1 General

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

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

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

5.2 Procedure

5.2.1 The power tiller shall be placed out of gear on a slope of not less than 18% 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 shall be measured.

5.2.2 The data shall be recorded in Annex D-5.

6.0 NOISE MEASUREMENT TEST (IS 12180 (Part 1): 2000)

6.1 General

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

6.1.2 Sound level meter which meets at least the requirements of IEC 651- 1979 for a type 1 instrument shall be used.

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

6.1.4 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.

6.1.5 The air temperature shall be in the range from -5 ℃ to 35 ℃ and the wind velocity shall not exceed 5 m/s at the operator's position (9.2.4 GB/T 6229-2007).

6.1.6 For seated operators, the microphone shall be located 250 mm ± 20 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 axis of the microphone shall be horizontal and the diaphragm shall face forwards. The centre of the microphone shall be 700 mm ± 20 mm above the seat index point and 100 mm ±20 mm forward of that point. Excessive vibration of the microphone shall be avoided. The seat index point shall be determined in accordance with ISO 5353: 1995.

6.2 Procedure

6.2.1 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.

6.2.2 During the measurement, the microphone shall be horizontal and facing forward. It shall be 5 cm to the side of the operator’s forehead and in line with his eyebrows. It shall be mounted on an open frame helmet.

6.2.3 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 2km/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.

6.2.4 The data shall be recorded in Annex E.

V. ANNEX A

LIST OF CITED STANDARDS

Standards No.	Title
GB/T 6229-2007	Test methods for walking tractor
IEC 651-1979	Sound level meters
IS 12036:1995	Agricultural tractors--Test Procedures-Power tests for power take-off
IS 12180 (Part 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 12226:1995	Agricultural tractors -- Power tests for drawbar -Test procedure (first revision)
IS 9935:2002	Power tiller -- test codes
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
JB/T 7282-2004	Types and specifications of oils for tractors
OECD Code 2-2014	OECD standard code for the official testing of 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 787-2008	Small size water cooled diesel engines

***** *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[1]

(Clause 1.1.1)

SPECIFICATION SHEET FOR POWER TILLERS

B-1 POWER TILLER 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:
B-2 ENGINE a) Type/Make/Model: b) Manufacturer: c) Serial number: d) Engine rated speed (recommended by manufacturer) : e) Power at rated speed, kW: f) Net mass, kg:
B-3 CYLINDERAND CYLINDER HEAD a) Configuration (vertical or horizontal): b) Bore/stroke, mm: c) Capacity, cm^3: d) Compression ratio: e) Type of combustion chamber:
B-4 FUEL SYSTEM 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:
B-5 GOVERNOR a) Type: b) Governed range of engine speed, rpm: c) Rated engine speed, rpm:
B-6 AIR CLEANER a) Type (wet or dry) : b) Location of air intake (in case of no pre-cleaner) : c) Oil sump capacity, liter:
B-7 EXHAUST a) Type of silencer: b) Location:

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

B-8 Oil sump capacity, liter:

B-9 COOLING SYSTEM

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

B-10 ELECTRICAL SYSTEM

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

B-11 POWER TRANSMISSION SYSTEM

a) Gearbox
1) Oil capacity, liters:
2) Number of gears
i) Forward:
ii) Reverse:
3) 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	L1	
	H1	

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

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

B-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:

B-13 MAIN PULLEY

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):

B-14 HITCH (If applicable)

a) Type (pin or nut and bolt):
b) Location:
c) Height above ground level, mm
  1) Maximum:
  2) Minimum:

B-15 PARKING BRAKE

a) Type:
b) Method of operation:

B-16 WHEEL

a) Tyres
  1) Make:
  2) Size:
  3) Type of tyre:
  4) Ply rating:
  5) Recommended inflation pressure, kPa
    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
  1) Track width, mm:
  2) Type:
  3) Size
    i) Diameter, mm:
    ii) Width, mm:
  4) Total mass (2 wheels), kg:
c) Tail wheel (if applicable)
  1) Steel wheel
    i) Diameter, mm:
    ii) Width, mm:
    iii) Mass, kg:
  2) Pneumatic tyre
    i) Type:
    ii) Tyre inflation, kPa:
    iii) Mass, kg:

B-17 OPERATOR'S SEAT FOR RIDING TYPE

a) Type:
b) Type of suspension:
c) Range of adjustment (if any), mm:

B-18 MASS OF BALLAST

Ballast Mass as Used, kg		
	Water	*Cast Iron Weight on -Wheel*

Optional ballast		
B-19 MASS OF POWER TILLER (WITHOUT DRIVER BUT WITH LUBRICANT, FUEL AND COOLANT FULL)		
	Ballast	Unballast
Total		

B-20 OVERALL DIMENTIONS (mm)				
Conditions	*Length**	*Width**	*Height**	*Ground Clearance*
With ballast				
Without ballast				
* *Measure the outermost points*				

ANNEX C

(Clause 4.2.1 and 4.5)

PROFORMA FOR SELECTION, RUNNING-IN AND REPAIRS

C-1 NAME OF THE MANUFACTURER

C-2 ADDRESS

C-3 SUBMITTED FOR TEST BY

C-4 SELECTED BY

C-5 PLACE OF RUNNING-IN

C-6 DURATION AND SCHEDULE OF RUNNING-IN

C-7 REPAIRS AND ADJUSTMENTS MADE DURING RUNNING-IN

C-8 NO. OF SEALING

C-9 LOCATION OF SEALING

ANNEX D

(Clause 2.2.1 to 2.2.5, 3, 4, 5)

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 ℃:
d) Engine oil used
  1) Type:
  2) Grade:
e) Transmission oil used:
f) No load maximum engine speed, rpm:
g) Engine performance test data sheet 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 ℃:
d) Engine oil used
  l) 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

Description	*Minimum Turning Circle Diameter*		*Minimum Turning Space Diameter*	
	Right Hand Side (m)	*Left Hand Side (m)*	*Right Hand Side (m)*	*Left Hand Side (m)*

(1)	*(2)*	*(3)*	*(4)*	*(5)*
With Steering Clutch				

D-5 PARKING BRAKE TEST Power tiller mass, kg:		
Degree of slope (^{0}):		
Observations	*Parking Braking Device Facing up Slope*	*Parking Braking Device facing down Slope*
(1)	*(2)*	*(3)*
Parking device control force (N)		
Whether rolling of braking wheels noticed	*Yes/No*	*Yes/No*
Efficacy of brakes	*Yes/No*	*Yes/No*

D-6 ENGINE PERFORMANCE TEST DATA SHEET													
Test Conditions	Test	Power (kW)	Crank Shaft Torque (N-m)	Engine Speed (rpm)	Fuel Consumption		Specific Energy (kWh/1)	Temperature, ^{0}C			Atmospheric Conditions		
					Hourly (kg/h)	Specific (g/kWh)		Fuel	Engine oil	Coolant	Temp (^{0}C)	Relative Humidity (%)	Pressure (kPa)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Normal Ambient test	i)Maximum power test												
	ii) Power at rated engine speed												
-do-	Varying engine speed at full load i) ii) iii) iv) v) vi)												
-do-	Rated engine speed at varying load i) ii) iii) iv) v) vi)												

FIVE HOURS TEST

Test Condi-tions	Test	Power (kW)	Crank Shaft Torque (N-m)	Engine Speed (rpm)	Fuel Consumption		Specific Energy (kWh/1)	Temperature, ^{0}C			Atmospheric Conditions		
					Hourly (kg/h)	Specific (g/kWh)		Fuel	Engine oil	Coolant	Temp (^{0}C)	Relative Humidity (%)	Pressure kPa
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
-do-	Five hours engine rating test a) At load corresponding to 80% 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

Test Conditions	Test	Rotary Shaft Power kW	Rotary Shaft Torque N-m	Engine Speed rpm	Fuel Consumption		Specific Energy KWh/1	Temperature, ℃					Pressure, kPa			Atmospheric Conditions			Rotary Shaft Chain Speed rpm	Rotary Shaft Oil Temp ℃
					Hourly g/h	Specific g/kWh		Fuel	Engine oil	Exhaust	Intake Air	Cool -ant	Intake Air	Exhaust Gas	Lub Oil	Temp ℃	Relative humidity	Pres-sure kPa		
		(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Normal ambient test	Varying engine speed at full load i) ii) iii)																			
-do-	Five hours test at rated power of rotary shat a) At load corresponding to 90% of maximum power (4 hour) i) ii) iii) etc. b) At load corresponding to minimum power i) ii) iii) etc.																			

D-8 TEST DATA DRAWBAR PERFORMANCE TEST												
Test	Gear Number Used	Travel Speed (km/h)	Drawbar Pull (kN)	Drawbar Power (kW)	Wheel Slip (%)	Engine Speed (rpm)	Fuel Consumption			Atmospheric Conditions		
							kg/h	g/kWh	kWh/1	Temperature (^{0}C)	Pressure (kPa)	Relative Humidity (%)
(1)	(2)	(3)		(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Maximum power test (power tiller un-blasted) i) ii) iii)												

ANNEX E

(Clause 6.2)

DATA SHEET FOR NOISE MEASURAMENT

E-1 AT OPERATOR'S EAR LEVEL						
E-1.1 Brief Description of the Silencing System						
E-1.2 Background Noise Level, dB (A)						
E-1.3 Sound Level Meter Sound Level Meter 1) Type: 2) Make: 3) Model:						
E-1.4 Date of Test						
E-1.5 Atmospheric Conditions a) Temperature, ^{0}C b) Pressure, kPa c) Relative humidity, %						
E-1.6 Test Data						
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						

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