TRAINING MANUAL FOR ANTAM STANDARD CODE FOR TESTING OF POWER TILLERS

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

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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.

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Training Manual for ANTAM Standard Code for
Testing of Power Tillers

Centre for Sustainable Agricultural Mechanization

United Nations Economic and Social Commission for Asia and the Pacific
Forward

This training manual was prepared to support the 2nd Training of Trainers on ANTAM Test Codes organized in Nanjing, China, on 18-30 October, 2016 and part of the capacity building activities promoted by the United Nations Economic and Social Commission for Asia and the Pacific-Centre for Sustainable Agricultural Mechanization (UNESCAP- CSAM) in support of sustainable agricultural mechanization.

The ANTAM Codes for testing of Power Tillers are developed and revised on a yearly basis by appointed members of Technical Working Groups. ANTAM Codes for Testing of Power Tillers 001-2016 are enriched with three additional tests - i.e. rotary shaft performance, vibration level and waterproof ability- to better reflect the agricultural characteristics of participating countries and guarantee an enhanced level of safety and performance. The training manual is based on the first version of the ANTAM Training Manual on testing of Power Tillers published in 2015\(^1\) and further developed based on the content of the second version of ANTAM Code for testing of Power Tillers published in 2016.

The training manual will guide participating countries testing stations in the implementation of ANTAM Codes by providing pictures of needed equipment and detailed instructions on each test methodology. Kindly note, that where equipment provided by the facilitating testing station for the training was not in supply, slight modifications of ANTAM standard testing methodologies were made in order to demonstrate the procedure.

The 2\(^{nd}\) Training of Trainers on ANTAM Test Codes is jointly organized by CSAM and the China Agricultural Machinery Testing Centre of the Ministry of Agriculture (CAMTC/ MoA). The training manual was prepared by Dr. David David Manohar Jesudas, Head of the Agricultural Machinery Research Centre of Tamil Nadu Agricultural University, CSAM and CAMTC. Valuable comments and suggestions were received from Mr. Chang Xiongbo of CAMTC that assisted in the training preparation and tests demonstration. Mr. Wei Zhen contributed to the design of the cover page. Special thanks go to Ms. Han Xue and Ms. Bai Mengliang of CAMTC for facilitating communication.

Profound appreciation and deep gratitude are given to CAMTC for its generous financial support and the Nanjing Testing Station for sparing no efforts in providing testing facilities.

The training manual is 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 manual.

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\(^1\) Available at: http://www.antam-network.net/2016/2016/04/22/training-manual-for-antam-standard-codes-for-testing-of-power-tillers/
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PART ONE

GENERAL TEXTS

1.0 SCOPE
This standard covers the terminology, general guidelines and tests to be conducted on power 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 at operator’s ear level and waterproof ability.

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 of the test code 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.

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, cultivator, harrow, plough, seeder, harvester, and trailer.

Walk behind type Power tiller with rotary   Riding type power tiller with rotary

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 tanks 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 $2\pi$). 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:

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

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 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 and JB/T 7282).

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°C.

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±7°C (5.2.3 GB/T 6229-2007). Ambient air temperature at a representative point shall be measured as follows: Approximately 2m in front or side depending upon the location of suction or blower device of power tiller and approximately 1.5m above the ground.
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, Nm ±1.0 percent
e) Acceleration, m/s²
   ± 1.0 percent
(f) Mass, kg
   +0.5 percent
(g) Atmospheric pressure, kPa
   ±0.2
(h) Tyre pressure, kPa
   ±5 percent
(i) Temperature of fuel set c, °C
   ±2
(j) Wet and dry bulb thermometers, °C
   + 0.5 °C
(k) Fuel consumption (overall for the apparatus used):
   (1) Engine test, kg
   + 1.0 percent
   (2) Rotary shaft test, kg
   + 1.0 percent
   (3) Drawbar test, kg
   + 2.0 percent
(i) Angle, degree
   + 0.5

6.0 TESTS TO BE CONDUCTED ON A POWER TILLER ARE GIVEN BELOW:

- Checking of the specification,
- Engine performance,
- Rotary shaft performance test,
- Vibration measurement test,
- Drawbar performance,
- Turning ability,
- Parking brake,
- Noise measurement at operator’s ear level and,
- Water proof test.
PART TWO

CHECKING OF SPECIFICATIONS

1. The information given by the manufacturer/applicant in the specification sheet (Clause 1.1.1) shall be verified by the testing authority and reported.

2. Details of the components and assemblies which do not conform to the relevant ANTAM Standards shall also be reported.

3. The adequacy or otherwise of the literature shall be indicated (7.1 IS 9935-2002).

4. Specification checking / measurement (see Annex B below).

5. Park the power tiller after completion of checking / measurement.

Weighing Balance
# ANNEX B
*(Clause 1.1.1)*

## SPECIFICATION SHEET FOR POWER TILLERS

### B-1 POWER TILLER
- a) Name and address of the manufacturer: **check**
- b) Name and address of the applicant for test: **check**
- c) Type: **check**
- d) Make/Model: **check**
- e) Serial number: **check**
- f) Year of manufacture: **check**
- g) Net mass, kg: **measure**

### B-2 ENGINE
- a) Type/Make/Model: **check**
- b) Manufacturer: **check**
- c) Serial number: **check**
- d) Engine rated speed (recommended by manufacturer): **applicant’s declaration to be endorsed.**
- e) Power at rated speed, kW: **applicant’s declaration to be endorsed.**
- f) Net mass, kg: **measure**

### B-3 CYLINDER AND CYLINDER HEAD
- a) Configuration (vertical or horizontal): **check**
- b) Bore/stroke, mm: **measure**
- c) Capacity, cm³: **calculation = No. of cylinders x (πd²h/4)**
- d) Compression ratio: **applicant’s declaration to be endorsed.**
- e) Type of combustion chamber: **check**

### B-4 FUEL SYSTEM
- a) Type of fuel: **Diesel / Petrol or other to be specified**
- b) Capacity of fuel tank, liters: **check**
- c) Type of fuel filter: **check**
- d) Manufacturer’s production setting of fuel injectors (Valve opening pressure), kPa: **applicant’s declaration to be endorsed.**
- e) Injection timing: **applicant’s declaration to be endorsed.**
- f) Type of injection pump: **check**

### B-5 GOVERNOR
- a) Type: **applicant’s declaration to be endorsed.**
- b) Governed range of engine speed, rpm: **applicant’s declaration to be endorsed.**
- c) Rated engine speed, rpm: **applicant’s declaration to be endorsed.**

### B-6 AIR CLEANER
- a) Type (wet or dry): **check**
- b) Location of air intake (in case of no pre-cleaner): **check**
- c) Oil sump capacity, liter: **check**

### B-7 EXHAUST
- a) Type of silencer: **check**
- b) Location: **check**

### B-8 Oil sump capacity, liter: **check**

### B-9 COOLING SYSTEM
- a) Type: **check**
- b) Details of pump and fan, if available: **check & measure**
c) Coolant capacity, liter: check

B-10 ELECTRICAL SYSTEM

a) Voltage: applicant’s declaration to be endorsed.
b) Output power of generator, kW: applicant’s declaration to be endorsed.
c) Details of headlights (number, Watt): Check

B-11 POWER TRANSMISSION SYSTEM

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

<table>
<thead>
<tr>
<th>Gear Number</th>
<th>Nominal traveling speed (*) at the rated engine speed of … rpm (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward</td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>Test</td>
</tr>
<tr>
<td>L2</td>
<td>Test</td>
</tr>
<tr>
<td>L3</td>
<td>Test</td>
</tr>
<tr>
<td>H1</td>
<td>Test</td>
</tr>
<tr>
<td>H2</td>
<td>Test</td>
</tr>
<tr>
<td>H3</td>
<td>Test</td>
</tr>
<tr>
<td>Reverse</td>
<td></td>
</tr>
<tr>
<td>L1</td>
<td>Test</td>
</tr>
<tr>
<td>H1</td>
<td>Test</td>
</tr>
</tbody>
</table>

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

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

B-12 ROTARY SHAFT

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

B-13 MAIN PULLEY

a) Type and number of belts: Check / measure
b) Diameter, mm: measure
c) Location: check
d) Reduction ratio (from engine to clutch) : measure
e) Rotational speed at rated engine speed (rpm): measure

B-14 HITCH

a) Type (pin or nut and bolt): check
b) Location: check
c) Height above ground level, mm
   1) Maximum: measure
   2) Minimum: measure
### B-15 PARKING BRAKE
- **a)** Type: check
- **b)** Method of operation: check

### B-16 WHEELS
- **a)** Tyres
- 1) Make: check
- 2) Size: check
- 3) Type of tyre: check
- 4) Ply rating: check
- 5) Recommended inflation pressure, kPa
  - i) For fieldwork: applicant’s declaration to be endorsed.
  - ii) For transport: applicant’s declaration to be endorsed.
- 6) Track width, mm: measure
- 7) Method of changing track width, range and number of steps: check
- 8) Method of changing track width, if any, and range: check
- **b)** Steel wheel for wet land
- 1) Track width, mm: measure
- 2) Type: check
- 3) Size
  - i) Diameter, mm: measure
  - ii) Width, mm: measure
- 4) Total mass (2 wheels), kg: measure
- **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
- **a)** Type: check
- **b)** Type of suspension: check
- **c)** Range of adjustment (if any), mm: measure

### B-18 MASS OF BALLAST

<table>
<thead>
<tr>
<th>Optional ballast</th>
<th>Water</th>
<th>Cast Iron Weight on-Wheel</th>
</tr>
</thead>
<tbody>
<tr>
<td>measure</td>
<td>measure</td>
<td></td>
</tr>
</tbody>
</table>

### B-19 MASS OF POWER TILLER (WITHOUT DRIVER BUT WITH LUBRICANT, FUEL AND COOLANT FULL)

<table>
<thead>
<tr>
<th>Total</th>
<th>Ballast</th>
<th>Unballast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
</tbody>
</table>

### B-20 OVERALL DIMENSIONS (mm)

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Length*</th>
<th>Width*</th>
<th>Height*</th>
<th>Ground Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>With ballast</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>Without ballast</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
</tbody>
</table>

*Measure the outermost points*
PART THREE

NOMINAL SPEED TEST MEASUREMENT
(See paragraph 3 of B-11 of Annex B)

1.0 MEASUREMENT OF TEST DATA

1. Check & adjust the tyre pressure of power tiller recommended by the manufacturer for road work.

2. Define a certain distance S on track, e.g. 100 m for high speed and 50 m for low speed.

3. Measure the time T taken in seconds when the power tiller is driven through the certain distance at rated engine speed at different gears.

4. Photographs

Plumb bob, measuring tape – 5m, 30m

Tachometer

5. Calculation the nominal speed at rated engine speed through the following formula

\[
velocity = \left( \frac{S}{1000} \right) \frac{T}{3600} = \frac{3.65 \text{ km}}{T \text{ h}}
\]

1.1 Observations

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Gear used</th>
<th>Distance in meter</th>
<th>Time in seconds</th>
<th>Nominal speed at rated engine speed, (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Park the power tiller after completion of test.
PART FOUR

ENGINE PERFORMANCE TEST

1.0 GENERAL CHECKING BEFORE CONDUCT OF TEST

1. Remove the engine from the power tiller. Couple the engine with the dynamometer.
2. Check the angle of the connection of the shaft connecting the crankshaft to the dynamometer. The angle shall not exceed 2°.
3. Install the sensor for measurement of temperature of fuel, engine oil and coolant.
4. Measure the density of fuel.
5. Note down the Type of dynamometer used, Fuel used – Type & Density at 15°C, Engine oil used – Type & Grade, Transmission oil used, No load maximum engine speed, rpm.
6. Measure the ambient temperature (the surrounding temperature shall be 27±7°C), atmospheric pressure (shall not be less than 96.6 kPa) etc.
7. The various tests shall normally be carried out continuously.
8. Photographs

2.0 MEASUREMENT OF TEST DATA

2.1 Maximum Power

1. Start the power tiller and governor control set for maximum power.
2. Warm up the engine to reach stabilized running conditions.
3. Start the test and search the maximum power of engine.
4. Operate the engine at the speed where maximum power occurs for a period of 2 hours.
5. Measure the power, torque and fuel consumption and other relevant parameters. Take at least six readings during the period of 2 hours (i.e. each measurement after every 20 minutes of interval).
6. Calculate the average of power observed in the six readings. If the power varies by more than ±2 percent from the average, repeat the test. If the variation continues, report the deviation.

**Calculations:**

\[
Power \, P \, (kW) = \frac{\text{Speed of Engine (rpm) \times 2\pi}}{60} \times \frac{\text{Dynamometer torque Nm}}{1000}
\]

**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.

1. Operate the engine at the rated speed for a period of 1 hour.
2. Measure the power, torque and fuel consumption and other relevant parameters. Take at least six readings during the period of 1 hour (i.e. each measurement after every 10 minutes of interval).
3. Calculate the average of power observed in the six readings. If the power varies by more than ±2 percent from the average, repeat the test. If the variation continues, report the deviation.

**2.3 Varying Speed at Full Load**

1. Measure the power, torque and fuel consumption as a function of speed at full power at approximately 10 percent speed increments.
2. Measure the power, torque and fuel consumption and other relevant parameters for each increment of speed.
3. The minimum speeds at which measurements are made shall be at the speed of maximum torque and, if possible, 15 percent below that speed.

**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.

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)].

**2.5 Five Hours Engine Rating Test**

1. 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-hour during the first 4 hours and after every 15 minutes during the 5th hour (6.1.7 IS 12036).
2. Measure the power, torque and fuel consumption and other relevant parameters during the test.
Note:
1. The engine may be unloaded and may be allowed to run for few minutes to lower down the engine oil and coolant temperature.
2. The engine may be stopped.
### D-6 ENGINE PERFORMANCE TEST DATA SHEET

<table>
<thead>
<tr>
<th>Test</th>
<th>Power (kW)</th>
<th>Crank Shaft Torque (Nm)</th>
<th>Engine Speed (rpm)</th>
<th>Fuel Consumption Hourly (kg/h)</th>
<th>Specific Energy (g/kWh)</th>
<th>Specific Energy (kWh/1)</th>
<th>Temperature, °C</th>
<th>Atmospheric Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
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<tr>
<th>Temperature, °C</th>
<th>Fuel</th>
<th>Intake air</th>
<th>Engine oil</th>
<th>Coolant</th>
<th>Exhaust air</th>
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<tr>
<th>Atmospheric Conditions</th>
<th>Temp (°C)</th>
<th>Relative Humidity (%)</th>
<th>Pressure (kPa)</th>
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</thead>
<tbody>
<tr>
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<td>(13)</td>
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</table>
### FIVE HOURS TEST

<table>
<thead>
<tr>
<th>Test</th>
<th>Power (kW)</th>
<th>Crank Shaft Torque (Nm)</th>
<th>Engine Speed (rpm)</th>
<th>Fuel Consumption Hourly (kg/h)</th>
<th>Fuel Consumption Specific (g/kWh)</th>
<th>Fuel Consumption Specific Energy (kWh/1)</th>
<th>Temperature (°C)</th>
<th>Atmospheric Conditions</th>
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</table>

**Five hours Engine rating Test**

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

b) At load corresponding to maximum power (1 hour)
   i)  
   ii) 
   iii) iv)
2.6 Presentation of Results
1. The data shall be reported in tabular form for each test condition (Annex D-6).
2. If also presented in graphical form (which is optional), the following, covering the full range of engine speeds tested, shall be included:
   - Power as a function of speed;
   - Torque as a function of speed;
   - Fuel consumption (mass) and specific fuel consumption (mass) as a function of speed;
   - Specific fuel consumption (mass) as a function of power;
   - Report the no-load maximum engine speed.
ENGINE PERFORMANCE CHARACTERISTICS
ENGINE PERFORMANCE CHARACTERISTICS

Specific Fuel Consumption (g/kWh)

Engine Power (kW)
PART FIVE

ROTARY SHAFT PERFORMANCE TEST

1.0 PREPARING THE POWER TILLER FOR ROTARY PERFORMANCE TEST

1. The method of coupling the rotary to the dynamometer requires providing suitable coupling arrangement.
2. The drive can be taken from the rotary shaft by using standard adopter if the rotary shaft confirms to standards (Specification for shaft assembly for rotary for Power Tiller IS : 11905.1188) (Fig 5.1)
3. The non drive end of a standard rotary of a power tiller can be modified to adopt to the cardon shaft connecting the rotary to the dynamometer.(Fig 5.2)
4. The Power tiller is suitably jacked and restrained to prevent its movement during testing.
5. Check the angle of the connection of the shaft connecting the crankshaft to the dynamometer. The angle shall not exceed 2°. The alignment should be done in the vertical and horizontal planes.

2.0 GENERAL CHECKING BEFORE CONDUCT OF TEST

1. Note the lowest rotary speed and select the lowest speed in case of multispeed rotary gearbox.
2. Install the sensor for measurement of temperature of fuel, Exhaust, Intake air engine oil, coolant and rotary chain drive case oil.
3. Measure the density of fuel.
4. Connect monometers to measure pressure of inlet air, exhaust air and pressure gauge for Lube oil pressure.
5. Note down the Type of dynamometer used, Fuel used – Type & Density at 15°C, Engine oil used – Type & Grade, Transmission oil used, No load maximum engine speed, rpm.
6. Note down the Type of dynamometer used, Fuel used – Type & Density at 15°C, Engine oil used – Type & Grade, Transmission oil used, No load maximum engine speed, rpm.
7. Measure the ambient temperature (the surrounding temperature shall be 27±7°C), atmospheric pressure (shall not be less than 96.6 kPa) etc. Provision should be made in the test cell to maintain the ambient temperature within limits.
8. The various tests shall normally be carried out continuously.

3.0 MEASUREMENT OF TEST DATA

3.1 Varying Speed Test

1. Start the power tiller and set governor control for maximum power.
2. Warm up the engine to reach stabilized running conditions.
3. Reduce the dynamometer torque to allow the engine to run at High idle. Care should be taken not to run the engine above the manufacturers recommended High idle speed.
4. Vary the dynamometer torque and record the speed at different torques.
5. Allow the engine to stabilize at the speed for two to three minutes before recording measurements.
6. Increase the torque gradually so as to obtain speed change.
7. The engine is allowed to run at steady state at each torque speed combination and the measurements are taken.
8. Measure the power, torque and fuel consumption as a function of speed at full power at approximately 1-2 percent speed increments.
9. Measure the power, torque and fuel consumption and other relevant parameters for each increment of speed.
10. The minimum speeds at which measurements are made shall be at the speed of maximum torque and, if possible, 15 percent below that speed.

<table>
<thead>
<tr>
<th>Calculations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ P \text{ (kW)} = \frac{\text{Speed of rotary shaft (rpm)} \times 2\pi}{60} \times \frac{\text{Dynamometer torque Nm}}{1000} ]</td>
</tr>
</tbody>
</table>

3.2 Five Hour Test at Rated Power of Rotary Shaft
1. The maximum power available at the rotary will be arrived from the test in 2.1. The speed torque point is also identified.
2. The torque at Maximum power is taken as the reference.
3. The rotary shaft shall be run at 90 percent of load (torque) corresponding to maximum power continuously for 4 hours.
4. During the test the power, torque and fuel consumption will be reported after every half-an-hour during this first 4 hours.
5. During the 5th hour, the engine shall be run at a load corresponding to maximum power and the power, torque and fuel consumption will be reported after every 15 minutes during the 5th hour (IS 9935:2002).

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.

Note:
1. The power tiller engine may be allowed to run for few minutes under no load to reduce temperature of engine oil and coolant.
2. The engine may be stopped.

4.1 Presentation of Results
The data shall be reported in tabular form for each test condition (Annex D-7).

If also presented in graphical form (which is optional), the following, covering the full range of engine speeds tested, shall be included:
1. Power as a function of speed
2. Torque as a function of speed
3. Fuel consumption (mass) and specific fuel consumption (mass) as a function of speed
4. Specific fuel consumption (mass) as a function of power
5. No-load maximum engine speed.
6. Rotary shaft torque at Maximum Power
7. Max. Rotary shaft Torque
8. Engine sped at Max rotary shaft torque

The following are reported:
   i. Ambient air temperature
   ii. Atmospheric pressure
   iii. Relative air humidity
   iv. Air temperature at the engine air intake
   v. Maximum coolant temperature (in the case of an air cooled engine, measure the
temperature of the cylinder block at representative points);
   vi. The fuel temperature at the inlet to the injection pump;
   vii. Engine oil temperature;
   viii. Exhaust gas temperature.
## D7 ROTARY SHAFT PERFORMANCE TEST DATA SHEET

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Test Condition</th>
<th>Tests</th>
<th>Rotary Shaft Power kW</th>
<th>Rotary Shaft Torque N.m</th>
<th>Engine Speed rpm</th>
<th>Fuel Consumption g/h</th>
<th>Specific Energy kWh/l</th>
<th>Temperature °C</th>
<th>Pressure kPa</th>
<th>Atmospheric Conditions</th>
<th>Rotary Shaft Oil Temp °C</th>
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<tbody>
<tr>
<td>1</td>
<td>i) Normal Ambient Test</td>
<td>Varying engine speed at full load</td>
<td>i)</td>
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<td>2</td>
<td>Normal Ambient Test</td>
<td>Five hours test at rated power of rotary shaft</td>
<td>a) At load corresponding to 90% of maximum power (4 hours):</td>
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<td>ii)</td>
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ROTARY PERFORMANCE CHARACTERISTICS

Specific Fuel Consumption (g/kWh)

Engine Power (kW)
PART SIX

VIBRATION MEASUREMENT TEST

1.0 PREPARATION FOR TEST

1. Provision is to be made for mounting of the vibration pickup (accelerometer at the steering handles, Operator's seat and the main frame.

2. If the accelerometer is having a magnetic base for attachment, a plane surface with magnetic properties is to be provided at the measurement location.

3. Power tillers are usually provided with plastic / rubber hand grips in the steering handles (Specification for hand grip for power tiller IS11858-1986 Reaffirmed 2012). A block of steel is to be rigidly clamped to the handle, as proposed in IS/ISO 5349-2:2001, D2.3 Clamp connections.

4. If the Power tiller is a ride on type and is provided with operators seat, then the location for fixing the vibration pickup is to be identified. IS 13581: 1993 ISO 5007: 1990 reaffirmed 1997, gives the location for mounting the accelerometer for measuring the vibration at seat base. The point accordingly can be located in the central longitudinal plane, where the vertical axis of a hypothetical operator passing from buttocks- to head intersects the seat plane. If the location of the point of placement of the accelerometer is not horizontal, then a adopter plate should be fixed to the seat pan to hold the accelerometer in the vertical and longitudinal vibration measurement position.

2.0 GENERAL CHECKING BEFORE CONDUCT OF TEST
1. Check and inflate the tyres as per manufacturers recommendation for road work.
2. Park the power tiller on a level concrete surface
3. If no tail wheel is present, the Power tiller will be allowed to rest on the front stand.
4. If tail wheel is present along with rotary, the power tiller will be rested on the tail wheel.
5. Run the power tiller engine in the stationary position.
6. The engine speed is adjusted to rated engine speed, however no load is applied.

3.0 MEASUREMENT OF TEST DATA
1. The vibration is recorded in the designated points, in the vertical direction and the direction perpendicular to the longitudinal axis along the horizontal plane. (The vibration along the longitudinal axis are not considered).

2. The maximum horizontal displacement (HD) and vertical displacement (VD) in microns are measured by mounting the measuring device in related positions.
3. The values are reported as displacement in microns and RMS value of acceleration in m/s² along the different direction and locations as tabulated below

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Measuring points</th>
<th>Vibration (Hz)</th>
<th>Acceleration (m/s²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Steering handle</td>
<td>Left arm grip</td>
<td>HD</td>
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<tr>
<td></td>
<td></td>
<td>Right arm grip</td>
<td>VD</td>
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<td>2</td>
<td>Operator’s seat (without operator)</td>
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<td>3</td>
<td>At main frame where engine mounted</td>
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</table>

- 30 -
PART SEVEN

DRAWBAR PERFORMANCE TEST

1.0 GENERAL CHECKING BEFORE CONDUCT OF TEST
1. Check and measure the height of tyre tread bars at the centre line of the standard tyres. Should not be less than 65% of their height when new.
2. Check & adjust the tyre pressure of power tiller recommended by the manufacturer for field work.
3. Check the condition of concrete track - should be clean, horizontal and dry, containing a minimum number of joints.
4. Couple the un ballasted power tiller with loading van.
5. Check the zero of load cell.
6. Install the sensor for measurement of ‘Actual Travel speed’ of the power tiller on load during the test.
7. Measure the density of fuel.
8. Calibration the fifth wheel.
9. Measure the ambient temperature, humidity, wind speed, air pressure etc.
10. Photographs:

Comprehensive Computer for Drawbar Test
Concrete Test Track
Drawbar Power Test
Laptop for Drawbar Test
Loading Van
2.0 MEASUREMENT OF TEST DATA FOR MAXIMUM POWER AND PULL

1. Start the power tiller and governor control set for maximum power.
2. Check that the line of pull should be horizontal.
3. Take 2 - 3 rounds of power tiller on test track to achieve the stability of operational conditions.
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).
5. After the operational conditions are stabilized, the measurements of engine speed, drawbar pull, fuel consumption, forward speed and wheel slip shall be recorded.

Calculations:
(a) Forward speed (km/h) = Distance (m) x 3.6 / Time (sec) (can be measured by fifth wheel directly during drawbar test, not need to calculation)

(b) Drawbar Power = Drawbar Pull (kN) x Forward speed (km/h) / 3.6

(c) Forward speed at No load (km/h) = (the speed can be measured by fifth wheel directly)

\[
\text{Slip, percent} = \frac{100 \left( \frac{N_1}{N_2} - 1 \right)}{N_1}
\]

(d) Wheel slip (%) =

6. Increase the drawbar pull and repeat the measurements as in (4) above. The maximum pull and maximum power shall be recorded at power tiller wheel slippage only up to 15 percent.
7. The set of measured data for each selected gear shall be recorded in the following format:

<table>
<thead>
<tr>
<th>Test</th>
<th>Gear Number Used</th>
<th>Travel Speed (km/h)</th>
<th>Drawbar Pull (kN)</th>
<th>Drawbar Power (kW)</th>
<th>Wheel Slip (%)</th>
<th>Engine Speed (rpm)</th>
<th>Fuel Consumption</th>
<th>Atmospheric Conditions</th>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
8. The test shall be conducted until the maximum power and pull are found in different forward speed gears.

9. Compilation of data in the Test Report may be as under - Select one of the measured data of maximum power and or pull from the set of readings obtained in (7) for each gear. Same may be repeated for other different gears and may be tabulated as under.

<table>
<thead>
<tr>
<th>Test</th>
<th>Gear Number Used</th>
<th>Travel Speed (km/h)</th>
<th>Drawbar Pull (kN)</th>
<th>Drawbar Power (kW)</th>
<th>Wheel Slip (%)</th>
<th>Engine Speed (rpm)</th>
<th>Fuel Consumption</th>
<th>Atmospheric Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
<td>(9)</td>
</tr>
<tr>
<td>Maximum Power test (power tiller un-blasted)</td>
<td>H1</td>
<td>L3</td>
<td>L2</td>
<td>L1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Park the power tiller after completion of test.
PART EIGHT

TURNING ABILITY TEST

1.0 GENERAL CHECKING BEFORE CONDUCT OF TEST

1. Check the test area - the test area shall be a horizontal compacted or paved surface having good tire adhesion and capable of displaying legible marking.
2. Check the power tiller - all liquid reservoirs filled to the specified level but without ballast, mounted implements and any other specified components.
3. Check the tyres - 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 shall be maintained as recommended for the road work by the manufacturer.

2.0 MEASUREMENT OF TEST DATA

1. The test shall be conducted with the power tiller without tailed wheel at the minimum attainable speed.
2. The measurement of the turning circle and turning space are referred in figure 1.
3. 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.
4. During the test the following shall be recorded:
   a) Diameter of the minimum turning circle, and
   b) Diameter of the minimum turning space required.
5. The data shall be recorded in D-4.
**D-4 TURNING ABILITY**

a) Details of wheels
   1) Wheel track, mm: **measure**
   2) Size of tyres: **check**
   3) Pressure of tyres, kPa: **Check & measure**

b) Test data

<table>
<thead>
<tr>
<th>Description</th>
<th>Minimum Turning Diameter</th>
<th>Minimum turning Space Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right Hand Side (m)</td>
<td>Left Hand Side (m)</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>With Steering Clutch</td>
<td>measure</td>
<td>measure</td>
</tr>
</tbody>
</table>
PART NINE

PARKING BRAKE TEST

1.0 GENERAL CHECKING BEFORE CONDUCT OF TEST
1. The performance of the parking brake shall be based on the ability to hold the power tiller stationary, facing up and down slopes.
2. Check the power tiller - shall be attached with any matching implement e.g. rotary, plough etc. and without ballast.
3. Check the test track – test shall be conducted on a clean, flat and dry concrete test track.
4. Photograph:

20% slope

2.0 PROCEDURE
1. Install load cell and indicator to measure the parking device control force.
2. Start the power tiller and take it to the test area.
3. 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.
4. 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. The data shall be recorded in Annex D-5.
D-5 PARKING BRAKE TEST

Power tiller mass, kg:

Degree of slope (°):

<table>
<thead>
<tr>
<th>Observations</th>
<th>Parking Braking Device Facing up Slope</th>
<th>Parking Braking Device facing Down Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Parking device control force (N)</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>Whether rolling of braking wheels noticed</td>
<td>Yes/No Check</td>
<td>Yes/No Check</td>
</tr>
<tr>
<td>Efficacy of brakes</td>
<td>Yes/No Check</td>
<td>Yes/No Check</td>
</tr>
</tbody>
</table>

Note:

1. The engine may be may be stopped and park the power tiller in the parking area.
PART TEN

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

1.0 GENERAL CHECKING BEFORE CONDUCT OF TEST

1.1 Sound Level Meter

1. Sound level meter which meets at least the requirements of IEC 651 for a type 1 instrument shall be used.
2. The noise shall be measured with instrument of A weighted expressed in decibels set on slow level.
3. Photograph:

   Hand held sound level meter

   B&K sound & vibration measuring instrument with calibrator and microphone

1.2 Test Area and Other Conditions

1. Check 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.
2. Check the air temperature & wind velocity: the air temperature shall be in the range from -5 °C to 35 °C and the wind velocity shall not exceed 5 m/s at the operator's position (9.2.4 GB/T 6229-2007).
3. Check the microphone position: 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.

2.0 PROCEDURE

1. The noise measurement test shall be conducted at the operator’s ear level during the drawbar pull test.
2. 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.
3. 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.
4. 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.

5. The data shall be recorded in Annex E.

ANNEX E
(Claude 6.2)
DATA SHEET FOR NOISE MEASUREMENT

<table>
<thead>
<tr>
<th>E-1 AT OPERATOR’S EAR LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-1.1 Brief Description of the Silencing System</td>
</tr>
<tr>
<td>E-1.2 Background Noise Level, dB (A)</td>
</tr>
<tr>
<td>E-1.3 Sound Level Meter</td>
</tr>
<tr>
<td>Sound Level Meter</td>
</tr>
<tr>
<td>1) Type:</td>
</tr>
<tr>
<td>2) Make:</td>
</tr>
<tr>
<td>3) Model:</td>
</tr>
<tr>
<td>E-1.4 Date of Test</td>
</tr>
<tr>
<td>E-1.5 Atmospheric Conditions</td>
</tr>
<tr>
<td>a) Temperature, °C</td>
</tr>
<tr>
<td>b) Pressure, kPa</td>
</tr>
<tr>
<td>c) Relative humidity, %</td>
</tr>
<tr>
<td>E-1.6 Test Data</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Gear Used</th>
<th>Travelling Speed (km/h)</th>
<th>Engine Speed (rpm)</th>
<th>Slip (%)</th>
<th>Drawbar Pull (kN)</th>
<th>Sound Level dB (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Report</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>1</td>
<td>Report</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>2</td>
<td>Report</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>3</td>
<td>Report</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>4</td>
<td>Report</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>5</td>
<td>Report</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
<tr>
<td>6</td>
<td>Report</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
<td>Measure</td>
</tr>
</tbody>
</table>

Note: The engine may be may be stopped and park the power tiller in the parking area.
PART ELEVEN

WATER PROOF TEST

1.0 PREPARING THE POWER TILLER AND TEST BED FOR WATER PROOF TEST

1. Prepare the test bed for water proof test by mixing soil and water in the ratio 1:3 by volume in a soil bin or water bath.

2. The soil should contain 10-30% sand, 10-30% silt and 40-80% clay by weight. Only portable water should be used. The soil and water mixture should be thoroughly mixed and prevented from settlement.

3. The soil bin should have provision like ramp to lower the Power tiller into the bin so that the power tiller is immersed in the mud up to the axle height.

4. The power tiller is fitted with puddling wheel but no implement is mounted. If the rotary is part of power tiller then it should not be dismantled.

5. The power tiller is fitted with cage wheels as per manufacturers recommendation for wet rice field work.

6. The power tiller is supported on a stand/platform in the horizontal position in order to allow the wheels to rotate freely, without the power tiller moving forward.

2.0 GENERAL CHECKING BEFORE CONDUCT OF TEST

1. The water in the tank is adjusted so that the water level is up to the centerline of wheel axle.

2. The transmission gear ratio is chosen so that the forward speed is closer to 6kmph at rated engine speed.

3. The lubricating oils in the engine and gearbox including the rotary chain case should be inspected to ensure that there is no contamination with water prior to the test.

3.0 TEST PROCEDURE

1. The Power tiller is operated at rated engine speed continuously for five hours.

2. If there will be 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.

3. The power tiller is removed (immediately-OECD Code-2) from the soil bin and cleaned.

4. Wipe of water from the external parts with a rag.

5. The power tiller is allowed to stand for 12hours, protected from rain and snow.

6. The power tiller is partially dismantled to investigate any evidence of soil and water solution penetration into the axle, clutch housing, and the brake assembly. into them. (OECD Code-2).

7. If the test fails, the manufacturer may ask for a repeat test of the same power tiller but only once.
4.0 TESTING PRESENCE OF WATER

1. The ingress of water into oil lubricated housing like, engine sump, Transmission case and chain case can be ascertained from change in colour of oil and emulsification of oil water mixture.

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.

3. Other methods of checking presence of water in lubricant:
   a. Centrifuging the oil to separate water if present
   b. Titration by Karl-Fisher method
   c. Gravimetric separation by allowing to stand undisturbed for 24 Hours in test tube.

5.0 REPORTING RESULTS.

The results of the waterproof test shall be reported as per D-11 data sheet for waterproof test.

<table>
<thead>
<tr>
<th>Sr No.</th>
<th>Components</th>
<th>Ingress of Mud/Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Axle</td>
<td>Yes/No Check</td>
</tr>
<tr>
<td>2</td>
<td>Clutch housing</td>
<td>Yes/No Check</td>
</tr>
<tr>
<td>3</td>
<td>Brake assembly</td>
<td>Yes/No Check</td>
</tr>
</tbody>
</table>