

**POWER TILLERS – TERMINOLOGY,
GENERAL GUIDELINES AND TESTING
METHODS**

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TESTING OF POWER TILLERS

1. SCOPE

This standard covers the terminology, general guidelines and test's methodology to be conducted on internal combustion (IC) engine Power Tillers.

2. REFERENCES

The complete list of references to existing international standards that have been incorporated to this text is provided in **Annex A**.

3. TERMINOLOGY

3.1 Type of test

3.1.1 Commercial Tests

The tests conducted for establishing performance characteristics of Power Tillers that are ready for commercial production/imported or already in production.

(a) Initial Commercial Tests (ICT)

The tests conducted indigenous or imported prototype Power Tiller ready for commercial production. Validity of ICT report will be for five years from the date of release of report, if manufacturer wants to continue their ICT report for further time, the same make and model tested earlier shall be re-submitted for batch test whose validities is applicable for next five years.

(b) Batch Test

The tests conducted on Power Tillers which have already undergone initial commercial test and/or being manufactured/imported commercially in the country.

3.1.2 Confidential Tests:

The tests conducted for providing confidential information on the performance of Power Tillers whether ready for commercial production or not, or to provide any special data that may be required by the manufacturer/ authorized person.

3.2 Power Tiller

Power Tiller is self-propelled agricultural machinery used for field operations (tilling, seeding, plant protection, harvesting etc.) and haulage having a single axle, in which the direction of travel and its control are performed by the operator. The machine may be walk behind or riding type. The maximum speed of the power tiller when coupled to a trailer shall not exceed 22 km/h.

3.2.1 General Purpose Type

The Power Tillers which can be used for several farm operations, including the types defined under pull type and tilling type.

3.2.1.1 Pull type

The Power Tiller which pulls various kinds of implements.

3.1.1.2 Tilling Type

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

3.3 Maximum Engine Power

Maximum sustainable engine power available at the crankshaft.

3.4 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.

3.5 Rated Engine Power

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

3.6 Tyre Rolling Radius

The effective tyre rolling radius is the average distance travelled by the Power Tiller in one rotation of the driving wheels divided by 2π , when the Power Tiller is driven without drawbar load at a speed of approximately 2 km/h. The mass of Power Tiller with full tank and radiator; and the mass of seated operator (if applicable) shall be reported separately.

3.7 Wheel Slip

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. GENERAL GUIDELINES

4.1 Conditions for Checking of Dimensions/ specification in details

The Power Tiller shall be without ballast, any wear on tyres and placed on a firm horizontal surface. The height of the tyre (pneumatic tyre/solid tyre/steel-track etc.) tread bars shall not be less than 65 % of their height when new. The main frame shall be in horizontal position.

Unless otherwise stated by the manufacturer/applicant, the Power Tiller shall be stationary with its wheels and standard components in the positions they would be, if the Power Tiller was travelling

in a straight line.

- 4.1.1** The pressure in pneumatic tyres shall be adjusted to the value recommended by the Power Tiller manufacturer for field work. If a range of value is indicated the mean tyre pressure shall be used.

4.2 Running-in

The manufacturer/authorized applicant shall run-in the Power Tiller before the test under their responsibility and in accordance with the procedure prescribed or agreed with the manufacturer/authorized applicant and in any case in ordinary. 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 run-in the Power Tiller in accordance with the procedure prescribed or agreed to with the manufacturer/authorized applicant.

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

4.3 Servicing and Preliminary Setting after Running-in

- 4.3.1** After completion of running-in, servicing and preliminary settings should be done according to the printed literature supplied by the manufacturer/authorized applicant.

The following may be carried out, wherever applicable:

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

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

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

4.4 Ballasting

The ballast mass, which are commercially available and approved by the manufacturer for use in agriculture, shall be within the limits specified by the manufacturer or load limit of axle. For wheeled Power Tillers, inflation pressure and ballast on each tyre shall be

within the limits specified by the tyre manufacturer or load limit of axle, whichever is lower. Inflation pressure shall be measured with the tyre/tube valve in the lowest position.

4.5 Repairs and Adjustments during Tests

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

4.6 Fuels and Lubricants

Fuels and lubricants shall be selected from the range of products commercially available in the country where the equipment is tested and shall conform to the minimum standards approved by the Power Tiller manufacturer. If the fuel or lubricant conforms to a national or international standard, it shall be mentioned, and the standard stated.

4.7 Auxiliary Equipment

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

4.8 Fuel Consumption

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

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

The atmospheric pressure shall not be less than 96.6 kPa during laboratory tests. The pressure shall be noted at the start, middle and end of the test.

4.9.2 Temperature

For power tests, the normal ambient temperature shall be from 16 °C to 34 °C. Ambient air temperature shall be measured 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.

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

5. MEASURING TOLERANCES

The measuring apparatus shall be such that the following items shall have the tolerances within the limits shown against each in Table 1:

Table 1. Accuracy requirements of measurement

Parameters	Tolerances
a) Rotational speeds (rpm)	$\pm 1.0 \%$
b) Time (s)	± 0.2
c) Distance (m or mm)	$\pm 0.5 \%$
d) Force (N) and torque (Nm)	$\pm 1.0 \%$
e) Acceleration (m/s^2)	$+ 1.0 \%$
f) Mass (kg)	$\pm 0.5 \%$
g) Atmospheric pressure (kPa)	± 0.2
h) Tyre pressure (kPa)	$\pm 5\%$
i) Temperature of fuels etc. ($^{\circ}\text{C}$)	± 2
j) Wet and dry bulb temperatures ($^{\circ}\text{C}$)	± 0.5
k) Fuel consumption (overall for the apparatus used):	
1) Engine test (g/h or l/h)	$\pm 1.0 \%$
2) Drawbar test (g/h or l/h)	$\pm 2.0 \%$

6. TESTS

Tests to be conducted on a Power Tiller are given below:

S.N.	Compulsory tests
1	Checking of specifications
2	Running in of engine and transmission system as per requirement
3	Engine performance
4	Rotary shaft performance
5	Drawbar performance
6	Haulage test
7	Turning space and turning circle ability
8	Parking brake, clutch brake and hand brake if any
9	Noise test for sound level measurement at bisector position and operators ear level
10	Vibration test
11	Oil pull-over test in case of wet type air cleaner
12	Material test (hardness of soil engaging component)
13	Field performance test with matching implements and tools including with wet land cultivation to check entry of mud and water in various sealing.
14	Wear assessment of engine component, and
15	Basic safety requirements for road and field operation.
	Optional test
1	Engine test at high ambient temperature on request of manufacturer/authorized applicant
2	Waterproof test on request of manufacturer/authorized applicant

7. CHECKING OF SPECIFICATIONS

7.1 Specification Sheet

7.1.1 The Power Tiller manufacturer/ authorized applicant shall supply the specifications of the Power Tiller consisting of the items listed in the specimen report given in **Annex C**, as well as any other information required by the testing authority to carry out the tests. The manufacturer/applicant shall also supply technical literature such as operation, maintenance and service manuals, and parts catalogue.

7.1.2 The information given by the manufacturer/authorized applicant in the specification sheet shall be verified by the testing authority and reported. Details of the components and assemblies which do not conform to the relevant Nepal Standards shall also be reported. The adequacy or otherwise of the literature shall be indicated.

7.2 Conditions for Checking of Dimensions

While checking the dimensions of the Power Tiller, the conditions laid down in 4.1 of the general guidelines shall be followed.

7.3 Selection

The Power Tiller under production should be selected random from the production line/ imported

lot complete with its standards accessories which is commercially ready to launch.

8. ENGINE TEST

8.1 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°.

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 at maximum speed and full throttle.

8.2 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 fuel pump setting may be used, the details of which shall be included in the report. The surrounding temperature shall be from 16 to 34 °C.

The following tests shall be conducted on the engine:

8.2.1 Maximum Power Test

Operate the engine at the speed where maximum power occurs for a period of two hours subsequent to a warming-up period to reach stabilized running conditions. Measure the power, torque and fuel consumption.

The maximum power quoted in the test report shall be the average of at least 6 readings made at regular intervals during two-hour period. If the power varies by more than ± 2 % from the average, repeat the test. If the variation continues, report the deviation.

8.2.2 Power at Rated Engine Speed

If maximum power does not occur at rated engine speed, an additional one-hour test shall be carried out using the procedure stated in 8.2.1.

8.2.3 Test at Full Load and Varying Speed

The hourly fuel consumption, torque and power are measured as a function of speed. To plot the curves, the test shall go down to an engine speed at least 15 per cent below the speed at which maximum torque occurs or to an engine speed at least 50 per cent of rated engine speed, whichever speed is lower. This is subject to any limitations such as safe operation of the power tiller and test equipment or as stated by the manufacturer in agreement with the test station Varying Load Tests

Torque, engine speed, hourly fuel consumption, and shall be recorded at the following loads:

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

8.2.4 Five Hours Engine Rating Test

The engine shall be run continuously for 5 hours. For the first 4 hours, the engine shall be run at 90% of load (torque) corresponding to maximum power. During the 5th hour, the engine shall be run at a load corresponding to maximum power. During the test, all the parameters specified in 8.2.4 of this standard shall be recorded at every half-an-hour interval during the first 4 hours and after every 15 minutes during the 5th hour.

Report the following:

- Atmospheric pressure as specified in 4.9.1
- Ambient air temperature at a representative point as specified in 4.9.2
- Relative air humidity;
- Air temperature at the engine air intake;
- Maximum coolant temperature (no need to report coolant temperature in case of an air-cooled engine);
- The fuel temperature at the inlet to the injection pump;
- Engine oil temperature;
- Exhaust gas temperature.

8.2.5 Presentation of Results

The observed data in 8.2.1 to 8.2.5 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 (kW);
- b) Torque as a function of speed (Nm);
- c) Fuel consumption (mass or volume^{*}) and specific fuel consumption (mass or volume^{*}) as a function of speed (g/h or l/h);
- d) Specific fuel consumption (mass or volume^{*}) as a function of power (g/kWh or l/kWh);
- e) No-load maximum engine speed (rpm).

*Indicate the density of the fuel

8.3 High Ambient Test (Optional)

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

8.3.1 Maximum Power Test

8.3.1.1 Maximum Power Absolute

Operate the Power Tiller at the engine speed where maximum power occurs for a period of two- hour subsequent to a warming-up period to reach stabilized running

conditions. Measure the power, torque, fuel consumption and speed.

The maximum power quoted in the test report shall be the average of at least six readings made at regular intervals during two-hour period. If the power varies by more than ± 2 % from the average, repeat the test. If the variation continues, report the deviation.

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

8.3.1.2 Maximum Power at Rated Engine Speed

If maximum power does not occur at rated engine speed, additional one-hour test shall be carried out using the procedure stated in 8.3.1.1.

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

- a) Coolant consumption (L/kWh) in case of water cooled engine and in case of air cooled engine liner jackets temperature ($^{\circ}\text{C}$) should be measured as recommendation from manufacture.
- b) Lubricating oil (g/kWh)

8.3.1.3 Test at Full Load and Varying Speed

The hourly fuel consumption, torque and power are measured as a function of speed. To plot the curves, the test shall go down to an engine speed at least 15% below the speed at which maximum torque occurs or to an engine speed at least 50% of rated engine speed, whichever speed is lower. This is subject to any limitations such as safe operation of the Power Tiller and test equipment or as stated by the manufacturer/ authorized applicant in agreement with the test station.

8.3.2 Presentation of Results

The observed data in 8.3.1 to 8.3.2 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 (kW);
- b) Torque as a function of speed (Nm);
- c) Fuel consumption (mass or volume^{*}) and specific fuel consumption (mass or volume^{*}) as a function of speed (g/h or l/h);
- d) Specific fuel consumption (mass or volume^{*}) as a function of power (g/kWh or l/kWh);
- e) No-load maximum engine speed (rpm).

*Indicate the density of the fuel

9. ROTARY SHAFT TEST

9.1 General

This test is applicable for tilling type Power Tiller.

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

9.2 Natural Ambient Temperature Test

During the test, the surrounding temperature will be within the range of 16⁰C to 34 ⁰C.

9.3 Varying Speed Test

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

9.4 Five Hour Test at Rated Power of Rotary Shaft

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

Report the following:

- Atmospheric pressure as specified in 4.9.1
- Ambient air temperature at a representative point as specified in 4.9.2
- Relative air humidity;
- Air temperature at the engine air intake;
- Maximum coolant temperature (no need to report coolant temperature in case of an air-cooled engine);
- The fuel temperature at the inlet to the injection pump;
- Engine oil temperature;
- Exhaust gas temperature.

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

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

10. DRAWBAR TEST

10.1 General

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

10.1.2 The test shall be conducted in running state corresponding to the manufacturer's recommendations. During the test, the operator of Power Tiller shall be sitting at the

provided seating arrangement.

- 10.1.3** At the beginning of the test, the height of the lug of tyres (pneumatic tyre/solid tyre /steel-track etc.) shall not be less than 65% of their height when new. The measurement shall be made at the center line of the standard tyres.
- 10.1.4** During the drawbar performance test, the governor control shall be set at maximum speed and full throttle.
- 10.1.5** The test shall not be conducted in the gear for which the forward speed exceeds the safety limit of the Power Tiller as stated by the manufacturer and in the testing equipment.
- 10.1.6** 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 and one immediately slower than the gear setting allowing maximum pull to be developed.
- 10.1.7** 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.
- 10.1.8** The measurement of drawbar pull, speed and slip shall be started only after the operational conditions are stabilized.
- 10.1.9** The test shall be conducted for at least 20 m run continuously without varying atmospheric or track conditions significantly.

10.2 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.

The maximum drawbar pull and drawbar power shall be recorded at Power Tiller wheel slippage only up to 15%. 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.

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

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

11. TURNING ABILITY TEST

11.1 General

- 11.1.1** The test area shall be a horizontal compact or paved surface having good tyre adhesion and capable of displaying legible marking.
- 11.1.2** 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.
- 11.1.3** 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/ authorized applicants.

- 11.1.4** The test shall be conducted with the Power Tiller without tail wheel at the minimum attainable speed. The measurement of radius of turning circle and turning space are referred in Fig 1.

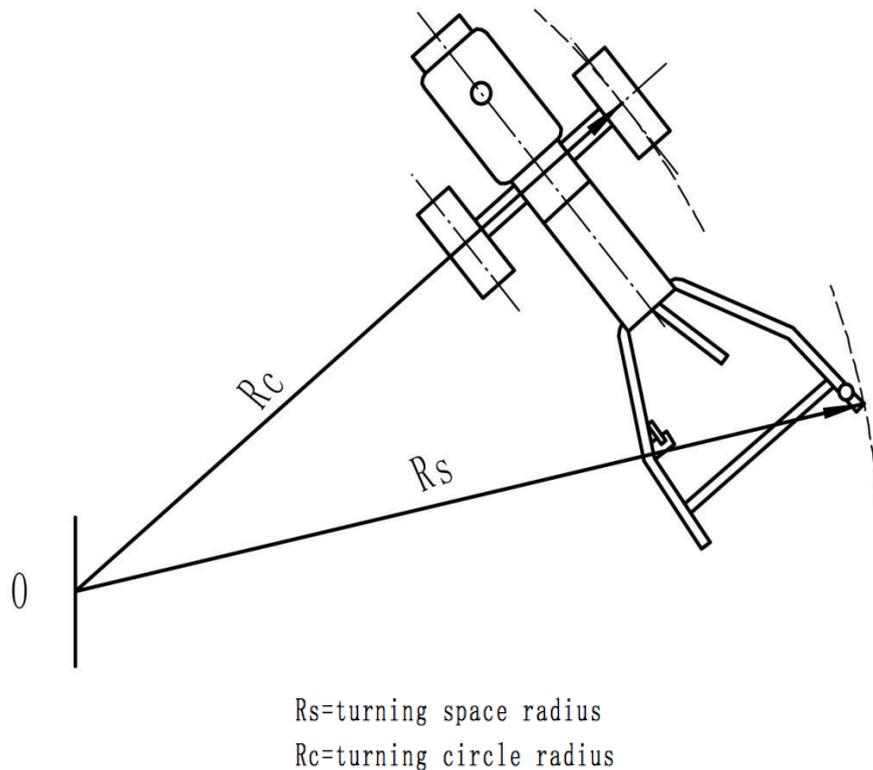


Fig 1: The measurement of radius of turning circle and turning space.

11.2 Procedure

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

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

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

12. PARKING BRAKE TEST HAND BRAKE INCASE MAYBE

12.1 General

12.1.1 Performance of the parking brake shall be based on the ability to hold the Power Tiller stationary, facing up and down on slopes.

12.1.2 The Power Tiller without ballast shall be attached with any matching implement e.g. rotary, plough etc.

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

12.2 Procedure

12.2.1 The Power Tiller shall be placed out of gear on a slope of 18 %. Additional voluntary tests can be made on higher slopes up to the maximum slope stated by the manufacturer. 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.

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

The data shall be recorded in **ANNEX D-5**.

13. AIR CLEANER OIL PULL-OVER TEST

13.1 The Power Tiller shall be parked on a level ground. The air- cleaner shall be cleaned and filled up to level of 5 percent (on mass basis) over the specified level with an oil viscosity recommended by the manufacturer. The engine shall then be operated at full governed speed for 15 minutes. This shall be followed by sudden acceleration and deceleration made after every 30 second for the period of 15 minutes. The air- cleaner assembly shall be weighed before and after the test. The loss of mass of oil, shall be reported.

NOTE- Before starting the test, the engine shall be run for one hour.

13.1.1 The air-cleaner oil pull over test shall be carried out in following positions:

- a) In horizontal position;
- b) In case of wheeled Power Tillers, the test shall be repeated with Power Tiller tilted 15° to either side and then 15° forward and backward in relation to the direction of travel of the Power Tiller.

13.2 The data shall be recorded in accordance with **ANNEX D-9**

14. MATERIAL TEST (HARDNESS OF SOIL ENGAGING COMPONENT)

The blade shall be heat treated quenched and tempered. The hardness in edge portion shall be 56±3HRC and in shank portion shall be 37 to 45HRC.

Note: HRC stands for Hardness Rockwell C Scale.

15. NOISE TEST

15.1 General

15.1.1 Sound level meter which meets the requirements of International standards shall be used.

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

15.1.3 The air temperature shall be in the range from -5 °C to 35 °C and the wind velocity at 1.2 m above ground level shall not exceed 5 m/s.

15.1.4 The A-weighted sound pressure level of the background noise, including wind noise,

shall be at least 10 dB (A) below that produced by the Power tiller being tested.

15.2 Measurement at By-stander Position

- 15.2.1** The noise shall be measured with instrument of A weighted expressed in decibels set on fast level.
- 15.2.2** The measurement shall be made with the power tiller/ mini tillers stationary on dry concrete surface and/or during field operation.
- 15.2.3** The engine of the power tiller shall be operating at the maximum speed and all related components shall be functioning as in normal field work. Tillage or moving components shall not engage with the soil or crop.
- 15.2.4** The microphone positions shall be located at 7.5 m away from the centerline on each side of the power tiller. The microphone shall be 1.2 m above ground level. The microphone shall be oriented in a direction normal to the centerline of the path of travel of power tiller/mini tiller on the track.
- 15.2.5** The octave band sound pressure level may be optionally measured and reported.
- 15.2.6** At least 3 measurements shall be made at each position for each operating condition. The reading of the 3 consecutive measurements shall be within 3 dB(A).
The data shall be recorded in **Annex D-10**.

15.3 Measurement at Operator Ear Level

- 15.3.1** The noise measurement test shall be conducted at the operator's ear level during the drawbar pull test. The test will be applicable to Power Tillers on which drawbar test is conducted.
- 15.3.2** The noise shall be measured with instrument of A weighted expressed in decibels set on slow level.
- 15.3.3** The test shall be conducted at different drawbar loads in different forward speed gears. The drawbar loads shall be applied by the loading device remotely positioned to eliminate interference with the sound fields caused by the Power Tiller.
- 15.3.4** During the measurement, the microphone shall be horizontal and facing forward. It shall be 50 mm to the side of the operator's forehead and in line with his eyebrows. It shall be mounted on an open frame helmet.
- 15.3.5** For seated operators, the microphone shall be located at 250 mm \pm 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 center of the microphone shall be 700 mm \pm 20 mm above the seat index point and 100 mm \pm 20 mm forward of that point. Excessive vibration of the microphone shall be avoided.
- 15.3.6** The sound level measurements shall be made in all forward speed gears under safety test condition. The results shall be reported in the gear giving the nearest forward speed of 2 km/h and under any gear for which a sound level of at least 1 dB (A) above that of the above- mentioned gear was recorded. The data shall be recorded in **Annex D-10**.
- 15.3.7** The noise should be measured and when noise exceeds the national limit personal protective equipment should be supplied to the operator.

Note – National limits will be used as reference

16 VIBRATION TEST

- 16.1** The Power Tiller shall be parked on a level concrete surface and tyres inflated according to off

field pressure recommended for road work. The power tiller and its rotary tiller attachment (if recommended by manufacturer) shall be operated at rated engine speed at no-load.

16.2 The acceleration of mechanical vibration of components/assemblies of the Power Tiller shall be measured with the help of suitable vibration measuring device on the components listed in **Annex D-11**.

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

17 HAULAGE TEST WITH MATCHING TRAILER

17.1 The Power Tiller shall be tested for haulage with a matching trailer of the capacity recommended by the manufacturer/ applicants/ testing authority

17.2 The haulage test shall be conducted on a leveled road/ track. The short distance of track may have gradient not exceeding 10 percent.

17.3 The Power Tiller shall be ballasted in accordance with the recommendation of the manufacturer/ applicants. In case of pneumatic tyres, the inflation pressure shall be maintained as recommended by the manufacturer for road work.

17.4 The test consisting of equal test run in both the directions shall be conducted under identical conditions, and range and average of test observations shall be reported. The total distance covered in both the directions of one test shall be up to 20 km. During the initial commercial testing, three test runs and during batch testing, only one test run would be covered.

17.5 The gears selected the appropriate to the satisfactory and safe operation. The speed can be reduced by reducing the engine speed as and when necessary while conducting the test.

17.6 The observations/ data shall be recorded according to ANNEX-E

18 FIELD PERFORMANCE TEST OF POWER TILLERS

18.1 General

18.1.1 A range of implements, matched to the power tiller required for operations given under as, should be supplied by applicants. The test shall be conducted with these implements. If the supply of matching implements has not been made by the applicants, the test shall be performed with those implements which are available at the testing station and as mutually agreed upon by the applicant and the testing authority.

18.1.2 The field operation shall consist of rotary tilling as a standard attachment and rest two attachments optional recommended by the manufacturer/importer.

- a) Dry land operation
- b) Wet land operation
- c) Stationary operations, if recommended by the manufacturer/importer

18.2 Selection of land and preparation of Power Tillers for test

18.2.1 Selection of land

The land selected for test shall preferably be agricultural land on which a crop was harvested with the last one year. The field operation should be made, as far as possible, in test plots where furrow length of a minimum of 50 m would be available. In case of puddling test, the furrow length may be a minimum of 25 m. The plot selected for ploughing after the harvest of the last crop, should not be given any previous tillage operation. If tilted, it should have a

well settled and reasonably compact soil. The surface should be reasonably levelled. The condition of the plot shall be check and reported.

18.2.2 Preparation of Power Tiller for test

18.2.2.1 The Power Tiller should be fitted with accessories in accordance with the manufacturer's/ authorized applicant's recommendations. The servicing and maintenance shall be carried out in accordance with the schedule prescribed by the manufacturer/ applicants in the printed literature.

18.2.2.2 The Power Tiller shall be fitted with ballast as recommended by the manufacturer/ authorized applicants in his safe/ instruction manual. In case of pneumatic tyres, it shall be inflated according to the recommendation of manufacturer for field work.

18.2.2.3 At the beginning of the test, the height of the tyre tread bars or lugs of the steel wheels measured at the centerline of the trye/ steel wheel shall be at least 65 percent of their height, when new.

18.3 Field operation

Field operations with each implement shall be carried out for duration of at least 15 hours. The total duration of field operations with different implements during initial commercial and batch testing of the Power Tiller shall be 75 hours respectively.

18.3.1 The operations except puddling shall be carried out in fields having soil moisture generally required for the type of operation. The soil moisture range for tillage operation for different soils is given below for guidance:

S.N	Soil Type	Moisture, Percent (Wet Basis)
1	Fine Sand	Up to 5
2	Sandy Loam	2 to 8
3	Silt loam	5 to 8
4	Clay loam	6 to 12
5	Clay / black soil	6 to 12

18.3.1.1 The soil moisture should be determined by an approved moisture meter or in oven by weight basis

18.3.1.2 The selection of gear shall be one in which satisfactory and safe operation is attended recommended by the manufacturer/authorized applicant.

18.3.1.3 The limiting factor for the field speed should be such that the wheel slip shall be within 20 percent.

18.3.1.4 The throttle setting for a particular operation shall be in accordance with the manufacturers/ authorized applicant's recommendation for field work.

18.3.1.5 For puddling operation, the field should have an average initial water depth of at least 100 mm or 10 cm.

18.3.1.6 During and after the operation, the data/ observation shall be recorded in accordance with given ANNEX F.

18.3.1.7 Stationary Operation: - The Power Tiller shall be updated for running as per recommendation of the manufacturer/ applicant.

19 WATERPROOF TEST

19.1 General

- 19.1.1** The waterproof test is conducted to determine the effectiveness of the seals of the Power Tiller when operated under lowland condition.
- 19.1.2** The Power Tiller shall be fitted with puddling wheels as per recommendation of manufacturer and with no implement attached.
- 19.1.3** The Power Tiller is classed as “waterproof Power Tiller,” if after the test described below, there is no water penetration into axle, brake, and clutch system.

19.2 Test Conditions

19.2.1 Test Bed

- 19.2.1.1** The test shall be conducted in a testing water bath/soil bin filled with a mixture of soil and water with a ratio of 1:3 by volume.
- 19.2.1.2** The soil shall contain 10-30% sand, 10-30% silt and 40-80% clay by weight while potable water shall be used.

19.2.2 Soil Mixture/Water Level

- 19.2.2.1** The soil mixture/water level shall be adjusted to the height of the center line of the wheel axle with the Power Tiller in a horizontal position.
- 19.2.2.2** The Power Tiller shall be installed and fixed on a stand for free rotation of puddling wheels.

19.3 Test Procedures

19.3.1 General Provisions

- 19.3.1.1** The Power Tiller shall be in the gear giving the nominal forward speed nearest to 6 km/h and operated continuously at rated engine speed for 5 hours.
- 19.3.1.2** If there is leakage of oil from the axle shaft to water prior to the completion of test, then the test shall be terminated.
- 19.3.1.3** The Power Tiller shall then be removed from the testing bath and be cleaned.
- 19.3.1.4** The Power Tiller shall be left in a place free from rain or snow for at least 12 hours before being finally checked.
- 19.3.1.5** The axle and gearbox shall then be disassembled and any evidence of water penetration into them shall be stated in the test report.

19.3.2 Unsuccessful Test

If the test fails, the manufacturer may ask for a repeat test of the same Power Tiller but only once. The Power Tiller when re-tested shall be equipped with the same components after the seals have been changed and/or re-fixed in conformity with manufacturer’s specification.

19.3.3 Checking Methods for Ingress of Water in the Oil

The oil in the housing (e.g. gearbox, engine sump) shall be checked using one or more of the following alternative methods.

- 19.3.3.1** Visual method: Distinct emulsification and/or color change of the oil shall be regarded as proof of water ingress or;

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

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

The data shall be recorded in **Annex D-12**.

20 SAFETY REQUIREMENTS

20.1 Guards

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

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

20.2 Controls

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

20.2.2 The location of hand controls which determines the position of the operator relative to the Power Tiller and working parts of the tiller should be designed to prevent accidental contact of operator with such dangerous parts.

20.2.3 All controls shall be identifiable by symbols and displays.

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

20.2.5 Engine of the Power Tiller shall be provided with a device to enable it to stop immediately. A clutch device may be provided to disengage the rotary device instantaneously. This should be easily accessible to the operator in his/her working position. Method of operation shall be clearly indicated on the Power Tiller.

20.3 Working Stability

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

20.4 Lighting

For safe operation during night and on highway, effective lighting provision shall be made. At least a single head-lamp shall be mounted on the front or above the engine of the Power Tiller.

20.5 Power Transmission

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

20.5.2 Rotary tiller – When rotary tiller or other attachment with the Power Tiller is provided,

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

20.6 Other Requirements

- 20.6.1** The operator should be protected from effects of tillage device on the soil by means of a shield, wherever possible, including mudguards on wheels.
- 20.6.2** The outlet of the exhaust pipe shall be located and directed in such a way that the operator will not normally be exposed to harmful concentrations of noxious gases or fumes.
- 20.6.3** The Power Tiller is to be equipped with brakes which can stop the tiller under all manufacturer's/importers recommended operating conditions.

20.7 Operational Safety Requirements

All routine checks and maintenance schedules as indicated by the manufacture are to be clearly understood by the operator before operating the Power Tiller.

The observations shall be recorded in **ANNEX G**.

- 20.8** It shall be mandatory for each power tiller/ mini tiller that hardware used in the unit itself like size and type of "V"-belts, direction of rotation, drive driven pulley their size, moving fasteners, etc. should indicate in the form of symbolic or pictorial on the body of the machine for the user in Nepali language. Greasing, lubricating point (if recommended) and other necessary symbols should be highlighted by red paint better understanding.

21 COMPONENT /ASSEMBLY INSPECTION

- 21.1** The engine, transmission, parking brakes, axle and generator shall be partially dismantled after conducting all the tests. The following measurement/ observations shall be made and reported.

21.1.1 Cylinder bore

The cylinder bore shall be measured on the thrust side and perpendicular to it at the top, middle and at the bottom position of the liner.

21.1.2 Piston Diameter

The piston diameter shall be measured on the thrust side and perpendicular to it at the top above the gudgeon pin and at the skirt. The clearance between the piston and cylinder at the skirt shall be worked out from the measurement made on piston and cylinder liner. Clearance between the piston and cylinder at skirt shall be worked out from measurements made on piston and cylinder liner.

21.1.3 Ring End Gap

The ring end gap for all compression and oil rings shall be measured at the top, middle and bottom position of liner

21.1.4 Ring Groove Clearance

The ring groove clearance shall be measured for all compression and oil rings.

21.1.5 Clearance of Main and Big End Bearing

The radial and axial clearance of main and big end bearing shall be measured. The radial clearance shall be measured after tightening the crankshaft bolts with the torque specified by the manufacturer

21.1.6 Valves, Guides, and Timing Gear/Chain- Sprocket

The valve shall be inspected for overheating signs and pitting of the seats. The timing gear cover shall be opened and the gear/ sprocket inspected for damage wear. Stiffness of spring and clearance between valve and guide and valve stem shall be measured.

21.1.7 Clutch

The clutch shall be opened and inspected for condition of clutch release bearing, springs, and release levers. Clutch friction plate wear should be determined by measuring the thickness. The clutch housing shall be inspected for the entry of dust, mud, water and oil.

21.1.8 Gear Box

The top cover of the gear box shall be opened and inspected for visual damage to the gear teeth.

21.1.9 Brakes

The break housing shall be opened and inspected for the entry of mud, dust, water and oil. The wear of brakes lining shall be determined by measuring the thickness.

21.1.10 Rotary Chain Case

The chain case shall be opened and inspected for the entry of dust, mud, water and oil. The condition of the bearing chains and sprockets shall be examined.

21.1.11 Starter, Motors and Generator

These shall be dismantled and inspected for the entry of dust, mud, water and oil. The condition of the bearing shall also be examined.

Note: - The observations covered under 20.1.7 to 20.1.11 shall be made after cleaning, washing and greasing as recommended by the manufacturer in printed literature.

21.2 The data shall be recorded in ANNEX- H

22 PRINTING LITERATURE/ DOCUMENTATION RELATING TO TEST SAMPLE

Each test sample shall be provided following printing literature / documentation relating to test sample for adopting to periodic service of under gone test sample from time to time:

- Operator /instruction manual relating to machine
- Free service coupons/ guaranty /warranty card of the product for safe guard of the machine purchaser
- Workshop and repair manual,
- Part catalogue,
- Any other technical literature relating to the test sample

23 MARKING AND LABELING PLATE OR IDENTIFICATION PLATE

Each test sample shall be provided labeling plate or identification plate in permanents nature viz. embossing on the body or riveted plate with following information:

- Name of machine
- Make and model of machine
- Serial number of engine/ chassis number

- Month/Year of manufacturing
- Prime mover details viz. engine cc and kW power
- Test report number

ANNEX A: LIST OF CITED STANDARDS

Standards No.	Title
ANTAM 001-2022	Asian and Pacific Network for Testing of Agricultural Machinery Standard Code for Testing of Power Tillers
IS 4905 : 1968	Methods of random sampling
IS 6690:2022	Specification for blades for Rotavator for power tillers
IS 9935:2002	Power Tiller – Test Codes
IS 9980: 1988	Guidelines for field performance and haulage test of power tiller (first revision)
IS 12036:1995	Agricultural Tractors-Test Procedures-Power Test for Power Take-off
IS 12180-1:2000	Tractors and Machinery for Agriculture and Forestry-- Noise Measurement- Method of Test: Part: 1: Noise at the Operator's Position - Survey Method
IS 12180-2:2000	Tractors and Machinery for Agriculture and Forestry-- Noise Measurement- Method of Test: Part: 2: Noise Emitted when in motion
IS 12226 : 1995	Agricultural tractor- power test for drawbar- Test procedure (first revision)
IS 12239-3:1988	Guide for Safety and Comfort of Operator of Agricultural Tractors and Power Tillers: Part 3: Requirements Relating to Power Tillers
IS 15925: 2012	Walk-Behind Powered Rotary Tillers — Definitions, Safety Requirements and Test Procedures

ANTAM = Asian and Pacific Network for Testing of Agricultural Machinery

IS = Indian Standards

ANNEX B: PROFORMA FOR SELECTION, RUNNING-IN AND REPAIRS

B-1 Name of the manufacturer

B-2 Address

B-3 Submitted for test by

B-4 Selected by

B-5 Place of running-in

B-6 Duration and schedule of running-in

B-7 Repairs and adjustments made during running-in

B- 8 Number of sealing

B-9 Location of sealing

ANNEX C: SPECIFICATION SHEET FOR POWER TILLERS

<p>C-1 POWER TILLER</p> <p>a) Name and address of the manufacturer: b) Name and address of the applicant for test: c) Type: d) Make/Model: e) Serial number: f) Year of manufacturing: g) Net mass (kg):</p>
<p>C-2 ENGINE</p> <p>a) Type/Make/Model: b) Name and address of the manufacturer: c) Serial number: d) Engine rated speed (recommended by manufacturer): e) Power at rated speed (kW): f) Net mass (kg):</p>
<p>C-3 CYLINDER AND CYLINDER HEAD</p> <p>a) Configuration (vertical or horizontal): b) Bore/stroke (mm): c) Capacity (cm³): d) Compression ratio: e) Type of combustion chamber:</p>
<p>C-4 FUEL SYSTEM</p> <p>a) Type of fuel feed b) Material of fuel tank c) Capacity of fuel tank (l): d) Location of fuel tank e) Provision for draining of sediments/water f) Type of fuel filter: g) Fuel ON/OFF provision</p>
<p>C-5 GOVERNOR</p> <p>a) Type: b) Governed range of engine speed (rpm): c) Rated engine speed (rpm):</p>
<p>C-6 AIR CLEANER</p> <p>a) Type (wet or dry): b) Location of air intake (in case of no pre-cleaner): c) Oil sump capacity (l):</p>
<p>C-7 EXHAUST</p> <p>a) Type of silencer: b) Location:</p>
<p>C-8 LUBRICATING SYSTEM</p> <p>a) Type: b) Oil sump capacity (l):</p>
<p>C-9 COOLING SYSTEM</p> <p>a) Type: b) Details of pump and fan, if available: c) Coolant capacity (l):</p>

C-10 ELECTRICAL SYSTEMa) **Battery**

Make :

Model:

Serial no:

Type:

Capacity & Rating:

Location:

b) **Stater:**

Make:

Model:

Capacity & Rating:

c) **Spark plug**

Make:

Model:

Electrode Gap:

d) Output power of generator (W):

e) Details of headlights (number, W):

C-11 POWER TRANSMISSION SYSTEM

a) Gearbox

1) Oil capacity (l):

2) Grade of oil:

3) Number of gears

i) Forward:

ii) Reverse:

4) Nominal traveling speed at rated engine speed

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

* Calculated with a pneumatic tyre dynamic radius index of mm

b) Type of main clutch:

c) Type of steering clutch:

C-12 ROTARY SHAFT (If applicable)

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

C-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):

C-14 HITCH (If applicable)

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

C-15 PARKING BRAKE

- a) Type:
- b) Method of operation:

C-16 WHEEL

- a) Pneumatic Tyres
 - 1) Make:
 - 2) Size:
 - 3) Type of tyre:
 - 4) Ply rating:
 - 5) Recommended inflation pressure (kPa)
 - i) For field work:
 - 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) Number of lugs:
 - 5) Total mass (two wheels) (kg):

c) Tail wheel (if applicable) <ol style="list-style-type: none"> 1) Steel wheel <ol style="list-style-type: none"> i) Diameter (mm): ii) Width (mm): iii) Mass (kg): 2) Pneumatic tyre <ol style="list-style-type: none"> i) Type: ii) Tyre inflation (kPa): iii) Mass (kg):
C-17 OPERATOR'S SEAT FOR RIDING TYPE <ol style="list-style-type: none"> a) Type: b) Type of suspension: c) Range of adjustment (if any) (mm):
C-18 OPERATOR'S SEAT FOR RIDING TYPE <ol style="list-style-type: none"> a) Type: b) Type of suspension: c) Range of adjustment (if any) (mm):
C-19 OPERATOR'S SEAT FOR RIDING TYPE <ol style="list-style-type: none"> a) Type: b) Type of suspension: c) Range of adjustment (if any) (mm):

C-20 MASS OF BALLAST				
Ballast Mass as Used (kg)				
	Water		Cast Iron Weight on Wheel	
Optional ballast				
C-21 MASS OF POWER TILLER (kg) (without driver but with lubricant, fuel and coolant full)				
	Ballast		Un-ballast	
Total				
C-22 OVERALL DIMENTIONS (mm)				
Conditions	Length*	Width*	Height*	Ground Clearance
With ballast				
Without ballast				
* Measure at the outermost points				

ANNEX D: 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 ⁰ C: d) Engine oil used 1) Type: 2) Grade: e) Transmission oil used: f) No load maximum engine speed (rpm): g) Engine performance test data are given in D-6 :				
D-2 ROTARY SHAFT TEST				
a) Date and place of test: b) Type of dynamometer used: c) Fuel used 1) Type: 2) Density at 15 ⁰ C : d) Engine oil used 1) Type: 2) Grade: e) Type of transmission oil used: f) No load maximum engine speed (rpm): g) Engine performance test data sheet given in D-6 :				
D-3 DRAWBAR PERFORMANCE TEST				
a) Date and location of tests: b) Type of track: c) Height of drawbar point above ground (mm): d) Mass of power tiller, without ballast (kg): 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 pneumatic/solid tyre/ steel tyre 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 (degree):		
Observations	Parking Brake Device Facing up Slope	Parking Brake Device Facing down Slope
(1)	(2)	(3)
Parking brake 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	Power (kW)	Crank Shaft Torque (Nm)	Engine Speed (rpm)	Fuel Consumption		Specific Energy (kWh/l)	Temperature (°C)					Atmospheric condition		
				Hourly (kg/h)	Specific (g/kWh)		Fuel	Intake air	Engine oil	Coolant	Exhaust air	Temp (°C)	Relative Humidity (%)	Pressure (kPa)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Natural Ambient														
A) Maximum power test														
B) Power at rated engine speed														
C) Varying engine speed at full load i) ii) iii) iv) v) vi)														
D) Rated engine speed at varying load i) ii) iii) iv)														

v) vi)														
E) Five hours engine rating test a) At load corresponding to 90% of maximum power (4 hour) i) ii) iii)														
b) At load corresponding to maximum power (1 hour) i) ii) iii) iv)														
2. High Ambient (Optional)														
A)Maximum power test absolute i) ii) iii)														

- a) Coolant consumption (l/kWh):
- b) Specific lubricating oil consumption (g/kWh)

D-7 ROTARY SHAFT PERFORMANCE TEST DATA SHEET

S.N	Test Condition	Tests	Rotary Shaft Power (kW)	Rotary Shaft Torque (Nm)	Engine Speed rpm	Fuel Consumption		Specific Energy (kWh/l)	Temperature (°C)						Pressure (kPa)			Atmospheric Condition		
						Hourly (g/h)	Specific (l/h)		Fuel	Engine Oil	Exhaust	Intake Air	Coolant	Rotary Shaft Oil Temp	Intake Air	Exhaust Gas	Lub. Oi	Temp (°C)	Relative Humidity (%)	Pressure (kPa)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
1	Normal Ambient Test	Varying engine speed at full load i) ii) iii) etc.																		
2	Normal Ambient Test	Five hours test at rated power of rotary shaft a) At load corresponding to 90 % of maximum power (4 hours): i) ii) iii) etc. b) At load corresponding to maximum power i) ii) iii)																		

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

D-9 DATA SHEET FOR AIR-CLEANER OIL PULL-OVER TEST

1. Type of oil used:
2. Relative humidity (%):
4. Mass of oil before test (with 5% excess on mass basis):
3. Atmospheric condition
 - a) Temperature:
 - b) Pressure, kPa:

TEST DATA

S.N	Position of Power tiller	Starting time	Stopping time	Mass before test (g)	Mass after test (g)	Loss of oil (g)	Loss of oil (%)	Oil pressure kPa	Remark
i	Power tiller parked on levelled ground								
ii	Power tiller tilted to 15° laterally on RHS								
iii	Power tiller tilted to 15° laterally on LHS								
iv	Power tiller tilted to 15° longitudinally with front end up								
v	Power tiller tilted to 15° longitudinally with front end up								

D-10 DATA SHEET FOR NOISE MEASUREMENT

MEASUREMENT POSITION					Operator Ear Level	By-stander
D-10.1 Brief Description of the Silencing System						
D-10.2 Sound Level Meter 1) Type: 2) Make: 3) Model:						
D-10.3 Date of Test						
D-10.4 Background Noise Level, dB(A)						
D-10.5 Atmospheric Conditions a) Temperature ($^{\circ}$ C) b) Wind velocity (m/s) c) Pressure (kPa) d) Relative humidity (%)						
D-10.6 Test Data for Operator Ear Level conducted during drawbar test						
S.N.	Gear Used	Travelling Speed (km/h)	Engine Speed (rpm)	Slip (%)	Drawbar Pull (kN)	Sound Level (dB(A))
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1						
2						
3						
4						
5						
6						

D-10.7 Test Data for By-stander Position

S.N.	Gear Used	Engine Speed (rpm)	Noise Level (dB(A))

D-11 TEST DATA FOR VIBRATION MEASUREMENT

D-11.1 Date of test

D-11.2 Type of instrument

D-11.3 Location of test
(tilling or pull)

D-11.4 Type of power tiller

S.N.	Measuring points		Displacement , micron	
			HD	VD
1	Steering handle	Left arm grip		
		Right arm grip		
2	Rotavator speed gear lever			
3	Tail wheel adjustment handle			
4	Clutch/ brake lever			
5	Fuel tank top			
6	Air cleaner top			
7	Fender assembly Right Left			
8	Chain drive cover center			
9	Air intake pipe			
10	Fuel tank top lid			
11	Fuel filter			
12	A gear shifting lever			
13	Accelerator lever			
14	Radiator cap			
15	Operators sheet back and bottom			
16	Engine bonnet Front Middle Rear			

* HD: Horizontal direction

VD: Vertical direction

D-12 DATA SHEET FOR WATERPROOF TEST

S.N.	Components	Ingress of Water
1	Axle	Yes/No
2	Gearbox	Yes/No
3	Engine Sump	Yes/No
4	Air cleaner in wet type	Yes/No

ANNEX E: DATA SHEET FOR HAULAGE TEST

E-1: Matching Trailer details

- a) Brief specification of trailer used,
- b) Make and model,
- c) Type,
- d) Size of plate form,
- e) Unloaded mass of the trailer (tonne),
- f) Gross mass of the trailer (tonne, t),
- g) Distance between the center of power tiller wheel and the center of the trailer wheel (mm),
- h) Tyre size, PR and inflation pressure,
- j) Height of the hitch above the ground (mm),

E-2: Power Tiller details

- a) Type, size and inflation pressure of power tiller wheel,
- b) Ballasting of the power tiller,
- c) Wheel track (mm),
- d) Height of hitch above the ground level (mm),
- e) Mass of power tiller (kg)

E-3: Test results

- a) Date of test,
- b) Total distance travelled (km)
- c) Total duration of test (hr.)
- d) Net stoppage of run (hr.)
- e) Total stoppage time (hr.)
- f) Net duration of run (hr.)
- g) Average speed of travel (kmph)
- h) Fuel consumption
 - i- Total, l
 - ii. Hourly, l/hr.
 - iii. Specific (l/km/t)
- i) Distance travelled per liter, Km
- k) General observations
 - i. Effectiveness of brakes
 - ii. Maneuverability of power tiller- trailer combination

ANNEX F: DATA SHEET FOR RECORDING FIELD OPERATION

S.N.	Particulars / Details	Observations
1	Place of Test	
2	Size of plot (l * w), m ²	
3	Field Conditions	
	a) Type of soil	
	b) Topography of field (levelled/ sloppy)	
	c) Last crop grown	
	d) Previous treatment before test	
	e) Type of weed and intensity, Number/m ²	
	f) Soil moisture , %	
	g) Bulk density of soil, gm/cc	

	h) Shear strength (kg/cm ²)	
	i) Any others field condition influencing Power Tiller performance	
4	Field operation date	
a	Gear used for Power Tiller/ rotary	
b	Engine speed, rpm At NO LOAD AT ON LOAD	
c	Type of operation	Dry land operation / wet land operation
d	Width of head line and method of ploughing/ tilling (Center to side/ side to center)	
e	Average operating speed (kmph)	
f	Average width and depth of cut/ Average depth of standing for puddling test, mm	
g	Average draft of implement, kN	
h	Average wheel slip, %	
i	Average wheel sinkage during puddling operation	
j	Total duration of test, hr.	
k	Stoppage if any, hr.	
l	Net duration of work, hr.	
m	Total area covered, ha	
n	Time required, hr./ha	
o	Area covered, ha/hr.	
p	Fuel consumed, l/hr. and l/ha	
q	Lubricating oil consumption , ml/hr.	
r	Coolant(water) consumption, ml/hr.	
s	Ambient Condition Temperature, °C RH, %	
5	Observation, after puddling test, for entry of water and mud/ dust in the following component/ assemblies	
a	Engine sump	
b	Air cleaner assembly	
c	Brake assembly	
d	Clutch assembly	
e	Axle assembly	
f	Electrical component	
6	General Observation	
a	Type and size of implements used	
b	Point of hitch and its height (in case of trailed implement)	
c	Ease of steering	
d	Unusual sound and vibration during operation	

ANNEX G: PROFORMA FOR SAFETY CHECK

G-1 Guards

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

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

G-2 Controls

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

G-3 Working Stability

Is ground stand of Power Tiller retractable? Yes/No

G-4 Lighting

Is head light available in the Power Tiller? Yes/No

G-5 Power Transmission

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

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

G-6 Other Observations, if any

ANNEX H: COMPONENTS / ASSEMBLY INSPECTION

H-1 Engine:

Cylinder bore:

Cylinder No.	Cylinder bore dia., (mm)						Max. permissible wear limit, (mm)
	Top position		Middle position		Bottom position		
	Thrust side	Non-thrust Side	Thrust side	Non-thrust Side	Thrust Side	Non-thrust side	
1.							

Piston:

Piston No.	Piston dia. (mm)					Clearance between piston & cylinder liner at the skirt of the piston, (mm)	
	Top (above top compression ring)		At skirt			As observed	Maximum permissible clearance limit
	Thrust side	Non-thrust Side	Thrust side	Non-thrust side	Maximum permissible were limit		
1.							

*Not measured due to piston design constraints

Ring end gap:

Rings	Ring end gap, (mm)			Max. permissible end gap limit, (mm)
	Top	Middle	Bottom	
1 st comp. Ring				
2 nd comp. Ring				
Oil ring				

Ring side clearance:

Rings	Ring side clearance, (mm)	Max. permissible clearance limit, (mm)
1 st Compression ring		
2 nd Compression ring		
Oil ring		

Main and big end bearings:

Main bearings:

Bearing No.	Diametrical clearance, (mm)	Crankshaft end float, (mm)	Max. permissible clearance limit,(mm)	
			Diametrical clearance	Crankshaft end float
1.	Fly wheel side (Ball bearing)			
2.	Transmission end (Ball bearing)			

Big end bearings:

Bearing No.	Clearance, (mm)		Max. permissible clearance limit,(mm)	
	Diametrical	Axial	Diametrical	Axial
1.				

	Valve, guides and timing gears:		
	Any marked sign of overheating of valves	:	
	Pitting of seat/faces of valves	:	
	Any visual damage to the teeth of timing gears	:	
	Clearance between valve guide and valve stem (mm):		
	- Intake valve	:	
	- Exhaust valve	:	

H-2	Clutch:		
	Any marked wear in clutch friction plate	:	
	Thickness of clutch plate, (mm)	:	
	Condition of clutch release bearing.	:	
	Condition of pilot bearing	:	
	Condition of pressure plate	:	
	Presence of oil and water in clutch housing	:	
H-3	Transmission gears:		
H-4	Rotary drive unit:		

ANNEX I: COMMITTEE COMPOSITION

क्र.स.	पद , निकाय	कैफियत
१	संयोजक: निर्देशक भौतिक गुणस्तर शाखा , नेपाल गुणस्तर तथा नापतौल बिभाग, बालाजु, काठमाडौं	
२	सदस्य : प्रतिनिधि कृषि यन्त्र परीक्षण तथा अनुसन्धान केन्द्र , नवलपुर, सर्लाही	
३	सदस्य : प्रतिनिधि ईन्जिनियरिङ अध्ययन संस्थान, पुलचोक	
४	सदस्य : प्रतिनिधि राष्ट्रिय ईन्जिनियरिङ अनुसन्धान केन्द्र , खुमलटार, ललितपुर	
५	सदस्य : प्रतिनिधि कृषि पूर्वाधार विकास तथा कृषि यान्त्रिकीकरण प्रवर्धन केन्द्र, काठमाडौं	
६	सदस्य : प्रतिनिधि नेपाल कृषि मेशिनरी व्यवसायी संघ, काठमाडौं	
७	सदस्य सचिव: भौतिक गुणस्तर शाखा , नेपाल गुणस्तर तथा नापतौल बिभागबाट तोकिएको अधिकृत, बालाजु, काठमाडौं	
८	सदस्य : प्रतिनिधि विज्ञहरु तथा गुणस्तर निर्धारण शाखाका अधिकृतहरु आवश्यकता अनुसार	