PHILIPPINE NATIONAL STANDARD

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ICS 65.060.10

Power Tiller— Methods of Test

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1 Scope

This Standard specifies the methods of test and inspection for the performance of the power tiller. Specifically, it shall be used to:

a) Verify the mechanism, dimensions, materials, accessories of power tiller, and the list of specifications submitted by the manufacturer;
b) Determine the performance of the machine;
c) Evaluate safety features; and
d) Prepare the test report.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For all references, the latest edition of the referenced document (including any amendments) applies.

AMTEC-UPLB. (2015). Agricultural machinery – Disc plow for walking type agricultural tractor – Specifications (PNS/PAES 167:2015). https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PNS-PAES-167-2015-Agricultural-Machinery-Disk-Plow-for-Walking-Type-Agricultural-Tractor-S.pdf

Bureau of Agriculture and Fisheries Standards (BAFS)-Department of Agriculture (DA). (2022). Walking-type agricultural tractor — Specifications — Part 1: Pull-type (PNS/BAFS 345:2022). https://drive.google.com/file/d/110A1D-XXgJfLJmvzVtvwLz1TCxjlpuu3/view

BAFS-DA. (2022). Walking-type agricultural tractor — Specifications — Part 2: Rotary-tilling type (PNS/BAFS 346:2022). https://drive.google.com/file/d/1sytv07f1yTQbQWdOXZa7Kq-K0SxhDbAM/view

BAFS-DA. (2022). Walking-type agricultural tractor — Specifications — Part 3: Float-assisted tiller (PNS/BAFS 347:2022). https://drive.google.com/file/d/18eZA2MHsQ7OO0kWhlPhwT0T7-fT_k-Tb/view

BAFS-DA. (2024). Methods of sampling for agricultural and biosystems power and machinery — Guidelines (PNS/BAFS 391:2024). https://drive.google.com/file/d/1U942cHfs_mHJuqUu7BFk-58Zm3sySnns/view

3 Terms and Definitions

For the purpose of this Standard, the terms and definitions given in PNS/BAFS 345:2022 (Walking-type agricultural tractor — Specifications — Part 1: Pull-type), PNS/BAFS 346:2022 (Walking-type agricultural tractor — Specifications — Part 2: Rotary tilling-type), PNS/BAFS 347:2022 (Walking-type agricultural tractor — Specifications — Part 3: Float-assisted tiller), or their latest issuances, and the following shall apply:

3.1
ground clearance
distance between the supporting surface and the lowest point of the power tiller provided that the machine is on a leveled surface

3.2
operating width
horizontal distance perpendicular to the direction of travel within which an implement or attachment performs its intended function

3.3
overall height
distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the power tiller including fixed components projecting upward

3.4
overall length
distance between two vertical planes at right angles to the median plane of the power tiller and touching its front and rear extremities

3.5
overall width
distance between two vertical planes parallel to the median plane of the power tiller, each plane touching the outer-most point of the power tiller on its respective side and with wheels set for minimum

3.7
power tiller
a self-propelled, single-axle agricultural machinery used for field operations (eg. tilling, seeding, plant protection, harvesting, haulage etc.) which may be used as walk-behind or riding type

NOTE The maximum speed of the power tiller when coupled to a trailer shall not exceed 22 km/h (IS 13539: 2008). The rated power output of the power tiller engine shall be in the range from 6 kW to 13.5 kW.

3.7
power tiller weight
total weight of the machine excluding ballast and implements with the fuel tank filled to 80% capacity and with normal amount of cooling water and lubricating oil (if engine is integrated with the power tiller) and with specified wheels

3.8
wheel slip
reduction on the distance traveled by the tractor due to the attached implement

4 Principles of Test

The test shall be carried out to verify the actual specification of the power tiller. Its specifications shall be validated with any of the following Standards or its latest issuance, as applicable:

a) PNS/BAFS 345:2022 (Walking-type agricultural tractor — Specifications — Part 1: Pull-type);
b) PNS/BAFS 346:2022 (Walking-type agricultural tractor — Specifications — Part 2: Rotary-tilling type); or
c) PNS/BAFS 347:2022 (Walking-type agricultural tractor — Specifications — Part 3: Float-assisted tiller)

5 Test Equipment, Instruments, and Materials

The test shall be carried out using the suggested minimum list of test equipment, instruments, and materials in Annex A (Minimum list of test equipment, instruments, and materials for field performance test). The test equipment and instruments to be used shall be calibrated regularly, physically checked for operation, and shall be cleaned before and after each test.

6 General Considerations

6.1 Conditions for the test

6.1.1 Test site conditions

The power tiller shall be assembled and tested for normal operation. The test site should be in an appropriate environment with ample space and suitable for safe working conditions.

6.1.2 Sampling of power tiller to be tested

6.1.2.1 Power tiller submitted for testing shall be sampled in accordance with PNS/BAFS 391:2024 (Methods of sampling for agricultural and biosystems power and machinery — Guidelines)

6.1.2.2 The prime mover shall have a valid test report issued by UPLB-AMTEC or any testing center accredited by the competent authority based on PNS/BAFS 396:2024 (Internal combustion engine — Specifications) and PNS/BAFS 397:2024 (Internal combustion engine — Methods of test).

6.1.3 Repairs during test

All repairs made during the tests shall be noted together with comments on any practical defect.

6.1.4 Suspension of test

During the test run, if the power tiller stops (due to minor breakdown or malfunction) affecting its performance, the test shall be suspended. The test applicant shall be given an opportunity to make minor repairs or adjustments within a reasonable time, and as agreed by the test applicant and testing engineer.

6.1.5 Termination of test

In cases of terminated tests, test reports shall be prepared. The test shall be terminated when any of the following conditions are observed:

a) If the prime mover fails to reach the rated speed within the specified test duration.

b) If the prime mover speed fails to stabilize for five minutes during testing.

c) If the power tiller is unable to continue operation after three attempts and all efforts have been exerted without replacing any major parts that can affect the performance of the machine.

d) If the test applicant voluntarily terminates the test.

6.2 Pre-test activities

6.2.1 Running-in and preliminary adjustments

The power tiller shall have undergone a running-in period, and various adjustments shall be made by the test applicant according to the manufacturer’s recommendation prior to the conduct of testing to ensure the readiness of the machine.

6.2.2 Verification of specifications

The specifications claimed by the manufacturer and other physical details given in Annex B (Specifications of power tiller) shall be verified. A stable and level surface shall be used as a reference plane for verification of dimensional machine specifications when fully assembled and ready for use. All specifications of available attachments used for land preparation shall be verified.

6.2.3 Preparation of the power tiller for testing

The power tiller shall be checked to ensure that the machine has been assembled and installed in conformance with the instructions of the manufacturer. It shall be tested according to the manufacturer's specifications.

7 Performance Test and Procedures

7.1 Field performance test

7.1.1 Size and field condition of test plot

7.1.1.1 The plot shall have a loam, silty loam, clay loam, silty clay loam, silty clay or clay soil texture but shall not be sand/sandy. Soil texture and moisture content shall be determined using the recommended methods given in Annex C (Soil Analysis [Laboratory Method]) or any other applicable method like the use of soils map.

7.1.1.2 The total size of the prepared test plots shall be sufficient for the required number of test trials and running-in. If the test plots are not conforming to the recommended characteristics, the test shall be suspended.

7.1.1.3 For testing of pull-type, the test plot shall be dry, pliable, and unplowed. It should be rectangular with sides in the ratio of 2:1 as much as possible and shall not be less than 500 m^2. The forward speed should be set at about 3.0-3.5 kph.

7.1.1.4 For testing of rotary type and general purpose rotary type on dry soil, the test plot shall be friable and plowed. It should be rectangular with sides in the ratio of 2:1 as much as possible and shall not be less than 500 m^2. The forward speed should be set at about 3.0-3.5 kph.

7.1.1.5 For testing of float-assisted type and general purpose rotary type on wet soil, the test plot shall be unplowed. The test plot should be soaked for at least 24 h with water level of at least 5 cm. It should be rectangular with sides in the ratio of 2:1 as much as possible and shall not be less than 500

m^2.

7.1.1.6 For testing of small rotary type, the test plot shall be dry, friable, and plowed. It should be rectangular with sides in the ratio of 2:1 as much as possible and shall not be less than 150 m^2. The forward speed should be set at about 1.0-1.5 kph.

7.1.1.7 For an unplowed test site, it should have a low weed density, and should have been used for the previous cropping season and clear from chopped crop residue, low stubble, straw, and stovers. The test applicant should clear the test site before the testing as applicable.

7.1.2 Machine setting

7.1.2.1 The machine's depth of cut shall be set between 90 mm to 110 mm for plowing and rotary tilling of dry fields, and between 90 mm to 200 mm for wet fields. For plowing, the specifications of the disc plow to be used shall conform with PNS/PAES 167:2015 (Agricultural machinery — Disc plow for walking type agricultural tractor — Specifications), or its latest issuances, and shall have an operating width of at least 150 mm.

7.1.2.2 Brand new tires shall be used for the field performance test. The inflation pressure in the tires shall be maintained as recommended by the manufacturer.

7.1.3 Operation of the power tiller

The power tiller shall be operated with load at the test site until the operation is finished. It shall be operated by the official representative of the test applicant using the recommended settings. Pull-type power tiller shall be operated for plowing, while both rotary-tilling type and float-assisted type shall be operated for rotary tilling. As part of the test, the testing agency shall make all measurements. No other adjustments shall be permitted during the test.

7.1.4 Field operational pattern

Field capacity and field efficiency can be influenced by the field operational pattern. For pull-type, a headland pattern from boundaries shall be used. For reversible plow, continuous pattern turn strips each end shall be used. For rotary type and float-assisted type, a circuitous pattern rounded corners shall be used as shown in Figure 1.

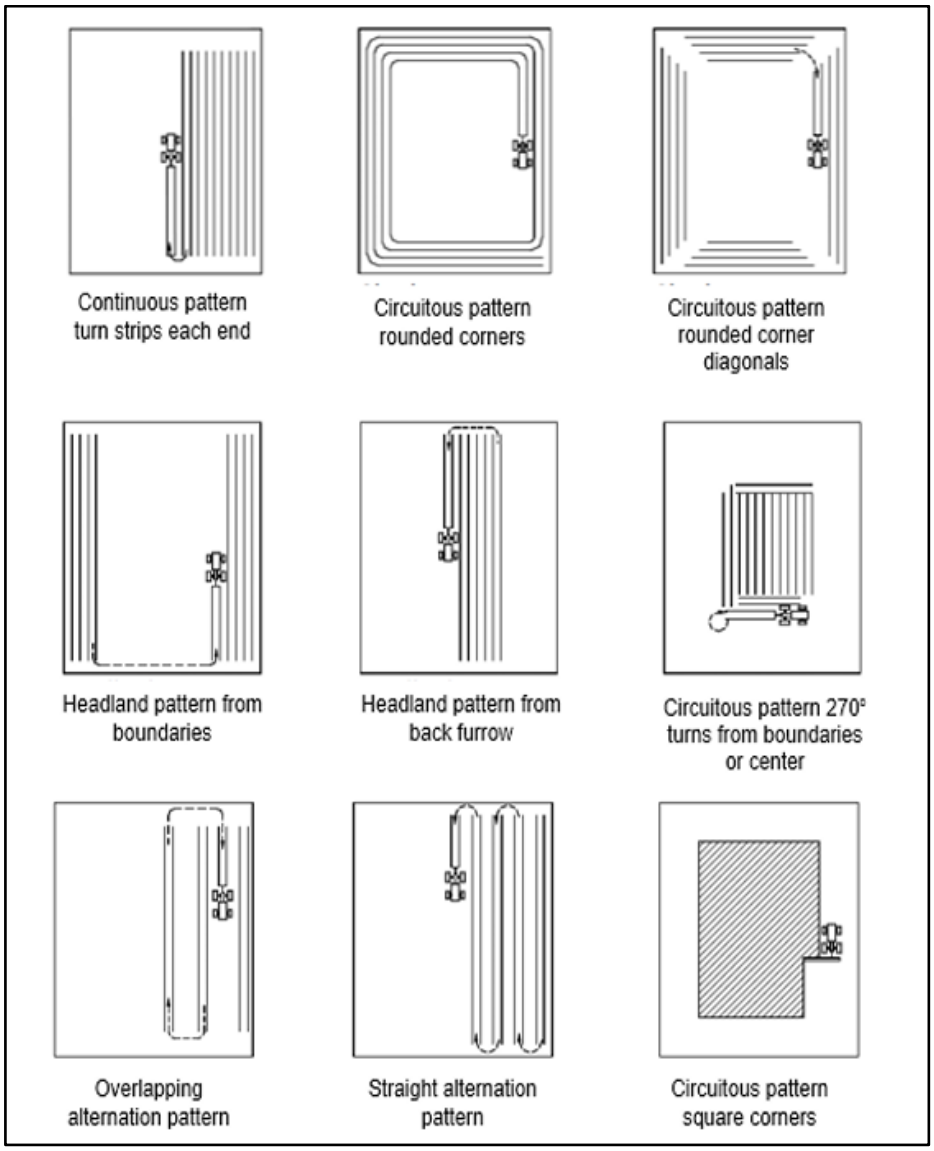

Figure 1. Field operational patterns (Regional Network for Agricultural Machinery [RNAM],1995)

7.1.5 Test trials

A minimum of two test trials shall be conducted.

7.1.6 Data collection

7.1.6.1 Duration of test

The duration of each trial shall last until the plowing or rotary tilling operation in the required area is finished.

7.1.6.2 Soil resistance before plowing/rotary tilling

Soil resistance shall be measured using a cone penetrometer in either lowland/wetland or upland field. There shall be at least 10 observations conducted.

7.1.6.3 Traveling speed

Outside the long boundary of the test plot, two poles 10 m apart (A, B) should be placed approximately in the middle of the test plot. Two poles should also be placed in a similar position, 10 m apart (C, D) so that all four poles form corners of a rectangle, parallel to at least one long side of the test plot as shown in Figure 2. The speed shall be calculated from the time required for the plowing/tilling to travel the distance (10 m) between the assumed line connecting two poles on opposite sides AC and BD. The easily visible point of the machine should be selected for measuring the time. The starting position shall be at least 2 to 5 m from poles A and C to stabilize speed before measuring and recording data. The tractor shall be operated at rated engine speed (rpm).

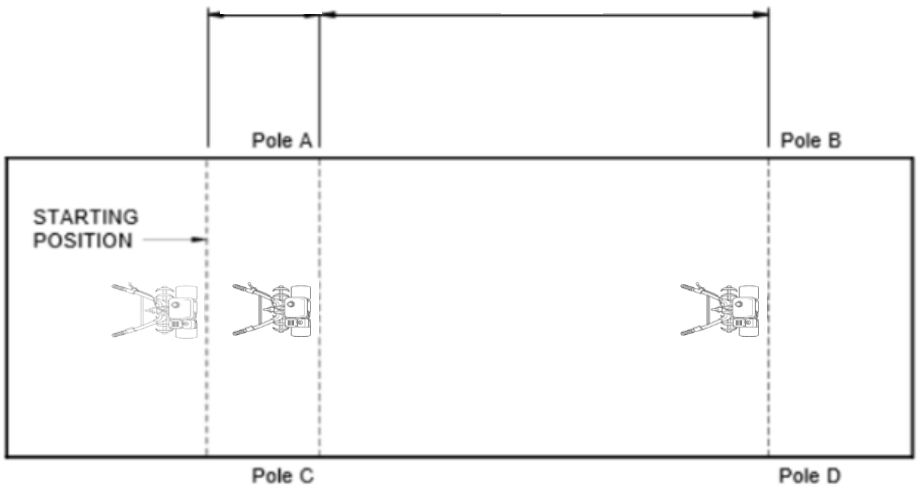

Figure 2. Measurement of operating/traveling speed

7.1.6.4 Effective working width and depth of plowing/rotary tilling

7.1.6.4.1 Effective working width should be determined by dividing the total width of the plot by the number of passes. A depth meter, as shown in Figure 3, shall be used in measuring the depth of plowing/rotary tilling.

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7.1.6.4.2 The depth shall be measured by placing the tip of graduated depth scale on the rototilled/plowed surface (point B) and putting a pin at point A of width scale. This procedure shall be repeated for the succeeding passes. The distance between point B and baseline for reading depth shall represent the depth of rotary tilling/plowing. However, the rototilled/plowed surface may not always level depending on the feature of the rotary tiller. Therefore, the tip of the depth scale shall be placed at relatively the same point in each pass.

7.1.6.4.3 The average of the measured depth for the average depth of plowing/rotary tilling shall be determined.

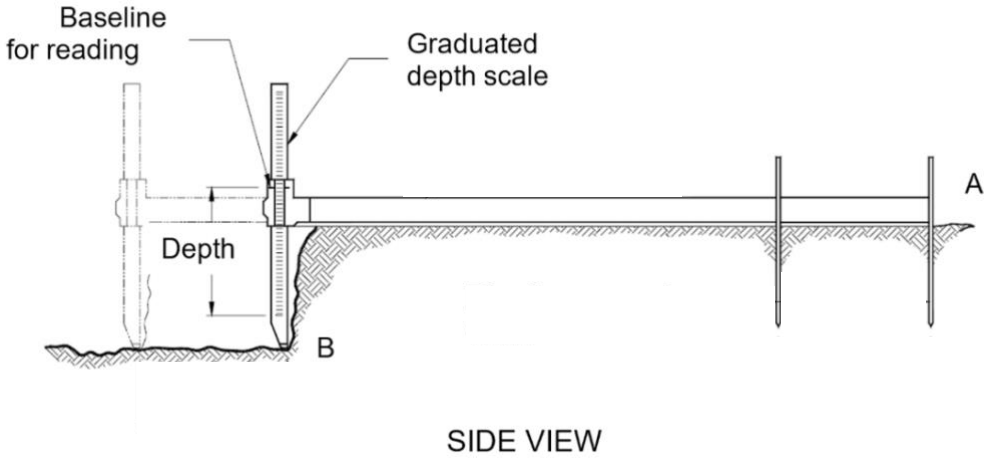

Figure 3. Measurement of depth of rotary tilling

7.1.6.5 Effective field capacity and percent overlapped/untilled

7.1.6.5.1 Operating width of implement or attachment, test plot's length, width and area, and number of rounds during operation shall be recorded for each trial. Effective width of cut, total distance traveled, effective area, and effective field capacity shall be calculated using the formulas in Annex D (Formulas used during calculations and testing).

7.1.6.5.2 Percent overlapped or untilled shall be calculated using the formula in Annex D (Formulas used during calculations and testing). If the actual width of cut is less than the actual width of implement, the operator has passed over part of the area twice to secure better coverage. If the actual width of cut is greater than the actual width of implement, the operator has left part of the area untilled.

7.1.6.6 Theoretical field capacity

With the operating width of implement or attachment recorded and

operating speed computed, the theoretical field capacity shall be obtained using the formula in Annex D (Formulas used during calculations and testing).

7.1.6.7 Fuel consumption

7.1.6.7.1 The total operating time of the power tiller's engine from the time it started until the time it stopped shall be recorded.

7.1.6.7.2 The refill method shall be used to get the amount of fuel consumed. The fuel tank shall be filled to full capacity before and after each trial. The amount of fuel used to refill the tank shall be recorded. While filling up the fuel tank, it shall be kept horizontal and shall have no empty space left inside.

7.1.6.7.3 The fuel consumption per unit time shall be calculated using the formula specified in Annex D (Formulas used during calculations and testing).

7.1.6.8 Noise level

7.1.6.8.1 The sound emitted by the power tiller during plowing or rotary tilling operation shall be measured approximately 50 mm away from the ear level of the operator/s using a sound level meter, expressed in decibel [dB (A)].

7.1.6.8.2 There shall be a minimum of five observations. Before collecting data, it should be ensured that the operations and other functional characteristics have stabilized. The time of recording shall be properly spaced during the whole duration of the test trial. There shall be at least 10 data or readings obtained.

7.1.6.9 Determination of wheel slip

7.1.6.9.1 The percentage of wheel slip with load and without load shall be obtained for three trials for the general-purpose type and pull-type power tillers.

7.1.6.9.2 To determine the wheel slip, the theoretical distance traveled without load (A) shall be established under ideal no-slip condition. The theoretical distance traveled for 10 wheel revolution, shall be calculated using the formula in Annex D (Formula used for calculation and testing).

7.1.6.9.3 A mark shall be placed on the wheel of the power tiller as shown in Figure 4. The actual distance traveled (B) for 10 wheel revolutions shall be measured during the operation of the power tiller. The percentage of wheel slip shall then be calculated by using the formula in Annex D (Formula used for calculation and testing).

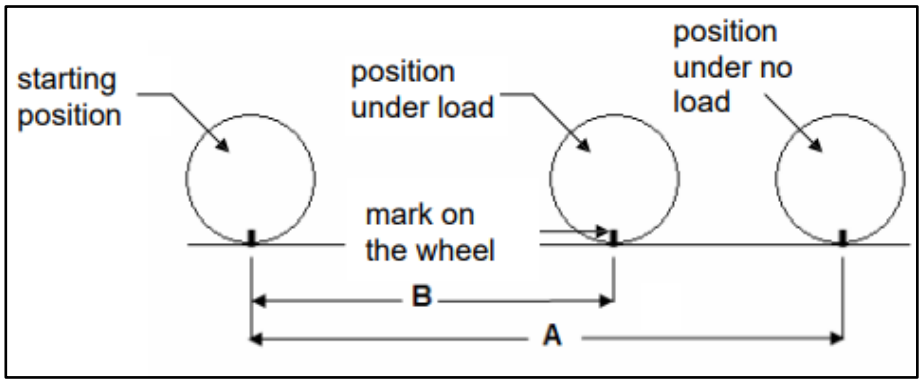

Figure 4. Measuring of wheel slip

7.1.7 Turning ability test

7.1.7.1 Condition of test area

The test area shall be a horizontal compact or paved surface having good tire adhesion and capable of displaying legible marking (Centre for Sustainable Agricultural Mechanization [CSAM]-United Nations Economic and Social Commission for Asia and the Pacific [ESCAP], 2018).

7.1.7.2 Machine setting

7.1.7.2.1 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 (CSAM-ESCAP, 2018).

7.1.7.2.2 Brand new tires shall be used for the turning ability test. The inflation pressure in the tires shall be maintained as recommended by the manufacturer (CSAM-ESCAP, 2018).

7.1.7.2.3 The test shall be conducted with the power tiller without a tail wheel at the minimum attainable speed (CSAM-ESCAP, 2018).

7.1.7.3 Data collection

7.1.7.3.1 The measurement of radius of turning circle and turning space are referred to in Figure 5 (CSAM-ESCAP, 2018).

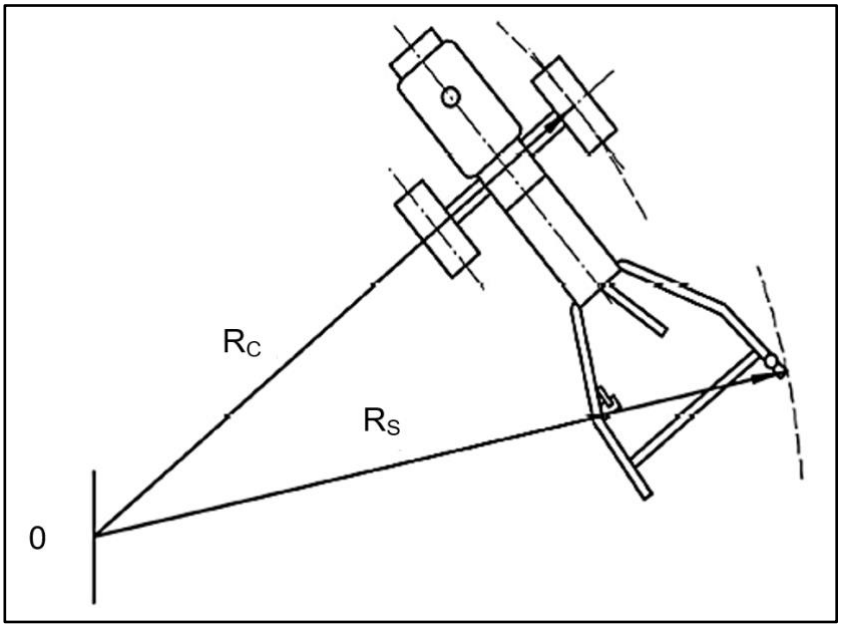

Figure 5. Measurement of radius of turning circle (R_C) and turning space (R_S) (adapted from CSAM-ESCAP, 2018)

7.1.7.3.2 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. The minimum travel speed shall be based on the lowest transmission gear setting of the power tiller. During the test, the diameter of the minimum turning circle and diameter of the minimum turning space required shall be measured.

7.2 Data recording and observations

All data and information during the test shall be recorded using the record sheet in Annex E (Field performance test data sheet). Necessary observations and other parameters to be taken during the performance test should be recorded in this sheet.

8 Formula

The formulas provided in Annex D (Formulas used during calculations and testing) shall be used.

9 Test Report

The test report shall include the following information in the given order:

a) Name of testing agency;

b) Test report number;
c) Title;
d) Summary of results;
e) Observations;
f) Purpose and scope of test;
g) Methods of test;
h) Description of the machine;
i) Specifications;
j) Results;
k) Observations (include pictures); and
l) Names, signatures, and designation of test engineers and assisting technicians.

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519 **Annex A**
520 (Informative)
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523 **Minimum list of test equipment, instrument, and materials for field**
524 **performance test**
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	Equipment, instrument, and materials	Quantity
A.1	Timers Maximum resolution: 0.1 s	2
A.2	Sound level meter Range: 30 dB(A) to 130 dB(A)	1
A.3	Cone penetrometer/proctor penetrometer	1
A.4	Measuring tape (at least 50 m)	1
A.5	Steel tape (at least 5 m)	1
A.6	Graduated cylinder Capacity: 500 mL (minimum)	1
A.7	Width and depth gauge	1
A.8	Camera	1
A.9	Caliper Accuracy: 0.025 mm	1
A.10	Tachometer	1
A.11	Hygrometer	1
A.12	Pegs	10
A.13	Aluminum can	1
A.14	Labeling tags	10

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Annex B
(Normative)

Specifications of power tiller

Name of Applicant : _____
Address : _____
Tel. No. : _____
Name of Manufacturer : _____
Address : _____
Tel. No. : _____

GENERAL INFORMATION

Make : _____ Type : _____
Serial No. : _____ Brand and Model : _____
Country of Manufacture/Origin: _____ Date of Manufacturer : _____
Testing Agency : _____ Test Engineer : _____
Location of Test : _____ Date of Test : _____

No.	Item[1]	Manufacturer's specification	Verification by the testing agency
B.1	**Main structure**		
B.1.1	Overall dimensions, mm		
B.1.1.1	Length		
B.1.1.2	Width		
B.1.1.3	Height		
B.1.1.4	Ground clearance, mm		
B.1.2	Weight, kg (if applicable)		
B.2	**Prime mover**		
B.2.1	Engine		
B.2.1.1	Brand		
B.2.1.2	Model		
B.2.1.3	Make or manufacturer		
B.2.1.4	Type		
B.2.1.5	Serial number		
B.2.1.6	Rated power, kW		
B.2.1.7	Rated speed, rpm		
B.2.1.8	Displacement, cm^3		
B.2.1.9	Cooling system		
B.2.1.10	Starting system		
B.2.1.11	Power transmission system		
B.2.1.12	Type of clutch		
B.3	**Power transmission system**		

No.	Item[1]	Manufacturer's specification	Verification by the testing agency
B.3.1	Type		
B.3.2	Lubrication system		
B.4	Engine pulley (outside diameter x no. of grooves x inside diameter, mm)		
B.5	Input shaft pulley (outside diameter x no. of grooves x inside diameter, mm)		
B.6	Axle, L x W, mm		
B.7	Hexagonal hub		
B.7.1	Thickness, mm		
B.7.2	Length, mm		
B.8	Type of hitch point		
B.9	**Wheels**		
B.9.1	Tractive wheels		
B.9.1.1	Pneumatic tire size[2]		
B.9.1.2	Tire pressure, kPa		
B.9.2	Cage wheel size, LxD, mm		
B.9.2.1	Number of lugs		
B.9.2.2	Dimension, Wxt, mm		
B.10	**Attachments**		
B.10.1	Disc Plow		
B.10.1.1	Type		
B.10.1.2	Number of bottoms		
B.10.1.3	Thickness, mm		
B.10.1.4	Diameter, mm		
B.10.1.5	Width of cut, mm		
B.10.1.6	Material		
B.10.1.7	Disc angle		
B.10.1.8	Tilt angle		
B.10.2	Rotary tiller		
B.10.2.1	Type		
B.10.2.2	Number of blades		
B.10.2.3	Number of flanges		
B.10.2.4	Blade thickness, mm		
B.10.2.5	Blade type		
B.10.2.6	Operating width, mm		

[1] The parameter will be checked upon availability

[2] The size shall be written in metric format:
[width in millimeter]/[aspect ratio][construction of tractor tire][rim size in inches]_[load index]_[speed index]_[tread style] (eg. 380/70R24 125 A8 R1)

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554 **Annex C**
555 (Normative)
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558 **Soil analysis (Laboratory method)**
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561 **C.1 Soil Texture Determination**
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563 **C.1.1** This test is carried out to analyze the soil samples taken during the
564 performance test to determine the soil texture of the test area.
565
566 **C.1.2** Three soil samples shall be taken from the test area. Each soil sample shall
567 be weighed and recorded.
568
569 **C.1.3** Each soil sample shall then be passed through a series of sieves.
570
571 **C.1.4** The type of soil (i.e. sand, silt and clay) that is retained in a particular sieve
572 shall be weighed as shown in Table C.1.
573
574 **Table C.1.** Grain Size for Different Soil Types

Soil type	Grain size, mm	Remarks
Sand	2.0 – 0.05	Passed through the 2 mm sieve but retained by the 0.05 mm sieve
Silt	0.05 – 0.002	Passed through the 0.05 mm sieve but retained by the 0.002 mm sieve
Clay	< 0.002	Passed through the 0.002 mm sieve

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577 **C.1.5** The relative composition of each soil type expressed in percent shall be
578 computed as follows:
579

580 $$\%\ Sand = \frac{Weight\ of\ sand}{Total\ weight\ of\ soil} \times 100$$

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582 $$\%\ Silt = \frac{Weight\ of\ silt}{Total\ weight\ of\ soil} \times 100$$

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584 $$\%\ Clay = \frac{Weight\ of\ clay}{Total\ weight\ of\ soil} \times 100$$

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C.1.6 The relative composition of the sand, silt and clay shall be used to determine the soil type using the soil texture triangle as shown in Figure 6.

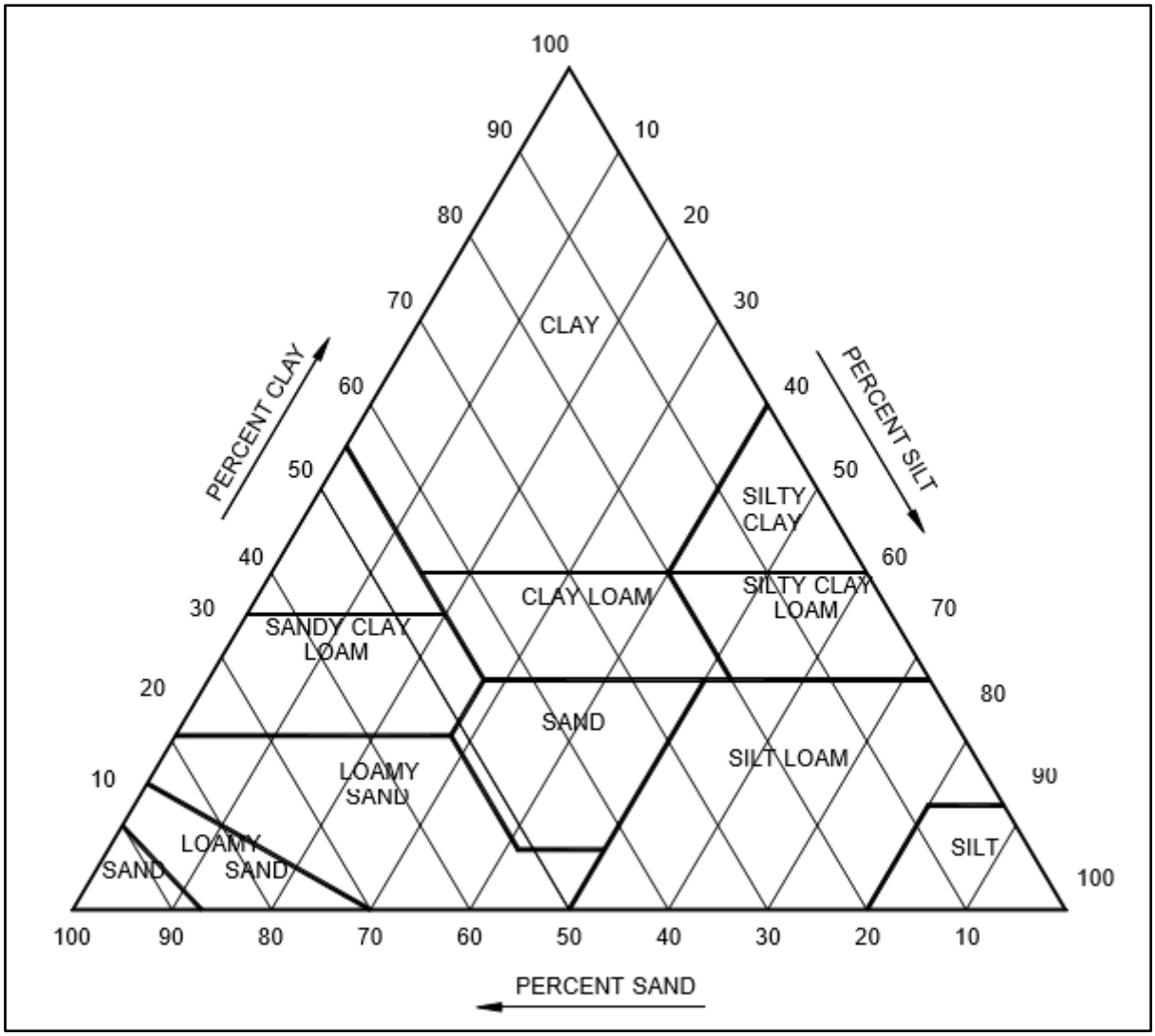

Figure 6. Soil texture triangle showing relative composition of texture class (Soil Survey Division Staff (1993)

C.2 Soil Moisture Content Determination (Oven method)

C.2.1 This test is carried out to analyze the soil samples taken during the performance test to determine the soil moisture of the test area.

C.2.2 Three core soil samples in at least three different locations of test plots shall be taken randomly from the test area. Each soil sample shall be weighed and recorded as the initial weight.

C.2.3 The samples shall be dried using a convection oven maintained at 105ºC for at least eight hours.

C.2.4 The oven-dried sample shall then be placed in a desiccator. Each soil sample shall be weighed and recorded as oven-dried weight.

C.2.5 The soil moisture (% dry weight basis) shall be computed using the formula in Annex D (Formulas used during calculations and testing).

C.2.6 The soil moisture content can also be measured using a soil moisture meter.

C.3 Bulk Density Determination

C.3.1 Soil sampling

C.3.1.1 A bottomless drum is to be placed on the soil. The bottomless drum shall be filled with water, allowing it to wet naturally for 24 hours.

C.3.1.2 An undisturbed flat horizontal surface in the soil at a depth to be sampled shall be prepared.

C.3.1.3 The steel ring should be gently pushed into the soil. Pushing the ring in too far should be avoided.

C.3.1.4 The ring should be excavated without disturbing or loosening the soil it contains. The ring should be carefully removed with the soil intact

C.3.1.5 Any excess soil shall be removed from outside the ring along with any plants or roots at the soil surface.

C.3.1.6 The soil shall be placed into the plastic bag with appropriate marks, date and location, and seals.

C.3.2 Bulk density calculation

C.3.2.1 The soil sample shall be dried using a convection oven maintained at 105ºC for at least eight hours.

C.3.2.2 The oven dried sample shall then be placed in a desiccator. The soil sample shall be weighed and recorded as oven-dried weight.

C.3.2.3 The volume of the ring shall be determined.

C.3.2.4 The bulk density can be computed using the formula in Annex D (Formulas used during calculations and testing).

C.4 Soil Puddling Index Determination

C.4.1 Oven-dry the 100 ml soil and water suspension samples at 105 °C for 48 hours.

C.4.2 Determine and record the volume of settled soil. Calculate the puddling index using the formula in Annex D (Formulas used during calculations and testing).

Annex D
(Normative)

Formulas used during calculations and testing

D.1 Bulk density

$$bulk\ density = \frac{W}{V_s}$$

where:

W is the oven-dried weight of the soil, g
V_s is the soil volume, cm^3

D.2 Determination of effective field capacity

D.2.1 Effective width of cut

$$S = \frac{W}{2n}$$

where:

S is the effective width of cut
W is the width of plot, m
n is the number of rounds
2 is the number of trips per round

D.2.2 Theoretical distance traveled

$$D = \frac{A}{S} = 2nL$$

$$A = L \times W$$

where:

D is the total distance travelled, m
A is the area of plot, m^2
L is the length of the plot, m

D.2.3 Effective area accomplished

$$A_e = wD = 2nLw$$

where:

A_e is the effective area accomplished, m^2
w is the operating width of implement or attachment, m

D.2.3.1 If the average width of tillage is less than the operating width of the implement or attachment, the operator has passed over part of the area twice to secure better coverage, therefore:

$$A_o = A_e - A$$

where:

A_o is the overlap (area which is plowed or rototilled twice), m^2

D.2.3.2 If the average width of tillage is greater than the operating width of the implement or attachment, the operator has left part of the area untilled, therefore:

$$A_u = A - A_e$$

where:

A_u is the untilled area (area missed), m^2

D.2.4 Effective field capacity

$$C_E = \frac{60A_e}{t}$$

where:

C_E is the effective field capacity, m^2/h
t is the time used during the operation, min

D.3 Theoretical field capacity

$$C_T = w_e \, x \, v$$

where:

C_T is the theoretical field capacity, m^2/h
w_e is the operating width of implement or attachment, m
v is the operating speed, m/h

D.4 Field efficiency

$$F_{eff} = \frac{efc}{tfc}\ x\ 100$$

where:

F_{eff} is the field efficiency, %

D.5 Fuel consumption

$$FC = \frac{V}{t}$$

where:

FC is the fuel consumption, L/h
V is the volume of fuel consumed, L
t is the total fuel consuming time, h

D.6 Percentage of wheel slip

$$A = \pi D \times 10 \qquad (1)$$

$$\%W.S. = \frac{A-B}{A} \times 100 \qquad (2)$$

where:

A theoretical distance traveled in 10 revolutions
%W.S. is the percent of wheel slip, %
D wheel diameter, m
B is the distance traveled by the tractor with implement attached after a given number of revolutions, m

D.7 Soil puddling index

$$PI = \frac{V_{ss}}{V_{sw}} \times 100 \qquad (1)$$

$$\%W.S. = \frac{A-B}{A} \times 100 \qquad (2)$$

where:

PI is the puddling index (%)

V_{ss} is the volume of settled soil (mL)
V_{sw} s the volume of soil and water suspension (mL)

D.8 Soil moisture content

$$Soil\ Moisture\ (\%dry\ weight\ basis) = \frac{W_i - W_f}{W_f} \times 100$$

where:

W_i is the initial weight of the soil, kg
W_f is the oven-dried (final) weight of the soil, kg

Annex E
(Informative)

Field performance test data sheet

Test trial no. : _____ Date : _____
Test engineers : _____ Location : _____
Assistants : _____ Machine : _____
Test applicant : _____ Manufacturer : _____

No.	Item	Trial 1	Trial 2	Trial 3	Average
E.1	**Test conditions**				
E.1.1	**Condition of field**				
E.1.1.1	Type				
E.1.1.2	Location (coordinates)				
E.1.1.3	Soil type				
E.1.1.4	Dimensions of field				
E.1.1.4.1	Length, m				
E.1.1.4.2	Width, m				
E.1.1.5	Area, m^2				
E.1.1.6	Depth of water, mm (for wet preparation)				
E.1.1.7	Moisture content, % (for dry preparation)				
E.1.1.8	No. of hours soaked (for wet preparation)				
E.1.1.9	Soil resistance, kg/cm^2				
E.1.1.10	Bulk density, g/cm^3				
E.1.1.11	Soil puddling index, %				
E.1.1.12	Spacing of stubbles (rows x hills), mm (if applicable)				
E.1.1.13	Height of stubbles, mm (if applicable)				
E.1.1.14	Weed density				
E.1.2	**Weather conditions**				
E.1.2.1	Temperature, °C				
E.1.2.1.1	Wet bulb				
E.1.2.1.2	Dry bulb				
E.1.2.2	Relative humidity, %				
E.1.2.3	Weather (sunny, cloudy, rainy)				
E.1.3	**Condition of power tiller**				

No.	Item	Trial 1	Trial 2	Trial 3	Average
E.1.3.1	Tractive device				
E.1.3.1.1	Type				
E.1.3.1.2	Size, mm				
E.1.3.2	Implement				
E.1.3.2.1	Type				
E.1.3.2.2	Size, mm				
E.1.3.3	Wheel track, mm				
E.1.3.4	Additional weight, kg				
E.1.3.4.1	Front end				
E.1.3.4.2	Wheel				
E.1.3.5	Gross weight, kg				
E.1.3.6	Speed-gear positions				
E.1.3.6.1	Main transmission				
E.1.3.6.2	Auxiliary transmission				
E.1.3.6.3	Belt speed change				
E.1.3.6.4	Rotary speed change				
E.1.3.7	Others				
E.2	**Field performance**				
E.2.1	Date of test				
E.2.2	Type of field operation				
E.2.3	Operating time, min				
E.2.4	Time lost				
E.2.4.1	Turning, min				
E.2.4.2	Others (specify), min				
E.2.5	Field operational pattern				
E.2.6	Depth of cut, mm				
E.2.7	Traveling speed, km/h				
E.2.8	Operating width of implement/attachment, mm				
E.2.9	Average width of tillage, mm				
E.2.10	Theoretical field capacity, ha/h				
E.2.11	Effective field capacity, ha/h				
E.2.12	Field efficiency, %				
E.2.13	Fuel consumed, L				
E.2.14	Fuel time, min				
E.2.15	Fuel consumption, L/h				
E.2.16	Others (specify)				
E.3	**Turning ability**				
E.3.1	Size of tire, mm				

No.	Item	Trial 1	Trial 2	Trial 3	Average
E.3.2	Pressure of tire, kPa (Bar)				
E.3.3	**Minimum turning circle diameter**				
E.3.3.1	Right hand side, m				
E.3.3.2	Left hand side, m				
E.3.4	**Minimum turning space diameter**				
E.3.4.1	Right hand side, m				
E.3.4.2	Left hand side, m				

E.4 Observations

E.4.1 Ease of handling and stability of the power tiller

_____
_____

E.4.2 Ease of manipulating of the operating levers

_____
_____

E.4.3 Ease of replacing and adjusting the parts

_____
_____

E.4.4 Safety features

_____
_____

E.4.5 Failure or abnormalities that may be observed on the power tiller or its component parts

_____
_____

E.4.6 Others

_____
_____

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