PHILIPPINE NATIONAL STANDARD

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ICS 65.060.20

Field Cultivator — Methods of Test

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Foreword

The Department of Agriculture (DA)-Bureau of Agriculture and Fisheries Standards (BAFS) was mandated under Section 21 (Standards Development and Enforcement) particularly Rule 21.2 of the Implementing Rules and Regulations (IRR) for Republic Act (RA) No. 10601 (Agricultural and Fisheries Mechanization [AFMech] Law) to update existing standards under the Philippine Agricultural Engineering Standards (PAES) in collaboration with concerned agencies.

In 2022, the DA-Bureau of Agricultural and Fisheries Engineering (BAFE) formally endorsed a list of aged PNS/PAES/PABES with concerns to the DA-BAFS to be considered for revision/amendment. The list was subjected to a prioritization assessment by the DA-Philippine Council for Agriculture and Fisheries (PCAF)-National Sectoral Committee on Agriculture and Fishery Mechanization (CAFMech) and was subsequently endorsed to the DA-BAFS. Further assessment was conducted by the DA-BAFS to identify the priority list for CY 2025, which was then presented during the PCAF-CAFMech Regular Meeting held on October 30, 2024. Accordingly, PAES 148:2010 (Agricultural Machinery — Field Cultivator — Methods of Test) was included in the 2025 priority list for standardization to update its provisions in line with evolving industry practices and enhance clarity, consistency, and usability for stakeholders

To expedite the review of these aged standards, the Bureau conducted a Table Review Assessment and Writeshop. This initiative aimed to reevaluate and validate whether the provisions of these existing standards remain relevant and reflective of current regulatory and industry practices, as well as harmonized with related regional and international standards. Moreover, this enables the Bureau to check and, if applicable, revise or amend the standards, especially those that pose a risk to end-users' safety and are potential trade barriers.

The revision was guided by the Technical Working Group (TWG) officially created under Special Order (SO) No. 745, series of 2025 (Composition of TWG and Project Management Team (PMT) for the Development of the Philippine National Standards (PNS) for the Agricultural and Fishery Products and Machinery). The TWG was composed of representatives from relevant government agencies, academe/research institutions, private sector organizations, and civil society organizations (CSO). The draft PNS underwent a series of TWG writeshops and a stakeholder consultation conducted via online platforms or a hybrid setup before its endorsement to the DA Secretary for approval.

This Standard includes the following significant changes compared to the previous version:

a) Amendment of Scope;
b) Determination of test site condition based on the type of operation;
c) Removal of the provision for roles under the General Conditions for Test and Inspection;
d) Specifying the determination of draft as optional;

e) Removal of general provisions under the field performance test; and
f) Conversion of inputs on the items under “Other observations” into descriptions, instead of rating.

This document cancels and replaces PAES 148:2010, which has been technically revised. This document was written in accordance with the formatting and editorial rules of the Standardization Guide (SG) No. 1 (Writing the PNS) and SG No. 5 (Writing the PNS for Agricultural and Fishery Machinery and Infrastructures) developed by the Standards Development Division (SDD) of the DA-BAFS.

Table of Contents

1 Scope

This Standard specifies the methods of test and inspection for a field cultivator. Specifically, it shall be used to:

a) Verify the mechanism, dimensions, materials, accessories, and workmanship of the field cultivator and the list of specifications submitted by the manufacturer;
b) Determine the performance of the machine except for weeding operation; and
c) Prepare the test report.

2 Normative References

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

Agricultural Machinery Testing and Evaluation Center (AMTEC)-University of the Philippines (UPLB). (2010). Agricultural machinery — Field Cultivator — Methods of Test (PNS/PAES 148:2010). https://amtec.uplb.edu.ph/wp-content/uploads/2019/07/pns-paes-148-2010.pdf

Bureau of Agriculture and Fisheries Standards (BAFS)-Department of Agriculture (DA). (2025). Field Cultivator — Specifications (PNS/BAFS 414:2025).

3 Terms and Definitions

For the purpose of this Standard, the definitions given in PNS/BAFS 414:2025 (Field Cultivator — Specifications) and the following shall apply:

3.1
draft
total force parallel to the direction of travel required to move the implement (AMTEC-UPLB, 2010)

3.2
drawbar power
power requirement of an implement being towed or pushed (AMTEC-UPLB, 2010)

3.3
effective field capacity
function of field speed, operating width, and field efficiency expressed in hectares per hour (AMTEC-UPLB, 2010)

3.4
field efficiency
ratio between the productivity of a machine under field conditions and the theoretical maximum productivity (AMTEC-UPLB, 2010)

3.5
implement
non-self-propelled device designed to be attached, hitched or connected to a tractor to perform an agricultural operation

3.6
implement width
horizontal distance perpendicular to the direction of travel between the outermost edges of the implement (AMTEC-UPLB, 2010)

NOTE See Figure 1.

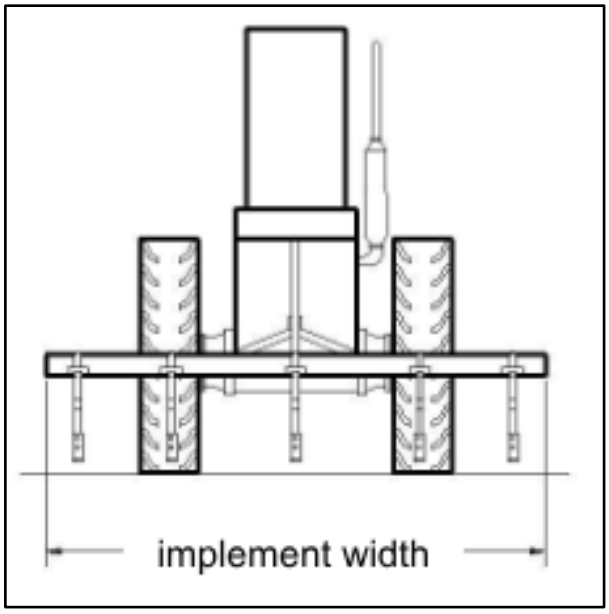


Figure 1. Implement width (adapted from AMTEC-UPLB, 2010)

3.7
nose angle
angle formed by the edges of the sweep (AMTEC-UPLB, 2010)

NOTE See Figure 2.

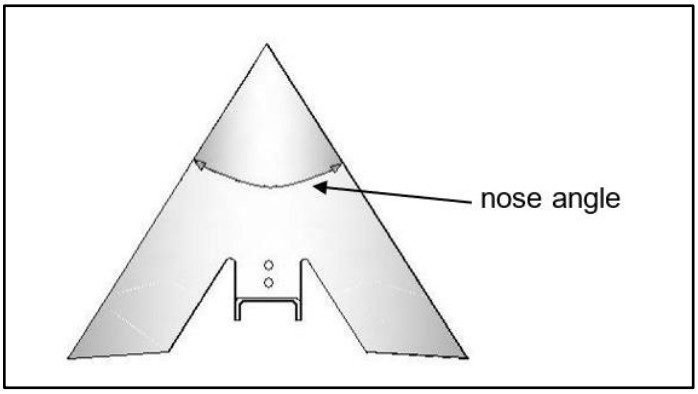


Figure 2. Nose angle (AMTEC-UPLB, 2010)

3.8
operating width
horizontal distance perpendicular to the direction of travel within which an implement performs its intended function; distance between the outermost shanks of the implement (AMTEC-UPLB, 2010)

NOTE See Figure 3.

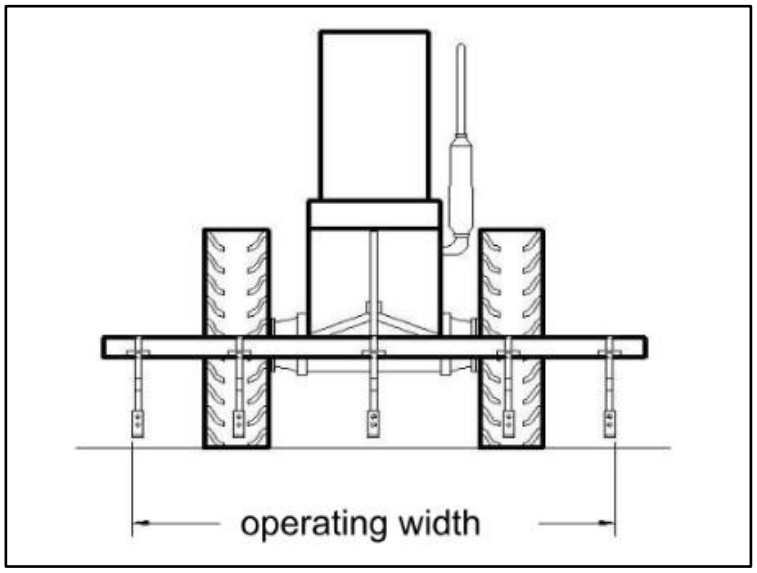


Figure 3. Operating width (adapted from AMTEC-UPLB, 2010)

3.9
stem angle
angle formed by the shank or the shovel relative to the ground surface or to its base, respectively (AMTEC-UPLB, 2010)

NOTE See Figure 4.

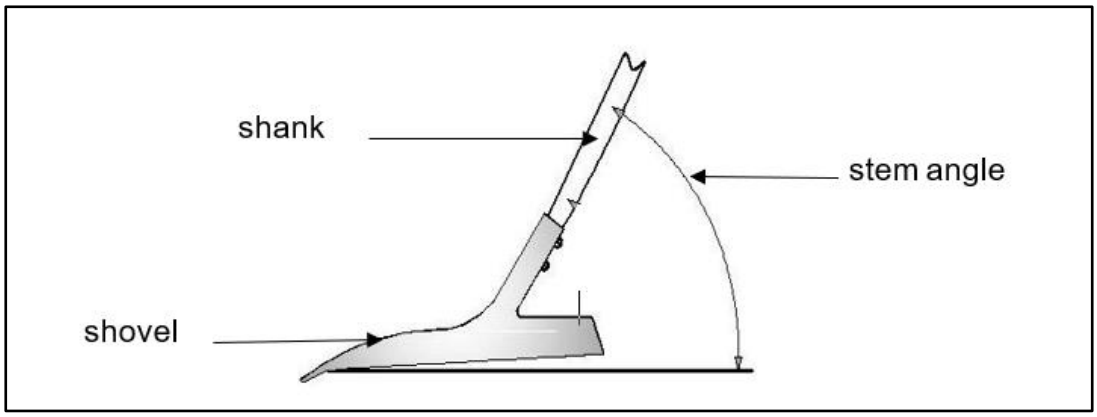
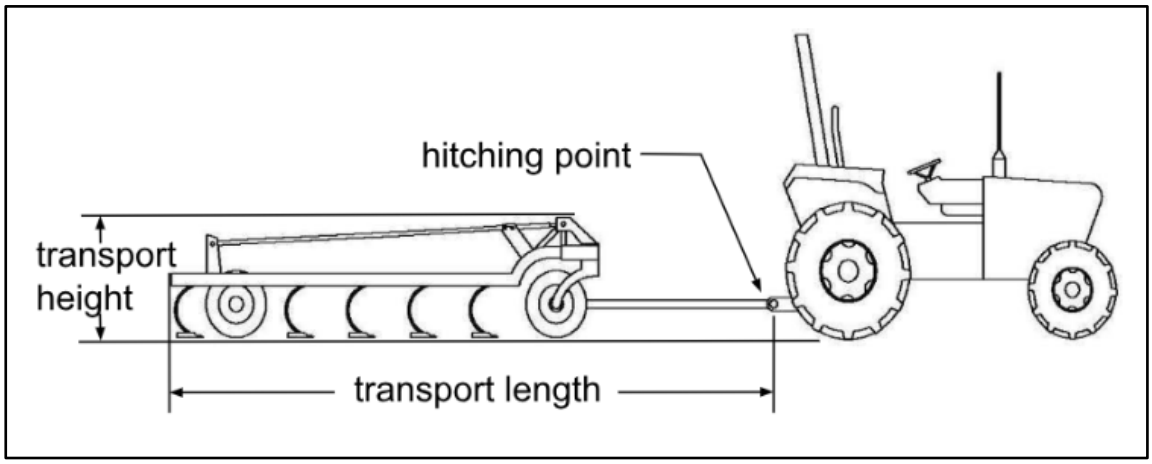


Figure 4. Stem angle (adapted from AMTEC-UPLB, 2010)

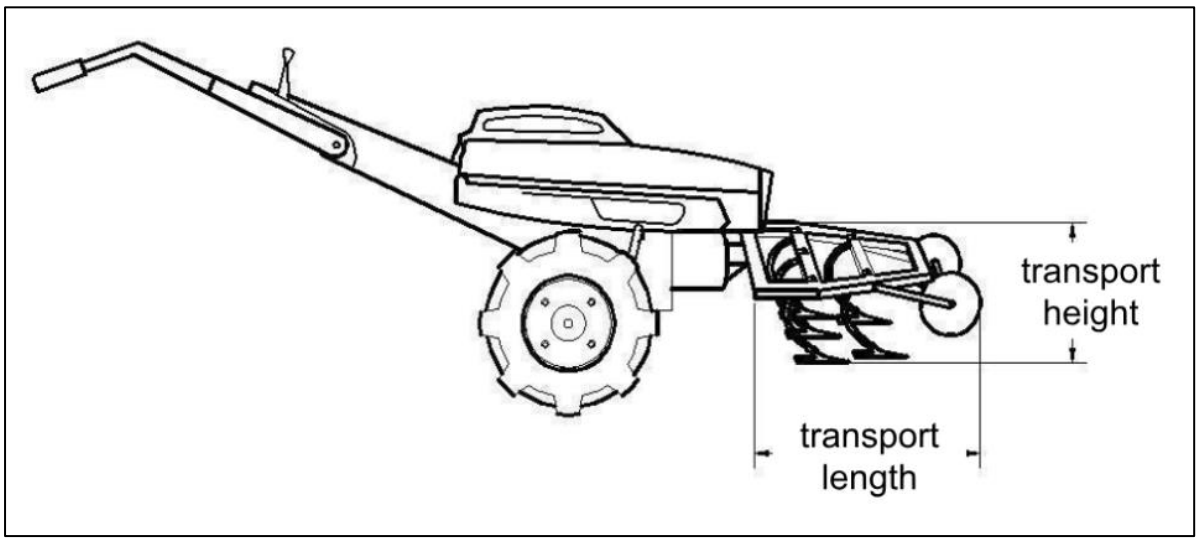
3.10
theoretical field capacity
function of speed and operating width expressed in hectares per hour (AMTEC-UPLB, 2010)

3.11
transport height
overall height of the implement measured from the topmost point to its lowest point (AMTEC-UPLB, 2010)

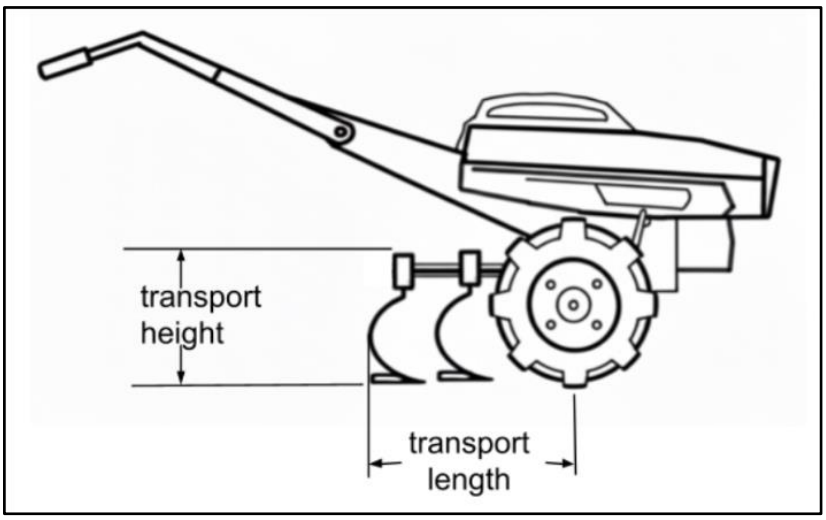
NOTE See Figure 5.



a) Four-wheel driven type



b) Front-mounted walking-type agricultural tractor (WTAT) driven type



c) Back-mounted WTAT driven type

Figure 5. Transport height and length (adapted from AMTEC-UPLB, 2010)

3.12
transport length
overall length of the implement measured from the terminal point of the implement to the hitching point as shown in Figure 5 (AMTEC-UPLB, 2010

3.13
wheel slip
reduction on the distance traveled by the tractor due to the attached implement (AMTEC-UPLB, 2010)

4 Principles of Test

The test shall be carried out to verify the actual specifications of the field cultivator. Its specifications shall be validated with PNS/BAFS 414:2025 (Field Cultivator — Specifications).

5 Test Equipment and Materials

The test shall be carried out using the suggested minimum list of test equipment and materials in Annex A (Minimum list of test equipment and materials). 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 Test site conditions

6.1.1 The test site should be in an appropriate environment with ample space and suitable to safe working conditions.

6.1.2 The test shall be carried out on a test site based on the specific type of operation, as shown in Table 1 below. Soil texture shall be determined using the recommended methods given in Annex B (Soil analysis [Laboratory Method]).

Table 1. Condition of test site based on the type of operation.

Type of Operation	Condition of Test Site	Soil Conditions
seedbed preparation	without crop	dry and semi-dry clay loam, silty clay loam, sandy clay loam
fallow cultivation	without crop but with vegetation	dry and semi-dry clay, loam, silty clay loam, sandy clay loam

6.1.3 The cultivating operation shall be done in fields of not less than 500 m^2 for WTAT and 1000 m^2 for Four-Wheel drive Tractor (4WT). It should be rectangular in shape, with sides in the ratio of 2:1 as much as possible. The headland of the field shall have at least 3 m in length.

6.1.4 The soil hardness should be measured using a cone penetrometer.

6.2 Pre-test activities

6.2.1 Running-in and preliminary adjustments

The field cultivator 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 C (Specifications of field cultivator) 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 testing.

6.2.3 Preparation of the field cultivator for testing

The field cultivator shall be checked to ensure that the machine has been properly assembled and installed in conformance with the instructions of the manufacturer. It shall undergo a running-in according to the protocol of the testing agency. The tractor to be used to conduct the test shall be compatible with the field cultivator in accordance with the manufacturer's specification of required power.

6.3 Suspension/termination of test

6.3.1 During the test run, if the field cultivator stops (due to minor breakdown or malfunction), the test shall be suspended. The test applicant shall be given an opportunity to make minor repairs or adjustments within a reasonable time.

6.3.2 The test shall be terminated if the machine 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. The test applicant has the option to terminate the test voluntarily at any stage of the testing process. In cases of a terminated test, a test report shall be prepared.

7 Performance Test and Procedures

7.1 Field performance test

7.1.1 The performance test shall be carried out to obtain actual data on overall performance of the equipment.

7.1.2 The field cultivator shall be tested at the recommended depth settings of the manufacturer. The actual operating depth shall be noted and shall be compared with the recommended operating depth.

7.1.3 The tractor speed shall be determined according to the recommended depth setting. This can be done by recording the time required for the tractor to travel a 20 m distance in the field as shown in Figure 6.

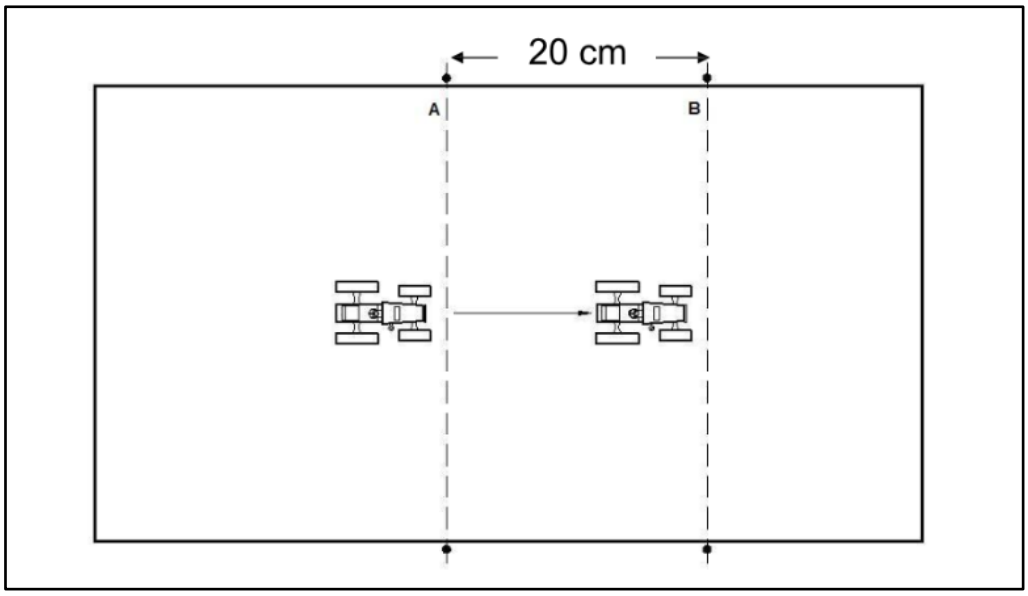


Figure 6. Points for speed test (adapted from AMTEC-UPLB, 2010)

7.1.4 The operating width shall be obtained by measuring the distance between the outermost shanks and shall be noted.

7.1.5 Field efficiency, effective field capacity, and drawbar power requirements of the implement shall be obtained using the formula in Annex D (Formula used for calculation and testing).

7.2 Operational pattern

Field capacity and field efficiency are influenced by field operational pattern. The operational pattern shall follow the circuitous pattern as shown in Figure 7.

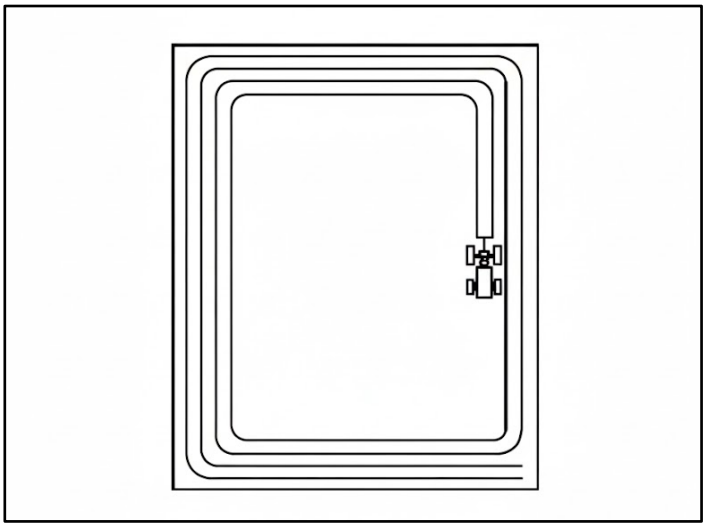


Figure 7. Circuitous field operational pattern (AMTEC-UPLB, 2001)

7.3 Test trial

The test shall be conducted with at least three test trials. Test data shall be measured for each pass.

7.4 Measurement of initial data

7.4.1 The initial data, such as field area, soil type, soil hardness, and soil moisture content, shall be obtained and recorded in Annex E (Performance test data sheet) before the test operation.

7.4.2 The total test time shall be determined by measuring the total time required to complete cultivating the test field. Non-productive time (e.g., headland turns) shall be recorded separately. The productive time shall be calculated by subtracting the non-productive time from the total test time.

7.5 Determination of draft (Optional)

A spring, hydraulic or strain-gauge type dynamometer shall be attached to the front of the tractor on which the implement is mounted. Another auxiliary tractor shall pull the implement-mounted tractor through the dynamometer in neutral gear but with the implement in its operating position as shown in Figure 8. The draft in the measured distance of 20 m as well as the time it takes to traverse it shall be recorded. On the same field, the draft in the same distance shall be recorded while the implement is lifted above the ground. The difference in the draft readings shall yield the draft of the implement.

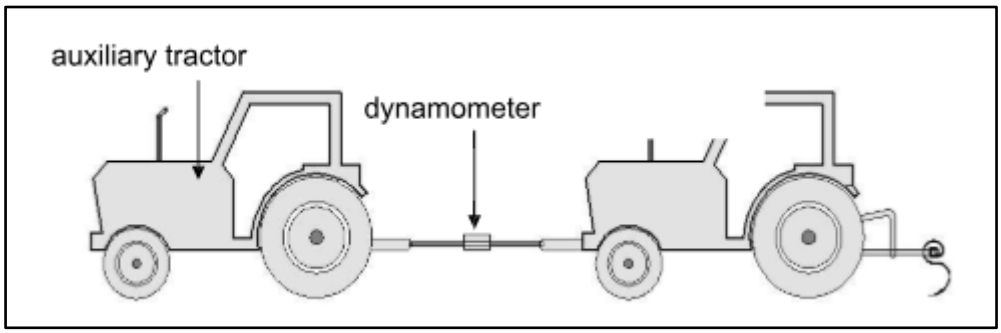


Figure 8. Position of tractors for draft measurement (AMTEC-UPLB, 2010)

7.6 Test for uniformity of depth of cut

7.6.1 Two points in the field passed shall be marked using pegs (points A and B). The distance between these points shall be 20 m. Every two meters, a marking peg shall be placed as shown in Figure 9.

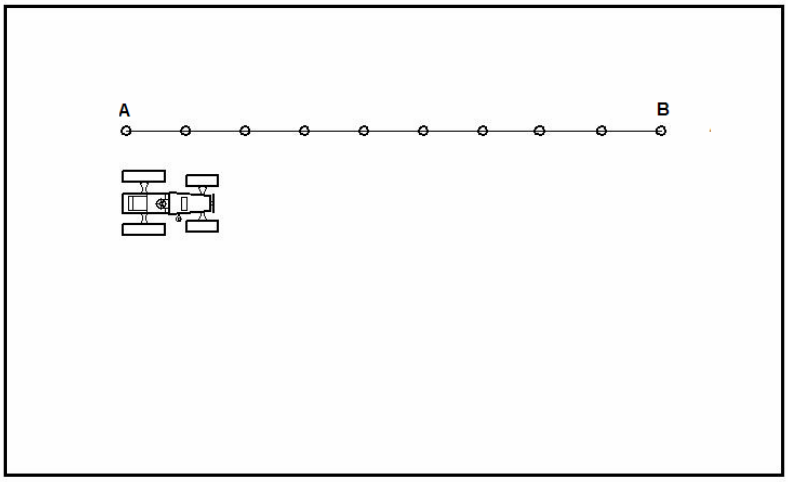


Figure 9. Soil strips marking for operating depth analysis (AMTEC-UPLB, 2010)

7.6.2 The operating depth of the field cultivator shall be set. The field cultivator shall be operated along the marked strips as shown in Figure 9. These strips of soil shall be observed.

7.6.3 The depth of cut for each strip shall be measured and shall be recorded. The mean depth shall be computed and shall be recorded as shown in Figure 10.

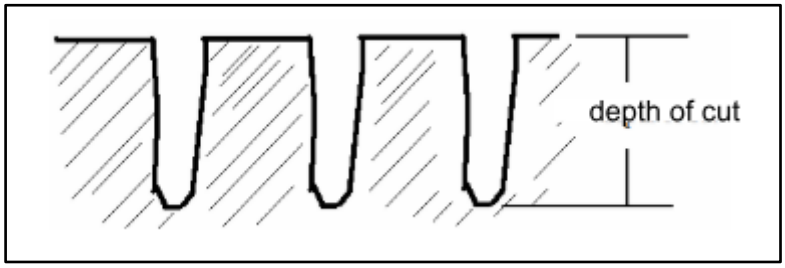


Figure 10. Depth of cut (AMTEC-UPLB, 2010)

7.6.4 The percent error for the mean depth shall be computed using the formula in Annex D (Formula used for calculation and testing).

7.7 Determination of wheel slip

The percentage of wheel slip shall be obtained by recording the difference of the distance traveled without load and the distance traveled with the implement attached. A mark shall be placed on the wheel of the tractor as shown in Figure 11. The tractor shall be allowed to move forward up to 10 revolutions of the marked wheel under no load (A). The distance shall be measured and recorded. On the same surface, the tractor shall be allowed to move forward with the implement attached. After some number of revolutions, the distance traveled shall be measured and recorded (B). The percentage of wheel slip shall then be computed using the formula in Annex D (Formula used for calculation and testing).

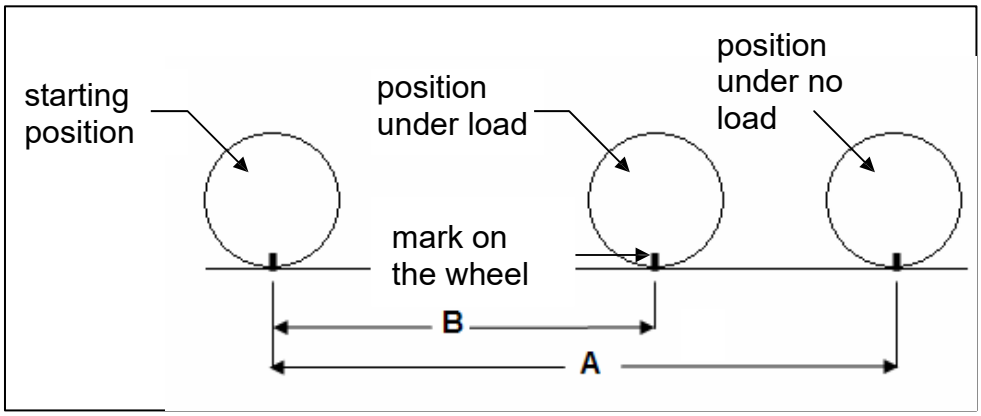


Figure 11. Measuring of wheel slip

7.7.1 Condition of field cultivator after test shall be compared to its initial condition.

7.7.2 Welded parts shall be inspected.

7.7.3 Loosened bolts shall be noted.

7.7.4 All data shall be recorded in Annex E (Performance test data sheet).

7.8 Fuel consumption

The energy consumption of engine of the prime mover of the field cultivator may be obtained using any of the following methods:

a) Refilling the fuel tank

The fuel consumption of the machine shall be obtained by measuring the volume of fuel refilled after the test. The tank shall be filled to full capacity before and after each trial. The total operating time of the machine shall be recorded. The fuel consumption shall be computed using the formula specified in Annex D (Formula used for calculation and testing).

b) Using fuel consumption meter

The fuel consumption shall be obtained by connecting the engine fuel line to a fuel consumption meter. The total time to consume a given volume of fuel (e.g., 10 mL, 15 mL) shall be recorded. The fuel consumption shall be computed using the formula specified in Annex D (Formula used for calculation and testing)

7.9 Noise level

7.9.1 The sound emitted by the four-wheel tractor used during the cultivating operation shall be measured 50 mm away from the ear level of the operator/s using a sound level meter, expressed in decibel [dB (A)].

7.9.2 There shall be a minimum of five observations. Before collecting data, it should be ensured that the operations and other functional characteristics of the field cultivator have stabilized. The time of recording shall be properly spaced during the whole duration of the test trial.

7.10 Data recording and observations

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

8 Formula

The formulas provided in Annex D (Formula used for calculation 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;
e) Purpose and scope of test;
f) Methods of test;
g) Description of the machine;
h) Specifications;
i) Results;
j) Observations (include pictures); and
k) Names, signatures, and designation of test engineers and assisting technicians.

Annex A
(Informative)

Minimum list of test equipment and materials

	Test equipment and materials	Quantity
A.1	**Test equipment and instruments**	
A.1.1	Sound level meter Range: 30 dB(A) to 130 dB(A) Resolution: 0.1 dB(A)	1
A.1.2	Digital stopwatch (Timer) Resolution: 0.1 sec	1
A.1.3	Measuring tape Minimum length: 10 m	1
A.1.4	Camera	1
A.1.5	Vernier caliper Resolution: 0.01 mm	1
A.1.6	Weighing scale	1
A.1.7	Graduated cylinder	1
A.1.8	Computer	1
A.1.9	Fuel consumption meter	1
A.1.10	Cone penetrometer	1
A.1.11	3-inch-diameter aluminum ring	1
A.1.12	Wood block or plastic insertion cap	1
A.1.13	Rubber mallet or weight	1
A.1.14	Flat-bladed knife	1
A.1.15	18-inch metal rod	1
A.1.16	Resealable plastic bags	6
A.1.17	Width and depth gauge	1
A.1.18	Four-wheel tractor or Two-wheel tractor	1
A.1.19	Convection oven or soil moisture meter	1
A.1.20	Electronic balance Capacity: 1kg	1
A.1.21	Sieve Sizes: 2 mm, 0.05 mm, and 0.0002 mm	3
A.2	**Test materials**	
A.2.1	Marking pegs	20

Annex B
(Normative)

Soil analysis (Laboratory method)

B.1 Soil Texture Determination

B.1.1 This test is carried out to analyze the soil samples taken during the performance test to determine the soil texture of the test area.

B.1.2 Three soil samples shall be taken from the test area. Each soil sample shall be weighed and recorded.

B.1.3 Each soil sample shall then be passed through a series of sieves.

B.1.4 The type of soil (i.e. sand, silt and clay) that is retained in a particular sieve shall be weighed as shown in Table B1.

Table B.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

B.1.5 The relative composition of each soil type expressed in percent shall be computed as follows:

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

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

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

B.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 13.

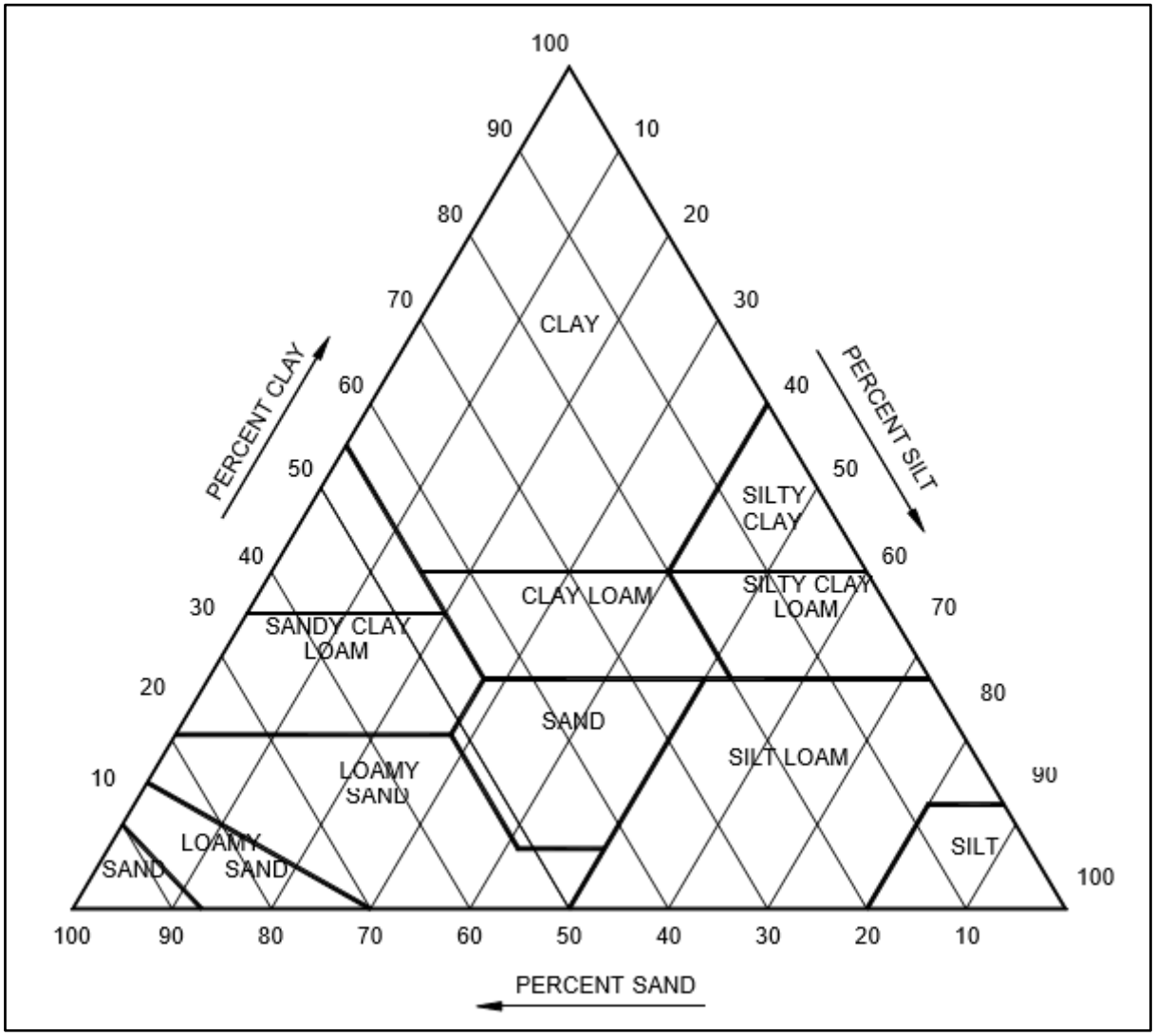


Figure 13. Soil texture triangle showing relative composition of texture class (Soil Survey Division Staff (1993)

B.2 Soil Moisture Content Determination (Oven method)

B.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.

B.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.

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

B.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.

B.2.5 The soil moisture (% dry weight basis) shall be computed as follows:

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

where:

Wi is the initial weight of the soil, kg
Wf is the oven-dried (final) weight of the soil, kg

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

Annex C
(Normative)

Specifications of field cultivator

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 Manufacture : _____
Testing Agency : _____ Test Engineer : _____
Location of Test : _____ Date of Test : _____

Items		Manufacturers' Specification	Verification by the Testing agency
C.1	**Overall dimensions**		
C.1.1	Transport height, mm		
C.1.2	Transport length, mm		
C.1.3	Implement width, mm		
C.1.4	Weight, kg		
C.1.5	Operating width, mm		
C.2	**Main frame**		
C.2.1	Material		
C.2.2	Dimensions, mm		
C.3	**Shank assembly**		
C.3.1	Shank protection Mechanism		
C.3.1.1	Material		
C.3.2	Shank		
C.3.2.1	Material		
C.3.2.2	Dimensions, mm		
C.3.2.3	Ground clearance, mm		
C.3.2.4	Stem angle, degrees		
C.3.2.5	Spacing, mm		
C.3.2.6	Type		
C.3.2.7	Number of shanks		
C.3.3	Shovel		

Items		Manufacturers' Specification	Verification by the Testing agency
C.3.3.1	Material		
C.3.3.2	Type		
C.3.3.3	Dimensions, mm		
C.3.3.4	Stem angle, degrees (for sweeps)		
C.3.3.5	Nose angle, degrees (for sweeps		
C.4	**Transverse toolbar**		
C.4.1	Material		
C.4.2	Dimensions, mm		
C.4.3	Number of shanks		
C.5	**Gauge wheels (if present)**		
C.5.1	Diameter, mm		
C.5.2	Adjustments		
C.6	**Mounting details**		
C.7	**Cylinder (if present)**		
C.7.1	Type		
C.7.2	Capacity, Pa		
C.7.3	Bore, mm		
C.7.4	Stroke, mm		
C.8	**Tractor required**		
C.8.1	Type		
C.8.2	Recommended traveling speed, kph		
C.8.3	Engine power, kW		

Annex D
(Normative)

Formula used for calculation and testing

D.1 Total distance travelled

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

where:

D total distance traveled, m
A area of plot, m^2
S average swath or width of cut, m

D.2 Average swath or width of cut

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

where:

S average swath or width of cut, m
W width of plot, m
N number of trips per round

D.3 Effective area accomplished

$$E = w \times D$$

where:

E effective area accomplished, m^2
w actual working width, m
D total distance traveled, m

D.4 Drawbar power

$$P = \frac{D \times S}{3.6}$$

where:

P drawbar power required for the implement, kW
D draft force required to move the implement, kN
S speed of tractor, kph

D.5 Field efficiency

$$Eff = \frac{C}{C_o} \times 100$$

where:

Eff field efficiency, %
C effective field capacity, m^2/h
C_o theoretical field capacity, m^2/h

D.6 Percent error for mean depth

$$\%error = \frac{|D_m - D_p|}{D_p} \times 100$$

where:

$\%error$ percent error, %
D_m mean depth, mm
D_p theoretical depth, mm

D.7 Percentage of wheel slip

$$\%W.S. = \frac{A - B}{A} \times 100$$

where:

$\%W.S.$ percent of wheel slip, %

A distance traveled by the tractor under no load after a given number of revolutions, m
B distance traveled by the tractor with implement attached after a given number of revolutions, m

D.8 Theoretical field capacity

$$C_o = \frac{w \times S}{10}$$

where:

C_o theoretical field capacity, ha/h
w operating width, m
S speed of tractor, kph

D.9 Effective field capacity

$$C = \frac{60E}{T}$$

where:

C effective field capacity, ha/h
E effective area accomplished, m^2
T operating time, h

D.10 Fuel consumption rate

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

where:

F_t is the fuel consumption rate, L/h
V is the total volume of fuel consumed, L
t is the total operating time, h

D.11 Effective fuel consumption rate

$$F_e = \frac{10{,}000V}{A_e}$$

where:

F_e is the effective fuel consumption rate, L/ha
V is the volume of fuel consumed, L
A_e is the effective area covered, m^2

Annex E
(Normative)

Performance test data sheet

E.1	Test site conditions	Remarks
E.1.1	Area of field, m^2	
E.1.2	Soil type (clay, clay loam, sandy, etc.)	
E.1.3	Soil texture (fine, medium, coarse)	
E.1.4	Soil moisture content (% d.b.)	
E.1.5	Soil hardness	

E.2 Field performance									
E.2.1 Actual operating width, mm									
E.2.2 Actual operating depth, mm									
E.2.3 Manufacturer's recommended setting, mm	Trials						Average		
	1		2		3				
E.2.4 Tractor speed, kph									
E.2.5 Operating time, h	Trials						Average		
	1		2		3				
	Test time	Non-productive	Test time	Non-productive	Test time	Non-productive	Test time	Non-productive	Productive time
E.2.6 Fuel consumed, mL	Trials						Average		
	1		2		3				
E.2.7 Field efficiency, %									
E.2.8 Effective field capacity, ha/h									

E.2.9 Draft, N (optional)	**Trials**			**Average**
	1	**2**	**3**	
E.2.10 Drawbar power, kW (optional)				

E.2.11 Depth of cut analysis

Depth of cut preset, mm:

Strip, m	**0-2**	**2-4**	**4-6**	**6-8**	**8-10**	**10-12**	**12-14**	**14-16**	**16-18**	**18-20**
Depth, mm										

Mean depth, mm:

Percent error, %:

E.2.12 Percentage of wheel slip (% W.S.)

Trials									**Ave, %**
1			**2**			**3**			
A(m)	**B(m)**	**% W.S.**	**A(m)**	**B(m)**	**% W.S.**	**A(m)**	**B(m)**	**% W.S.**	

E.3 Observations

E.3.1 Ease of mounting/dismounting

_____
_____
_____

E.3.2 Accessibility of grease points

_____
_____
_____

E.3.3 Number of shanks deformed after test

_____
_____
_____

E.3.4 Number of shovels detached after test

_____
_____
_____

E.3.5 Cracks on welded parts

_____
_____
_____

E.3.6 Detached welded parts

_____
_____
_____

E.3.7 Loosened bolts

_____
_____
_____

E.3.8 Miscellaneous

_____
_____
_____

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