

PHILIPPINE NATIONAL STANDARD

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**Agricultural machinery – Spike tooth harrow for
walking type agricultural tractor – Methods of test**



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National Foreword

The Philippine Agricultural Engineering Standards PAES 170:2015, Agricultural machinery – Spike tooth harrow for walking type agricultural tractor – Methods of test was approved for adoption as Philippine National Standard by the Bureau of Philippine Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center (AMTEC) and the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development of the Department of Science and Technology (PCAARRD-DOST).

PHILIPPINE AGRICULTURAL ENGINEERING STANDARD PNS/PAES 170:2015
Agricultural Machinery – Spike Tooth Harrow for Walking Type Agricultural Tractor
– Methods of Test

Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled “Development of Standards for Rice Production and Postproduction Machinery” which was funded by the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) of the Department of Science and Technology (DOST).

This standard has been technically prepared in accordance with PAES 010-2 – Rules for the Structure and Drafting of International Standards.

The word “shall” is used to indicate mandatory requirements to conform to the standard.

The word “should” is used to indicate that among several possibilities one is recommended as particularly suitable without mentioning or excluding others.

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1 Scope

This standard specifies the methods of test and inspection for a spike tooth harrow hitched to a walking type agricultural tractor. Specifically, it shall be used to:

- 1.1** verify the mechanism, dimensions, materials, accessories and workmanship of the spike tooth harrow and the list of specifications submitted by the manufacturer;
- 1.2** determine the performance of the equipment and;
- 1.3** report the results of the tests.

2 References

The following normative documents contain provisions, which through reference in this text, constitute provisions of this National Standard:

PNS/PAES 103:2000 Agricultural Machinery – Method of Sampling

PNS/PAES 169:2015 Agricultural Machinery - Spike Tooth Harrow for Walking Type Agricultural Tractor – Specifications

3 Definitions

For the purpose of this standard, the definitions given in PNS/PAES 169:2015 and the following shall apply:

3.1

draft

total force parallel to the direction of travel required to move the implement

3.2

drawbar power

power requirement of an implement being towed or pulled

3.3

actual field capacity

function of field speed, operating width and field efficiency, expressed in hectares per hour

3.4

field efficiency

ratio between the productivity of a machine under field conditions and the theoretical maximum productivity

3.5

implement

any agricultural tool hitched to the tractor

3.6

implement width

horizontal distance perpendicular to the direction of travel between the outermost edges of the implement (Figure 1)

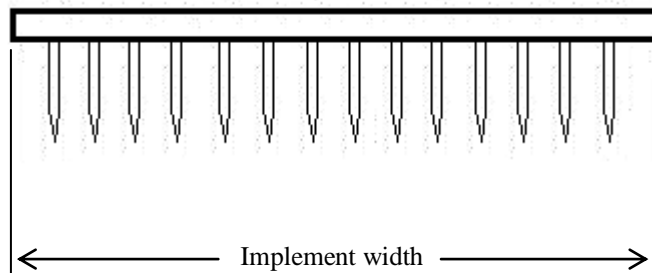


Figure 1 - Implement width

3.7

operating width

horizontal distance perpendicular to the direction of travel within which an implement performs its intended function (Figure 2)

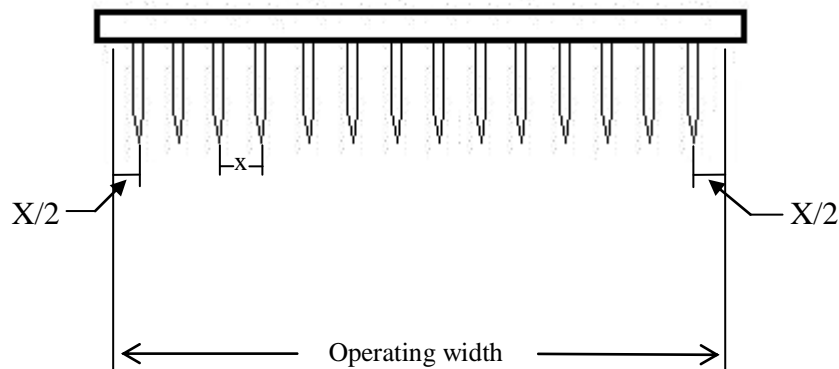


Figure 2 - Operating width

3.8

theoretical field capacity

function of speed and operating width, expressed in hectares per hour

3.9

Overall height

height of the implement measured from the topmost point to its lowest point

3.10

overall length

length of the implement measured from the terminal point of the implement to the mounting point

3.11

wheel slip

reduction on the distance travelled by the tractor due to the attached implement

4 General Conditions for Test and Inspection

4.1 Selection of spike tooth harrow to be tested

Spike tooth harrow to be tested should be in accordance with PNS/PAES 103:2000 Agricultural Machinery – Method of Sampling.

4.2 Role of requesting party

The requesting party shall submit to the official testing agency specifications and other relevant information on the harrow. He shall abide with the terms and conditions set forth by an official testing agency.

4.3 Role of the manufacturer

An officially designated representative of the manufacturer should operate, adjust, repair, and should decide on matters related to the operation of the machine.

4.4 Suspension of test

If the harrow fails to penetrate the soil or becomes non-functional during test, the test shall be suspended.

4.5 Test site conditions

Harrowing operation shall be done in fields initially plowed and has an area of not less than 500 m². The plot shall be rectangular in shape with sides in the ratio of 2:1 as much as possible.

4.6 Test instruments/equipment

The suggested list of minimum test equipment needed to carry out the field cultivator test is shown in Annex A.

4.7 Walking-type agricultural tractor to be used

The tractor to be used shall be compatible with the harrow in accordance with the manufacturer's specification of required power.

5 Test and Inspection

5.1 Verification of the manufacturer's technical data and information

This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the field cultivator in comparison with the list of manufacturer's technical data and information. All data shall be recorded in Annex B.

5.2 Performance test

5.2.1 This is carried out to obtain actual data on overall performance of the harrow.

5.2.2 Measurement of initial data

Initial data, such as field area, location, dimensions of field shall be obtained and recorded in Annex C before the test operation.

5.2.2.1 Implement characteristics

Dimensions and other measurements shall be noted.

5.2.3 Field performance test

5.2.3.1 The total test time shall be obtained by acquiring the total time to finish harrowing the test field. Test time shall start when harrowing operation starts. Productive time (time when teeth is engaged) shall be obtained by deducting the non- productive time from the total test time.

5.2.3.2 The operating width shall be obtained by measuring the distance between the outermost teeth and shall be noted.

5.2.3.3 Operational pattern

Field capacity and field efficiency are influenced by field operational pattern which is closely related to the size and shape of the field, and the kind and size of implement. The nonworking time should be minimized as much as possible using the suggested field operational patterns as shown in Figure 3.

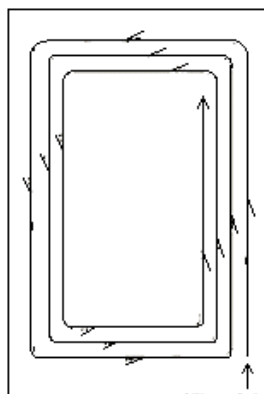


Figure 3 - Suggested operational pattern (Circuitous)

5.2.3.4 Operating Speed

Outside the longer side of the test plot, two poles 20 m apart (A, B) are placed approximately in the middle of the test plot (Figure 4). On the opposite side, two poles are also placed in similar position, 20 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. The speed will be calculated from the time required for the machine to travel the distance (20 m) between the assumed line connecting two poles on opposite sides AC and BD. The reference point (e.g. pneumatic wheels) of the machine should be selected for measuring the time.

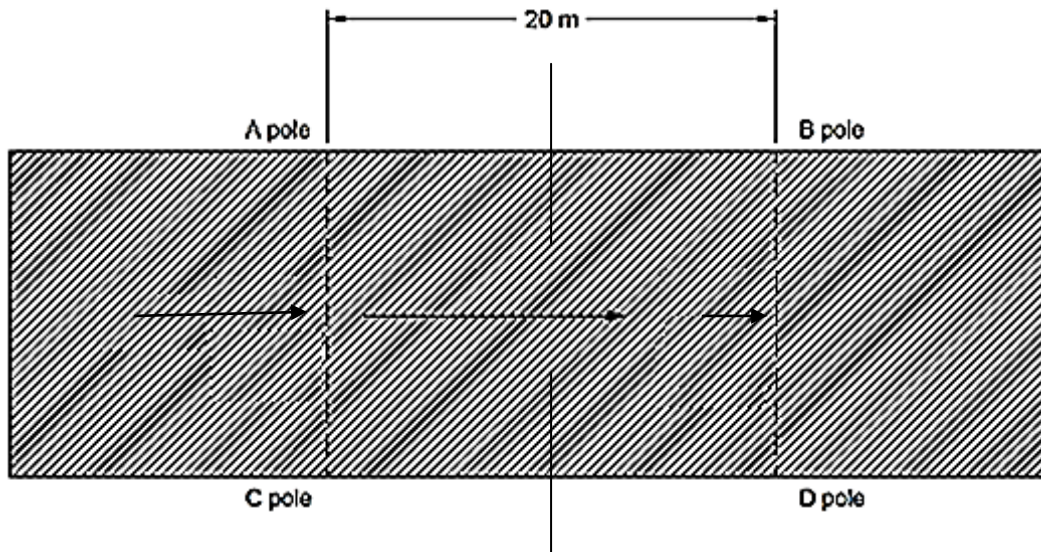


Figure 4 - Operating Speed Measurement

5.2.3.5 Fuel Consumption

Before the start of each test trial, fuel tank shall be filled to certain marked level. After each test trial, the tank shall be refilled using a graduated cylinder. The amount refilled is the fuel consumption for the test.

5.2.3.6 Field efficiency and effective field capacity of the implement shall be obtained using the formula in Annex D.

5.2.3.7 Wheel slip shall be determined as described in Annex E.

5.2.3.8 Condition of spike tooth harrow after test shall be compared to its initial condition.

5.2.3.9 Welded parts shall be inspected.

5.2.3.10 All data shall be recorded in Annex C.

5.3 Test trial

There shall be at least three (3) trials to conduct the test.

6 Test Report

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

- 6.1** Title
- 6.2** Summary
- 6.3** Purpose and Scope of Test
- 6.4** Methods of Test
- 6.5** Description of the Machine
- 6.6** Table 1 – Machine Specifications
- 6.7** Results and Discussions
- 6.8** Observations (include pictures)
- 6.9** Table 2 –Performance test data
- 6.10** Name(s), signature(s) and designation(s) of test engineer(s)

Annex A

Suggested Minimum List of Field and Laboratory Test Equipment and Materials

A.1	Equipment	Quantity
A.1.1	Field equipment	
A.1.1.1	Timers Range: 0 to 60 minutes Accuracy: 1/10	2
A.1.1.2	Steel tape, 50 m	1
A.1.1.3	Graduated cylinder, capacity: 1,500 mL	1
A.1.1.4	Width and depth gauge	1
A.1.1.5	Digital video camera	1
A.1.1.6	Colored Tape	1
A.1.2	Laboratory equipment (soil analysis and verification of specifications)	
A.1.2.1	Convection oven or soil moisture meter	1
A.1.2.2	Electronic balance, capacity: 1 kg	1
A.1.2.3	Vernier caliper	1
A.2	Materials for field test	
A.2.1	Marking pegs	10

Annex B
(informative)

Specifications of Spike Tooth Harrow

Name of Applicant/ Distributor: _____

Address: _____

Tel No: _____

GENERAL INFORMATION

Name of Manufacturer: _____

Make: _____

Classification: _____

Serial No: _____ Brand/Model: _____

Production date of spike-tooth harrow to be tested: _____

Testing Agency: _____ Test Engineer: _____

Date of Test: _____ Location of Test: _____

Items to be inspected

ITEM	Manufacturer's Specification	Verification by Testing Agency
B.1 Overall dimensions		
B.1.1 Overall height, mm		
B.1.2 Overall length, mm		
B.1.3 Operating width, mm		
B.1.4 Weight, kg		
B.2 Main frame		
B.2.1 Material		
B.2.2 Dimensions, mm		
B.3 Tooth or tine		
B.3.1 Material		
B.3.2 Thickness, mm		
B.3.3 Width, mm		
B.3.4 Number of teeth		
B.4 Mounting details		
B.5 Tractor		
B.5.1 Type		
B.5.2 Recommended travelling speed, kph		
B.5.3 Engine power, hp (kW)		

Annex C

Field Performance Test Data Sheet

Items to be Measured and Inspected

ITEM	TRIALS			Average
	1	2	3	
C.1 Test Conditions				
C.1.1 Condition of field				
C.1.1.1 Location				
C.1.1.2 Dimensions of field (L x W), m				
C.1.1.3 Area, m ²				
C.1.1.4 Weed density (low, medium, or high)				
C.1.1.5 Last crop planted				
C.2 Field performance				
C.2.1 Date of test				
C.2.2 Type of field operation				
C.2.3 Tractor's gearshift setting				
C.2.4 Traveling or operating speed, kph				
C.2.5 Depth of tillage, mm				
C.2.6 Width of tillage, mm				
C.2.7 Time lost, min				
C.2.7.1 Turning, min				
C.2.7.2 Others (specify), min				
C.2.8 Duration of test, min				
C.2.9 Actual field capacity, ha/h				
C.2.10 Theoretical field capacity, ha/h				
C.2.11 Field efficiency, %				
C.2.12 Fuel consumption rate, L/h (optional)				
C.2.13 Effective fuel consumption rate, L/ha (optional)				
C.2.14 Method of operation				

C.3 Observations

A minimum of three persons (test engineer, manufacturer's representative and the operator) shall rate the following observations.

ITEM	Rating*				
	1	2	3	4	5
C.3.1 Ease of hitching/unhitching					
C.3.2 Accessibility of grease points					
C.3.3 Number of tooth deformed after test					
C.3.4 Number of tooth detached after test					
C.3.5 Cracks on welded parts					
C.3.6 Detached welded parts					

*1 – Very Good

2 – Good

3 – Satisfactory

4 – Poor

5 – Very Poor

C.4 Other observations

Annex D
(informative)

Formula Used During Calculations and Testing

D.1 Drawbar Power

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

where:

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

D.2 Actual Field Capacity

$$FC_A = \frac{A_T}{T_T}$$

where:

FC_A is the actual field capacity, ha/h
A_T is the area covered during test, ha
T_T is the total operating time, h

D.3 Theoretical Field Capacity

$$FC_T = \frac{W_C S}{10}$$

where:

FC_T is the theoretical field capacity, ha/h
W_C is the cutting width, m
S is the operating speed, km/h

D.4 Field Efficiency

$$Eff = \frac{FC_A}{FC_T} \times 100$$

where:

Eff is the field efficiency, %
FC_A is the actual field capacity, ha/h
FC_T is the theoretical field capacity, ha/h

D.5 Wheel Slip

$$\text{Wheel slip, \%} = \frac{N_1 - N_0}{N_1} \times 100$$

where:

N_1 is the number of revolutions of the cage wheels for a given distance with slip, rpm

N_0 is the number of revolutions of the cage wheels for the same distance without slip, rpm

D.6 Fuel Consumption

$$FC = \frac{F_1}{T_T}$$

where:

FC is the fuel consumption, L/h

F_1 is the amount of fuel consumed, L

T_T is the time of operation, h

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