PHILIPPINE NATIONAL STANDARD

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Agricultural machinery – Disc plow for walking type agricultural tractor – Methods of test

BUREAU OF PRODUCT STANDARDS*

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National Foreword

The Philippine Agricultural Engineering Standards PAES 168:2015, Agricultural machinery – Disc plow 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).

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.

In preparation of this standard, the following documents/publications were considered:

American Society of Agricultural Engineers (ASAE) EP 399.1:1985 – Preferred MetricDimensions for Agricultural Implement Disk Blades.

A web page document on *Disc Plough* by Albert Boers. Last updated: July 4, 2001.Wageningen University.

Stevens G.N. *Equipment Testing and Evaluation*. Overall Division, National Institute ofAgricultural Engineering (NIAE), Wrest Park, Silsoe Bedford England. 1982.

Regional Network for Agricultural Machinery (RNAM) Test Codes And Procedures for FarmMachinery. Technical Series No. 12 :1983.

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LIST OF FIGURES

ANNEXES

1 Scope

This standard specifies the methods of test and inspection for a disc plow attached to a walking type agricultural tractor. Specifically, it shall be used to:

1.1 verify the dimensions, weight, and other technical data of the disc plow submitted by the requesting party;

1.2 determine the field performance of the plow;

1.3 evaluate the ease of handling and;

1.4 prepare a report on 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 122:2001 Agricultural Machinery – Disc Plow – Methods of Test

PNS/PAES 167:2015 Agricultural Machinery – Disc Plow for Walking-Type Agricultural Tractor – Specifications

3 Definitions

For the purpose of this standard, the definitions given in PNS/PAES 167:2015 and the following shall apply:

3.1
headland
unplowed portion of the field at both ends of the furrow strip initially used for turning the tractor and implement

3.2
walking-type agricultural tractor
two-wheel tractor
hand tractor
pedestrian tractor
power tiller
self-propelled machine having a single axle designed primarily to pull and propel trailed or mounted agricultural implements and machinery

4 General Conditions for Test and Inspection

4.1 Selection of disc plow to be tested

Disc plow 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 the specifications and other relevant information of the disc plow to the official testing agency. He shall abide by the terms and conditions set forth by the 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 plow fails to penetrate the soil or becomes non-functional during test, the test shall be suspended.

4.5 Walking-type agricultural tractor to be used

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

5 Tests and Inspection

5.1 Verification of manufacturer's technical data and information

5.1.1 This investigation is carried out to verify that the mechanism and specifications conform to the list of technical data and information submitted by the manufacturer.

5.1.2 The suggested minimum list of field and laboratory test equipment and materials are given in Annex A and the items to be inspected and verified are given in Annex B.

5.2 Field performance test

5.2.1 This is carried out to test the field performance of the disc plow.

5.2.2 The test shall be carried out on a suitable field where the conditions are to be recorded.

5.2.3 The soil hardness shall be measured using a penetrometer before plowing.

5.2.4 Test site conditions

5.2.4.1 Size of the area per trial

Plowing operation shall be done in fields of not less than 500 m^2. The plot shall be rectangular in shape with sides in the ratio of 2:1 as much as possible.

5.2.4.2 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 non-working time should be minimized, as much as possible, using the suggested field operational patterns (Figure 1).

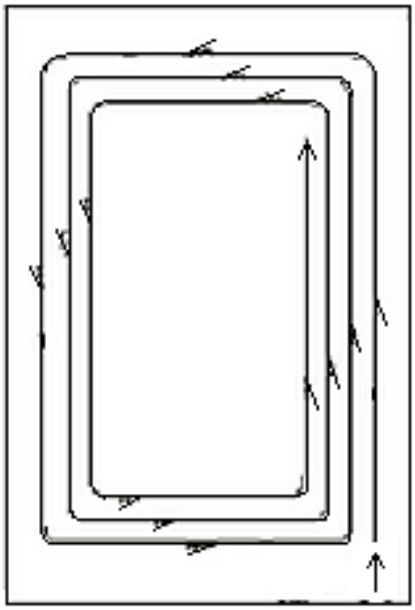


Figure 1 –Suggested operational pattern (Circuitous)

5.2.4.3 Traveling speed

A minimum traveling speed of 3 kph shall be attained during the operation of the walking-type agricultural tractor.

5.2.4.4 Test trials

The test shall be conducted with at least three trials.

5.2.4.5 Headland

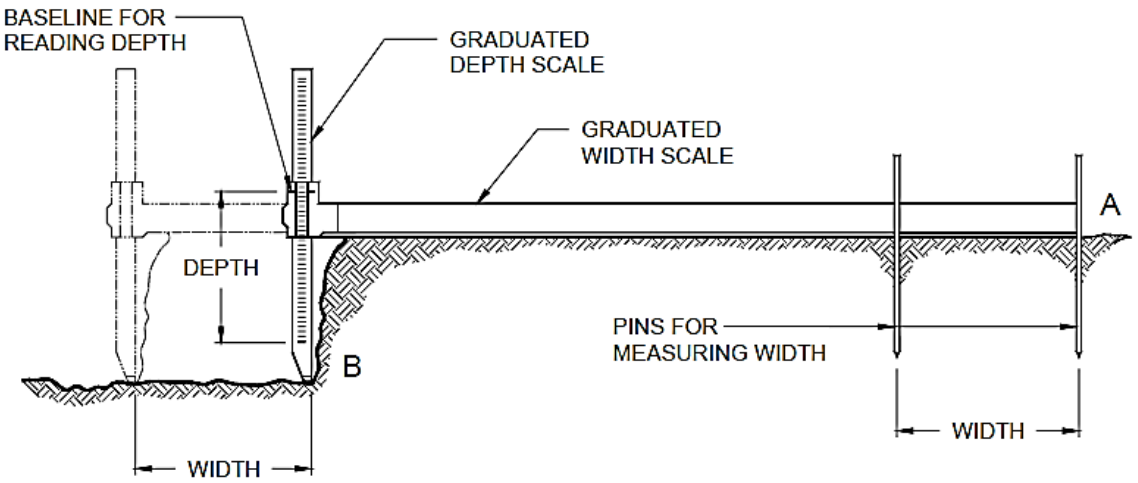
Headland shall be at least 3 m in width.

5.2.5 Measurement of performance parameters

5.2.5.1 Field capacity determination

5.2.5.1.1 Working width and depth

A depth and width meter (Figure 2) shall be used in measuring the working width and depth, simultaneously. The working depth and width are measured by placing the tip of graduated depth scale to the plowed surface (B) and putting a pin at point A of width scale. This procedure will be repeated for the succeeding passes and the distance between two pins adjacent to each other is the working width and the distance between point B and baseline for reading depth is the working depth. However, plowed surface is not always level depending on the feature of the implement. Therefore, the tip of the depth scale shall be placed at relatively same point in each pass.



SIDE VIEW

Figure 2 – Depth and Width Measurement

5.2.5.1.2 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 3). 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.

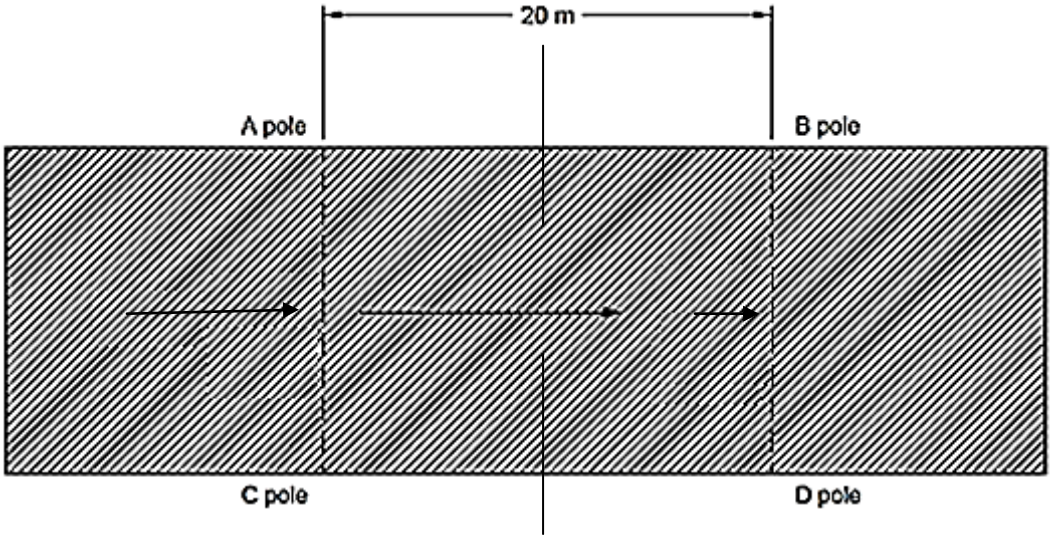


Figure 3 - Operating Speed

5.2.5.2 Wheel slip or travel reduction

The tractor drive wheel is marked with colored tape. For a given distance, the number of revolutions of the driving wheels, with load (*N1*) and without load (*N0*), shall be recorded. The formula used in calculating wheel slip is shown in Annex E.

5.2.5.3 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.

5.3 The items to be observed, measured and recorded during the field tests are given in Annex C.

6 Data Analysis

The formulas to be used during calculations and testing are given in Annex E.

7 Test Report Format

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

7.1 Name of testing agency

7.2 Test report number

7.3 Title

7.4 Summary

7.5 Purpose and scope of test

7.6 Methods of test

7.7 Description and Specifications of the Plow

7.8 1 – Table Machine Specifications

7.9 Results of Field Test

7.10 Observations (include pictures)

7.11 Table 2 –Performance test data

7.12 Name and Signature of Test Engineers

Annex A

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	Penetrometer	1
A.1.1.3	Steel tape, 50 m	1
A.1.1.4	Graduated cylinder, capacity: 500 mL	1
A.1.1.5	Width and depth gauge	1
A.1.1.6	Digital video camera	1
	Dynamometer	1
A.1.1.7	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

Specifications of the Disc Plow

Name of Applicant : _____
Address : _____
Telephone No. : _____
Name of Distributor : _____
Address : _____
Name of Manufacturer : _____
Factory Address : _____

GENERAL INFORMATION

Brand :_____ Model :_____
Serial No. : _____Type : _____
Production date of plow to be tested : _____

Items to be inspected

ITEM	Manufacturer's Specification	Verification by Testing Agency
B.1 Dimensions and weight		
B.1.1 Overall length, mm		
B.1.2 Overall width, mm		
B.1.3 Overall height, mm		
B.1.4 Weight, kg		
B.1.5 Weight per disc, kg		
B.2 Disc plow		
B.2.1 Number of discs		
B.2.2 Brand		
B.2.3 Make		
B.2.4 Diameter, mm		
B.2.5 Thickness, mm		
B.2.6 Concavity, mm		
B.2.7 Disc spacing, mm		
B.2.8 Side angle, °		
B.2.9 Tilt angle, °		
B.2.10 Scraper		
B.2.10.1 Length, mm		
B.2.10.2 Width, mm		
B.2.10.2 Thickness, mm		
B.2.11 Main frame		
B.2.11.1 Dimension, mm		

ITEM	Manufacturer's Specification	Verification by Testing Agency
B.2.11.2 Material		
B.2.12 Rear furrow wheel		
B.2.12.1 Diameter, mm		
B.2.12.2 Thickness, mm		

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 Soil type (clay, clay loam, sandy, etc)				
C.1.1.5 Moisture content, %				
C.1.1.6 Weed density (low, medium, or high)				
C.1.1.7 Soil hardness, kg/cm^2				
C.1.1.8 Last crop planted				
C.2 Field performance				
C.2.1 Date of test				
C.2.2 Type of field operation				
C.2.3 Traveling or operating speed, kph				
C.2.4 Depth of tillage, mm				
C.2.5 Width of tillage, mm				
C.2.6 Time lost, min				
C.2.6.1 Turning, min				
C.2.6.2 Others (specify), min				
C.2.7 Duration of test, min				
C.2.8 Actual field capacity, ha/h				
C.2.19 Theoretical field capacity, ha/h				
C.2.10 Field efficiency, %				
C.2.11 Fuel consumption rate, L/h (optional)				
C.2.12 Effective fuel consumption rate, L/ha (optional)				
C.2.13 Method of operation				
C.2.14 Percent unplowed/overlap				

C.4 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.4.1 Ease of handling and stability when machine is working					
C.4.2 Ease of handling and stability when machine is turning					
C.4.3 Straightness of furrow					
C.4.4 Quality of soil inversion					
C.4.5 Uniformity of depth					
C.4.6 Non-adhesion of soil to disc					
C.4.7 Ease of making adjustments					
C.4.8 Durability of parts (based on wear of soil-working parts, visible deformation, etc)					

*1 – Very Good
2 – Good
3 – Satisfactory
4 – Poor
5 – Very Poor

C.5 Other observations

_____
_____
_____
_____

Annex D
(informative)

Formula Used During Calculations and Testing

D.1.1 Determination of Actual Field Capacity

D.1.1.1 Width of cut

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

where:

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

D.1.1.2 Total distance traveled

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

where:

D is the total distance traveled, m
A is the area of the plot, m2
L is the length of the plot, m

D.1.1.3 Effective area accomplished

$$\mathbf{Ae = w\ D = 2nLw}$$

where:

Ae is the effective area accomplished, m^2
w is the width of plow, m

D.1.1.3.1 If width of cut is less than the plow's width, the operator has passed over part of the area twice to secure better coverage, therefore:

$$\mathbf{Ao = \left| Ae - A \right|}$$

where:

Ao is the overlap (area which is plowed twice), m^2

D.1.1.3.2 If the width of cut is greater that the plow's width, the operator has left part of the area unplowed, therefore:

$$\mathbf{Au = A - Ae}$$

where:

Au is the unplowed area (area missed), m^2

D.1.1.4 Actual field capacity

$$\mathbf{FC_A = \frac{0.006\ A_e}{t}}$$

where:

Cis the actual field capacity, ha/h
tis the time used during the operation, min

D.1.2 Theoretical Field Capacity

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

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.1.3 Field Efficiency

$$\mathbf{Eff = \frac{FC_A}{FC_T}\ x\ 100}$$

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.1.4 Wheel slip

$$\mathbf{Wheel\ slip,\ \% = \frac{N_1 - N_o}{N_1}\ x\ 100}$$

where:

N_1 is the number of revolutions of the driving wheels for a given distance with slip, rpm
N_0 is the number of revolutions of the driving wheels for the same distance without slip, rpm

D.1.5 Fuel Consumption

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

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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