PHILIPPINE NATIONAL STANDARD

PNS/PAES 152:2015
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ICS 65.060.30

Agricultural machinery – Mechanical rice transplanter – Methods of test

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National Foreword

The Philippine Agricultural Engineering Standards PAES 152:2015, Agricultural machinery – Mechanical rice transplanter – 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).

This standard cancels and replaces PNS/PAES 152:2010 (PAES published 2010).

Foreword

The revision 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:

Campbell, J.K. 1990. Dibble sticks, donkeys, and diesels. International Rice Research Institute. ISBN 971-104-185-5. 147-150.

Eam-o-pas, K. and Y. Goto. 1990. Comparative performance of the rice transplanters in Thailand's field conditions. Kasetsart J. (Nat.Sci. Suppl.) Vol.24:64-68.

Eam-o-pas, K., V. Munthimkarn, N. Ounkong, Y Goto and T. Yamauchi. 1988. Performance of a self-propelled riding type rice transplanter. Kasetsart J. (Nat.Sci. Suppl.) Vol.22:79-87.

Regional Network for Agricultural Machinery. 1983. Test codes and procedures for farm machinery. Technical Series No.12. Economic and Social Commission for Asia and the Pacific.

Regional Network for Agricultural Machinery. 1979. Rice Transplanter: highlights of research, design, development and evaluation from different countries. RNAM Digest 1. 43pp.

Thein, M. Mechanical rice transaplanters in Burma.

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LIST OF FIGURES

ANNEXES

1 Scope

This standard specifies the methods of test and inspection for a mechanical rice transplanter. Specifically, it shall be used to:

1.1 verify the mechanism, dimensions, materials and accessories of the mechanical rice transplanter and the list of specifications submitted by the manufacturer;

1.2 determine the performance of the equipment;

1.3 evaluate the ease of handling and safety features and;

1.4 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 151:2015 Agricultural Machinery – Mechanical Rice Transplanter – Specifications

3 Definitions

For the purpose of this standard, the definitions given in PNS/PAES 151:2015 and the following shall apply:

3.1
actual field capacity
actual rate of transplanting in a given area per unit of time

NOTE The time pertains to the actual time which includes the time spent for turning at the headland, adjustment of machine and minor repairs.

3.2
effective operating width
total width of the two outermost transplanting arms

3.3
field efficiency
ratio between the productivity of a machine under field conditions and the theoretical maximum productivity

3.4
hills
points in the field where seedlings are transplanted

3.5
overall length
measurement between extremities of the mechanical rice transplanter along its longer side including all protruding parts

3.6
overall width
measurement between extremities of the mechanical rice transplanter along its shorter side including all protruding parts

3.7
percent damaged hills
ratio of the total number of hills with seedlings damaged by cutting, bending or crushing during transplanting to the total number of hills; expressed in percent (%)

3.8
percent missing hills
ratio of the total number of hills without seedlings to the total number of hills, expressed in percent (%)

3.9
planting efficiency
ratio of the number of hills with seedlings to the total number of hills, expressed in percent (%)

3.10
rows
series of hills in a field

3.11
theoretical field capacity
computed product of the effective operating width and speed of operation of the mechanical rice transplanter

4 General Conditions for Test and Inspection

4.1 Selection of mechanical rice transplanter to be tested

Mechanical rice transplanter to be tested should be in accordance with PNS/PAES 103:2000 Agricultural Machinery – Method of Sampling.

4.2 Role of manufacturer/dealer

The manufacturer/dealer shall submit the operator's manual of the mechanical rice transplanter and shall abide by the terms and conditions set forth by an official testing agency.

4.3 Role of the operator

An officially designated operator shall be skilled and shall be able to demonstrate, operate, adjust and make repairs related to the operation of the equipment.

4.4 Test site conditions

The mechanical rice transplanter shall be tested through actual transplanting of rice seedlings. Each test, with three replications, shall be carried out in a rectangular field area with sides in the ratio of 2:1 as much as possible. The field shall have an area of at least 1000 m^2 with ample space for headland turns. The field to be used shall be puddled and leveled before the test.

4.5 Test instruments/equipment

The suggested list of minimum test equipment needed to carry out the mechanical rice transplanter test is shown in Annex A. Seedling preparation is shown in Annex E.

4.6 Suspension of test for mechanical rice transplanter

If during the test, the mechanical rice transplanter malfunctions or stops due to major component breakdown which is not repairable, the test shall be suspended.

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 and construction material of the mechanical rice transplanter 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 machine.

5.2.2 Soil data analysis

Initial data such as field area and soil type shall be obtained and recorded in Annex C before the test operation.

5.2.3 Field performance test

5.2.3.1 The mechanical rice transplanter shall be tested through actual transplanting of rice seedlings.

5.2.3.2 Five (5) sampling areas shall be randomly selected in the field (Figure 1).

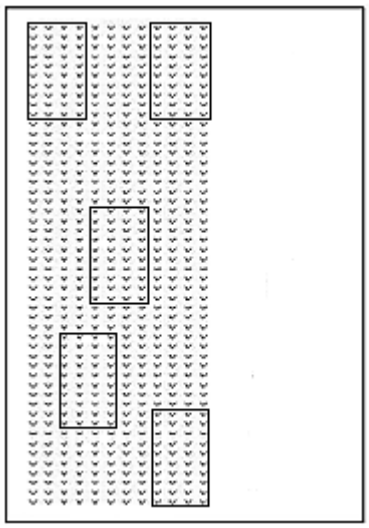

Figure 1 - Random sampling areas

5.2.3.3 The number of seedlings per hill shall be noted and shall be recorded.

5.2.3.4 The distances between hills and between rows shall be measured and shall be recorded in Annex C (Fig. 2).

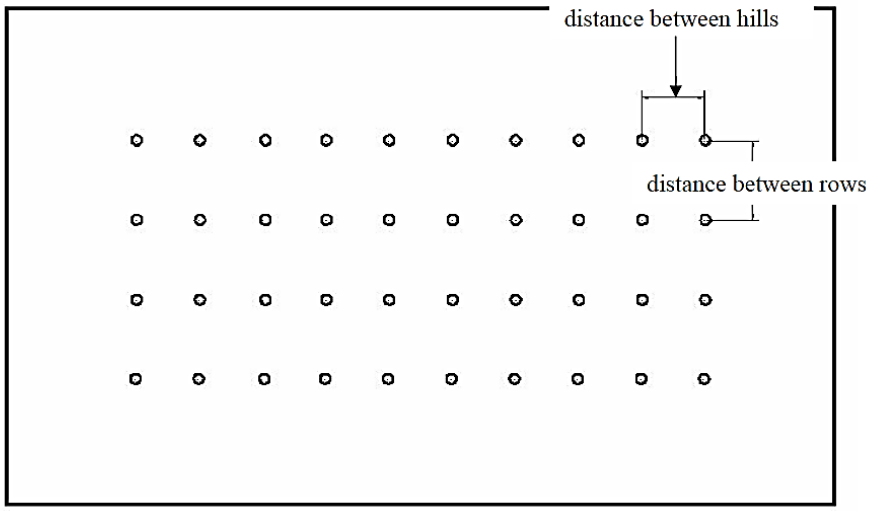

Figure 2 - Distance between hills and between rows

5.2.3.5 Percent error for the distances shall be computed using the formula in Annex D.

5.2.3.6 The number of hills, missing hills, and damaged hills shall be noted and shall be recorded.

5.2.3.7 Planting efficiency, percent damaged hills, and percent missing hills of the mechanical rice transplanter shall be computed using the formula in Annex D.

5.2.3.8 Test for uniformity of transplanting depth

5.2.3.8.1 The transplanting depth per hill in a row shall be noted and shall be recorded (Figure 3).

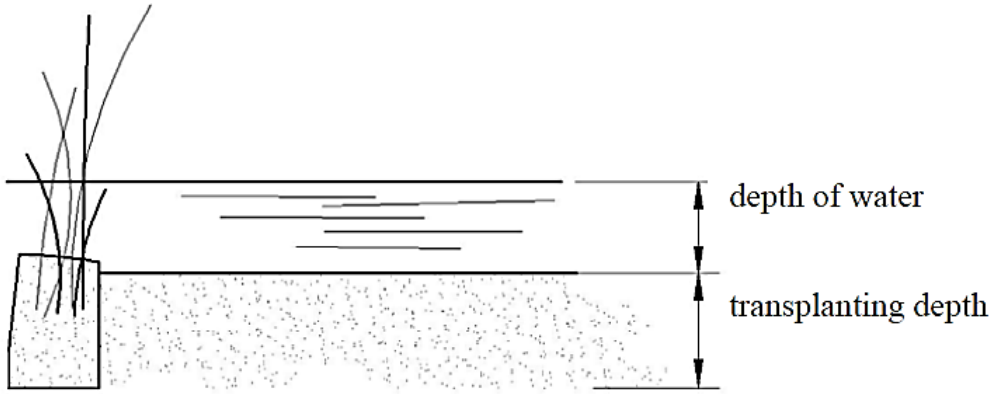

Figure 3 - Transplanting depth

5.2.3.9 Condition of the mechanical rice transplanter shall be inspected after the test to determine damage or breakdown.

5.2.3.10 The total operating time of the mechanical transplanter shall be recorded. Non-productive time shall also be recorded. Total productive time shall be obtained by subtracting the non-productive time from the total operating time.

5.2.3.11 Actual and theoretical field capacity, as well as field efficiency, shall be computed using the formula in Annex D.

5.2.3.12 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. 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 of the machine should be selected for measuring the time.

5.2.3.13 Fuel consumed

The fuel consumed by the mechanical rice transplanter shall be obtained. Before the start of each test trial, the fuel tank shall be filled to a 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. When filling up the tank, keep the machine in a level position.

5.2.3.14 Welded parts shall be inspected. Loosened bolts shall be noted and tightened.

5.2.3.15 All data shall be recorded in Annex C.

5.2.3.16 Planting pattern

Before the operation, a turning zone shall be established. It shall be about one cycle of going and returning. Seedlings shall be transplanted next to the straight side of the border along the longest side of the field (Figure 4).

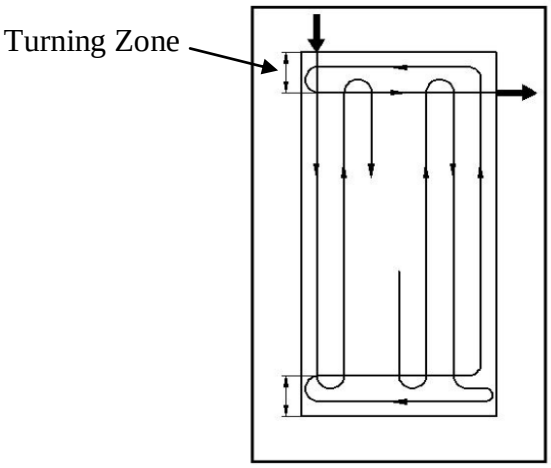

Figure 4 - Planting pattern

5.3 Test trial

At least three (3) trials shall be required in conducting the test. Test data shall be gathered as required in Annex D.

6 Test Report Format

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

Table 1 – Machine Specifications

6.6 Results and Discussions

6.7 Observations (include pictures)

Table 2 –Performance test data

6.8 Name(s), signature(s) and designation(s) of test engineer(s)

Annex A
Minimum List of Test Equipment

A.1	**Equipment**	**Quantity**
A.1.1	Timer	
	Accuracy: 0.10 s	1
A.1.2	Steel tape	
	Capacity: 5 m; 50 m	2
A.1.4	Fuel consumption	
	Graduated cylinder	
	Capacity, 500 mL	1
A.1.5	Marking pegs	4
A.1.6	Scientific calculator	1
A.1.7	Camera	1

Annex B
(informative)

Specifications of Mechanical Rice Transplanter

Name of Applicant/ Distributor: _____
Address:_____
Tel No: _____

GENERAL INFORMATION
Name of Manufacturer: _____
Make: _____
Classification: _____
Serial No: _____ Brand/Model: _____
Testing Agency: _____ Test Engineer: _____
Date of Test: _____ Location of Test: _____

Items to be inspected

ITEM	Manufacturer's Specification	Verification by the Testing agency
B.1 Overall dimensions		
B.1.1 Overall height, mm		
B.1.2 Overall length, mm		
B.1.3 Overall width, mm		
B.1.4 Weight, kg		
B.1.5 Operating width, mm		
B.2 Seedling tray		
B.2.1 Width, mm		
B.2.2 Length, mm		
B.2.3 Material		
B.3 Grasping fork		
B.3.1 Width, mm		
B.3.2 Length, mm		
B.3.3 Material		
B.3.4 Total number of grasping forks		
B.4 Transplanting arm		
B.4.1 Width, mm		
B.4.2 Length, mm		
B.4.3 Material		
B.4.4 Total number of transplanting arms		
B.5 Float		
B.5.1 Width, mm		
B.5.2 Length, mm		
B.5.3 Thickness, mm		
B.5.4 Material		

ITEM	Manufacturer's Specification	Verification by the Testing agency
B.6 Handle		
B.6.1 width, mm		
B.6.2 Length, mm		
B.6.3 Material		
B.7 Paddle wheel		
B.7.1 Diameter, mm		
B.7.2 Number of paddles		
B.7.3 Material		
B.8 Engine		
B.8.1 Type		
B.8.2 Power output, hp/kW		
B.9 Mode of transmission system		
B.9.1 type		

ANNEX C

Performance Test Data Sheet

Items to be measured and inspected

C.1 Test field conditions	**Remarks**
C.1.1 Field area, m^2	
C.1.2 Soil type	

C.2 Field performance											
C.2.1 Sampling Area 1											
C.2.1.1 Number of seedlings per hill											
C.2.1.2 Number of missing hills											
C.2.1.3 Number of damaged hills											
C.2.1.4 Distance between hills (mm)											**Ave**
C.2.1.5 Distance between rows (mm)											**Ave**
C.2.1.6 Percent error for distance between hills, %											
C.2.1.7 Planting efficiency, %											
C.2.1.8 Transplanting depth											

Hill no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Depth, Mm										

C.2.1.9 Mean depth, mm	
C.2.1.10 Standard deviation, mm	

C.2.2 Sampling Area 2											
C.2.2.1 Number of seedlings per hill											
C.2.2.2 Number of missing hills											
C.2.2.3 Number of damaged hills											
C.2.2.4 Distance between hills (mm)											**Ave**
C.2.2.5 Distance between rows (mm)											**Ave**
C.2.2.6 Percent error for distance between hills, %											
C.2.2.7 Planting efficiency, %											

C.2.2.8 Transplanting depth										
Hill no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Depth, Mm										
C.2.2.9 Mean depth, mm										
C.2.2.10 Standard deviation, mm										

C.2.3 Sampling Area 3											
C.2.3.1 Number of seedlings per hill											
C.2.3.2 Number of missing hills											
C.2.3.3 Number of damaged hills											
C.2.3.4 Distance between hills (mm)											**Ave**
C.2.3.5 Distance between rows (mm)											**Ave**
C.2.3.6 Percent error for distance between hills, %											
C.2.3.7 Planting efficiency, %											
C.2.3.8 Transplanting depth											
Hill no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Depth, Mm											
C.2.3.9 Mean depth, mm											
C.2.3.10 Standard deviation, mm											

C.2.4 Sampling Area 4											
C.2.4.1 Number of seedlings per hill											
C.2.4.2 Number of missing hills											
C.2.4.3 Number of damaged hills											
C.2.4.4 Distance between hills (mm)											**Ave**
C.2.4.5 Distance between rows (mm)											**Ave**
C.2.4.6 Percent error for distance between hills, %											
C.2.4.7 Planting efficiency, %											
C.2.4.8 Transplanting depth											

Hill no.	1	2	3	4	5	6	7	8	9	10
Depth, Mm										
C.2.4.9 Mean depth, mm										
C.2.4.10 Standard deviation, mm										

C.2.5 Sampling Area 5											
C.2.5.1 Number of seedlings per hill											
C.2.5.2 Number of missing hills											
C.2.5.3 Number of damaged hills											
C.2.5.4 Distance between hills (mm)											**Ave**
C.2.5.5 Distance between rows (mm)											**Ave**
C.2.5.6 Percent error for distance between hills, %											
C.2.5.7 Planting efficiency, %											
C.2.5.8 Transplanting depth											

Hill no.	1	2	3	4	5	6	7	8	9	10
Depth, Mm										
C.2.5.9 Mean depth, mm										
C.2.5.10 Standard deviation, mm										

C.3 Transplanting speed				
Items	**Trials**			**Average**
	1	**2**	**3**	
Total operating time to finish transplanting, h				
Total non-productive time, h				
Total productive time, h				
Transplanting speed, kph				

C.4 Actual field capacity, ha/h	**Trials**			**Average**
	1	**2**	**3**	

C.5 Theoretical field capacity, ha/h	**Trials**			**Average**
	1	**2**	**3**	

C.6 Field Efficiency, %	Trials			Average
	1	2	3	
C.7 Fuel consumed, mL	Trials			Average
	1	2	3	

C.9 Other observations	Remarks
C.9.1 Cracks on welded parts	
C.9.2 Detached welded parts	
C.9.3 Loosened bolts	
C.9.4 Miscellaneous:	

Annex D
(informative)

Formula Used During Calculations and Testing

D.1 Percent damaged hills

$$H_{pd} = \frac{H_d}{H_t} \times 100$$

where:

H_{pd} is the percent damaged hills, %
H_d is the number of damaged hills in the sampling area
H_t is the total number of hills in the sampling area

D.2 Percent missing hills

$$H_{pm} = \frac{H_m}{H_t} \times 100$$

where:

H_{pm} is the percent missing hills, %
H_m is the number of missing hills in the sampling area
H_t is the total number of hills in the sampling area

D.3 Planting efficiency

$$P_e = (1 - \frac{H_m}{H_t}) \times 100$$

where:

P_e is the planting efficiency of the transplanter, %
H_m is the total number of missing hills
H_t is the total number of hills in the sampling area

D.4 Actual field capacity

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

where:

FC_A is the actual field capacity, ha/h
A_T is the total area transplanted, ha
T_T is the total operating time required for transplanting, h

D.5 Theoretical field capacity

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

where:

FC_T is the theoretical field capacity, ha / h
W_C is the effective operating width of the transplanter, m
S is the speed of the transplanter, kph

D.6 Field efficiency

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

where:

Eff is the field efficiency of the transplanter, %
FC_A is the actual field capacity
FC_T is the theoretical field capacity

ANNEX E

Seedling Preparation Using Double Mulching Technique

1 Sowing is done manually using two plastic film sheets or canvass on seedbeds.

2 Preparation of plastic film

Wrap or fold the plastic film and make holes using the punching stick or common wire nail (with punching handle).

3 Preparation of seedling frames for the seedbed

Wooden or steel bars/plates/purlin (or any similar material) can be used to prepare the seedling frames. Seedling frames are fixed on the seedbed after the first mulch (plastic film) has been placed.

4 Seedbed preparation

4.1 Choose an area with good access to irrigation and drainage.

4.2 Prepare the seedbed area 2-3 days before the sowing schedule.

4.3 Plow once and harrow (puddle and level) the seedbed area.

4.4 Construct the seedbeds, 1.5 m width, 3-5 cm height and at any desired length. Keep 30cm distance between seedbeds.

4.5 Level the seedbed using wooden leveler *(paleta).*

5 Soil preparation

Prepare 1,500 kg of nutritional or garden soil for 1 ha before sowing. Dry the soil for 4-6 days to reduce moisture content to 10–20 % for easy crushing. Sieve crushed soil.

6 Seed soaking and incubation

6.1 Soak the seeds (40 kg/ha) in clean water for 6 hours. Keep the water and seeds at room temperature.

6.2 Remove the soaked seeds from the container. Drain the water and place the seeds in clean sack.

6.3 Tie the sack loose enough to allow the aeration of seeds.

6.4 Turn it every 2 hours to improve aeration. Keep it moist by sprinkling water each time you turn until seeds germinate.

6.5 Seeds are ready for sowing when they start to break and until roots have extended to 1 mm.

7 Sowing

7.1 Place the plastic film into the seedbed. Stretch the plastic film well to cover the surface.

7.2 Fix the seedling frame on top of the plastic film. Pegs can be used to hold or permanently fix the frames in place.

7.3 Place the pulverized soil inside the frame. The depth of soil bed in the frame should not exceed 2 cm and should also be uniform and leveled. Saturate the pulverized soil with water using a sprinkler or sprayer.

7.4 Spread the germinated seeds evenly using the required weight of seeds per area of the seedling frame.

7.5 Cover the broadcasted seeds with a very thin film of soil ranging from 0.3–0.5 cm. Then cover the seedbed with another plastic film (without holes) for 1-2 days depending on weather conditions. The cover will serve as protection from the rain and birds.

7.6 Remove the plastic cover when the height of the seedlings reached 1 cm.

8 Water management

8.1 Water should be leveled on the surface of the seedbed. This depth should be maintained during the single-leaf stage.

8.2 During 2-3 leaf stages, the water level should be frequently checked. During irrigation, water depth should be leveled with the surface of the frame and should be drained after 10 minutes.

8.3 Four to five days before transplanting, the water level should be half the depth of the seedbed to enhance the development of the roots.

8.4 Seedlings should be transplanted at 16-18 days of age.

9 Preparation of seedlings before transplanting

9.1 Drain the seedbed one day before transplanting.

9.2 Cut the seedling mat using sharp knife or cutter into tray size seedlings (28 cm x 116cm or 28 cm x 58 cm).

9.3 Roll each seedling mat and distribute along the paddy dikes.

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