PHILIPPINE NATIONAL STANDARD

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Agricultural machinery – Rice precision seeder – Methods of test

BUREAU OF PRODUCT STANDARDS*

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National Foreword

The Philippine Agricultural Engineering Standards PAES 172:2015, Agricultural machinery – Rice precision seeder – 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.

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LIST OF FIGURES

ANNEXES

1 Scope

This standard specifies the methods of test and inspection formechanically operated rice precision seeder for dryland and wetland operation. Specifically, it shall be used to:

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

1.2 determine the field performance of the seeder;

1.3 evaluate the ease of handling and safety features and;

1.4 prepare a report on the results of the tests.

2 Reference

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 171:2015 Agricultural Machinery – Rice Precision Seeder – Specifications

3 Definition

For the purpose of this standard, the definition of the terminologies given in PNS/PAES 171:2015 and the following shall apply:

3.1
actual field capacity
actual rate of planting for a given area per unit of time

NOTE The time includes the time spent for turning at headland, adjustment of machine and machine downtime

3.2
damaged seed
seed distinctly damaged during operation

3.3
field efficiency
ratio of actual field capacity to the theoretical field capacity

3.4
hopper capacity
maximum allowable amount of seeds (kg) which can be loaded to the hopper

NOTE Shall follow manufacturer's recommendation

3.5
percent damaged seeds
percentage of seeds damaged during operation

3.6
theoretical field capacity
computed area planted per unit of time

4 General Conditions for Test and Inspection

4.1 Selection of rice precision seeder to be tested

Rice precision seeder 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 rice precision seeder. 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 Test site conditions

The rice precision seeder shall be tested through actual seeding operation. 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 for mechanically operated seeders.

4.5 Suspension of test

If during the test, the machine malfunctions or stops due to major component breakdown, the test shall be suspended.

5 Test Preparation

5.1 Running-in and preliminary adjustment

Before the start of the test, the rice precision seeder should have undergone running-in period wherein various adjustments of the rice precision seeder shall conform withthe recommendation of the manufacturer.

5.2 Test instruments and other materials

The instruments to be used shall have been calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum field and laboratory test equipment and materials needed to carry out the rice precision seeder test is shown in Annex A.

6 Pre-test Observation

6.1 Verification of specifications

The specifications claimed by the manufacturer and physical details given in Annex B shall be verified by the official testing agency. A stable and level surface shall be used as reference plane for verification of dimensional machine specifications.

7 Laboratory Performance Test

7.1 Test for metering mechanism

7.1.1 This is carried out to examine the performance of the metering mechanism. The result of which can provide the basic data for the field performance.

7.1.2 This test should be conducted using a suitable type of seed as specified by the manufacturer.

7.1.3 In case of other seeder, it will be jacked up and the drive wheel of the metering mechanisms is rotated in a number of revolutions to collect sufficient amount of seeds to compute for its delivery rate. The delivery rates per hectare are calculated with the weight of seeds from the delivery tube with the corresponding distance travelled by the seeder based on the number of revolutions of the drive wheel.

7.1.4 If possible, this test shall be carried out at full, half and one-fourth of the seeder's hopper capacity with three delivery rate settings – low, medium and high.

7.2 The items to be investigated and measured shall be recorded in Annex D.

8 Field Performance Test

This test is carried out to obtain actual data on overall machine performance, operating accuracy, work capacity and adaptability to field conditions.

8.1 Data collection

8.1.1 Soil data analysis

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

8.1.2 Duration of test

The duration of each test trial shall start with the first seeding and ends after the final seeding of the test area.

8.1.3 Field performance test

8.1.3.1 Measure at random two-meters along each row for at least ten rows planted by theseeder. For each two meter distance, measure/record the following:

8.1.3.1.1 depth of seeding (for dryland operation)

8.1.3.1.2 distance between hills

8.1.3.1.3 number of seeds planted per hill

8.1.3.1.4 number of missed hills

8.1.3.1.5 number of damaged seeds

8.1.3.1.6 number of hills with incorrect number of seeds delivered

8.1.3.2 Other items to be measured and computed are:

8.1.3.2.1 Performance and accuracy

8.1.3.2.1.1 Population of seeds planted per unit area

8.1.3.2.1.2 Rate of missing hills

8.1.3.2.1.3 Wheel slippage and sinkage (for dryland operation only)

8.1.3.2.2 Work rate and labor requirement

8.1.3.2.2.1 Actual traveling speed

8.1.3.2.2.2 Actual operating time

8.1.3.2.2.3 Time spent for turning at headland

8.1.3.2.2.4 Time spent for machine downtime

8.1.3.2.2.5 Fuel consumed (mechanically operated)

8.1.3.2.2.6 Required number of workers

8.1.3.3 Other items to be observed are:

8.1.3.3.1 Handling and operation

8.1.3.3.2 Turning

8.1.3.3.3 Refilling of seed

8.1.3.3.4 Adjustments

8.1.4 Noise level

The noise emitted by the machine shall be measured using a noise level meter. The noise, expressed in dB(A), shall be taken approximately 5cm away from the ear level of the operator.

8.1.5 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 1). 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. front wheels) of the machine should be selected for measuring the time.

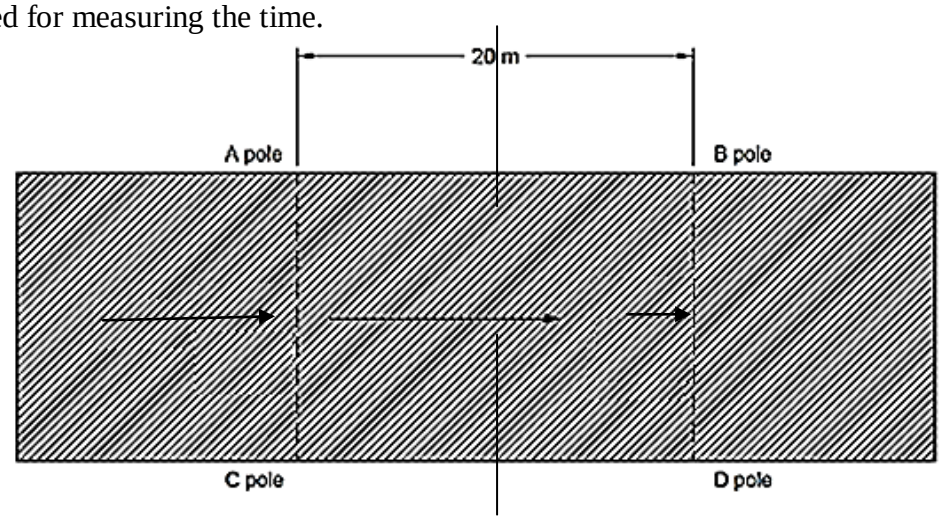

Figure 1 - Operating Speed Measurement

8.1.6 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.

8.1.7 Data recording and observations

Record sheet for all data, information during the test, and other observations are given in Annex C.

9 Data Analysis

9.1 Calculation

The formula to be used during calculations and testing is given in Annex E.

9.2 Presentation of results

Machine specifications and the results of the test shall be presented in tabular form using the data from Annexes B toD. Observations made on the machine while in operation shall be supported with photographs.

10 Test Report Format

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

10.1 Title

10.2 Summary of Results

10.3 Purpose and Scope of Test

10.4 Methods of Test

10.5 Condition of the Machine

10.6 Description of the Machine

10.7 Table 1 Machine Specifications

10.8 Results of Test

10.9 Table 2 Field Performance Data

10.10 Observations (include pictures)

10.11 Names and Signatures of Test Engineers

Annex A
Minimum List of Field and Laboratory Test Equipment and Materials

A.1	Equipment	Quantity
A.1.1	Noise Level Meter Range: 30 to 130 db(A)	**1**
A.1.2	Timers (range: 60 minutes) Accuracy: 1/10 sec	**2**
A.1.3	Measuring Tape (capacity: 5m) and 50 m	**2**
A.1.4	Camera	**1**
A.1.5	Graduated Cylinder (1-L capacity)	**1**
A.1.6	Marking pegs	**4**
A.1.7	Scientific Calculator	
A.1.8	Weighing Scale Capacity: 100 kg; Scale divisions: 0.5 kg	**1**
A.1.9	Weighing Scale (Sensitivity 0.1 g)	**1**
A.1.10	Moisture meter	**1**
A.1.11	Bulk density meter	**1**

Annex B
Specifications of Rice Precision Seeder

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

GENERAL INFORMATION

Make:_____ Brand/Model:_____
Serial No:_____ Classification:_____
Production date of precision seeder to be tested: _____
(or Date of manufacture)

ITEM	Manufacturer's Specifications	Verification by the Testing Agency
B.1 Dimension and weight of seeder		
B.1.1 Overall length, mm		
B.1.2 Overall width, mm		
B.1.3 Overall height, mm		
B.1.4 Overall weight, kg (hoppers empty)		
B.2 Number of rows and row spacing, mm		
B.3 Nominal working width, mm		
B.4 Hill distance, mm		
B.5 Seeds and their condition for which equipment is suitable		
B.6 Suitable field condition		
B.7 Traveling		
B.7.1 Source of power		
B.7.1.1 Manual		
B.7.1.2 Animal-drawn		
B.7.1.3 Tractor power-driven		
B.7.1.3.1 Seed drill		
B.7.1.3.2 Planter		
B.7.2 Recommended traveling speed of equipment, kph		
B.7.3 Recommended minimum drawbar output of power tiller or tractor, kW/hP		
B.8 Metering Mechanism		
B.8.1 Type and method of changing delivery rate		
B.8.1.1 Seed		
B.8.2 Source of power of metering mechanism		
B.8.2.1 Ground wheel		

ITEM	Manufacturer's Specifications	Verification by the Testing Agency
B.8.2.2 PTO		
B.8.2.3 Others		
B.8.3 Recommended PTO speed, rpm (if applicable)		
B.8.4 Transmission mechanism and speed ratio of metering shaft to input shaft (ground wheel or PTO shaft)		
B.9 Hill-dropping mechanism		
B.10 Hopper		
B.10.1 Number		
B.10.1.1 Seed		
B.10.2 Capacity, L		
B.10.2.1 Seed		
B.10.3 Material		
B.10.3.1 Seed		
B.11 Clutch for metering mechanism		
B.11.1 Type		
B.11.2 Location		
B.12 Ground wheel		
B.12.1 Diameter, mm		
B.12.2 Material		
B.13 Marking device (detail of marking)		
B.14 Hitch shape and construction (in case of tractor mounted with category of three point linkage)		
B.15 Safety features		
B.15.1 Cover		
B.15.2 Power transmission		
B.15.3 Other moving parts		
B.15.4 Other details		
B.16 Recommended traveling speed, kph		
B.17 Workingcapacity, ha/h (given by the manufacturer)		
B.18 Any other detail (special features)		

Annex C

Field Performance Test Data Sheet

ITEMS TO BE MEASURED AND INSPECTED

ITEM	TRIAL			
	1	2	3	Ave.
Date of Test				
C.1 Test Condition				
C.1.1 Condition of seed				
C.1.1.1 Name				
C.1.1.2 Variety				
C.1.1.3 Shape				
C.1.1.4 Size				
C.1.1.4.1 Length, mm				
C.1.1.4.2 Width, mm				
C.1.1.4.3 Thickness, mm				
C.1.1.5 Weight of 1000 seeds, g				
C.1.1.6 Moisture content, % wb				
C.1.1.7 Bulk density, kg/L				
C.1.1.8 Germination rate, %				
C.1.2 Condition of field				
C.1.2.1 Location				
C.1.2.2 Field type and soil condition				
C.1.2.3 Length, m				
C.1.2.4 Width, m				
C.1.2.5 Area, m^2				
C.1.2.6 Shape				
C.1.2.7 Method of land preparation				
C.1.3 Condition of operation				
C.1.3.1 Row spacing, mm				
C.1.3.2 Seeding rate, kg/ha				
C.1.3.3 Depth of seeding, mm				
C.1.3.4 Fertilizing rate, kg/ha				
C.1.4 Condition of metering mechanism				
C.1.4.1 Metering shaft speed adjustment (if any)				
C.1.4.2 Delivery opening adjustment				

ITEM	Trial			
	1	2	3	Ave.
C.1.5 Condition of power source				
C.1.5.1 Power tiller or tractor				
C.1.5.1.1 Make and model				
C.1.5.1.2 Rated engine horsepower, kW/hP				
C.1.5.1.3 Rated drawbar horsepower, kW/hP				
C.1.5.1.4 Gear shift setting				
C.2 Field Performance				
C.2.1 Actual operating time, min				
C.2.2 Time lost owing to				
C.2.2.1 Turning at headland, min				
C.2.2.2 Adjustment, min				
C.2.2.3 Refilling of seed, min				
C.2.2.4 Repair, min				
C.2.3 Actual area covered, m^2				
C.2.4 Effective working width, m (no of rows x row spacing)				
C.2.5 Traveling speed, kph				
C.2.6 Effective field capacity, ha/h				
C.2.7 Field efficiency, %				
C.2.8 Travel pattern				
C.2.9 Width of headland, m				
C.2.10 Wheel slip, %				
C.2.11 Fuel consumption				
C.2.11.1 L/h				
C.2.11.2 L/ha				
C.2.12 Depth of seeding, mm				
C.2.13 In case of hill planting				
C.2.13.1 Distance between hills, mm				
C.2.13.2 Number of seeds per hill				
C.2.13.3 Missing hills, %				
C.2.14 In case of drill No. of seeds sown per area				

C.2.15 Rate the following observations:

Items	Rating				
	1	**2**	**3**	**4**	**5**
C.2.15.1 Ease of handling and stability when machine isworking and turning					
C.2.15.2 Ease of manipulating the operating lever					
C.2.15.3 Ease of adjustments					
C.2.15.4 Ease of transporting the machine					

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

C.2.16 Observations:

C.2.16.1 Safety features

_____
_____
_____
_____

C.2.16.2 Failure or abnormalities that may be observed on the rice precision seeder or its component
parts_____
____
_____
_____
_____

C.2.16.3 Labor requirement

_____
_____
_____
_____

C.2.16.4 Others

_____
_____
_____
_____

Annex D
Laboratory Performance Test Data Sheet

D.1 Seed Metering

Date of test :_____

D.1.1 Test condition

D.1.1.1 Conditions of seeds

D.1.1.1.1 Name of seed : _____

D.1.1.1.2 Variety of seed : _____

D.1.1.1.3 Shape : _____

D.1.1.1.4 Average size of seeds : _____

D.1.1.1.4.1 Length, mm :_____

D.1.1.1.4.2 Width, mm :_____

D.1.1.1.4.3 Thickness, mm :_____

D.1.1.1.5 Weight of 1000 seeds, g : _____

D.1.1.1.6 Moisture content, % wb : _____

D.1.1.1.7 Bulk density, kg/L : _____

D.1.1.1.8 Purity (%), uniformity of size, etc : _____

D.1.1.2 Condition of grain seeder

D.1.1.2.1 Metering shaft speed (adjustment, if any) : _____

D.1.1.2.2 Mechanism and speed : _____

D.1.1.2.3 Delivery opening adjustment : _____

D.1.2 Delivery rate

Particulars	Delivery rate setting								
	High quantity of seeds in hopper			Medium quantity of seeds in hopper			Low quantity of seeds in hopper		
	1	1/2	1/4	1	1/2	1/4	1	1/2	1/4
D.1.2.1 Manually-operated metering									
D.1.2.1.1 Number of seeds delivered by one hand action									
D.1.2.1.2 Estimated delivery rate, kg/ha at row spacing, mm hill distance, mm									
D.1.2.1.3 Rate of damaged seed by metering mechanism, %									
D.1.2.2 Ground wheel-driven metering									
D.1.2.2.1 Effective rolling diameterof ground wheel, m									
D.1.2.2.2 Revolution of ground wheel for measuring delivery									
D.1.2.2.3 Delivery for D.1.2.2.2,kg									
D.1.2.2.4 Delivery rate, kg/ha									
D.1.2.2.5 Rate of damaged seeds bymetering mechanism									
D.1.2.2.5 Observations									
D.1.2.3 PTO-driven metering									
D.1.2.3.1 PTO speed, rpm									
D.1.2.3.2 Tractor traveling speed in relation to D.1.2.2.1, kph									
D.1.2.3.3 Time for measuring delivery, s									
D.1.2.3.4 Delivery for D.1.2.2.3, kg									
D.1.2.3.5 Delivery rate, kg/ha									
D.1.2.3.6 Quantity of damaged seeds by metering mechanism, %									
D.1.2.4 Pattern of seed deposition (line, band, hill, single seed, precision planting)									

Annex E
(informative)

Formula Used During Calculations and Testing

E.1 Field Performance Test

E.1.1 Delivery Rate

E.1.1.1 Nominal working width, W, (m)

$$\mathbf{W = n \times d_r}$$

where:

W is the nominal working width, m
n is the number of rows
d_r is the row spacing, m

E.1.1.2 Ground wheel-driven machine

E.1.1.2.1 Effective diameter of ground wheel under load

$$\mathbf{D_e = \frac{d}{\pi \times N}}$$

where:

D_e is the effective diameter, m
N is the number of revolutions, rpm
d is the distance for a given N, m

E.1.1.2.2 Seeding rate

$$\mathbf{Q = \frac{L \times 10{,}000}{\pi D_e \times N \times W}}$$

where:

Q is the delivery rate, kg/ha
L is the delivery for a given N, kg

E.1.1.3 PTO-driven machine

$$\mathbf{Q = \frac{L \times 10{,}000}{S \times t \times W}}$$

where:

Qis the delivery rate, kg/ha
Lis the delivery for a given N, kg
Sis the speed of operation, m/s
tis the time for measuring delivery, s

E.1.2 Actual Field Capacity

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

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

E.1.3 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 nominal working width, m
S is the operating speed, km/h

E.1.4 Field Efficiency

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

where:

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

E.1.5 Seeding Efficiency

$$\mathbf{SE = 1 - \left(\frac{E - A}{E} \right) x\ 100}$$

where:

SE is the seeding efficiency of the rice precision seeder, %
E is the expected amount of seeds to be dropped, pc
Ais the actual amount of seeds dropped, pc

E.1.6 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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BUREAU OF PRODUCT STANDARDS*

3F Trade and Industry Building
361 Sen. Gil J. Puyat Avenue, Makati City 1200, Metro Manila, Philippines
T/ (632) 751.3125 / 751.3123 / 751.4735
F/ (632) 751.4706 / 751.4731
E-mail: bps@dti.gov.ph
www.dti.gov.ph

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