PHILIPPINE NATIONAL STANDARD

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Agricultural machinery – Rice combine harvester – Methods of test

BUREAU OF PRODUCT STANDARDS*

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National Foreword

The Philippine Agricultural Engineering Standards PAES 225:2015, Agricultural machinery – Rice combine harvester – 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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ANNEXES

1 Scope

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

1.1 verify the mechanism, main dimensions, weight, materials and accessories of the rice combine harvester, and the list of specifications submitted by the manufacturer/supplier/dealer;

1.2 determine the performance of the machine;

1.3 evaluate the ease of handling and safety features;

1.4 determine the effect of harvesting on grain quality through laboratory analysis and;

1.5 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 102:2000 Agricultural Machinery – Operator's Manual – Content and Presentation

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

PNS/PAES 205:2015 Agricultural Machinery – Mechanical Rice Thresher – Methods of Test

PNS/PAES 213:2015 Agricultural Machinery – Rice Reaper – Methods of Test

PNS/PAES 224:2015 Agricultural Machinery – Rice Combine Harvester – Specifications

3 Definitions

For the purpose of this standard, the definition of the terminologies given in PNS/PAES - 224:2015and the following shall apply:

3.1
broken grain
grains that were broken and/or dehulled (partially or fully) as a result of harvesting and threshing operation

3.2
cracked grain
grains which show signs of fissures or fractures or splinters

3.3
cylinder peripheral speed
the equivalent linear speed of the cylinder tip when running at normal operating speed, expressed in m/s

3.4
grain quality
quality of threshed grain determined in terms of percent whole grain

3.5
overall height
distance between the horizontal supporting surface and the horizontal plane touching the uppermost part of the rice combine harvester

NOTE All parts of the rice combine harvester projecting upwards are contained between these two planes.

3.6
overall length
distance between the vertical planes at the right angles to the median plane of the rice combine harvester and touching its front and rear extremities

NOTE All parts of the rice combine harvester, in particular, components projecting at the front and at the rear are contained between these two planes. When an adjustment of components is possible, it shall be set at minimum length.

3.7
overall width
distance between the vertical planes parallel to the median plane of the rice combine harvester; each plane touching the outermost point of the harvester on its respective side

NOTE All parts of the rice combine harvester projecting laterally are contained between these two planes.

3.8
running-in period
preliminary operation of the machine to make various adjustments prior to the conduct of test until the operation is stable

3.9
separation loss
blower loss
grains that come out of the threshing chamber or the blower outlet with the straw which is also the outlet of the blower

3.10
throughput capacity
weight of the cleaned grain collected from the main grain outlet per unit of time

3.11
uncut loss
grains from the panicles that were not cut or were missed by the harvesting process

3.12
unthreshed loss
grains left in the panicles of the plant fed into the threshing chamber

4 General Conditions for Test and Inspection

4.1 Selection of rice combine harvester to be tested

Rice combine harvester 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 combine harvester. They 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 shall operate, adjust, repair, and shall decide on matters related to the operation of the machine.

4.4 Test site conditions

Each test, with three replications, shall be carried out in the rectangular field area with sides in the ratio of 2:1 as much as possible. For ride-on and attachment type rice combine harvester, the area should not be less than $1000m^2$ while for the walk-behind type, the area should not be less than $500m^2$. The field shall be completely dried before harvesting to prevent additional water absorption of the rice grains.

4.5 Test instruments

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 combine harvester test is detailed in Annex A.

4.6 Running-in and preliminary adjustment

Before the start of the test, the rice combine harvester should have undergone running-in period wherein various adjustments of the rice combine harvester shall be made according to

the recommendation of the manufacturer. (No other adjustments shall be permitted while the test is on-going).

4.7 Suspension of test

If during the test, the machine 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

5.1.1 This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the rice combine harvester in comparison with the list of manufacturer's technical data and information.

5.1.2 A plain and level surface shall be used as reference plane for verification of the rice combine harvester's dimensional specifications.

5.1.3 The items to be inspected and verified shall be recorded in Annex B.

5.2 Field performance test

5.2.1 This is carried out to obtain actual data on machine performance, operating accuracy, work quality and adaptability to varied rice crops and field conditions.

5.2.2 Initial data such as field conditions and crop condition shall be collected before the test.

5.2.3 Measurement of performance parameters:

5.2.3.1 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. rice combine harvester's cutting mechanism) of the machine should be selected for measuring the time.

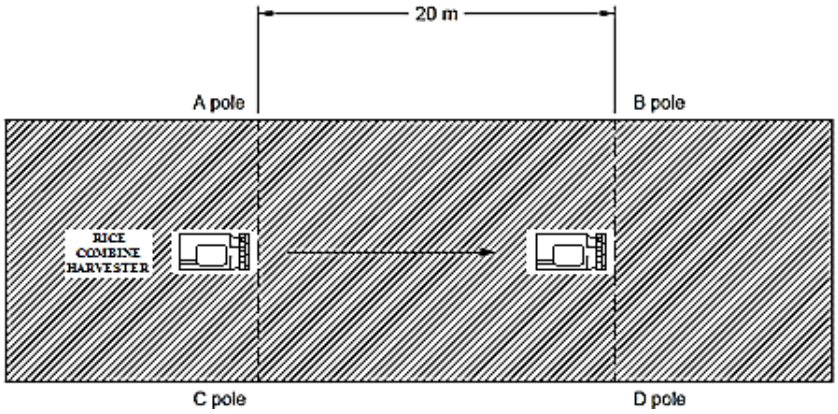

Figure 1 – Measurement of operating speed

5.2.3.2 Noise level measurement

The noise emitted by the machine shall be measured approximately 5 cm away from the ear level of the operator using a noise level meter.

5.2.3.3 Fuel consumption

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.

5.2.3.4 Total operating time

Total operating time shall be measured once the machine starts to harvest up to the time it harvests the last stalk. Time losses for adjustment, turning and machinery breakdown shall be deducted from the total operating time.

5.2.3.5 Potential yield

Before the test run, randomly select three 1 m x 1 m area within the test plot and manually harvest the panicles. The harvested panicles in each area shall be collected, labelled and taken to the laboratory for analysis.

5.2.3.6 Header loss

Before the test run, five 1 m x 1 m area shall be taken randomly within the test plot and the grains detached from the panicle within the area shall be collected, weighed and recorded as pre-harvest loss. After the test run, using the same area, loose grains on the ground, grains from cut panicles but fallen on the ground, and grains from uncut panicles fallen on the ground after harvesting, shall be collected, labeled and taken to the laboratory.

5.2.3.7 Record the turning time of the rice combine harvester.

5.2.3.8 The following items shall be observed:

5.2.3.8.1 Ease of handling and stability when the machine is working and turning

5.2.3.8.2 Ease of manipulating the operating levers

5.2.3.8.3 Ease of adjusting and repair of parts

5.2.3.8.4 Ease of transporting the machine

5.2.3.8.5 Safety

5.2.3.8.6 Vibration

5.2.3.8.7 Labor requirements

5.2.3.8.8 Other necessary items

5.2.4 The items to be inspected and measured shall be recorded in Annex C.

6 Laboratory Analysis

Laboratory analysis shall be made to determine the grain moisture content, grain-straw ratio, straw length, purity, cracked grain, mechanically damaged grain and losses (blower, separation, unthreshed, and scattering). The laboratory procedures to be followed in the analysis are given in Annex D while the data sheet is given in Annex E.

7 Data Analysis

The formula to be used during calculations and testing are given in Annex F.

8 Test Report Format

8.1 Name of testing agency

8.2 Test report number

8.3 Title

8.4 Summary

8.5 Purpose and scope of test

8.6 Methods of test

8.7 Table 1 – Machine specifications

8.8 Results and discussion

8.9 Table 2 – Field performance test data

8.10 Observations (include pictures)

8.11 Name, signature and designation of test engineers

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

A.1	**Equipment**	**Quantity**
A.1.1	**Field**	
A.1.1.1	Grain Moisture Meter (duly calibrated using the standard method) Range: 12% to 30%	**1**
A.1.1.2	Penetrometer	**1**
A.1.1.3	Tachometer (contact type or photo electric type; Range: 0-5,000 rpm)	**1**
A.1.1.4	Noise Level Meter Range: 30 to 130 db(A)	**1**
A.1.1.5	Timers (range: 60 minutes) Accuracy: 1/10 sec	**2**
A.1.1.6	Measuring Tape (capacity: 5m) and 50 m	**2**
A.1.1.7	Camera	**1**
A.1.1.8	Weighing Scale Capacity: 100 kg Scale divisions: 0.5 kg	**1**
A.1.1.9	Graduated Cylinder (at least 1-L capacity)	**1**
A.1.2	**Laboratory**	
A.1.2.1	Weighing Scale (Sensitivity: 0.1 g)	**1**
A.1.2.2	Magnifying Lens (minimum of 10 magnifications)	**1**
A.1.2.3	Grain Sample Cleaner	**1**
A.1.2.4	Grain Sampler/Divider	**1**
A.1.2.5	Air-oven	**1**
A.2	**Materials**	
A.2.1	Canvas Sheet (4m x 8m)	**1**
A.2.1	Nylon-Catch Bag (1.5m x 1.5m x 0.5m)	**1**
A.2.1	Nylon Net (1.5m x 1.5m)	**1**
A.2.1	Sample Bags	**20**
A.2.1	Labeling Tags which include	**20**
A.2.1.1	Date of test	
A.2.1.2	Machine on test	
A.2.1.3	Sample source	
A.2.1.4	Variety	
A.2.1.5	Trial number	

Annex B
Specifications of the Rice Combine Harvester

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

GENERAL INFORMATION
Model :_____ Make :_____
Serial No :_____ Classification :_____
Production date of rice combine harvester to be tested :_____

Items to be inspected:

ITEM	Manufacturer's Specifications	Verification by the Testing Agency
B.1 Overall dimensions and weight of rice combine harvester		
B.1.1 Length, mm		
B.1.2 Width, mm		
B.1.3 Height, mm		
B.1.4 Total weight of the machine, kg		
B.2 Crop condition		
B.2.1 Variety		
B.2.2 Maximum cutting angle of straw		
B.2.3 Plant height		
B.2.4 Crop moisture content		
B.3 Harvesting condition		
B.3.1 No. of cutting rows		
B.3.2 Cutting method		
B.3.3 Cutting width, mm		
B.3.4 Minimum cutting height, mm		
B.3.5 Field capacity, ha/h		
B.4 Starting system		
B.5 Operating condition		
B.5.1 Harvesting speed, m/s		
B.6 Ground drive		

Annex C

Field Performance Test Data Sheet

Test Engineer: _____ Date:_____
Assistants: _____ Location:_____
Test Requested by:_____ Manufacturer:_____
Test Specimen:_____

Items to be measured and inspected:

ITEMS	TRIAL			
	1	2	3	Ave.
C.1 Crop condition				
C.1.1 Variety				
C.1.2 Date of sowing/planting				
C.1.3 Row spacing				
C.1.4 Recommended period of maturity				
C.1.5 Average plant height (8 observations)				
C.1.6 Lodging angle of plant (8 observations)				
C.1.7 Plant population/m^2 (3 observations)				
C.1.8 Number of tillers/plant (5 observations)				
C.2 Field conditions				
C.2.1 Location of test field				
C.2.2 General topography (undulating/leveled)				
C.2.3 Area of test field				
C.2.4 Shape of field				
C.2.5 Soil type				
C.2.6 Penetrometer profile (8 observations)				
C.3 Test conditions				
C.3.1 Date of test				
C.3.2 Duration of test				
C.3.3 Time lost				
C.3.3.1 Turning, min				
C.3.3.2 Adjustments, min				
C.3.3.3 Minor repair, min				
C.3.3.4 Others (specify, min)				
C.3.4 Operating speed, m/s				
C.3.5 Effective width of cut, cm				
C.3.6 Fuel consumed, mL				
C.3.7 Fuel consumption, L/h				
C.3.8 Noise level, db(A)				
C.3.9 Height of cut or height of stubbles, mm				
C.3.10 Pre-harvest loss (average of 5 observations, g)				

ITEM	TRIAL			
	1	2	3	Ave.
C.3.11 Actual field capacity, ha/h				
C.3.12 Theoretical field capacity, ha/h				
C.3.13 Field efficiency, %				
C.4 Minimum labor requirements				

C.5 Rate the following observations:

ITEM	RATING				
	1	2	3	4	5
C.5.1 Ease of handling and stability when machine is working and turning					
C.5.2 Ease of manipulating the operating lever					
C.5.3 Ease of adjusting and repair of parts					
C.5.4 Ease of transporting the machine					
C.5.5 Safety					
C.5.6 Vibration					

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

C.6 Other observations

Annex D
Laboratory Work

D.1 Measurement of Straw Length

This shall be taken using at least ten representative samples of cut plants and measuring the length from the point of cut to the tip of the panicle.

D.2 Measurement of Grain Content

In measuring the grain-straw ratio, take three representative samples of approximately 500 grams each of cut plants from the test materials. For each sample, manually thresh the grains from the panicle. Determine the weight of the grain and the straw separately. Record and calculate the grain-straw ratio using the formula in Annex F.1. The average of the three samples shall be taken as the grain-straw ratio.

D.3 Purity Determination

Take 500 g from the final sample taken from the main grain outlet. Clean the grains to remove impurities and other foreign matters. The clean grain shall be weighed and recorded. The percent purity is calculated using the formula in Annex F.13.

D.4 Potential Yield Determination

Manually thresh the grains from the cut stalk from each sample separately. Clean the grains to remove impurities and other foreign matters. The clean grain shall be weighed and recorded. Calculate the average potential yield per square meter of the three samples.

D.5 Measurement of Grain Moisture Content

Five samples shall be taken for moisture content determination using a calibrated moisture meter. The mean moisture content of the samples shall be taken as the moisture content of the test paddy.

D.6 Determination of Losses

D.6.1 Header loss

Each of the five samples collected after the test run shall be manually threshed, cleaned and weighed. Calculate the average weight of grains of the five samples representing the loose grain on the ground, grains from cut panicles but fallen on the ground, and grains from uncut panicles fallen on the ground after harvesting (see sub-clause F.9).

Five samples taken before the test shall be cleaned and weighed separately. Calculate the average weight of grains of the five samples representing pre-harvest loss.

D.6.2 Blower loss

Five samples shall be taken at the chaff outlet to collect grains mixed with the chaff. Each sample shall be cleaned and weighed. The total weight of the clean grains and the total time of collection shall be recorded for the computation of blower loss. (see sub-clause F.5)

D.6.3 Separation loss

Five samples shall be taken at the straw outlet to collect loose grains mixed with the straw. The total weight of the clean grains collected and the total time of collection of the five samples shall be taken and recorded for the computation of separation loss. (see sub-clause F.6)

D.6.4 Unthreshed loss

Unthreshed grains collected at the straw outlet shall be hand threshed and weighed. The total weight and time of collection of the grains from the straw outlet shall be taken and recorded for the computation of unthreshed loss. (see sub-clause F.7)

D.7 Determination of Net Percent Cracked Grains

Three samples from manually threshed and machine threshed grains shall be taken for analysis. Each sample shall consist of 100 grains. These grains shall be manually dehulled and inspected for the presence of fissures. The net percent cracked grains shall be taken as the difference between the values obtained from the manual and machine-threshed grain samples (see sub-clause F.13).

D.8 Determination of Percent Broken Grains

Three samples from machine-threshed grains shall be taken for analysis. Each sample shall consist of 100 grams. Separate those grains that were broken crushed or dehulled (partially or fully) and weigh. Compute for the percentage of broken damaged grains (see sub- clause F.14).

Annex E
Laboratory Grain Analysis Data Sheet

Machine Tested: _____ Analyzed by : _____
Date of Test: _____ Date Analyzed: _____

E.1 Crop Conditions

E.1.1 Moisture Content, (% w.b.)

Average			

E.1.2 Grain-Straw Ratio

Sample No.	Weight of Grain and Straw (g)	Weight of Grain (g)	Grain-Straw Ratio
1			
2			
3			
Average			

E.2 Grain Analysis

E.2.1 Purity Determination

Initial Weight of Samples (uncleaned) = 500 grams

ITEMS	Trial 1				Trial 1				Trial 1				Gen. Ave.
	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	
Cleaned Grains (g)													
Purity (%)													

E.2.2 Loss Determination

Trial No.	Blower Loss		Separation Loss		Unthreshed Loss	
	Duration:		Duration:		Duration:	
	Sample Wt. (g)	Total (kg)	Sample Wt. (g)	Total (kg)	Sample Wt. (g)	Total (kg)
1a						
1b						
1c						
Ave.						
2a						
2b						
2c						
Ave.						
3a						

Trial No.	Blower Loss		Separation Loss		Unthreshed Loss	
	Duration:		Duration:		Duration:	
	Sample Wt. (g)	Total (kg)	Sample Wt. (g)	Total (kg)	Sample Wt. (g)	Total (kg)
3b						
3c						
Ave.						
Gen. Ave.						

E.2.3 Header loss

Sample No.	Preharvest loss (g)	Weight of Loose grains on the ground (g)	Weight of grains from cut but fallen panicles (g)
1			
2			
3			
4			
5			
Average			

E.3 Potential yield per square meter

Sample No	Weight of Grain and Straw (g)	Weight of Grain (g)
1		
2		
3		
4		
5		
Average		

E.4 Broken Grain Determination

Sample No	Total Weight of Grain (g)	Weight of Broken Grain (g)
1		
2		
3		
4		
5		
Average		

Annex F
(informative)

Formula Used During Calculations and Testing

F.1 Grain-straw ratio (R),

$$R = \frac{W_g}{W_s}$$

where:

W_g is the weight of grain, g
W_s is the weight of sample (grain and straw), g

F.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

F.3 Theoretical field capacity

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

where:

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

F.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

F.5 Blower loss (B_1)

a) Amount

$$B_1, \text{kg} = \frac{\text{Weight of blown clean grain, kg}}{\text{Duration of collection, h}} \times \text{duration of operation, h}$$

b) Percentage

$$B_1, \% = \frac{\text{Blower loss, kg}}{\text{Cleaned threshed grain, kg} + \text{Summation of all losses, kg}} \text{ x } 100$$

F.6 Separation Loss (S_1)

a) Amount

$$S_1, \text{kg} = \frac{Weight of separated clean grain,\ kg}{Duration of collection,\ h} \text{ x duration of operation, h}$$

b) Percentage

$$S_1, \% = \frac{Separation loss,\ kg}{Cleaned threshed grain,\ kg + Summation of all losses,\ kg} \text{ x } 100$$

F.7 Unthreshed Loss (U_1)

a) Amount

$$U_1, \text{kg} = \frac{Weight of unthreshed clean grain,\ kg}{Duration of collection,\ h} \text{ x duration of operation, h}$$

b) Percentage

$$U_1, \% = \frac{Unthreshed loss,\ kg}{Cleaned threshed grain,\ kg + Summation of all losses,\ kg} \text{ x } 100$$

F.8 Summation of all losses (L_T), kg

$$L_T = \text{Blower loss} + \text{Separation loss} + \text{Unthreshed loss}$$

F.9 Header Loss

$$L_H = \frac{(W_{g1} + W_{g2}) - Average W_{gp}}{Average W_{PY}} \text{ x } 100$$

where:

L_H is the header loss, %

W_{g1} is the weight of loose grain on the ground per square meter, g/m^2

W_{g2} is the weight of grains from cut panicles but fallen on the ground per square meter, g/m^2

W_{gp} is the weight of the grain on the ground (pre-harvest loss) per square meter, g/m^2

W_{PY} is the weight of the potential yield per square meter, g/m^2

F.10 Fuel consumption (FC), L/h

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

where:

F_1 is the amount of fuel consumed, L
T_T is the time of operation, h

F.11 Purity (P), %

$$P = \frac{W_c}{W_u} \times 100$$

where:

W_u is the weight of uncleaned grain, g
W_C is the weight of cleaned grain, g

F.12 Cracked grains (C_g), %

$$C_g, \% = \frac{\text{Number of cracked grains}}{\text{100 grain sample}} \times 100$$

F.13 Broken grains (B_g), %

$$B_g = \frac{\text{Weight of broken grains, g}}{\text{100 gram sample}} \times 100$$

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