

# PHILIPPINE NATIONAL STANDARD

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**Agricultural machinery – Coconut Coir  
Decorticator – Methods of Test**



**BUREAU OF PRODUCT STANDARDS**

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**National Foreword**

This Philippine Agricultural Engineering Standards PAES 251:2011, Agricultural machinery – Coconut Coir Decorticator – Methods of Test was approved for adoption as Philippine National Standard by the Bureau of Product Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center (AMTEC) and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development of the Department of Science and Technology (PCARRD-DOST).

## **Foreword**

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) through the project “Development of Standards for Agricultural Production and Postharvest Machinery” funded by the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development – Department of Science and Technology (PCARRD – DOST)

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – 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 the preparation of this standard, the following documents/publications were considered:

PAES 229:2005      Agricultural Machinery – Fiber Decorticator – Methods of Test

PAES 245:2010      Agricultural Machinery – Biomass Shredder – Methods of Test

Becina, Ariel Dexter Janairo. *Testing and evaluation of a coconut husk decorticator*. Undergraduate thesis. Agricultural and Bio-Process Division, Institute of Agricultural Engineering, College of Engineering and Agro-Industrial Technology, University of the Philippines Los Baños. June 1998.

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## **1      Scope**

This standard specifies the methods of test and inspection for coconut coir decorticator. Specifically, it shall be used to:

- 1.1**    verify the mechanism, dimensions, materials, accessories of the coconut coir decorticator and the list of specifications submitted by the manufacturer;
- 1.2**    determine the performance of the machine;
- 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:

- PAES 103:2000**      Agricultural Machinery – Methods of Sampling
- PAES 250:2010**      Agricultural Machinery – Coconut Coir Decorticator – Specifications

## **3      Definitions**

For the purpose of this standard, the definitions given in PAES 250 and the following shall apply:

### **3.1**

#### **coconut husk**

fibrous covering of a coconut fruit comprising of 30% fiber and 70% parenchymatous cells

### **3.2**

#### **coconut coir**

slender and elongated fibrous materials extracted from coconut husk

### **3.3**

#### **coconut peat**

fine and powder-like particles parenchymatous cells that are extracted from the coconut husk

### 3.4

#### **coconut coir decorticator**

machine to crush matured coconut husk through impact or beating action to separate coco fiber and coconut peat from the husk

### 3.5

#### **decorticating efficiency**

ratio of the weight of the input coconut husk partially and totally undecorticated coconut husk to the total weight of the input coconut husk to the decorticator, expressed in percent

### 3.6

#### **input capacity**

weight of coconut coir fed into the decorticator expressed in kilogram per hour

### 3.7

#### **coir quality**

refers to the physical and morphological (e.g. tensile strength, maturity, color, fiber length and cleanliness) properties of fibers extracted

### 3.8

#### **overall height**

distance between the horizontal supporting plane surface and the horizontal plane touching the uppermost part of the decorticator

NOTE: All parts of the decorticator projecting upwards are contained between these two planes.

### 3.9

#### **overall length**

distance between the vertical planes at the right angles to the median plane of the decorticator and touching its front and rear extremities

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

### 3.10

#### **overall width**

distance between the vertical planes parallel to the median plane of the machine, each plane touching the outermost point of the decorticator on its respective side

NOTE: All parts of the decorticator projecting sideways are contained between these two planes.

### 3.11

#### **running-in period**

preliminary operation of the machine to make various adjustments prior to the conduct of the test until the operation is stable

**3.12****undecorticated**

portion of the coconut husk that is partially crushed and totally crushed

**4 General Conditions for Test and Inspection****4.1 Selection of coconut coir decorticator to be tested**

Coconut coir decorticator selected for testing shall be sampled in accordance with PAES 103.

**4.2 Role of manufacturer/distributor**

The manufacturer/distributor shall submit specifications and other relevant information about the coconut coir decorticator and shall abide with 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 demonstrate, operate, adjust, and repair as the case maybe, related to the operation of the coconut coir decorticator.

**4.4 Test site conditions**

The coconut coir decorticator shall be tested as installed for normal operation. The site should have ample provisions for material handling, temporary storage, workspace and suitable for normal working condition.

**4.5 Test instruments**

The instrument to be used shall be calibrated and checked by the testing agency prior to the measurements. The suggested list of minimum test instruments and materials needed to carry out the coconut coir decorticator test is shown in Annex A.

**4.6 Test materials**

The test materials shall be coconut husk of 10 to 12 months maturity. The amount of test materials to be supplied shall be at least 75% of input capacity of coconut coir decorticator, the condition of the test material shall be specified either as wet or dry.

**4.7 Termination of Test**

If there is major component breakdown during testing, the test engineer from the official testing agency shall terminate the test.

## **5 Test and Inspection**

### **5.1 Verification of the technical data and information of the manufacturer**

- 5.1.1** This inspection is carried out to verify the mechanism, dimensions, materials and accessories of the coconut coir decorticator in comparison with the list of technical data and information of the manufacturer.
- 5.1.2** A level surface shall be used as reference plane for verification of dimensional specifications of coconut coir decorticator.
- 5.1.3** The items to be inspected and verified shall be recorded in Annex B.

### **5.2 Performance test**

- 5.2.1** This is carried out to obtain actual data on the overall performance of coconut coir decorticator.
- 5.2.2** Data on the test materials such as size and source of husk shall be recorded.
- 5.2.3** Test materials

Test materials to be used for the running-in and for each test trial shall be the same characteristics and conditions.

#### **5.2.4 Running-in and preliminary adjustment**

Before the start of the test, the decorticator should have undergone running-in period wherein various adjustments of the machine shall be made according to the recommendation of the manufacturer. (No other adjustment shall be permitted while the test is on-going).

#### **5.2.5 Operation of the decorticator machine**

Decorticator shall be operated at the speed and feed rate recommended by the manufacturer. The same recommended feeding rate shall be maintained during the test run. After the test run, the area and the decorticator shall be cleaned and then prepared for the next test trial. This procedure shall be repeated for succeeding test trials.

#### **5.2.6 Test trial**

There shall be a minimum of three test trials using either dry or wet (water-soaked) coconut husks.



## **5.2.7** Data collection

### **5.2.7.1** Duration of test

The duration of each test trial shall commence at the start of the decorticating operation and ends after feeding the last coconut husk and shall be recorded as operating time. Duration of test shall not be less than 15 minutes per trial.

### **5.2.7.2** Noise level

The noise emitted by the decorticator shall be measured using a noise level meter at the location of the feeders and operators. The noise level shall be measured 50 mm away from the ear level.

### **5.2.7.3** Speed of components

The speed of the rotating components (e.g. shaft of blade assembly, prime mover shaft) shall be taken using tachometer.

**NOTE:** Measurements shall be taken with and without load for sub-clauses 5.2.7.2 and 5.2.7.3 as specified in Annex C.

### **5.2.7.4** Energy consumption of decorticator

A power meter shall be used to measure electric energy consumption. In case an internal combustion engine is used, the fuel tank shall be filled to its capacity. After each test trial, the tank shall be refilled using graduated cylinder. The amount of refueling is the fuel consumption for the test.

### **5.2.7.5** Data recording and observations

Record sheet for all data and information during the test is given in Annex C.

## **5.2.8** Sampling and sample handling

### **5.2.8.1** Sampling for test materials

Before the start of each test trials, take at least ten representative samples of coconut coir for determination of material conditions (e.g size, moisture content)

### **5.2.8.2** Sampling from output chute

**5.2.8.2.1** During each test trial, samples shall be taken from the output chute to be analyzed in the laboratory for percentage of undecorticated coconut coir which will be used in the computation of decorticating efficiency.

**5.2.8.2.2** In the collection of sample in the outlet, use a rectangular box-shaped nylon catch with a dimension of 1.5 m x 0.5 m open at one end of the small side. Three samples shall be collected randomly from the outlet with five-second duration per collection.

**5.2.8.3** Handling of samples

Samples shall be taken to the laboratory shall be placed in appropriate containers and properly labeled.

**6 Laboratory Analyses**

Laboratory analyses shall be made to determine the processing efficiency of the coconut coir decorticator and the potential fiber content of the test materials. The laboratory test data sheet to be used is given in Annex D.

**6.1** Moisture content

This shall be taken using oven-dry method

**6.1.1** For each test trial, select three-100g of coconut coir, place in the moisture can and record the weight. Ensure that no moisture is lost or gained by the sample between the time it was collected and when it is weighed in a moisture can. Record the initial weight.

**6.1.2** Dry the samples in the oven with a temperature of  $105^{\circ}\text{C} \pm 1^{\circ}\text{C}$  for 72 hours.

**6.1.3** After removing the samples from the oven, sample container with samples should be placed in a desiccator and allowed to cool to the ambient temperature.

**6.1.4** Weigh each moisture can plus the dried sample. Record the final weight. Calculate the moisture content using the equation in Annex E.

**6.2** Determination of Percent Undecorticated

In each test trial, undecorticated coconut coir from the samples taken from the output chute shall be collected and weighed. The time of collection of the three samples shall be taken and recorded for the computation of the amount of undecorticated coconut coir. Percent undecorticated and decorticated efficiency shall be calculated using equation in Annex E.

**6.3** Fiber quality

The quality of fiber extracted shall be evaluated based on the existing grading system of fibers.

## **7 Formula**

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

## **8 Test Report**

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

**8.1** Title

**8.2** Summary of Results

**8.3** Purpose and Scope of Test

**8.4** Methods of Test

**8.5** Description of the Machine

Table 1 – Machine Specifications

**8.6** Results and Discussions

**8.7** Observations (include pictures)

Table 2 – Performance test data

**8.8** Names, signatures and designation of test engineers

## Annex A

Suggested List of Field and Laboratory  
Test Instruments and Materials

<b>A.1</b>	<b>Instruments</b>	<b>Quantity</b>
<b>A.1.1</b>	<b>Field</b>	
<b>A.1.1.1</b>	Digital Tachometer	1
<b>A.1.1.2</b>	Digital timers (Accuracy: 0.1 sec.)	2
<b>A.1.1.3</b>	Tape measure (with maximum length of 5m)	1
<b>A.1.1.4</b>	Noise level meter Range: 30 dB(A) to 130 dB(A)	1
<b>A.1.1.5</b>	Weighing scale (capacity: 100 kg) Scale division: 0.5 kg	1
<b>A.1.1.6</b>	Graduated cylinder (for engines) (500 mL capacity)	1
<b>A.1.1.7</b>	Power meter (for electric motors) 60 Hz, 220 V	1
<b>A.1.1.8</b>	Digital camera	1
<b>A.1.1.9</b>	Psychrometer	1
<b>A.1.1.10</b>	Vernier caliper (0.05 mm accuracy, 200 mm length )	1
<b>A.1.2</b>	<b>Laboratory</b>	
<b>A.1.2.1</b>	Weighing scale (sensitivity: 0.1 g)	1
<b>A.1.2.2</b>	Air oven	1
<b>A.1.2.3</b>	Desiccator	1
<b>A.1.2.4</b>	Vernier caliper (0.05 mm accuracy, 200 mm length )	1
<b>A.1.2.5</b>	Foot ruler (graduation 1 mm)	1
<b>A.1.2.5</b>	Sample container	9
<b>A.2</b>	<b>Materials</b>	
<b>A.2.1</b>	Sample bags	
<b>A.2.2</b>	Labeling tags which include	
<b>A.2.2.1</b>	Date of test	
<b>A.2.2.2</b>	Decorticator on test	
<b>A.2.2.3</b>	Sample during decorticating	
<b>A.2.2.4</b>	Sample after decorticating	
<b>A.2.2.5</b>	Trial number	

## Annex B

### Specifications of Coconut Coir Decorticator

Name of Applicant/ Distributor: \_\_\_\_\_

Address: \_\_\_\_\_

Tel No: \_\_\_\_\_

Name of Manufacturer: \_\_\_\_\_

Address: \_\_\_\_\_

Tel No: \_\_\_\_\_

#### GENERAL INFORMATION

Make: \_\_\_\_\_ Type: \_\_\_\_\_

Serial No: \_\_\_\_\_ Brand/Model: \_\_\_\_\_

Production date of Coconut coir decorticator: \_\_\_\_\_

Testing Agency: \_\_\_\_\_ Test Engineer: \_\_\_\_\_

Date of Test: \_\_\_\_\_ Location of Test: \_\_\_\_\_

#### Items to be inspected

ITEMS	Specification of the Manufacturer	Verification by the Testing Agency
<b>B.1 Coconut coir decorticator</b>		
<b>B.1.1 Overall dimensions, mm</b>		
<b>B.1.1.1 length</b>		
<b>B.1.1.2 width</b>		
<b>B.1.1.3 height</b>		
<b>B.1.2 Weight without prime mover, kg (if applicable)</b>		
<b>B.2 Loading hopper</b>		
<b>B.2.1 Material of construction</b>		
<b>B.2.2 Height from the ground, mm</b>		
<b>B.2.3 Dimension of bottom opening, mm</b>		
<b>B.2.3.1 length</b>		
<b>B.2.3.2 width</b>		
<b>B.3 Decorticating chamber</b>		
<b>B.3.1 Dimension, mm</b>		
<b>B.3.1.1 diameter</b>		
<b>B.3.1.2 length</b>		
<b>B.3.1.3 width</b>		
<b>B.3.2 Material of construction</b>		
<b>B.4 Blade</b>		
<b>B.4.1 Material of construction</b>		
<b>B.4.2 Dimensions, mm</b>		
<b>B.4.2.1 length</b>		

<b>B.4.2.2</b> width		
<b>B.4.2.3</b> diameter (sweep)		
<b>B.4.2.4</b> thickness		
<b>B.4.3</b> Number of blades		
<b>B.4.4</b> Shape of blades		
<b>B.4.5</b> Clearance to the lower concave, mm		
<b>B.5 Output chute</b>		
<b>B.5.1</b> Material of construction		
<b>B.5.2</b> Dimensions, mm		
<b>B.5.2.1</b> length		
<b>B.5.2.2</b> diameter (if circular)		
<b>B.5.2.3</b> width x height (if rectangular)		
<b>B.5.2.3</b> height from the ground		
<b>B.6</b> Safety features (enumerate)		
<b>B.7</b> Special features (enumerate)		
<b>B.8 Prime mover</b>		
<b>B.8.1 Electric motor</b>		
<b>B.8.1.1</b> Type of motor		
<b>B.8.1.2</b> Brand		
<b>B.8.1.3</b> Make or manufacturer		
<b>B.8.1.4</b> Serial number		
<b>B.8.1.5</b> Rated power, kW		
<b>B.8.1.6</b> Rated speed, rpm		
<b>B.8.1.7</b> Frequency, Hz		
<b>B.8.1.8</b> Voltage, V		
<b>B.8.2 Internal combustion engine</b>		
<b>B.8.2.1</b> Brand		
<b>B.8.2.2</b> Model		
<b>B.8.2.3</b> Make or manufacturer		
<b>B.8.2.4</b> Serial number		
<b>B.8.2.5</b> Type		
<b>B.8.2.6</b> Rated power, kW		
<b>B.8.2.7</b> Rated speed, rpm		
<b>B.8.2.8</b> Cooling system		
<b>B.8.2.9</b> Starting system		
<b>B.8.2.10</b> Weight, kg		

## Annex C

## Performance Test Data Sheet

Test Trial No. \_\_\_\_\_ Date: \_\_\_\_\_  
 Test Engineer: \_\_\_\_\_ Location: \_\_\_\_\_  
 Assistants: \_\_\_\_\_ Test Specimen: \_\_\_\_\_  
 Test Requested by: \_\_\_\_\_ Manufacturer: \_\_\_\_\_

	Trials			Ave
	I	II	III	
<b>C.1 Test Materials</b>				
C.1.1 variety				
C.1.2 source				
C.1.3 moisture content, %				
C.1.4 Dimensions, mm				
C.1.4.1 length				
C.1.4.2 thickness				
<b>C.2 Ambient Condition</b>				
C.2.1 Wet-bulb temperature, °C				
C.2.2 Dry-bulb temperature, °C				
C.3 Weight of input, kg				
C.4 Weight of output, kg				
C.5 Operating time, h				
C.6 Input capacity, kg/h				
C.7 Weight of undecorticated coconut coir, kg				
C.8 Decortivating efficiency, %				
<b>C.9 Speed of components, rpm</b>				
<b>C.9.1 Decortivating shaft</b>				
C.9.1.1 Without load				
C.9.1.2 With load				
<b>C.9.2 Prime mover</b>				
C.9.2.1 Without load				
C.9.2.2 With load				
<b>C.10 Noise level, dB(A)</b>				
C.10.1 Without load				
C.10.2 With load				
<b>C.11 Fuel/Power consumption</b>				
<b>C.11.1 Internal combustion engine</b>				
C.11.1.1 Engine operating time, min				
C.11.1.2 Fuel consumed, L				
C.11.1.3 Fuel consumption rate, L/h				

<b>C.11.2 Electric motor</b>				
<b>C.11.2.1 Power, kW</b>				
<b>C.11.2.1.1</b> Without load				
<b>C.11.2.1.2</b> With load				
<b>C.11.2.2 Current, A</b>				
<b>C.11.2.2.1</b> Without load				
<b>C.11.2.2.2</b> With load				
<b>C.11.2.3 Voltage, V</b>				
<b>C.11.2.3.1</b> Without load				
<b>C.11.2.3.2</b> With load				

<b>C.12 Welding Acceptance Test</b>	<b>Remarks</b>
<b>C.12.1</b> Crack prohibition	
<b>C.12.2</b> Weld/base-metal fusion	
<b>C.12.3</b> Crater cross-section	
<b>C.12.4</b> Weld profile	
<b>C.12.5</b> Time of inspection	
<b>C.12.6</b> Undersize welds (if any)	
<b>C.12.7</b> Undercut	
<b>C.12.8</b> Porosity (presence of air holes on the welded parts)	

**C.13 Evaluate the following observations**

<b>Items</b>	<b>Remarks</b>
<b>C.13.1</b> Ease of loading	
<b>C.13.2</b> Ease of operation	
<b>C.13.3</b> Ease of adjusting parts	
<b>C.13.4</b> Ease of repairing of parts	
<b>C.13.5</b> Ease of collecting output	
<b>C.13.6</b> Ease of cleaning parts	
<b>C.13.7</b> Safety	
<b>C.13.8</b> Ease of transporting the machine	
<b>C.13.9</b> Vibration	

**C.14 Other Observations (e.g. clogging):**

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### Laboratory Test Data Sheet

Machine Tested: \_\_\_\_\_ Analyzed by: \_\_\_\_\_  
 Date of Test: \_\_\_\_\_ Date Analyzed: \_\_\_\_\_

#### D.1 Moisture Content Determination (Oven Method)

Item	Trial 1			Trial 2			Trial 3			Average
	<i>I</i>	<i>2</i>	<i>3</i>	<i>I</i>	<i>2</i>	<i>3</i>	<i>I</i>	<i>2</i>	<i>3</i>	
Initial weight, g										
Final weight, g										
Moisture content, %										
<b>General Average</b>										

#### D.2 Determination of Undecorticated Samples

Trial	Weight of undecorticated coconut coir, g	Weight of coconut coir, g	Duration of collection, s	Total weight of sample, g
<b>I</b>				
<b>II</b>				
<b>III</b>				
<b>Average</b>				

#### D.3 Other physical observations

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## Annex E

## Formula

## E.1 Moisture Content

$$MC_{wb} = \frac{W_i - W_f}{W_i} \times 100$$

where:

$$\begin{aligned} MC_{wb} &= \text{moisture content wet basis, \%} \\ W_i &= \text{initial weight of the sample, g} \\ W_f &= \text{final weight of the sample, g} \end{aligned}$$

## E.2 Input Capacity

$$C_i = \frac{W_{in}}{T_o}$$

where:

$$\begin{aligned} C_i &= \text{input capacity, kg/h} \\ W_{in} &= \text{weight of input coconut coir, kg} \\ T_o &= \text{total operating time, h} \end{aligned}$$

## E.3 Undecorticated Coconut Coir

a) Amount:

$$U_{cc} = \frac{W_{ud} + W_{pd}}{T_c} \times T_o$$

b) Percentage:

$$U_{cc}(\%) = \frac{U_{cc}(\text{Amount})}{W_{in}} \times 100$$

where:

$U_{cc}(\%)$	=	undecorticated coconut coir, %
$W_{ud}$	=	weight of the undecorticated coconut coir, kg
$W_{pd}$	=	weight of the partially decorticated coconut coir, kg
$T_c$	=	duration of sample collecting in output chute, h
$W_{in}$	=	weight of total input coconut coir, kg
$T_o$	=	total operating time, h

#### E.4 Decortivating Efficiency

$$Eff_d = 100 - U_{cc} \text{ (Percentage)}$$

where:

$Eff_d$	=	decortivating efficiency, %
$U_{cc}$	=	undecorticated coconut coir, %

#### E.5 Fuel Consumption Rate

$$Fr = \frac{F_c}{T_e}$$

where:

$Fr$	=	fuel consumption rate, L/h
$F_c$	=	amount of fuel consumed, L
$T_e$	=	engine time of operation, h

# Philippine Agricultural Engineering Standards

AMTEC-UPLB – PCARRD Project: “Development of Standards for Agricultural Production and Postharvest Machinery”

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