PHILIPPINE NATIONAL STANDARD

PNS/BAFS PAES 254:2018
ICS 65.060.99

Agricultural Machinery- Cacao Huller- Methods of Test

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Foreword

The Philippine National Standards (PNS) for Agricultural Machinery- Cacao Huller-Methods of Test (PNS/BAFS/PAES 254:2018) has been prepared by the Technical Working Group (TWG) for Various Agricultural Machinery as per approved Department of Agriculture Special Order No. 1045 series of 2016.

This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2.

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.

1 Scope

This standard specifies the methods of test for cacao huller. Specifically, it shall be used to:

1.1 verify the mechanisms, dimensions, materials and accessories of the cacao huller 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 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this documents. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

PNS/BAFS PAES 253:2018, *Agricultural Machinery – Cacao Huller – Specifications*

PAES 103:2000, *Agricultural Machinery – Methods of Sampling*

ISO 1114:1977, *Cocoa Beans- Cut Test*

3 Terms and Definitions

For the purpose of this standard, the definitions given in PNS/BAFS PAES 253:2018 and the following shall apply.

3.1
bean count
total number of cacao beans (excluding flat and broken beans) required to make a weight
of 100 grams

3.2
cacao nib recovery
ratio of the total weight of cacao nibs collected at the cacao nib outlet to the total weight of dry cacao or roasted cacao beans loaded in the intake hopper of the machine, expressed in percentage (%)

3.3
foreign matter
impurity
all matters other than cacao nibs

3.4
moisture content (wet basis)
amount of moisture in the dry cacao or roasted cacao beans expressed as percent of the total weight of the sample

3.5
overall height
distance between the horizontal supporting plane surface and the horizontal plane touching the uppermost part of the cacao huller

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

3.7
overall width
distance between the vertical planes parallel to the median plane of the machine, each plane touching the outermost point of the huller on its respective side

3.8
prime mover
used to run the cacao huller

3.9
running-in period
preliminary operation of the machine to make various adjustments prior to the conduct of the test until the operation is stable

3.10
test applicant
manufacturer, direct importer, or any legitimate distributor, dealer, or end-user of the machine

4 General Conditions for Test

4.1 Selection of cacao huller to be tested

Cacao huller submitted for testing shall be sampled in accordance with PAES 103:2000 or any other suitable method of selection.

4.2 Role of the test applicant

The test applicant shall submit specifications and other relevant information about the cacao huller. They shall abide with the terms and conditions set forth by the official testing agency, provide testing materials and shoulder other variable costs to carry out the test.

4.3 Role of the representative of the test applicant

An officially designated representative of the test applicant shall operate, demonstrate, adjust, repair as the case maybe and decide on matters related to the operation of the machine.

4.4 Test site conditions

The cacao huller shall be tested and installed for normal operation. The site should have ample provisions for material handling, temporary storage, workspace and suitable for normal working condition. Adequate ventilation and lighting shall be provided in the area.

4.5 Suspension/termination of test

If during the test run, the machine stops due to breakdown or malfunction so as to affect
the machine's performance, the test may be suspended. If the machine will not be able to continue operation, the test shall be terminated.

5 Test Preparation

5.1 Preparation of the cacao huller for testing

The representative of the test applicant and testing agency shall check the cacao huller so as to ensure that the machine has been assembled and installed in accordance with the instruction of the manufacturer. The official testing agency will test the cacao huller according to the desired output of the manufacturer.

5.2 Test instruments and other materials

The suggested list of minimum field and laboratory test equipment and materials needed to carry out the cacao huller test is shown in Annex A. These instruments shall be calibrated regularly. Before and after each test, these instruments shall be physically checked for operation and shall be cleaned, respectively. A checklist of instruments and materials to be used before departure to and from the testing area shall be prepared.

5.3 Test materials

Dry cacao or roasted cacao bean to be used shall be from commonly or locally grown cacao with uniform moisture content and bean count of less than 120. The amount of test material to be supplied shall be sufficient for one hour of continuous operation. The excess amount shall be used for running-in prior to the actual conduct of test trials. If the test materials are not conforming to the recommended quantity and characteristics, the test engineer shall not pursue the test.

5.4 Running-in and preliminary adjustments

The cacao huller shall have undergone a running-in period before starting the test. During the running-in period, the various adjustments of the machine shall be made according to the recommendation of the manufacturer.

6 Pre-test Observation

6.1 Verification of specifications

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

The cracking mechanism or any other parts that are in direct contact to the cacao nibs will also be used as reference for the verification of specification claimed by the test applicant

6.2 Test samples

Representative test samples shall be collected by the testing agency from the test material for analysis. Sampling procedure is shown in Annex C.

7 Performance Test

7.1 Operation of the cacao huller

The cacao huller shall be operated at the manufacturer's recommended setting of its components. The same speed and feeding rate recommended by the manufacturer shall be maintained during the test run. The testing authority shall make all measurements, which form part of the test and take the prescribed samples. After the test run, the area shall be cleaned and then prepared for the next test trial. This procedure shall be repeated for the succeeding test trials.

NOTE No other adjustments shall be permitted during the test.

7.2 Test trials

A minimum of three (3) test trials, with duration of at least fifteen (15) minutes per trial, shall be adopted.

7.3 Sampling

Samples shall be collected at different outlets using each test trial. Sampling procedure is shown in Annex C.

7.4 Data collection

7.4.1. Duration of test

The duration of each test trial shall start from the feeding of the test materials into the hopper (first drop) and ends at the last drop of the test materials into the hopper. However, all discharge from the different outlets shall be included after the cut-off time.

7.4.2 Noise level

7.4.2.1 The sound emitted by the machine, with and without load, shall be measured using a sound level meter at the location of the operator/s. The noise level, expressed in decibel [dB (A)], shall be measured 50 mm away from the ear level of the operator/s.

7.4.2.2 For each data to be taken, there shall be a minimum of five (5) observations. Before taking data, it should be ensured that the feed rate, speed, and other functional characteristics have stabilized. The time of recording shall be properly spaced during the whole duration of the test trial.

7.4.3 Power requirement

Use a power meter to measure the voltage, current, and the total electric power consumption of the cacao huller. There shall be three (3) sets of data with a minimum of five (5) observations per set taken with and without load. Data shall be taken simultaneous with the collection of samples for laboratory analysis.

7.4.4 Speed of components

The speed of the rotating shafts of the major components of the cacao huller shall be taken using a tachometer, with and without load. Requirements for each data to be taken shall conform to 7.4.2.2.

7.5 Data recording and observations

Record sheet for all data and information during the test is given in Annex D. Observations to be taken during the performance test shall be recorded in this sheet.

8 Laboratory Analysis

Laboratory analysis shall be made to determine the moisture content, purity, blower loss, bean count, input cacao nibs and hulling efficiency. The laboratory procedure to be followed in the analysis is given in Annex E while the data sheet is given in Annex F.

9 Data Analysis

Machine specifications and the results of the test shall be presented in tabular form in which data shall be taken from Annexes B and D. A schematic diagram of the power transmission system and arrangement of the sieve shall also be included.

Observations made on the machine while in operation shall be supported with photographs.

10 Formula

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

11 Test Report

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

11.1 Name of testing agency

11.2 Test report number

11.3 Title

11.4 Summary of results (including the performance compared with the criteria)

11.5 Purpose and scope of test

11.4 Methods of test

11.5 Conditions of the machine

11.6 Description of the machine

11.7 Results and discussions

11.8 Observations (include pictures)

11.9 Names, signature and designation of test engineers

Annex A
(informative)

Minimum List of Field and Laboratory Test Equipment and Materials

A.1	Field test equipment and materials	Quantity
A.1.1	Hand-held Tachometer	1
A.1.2	Stop Watch	2
A.1.3	Measuring Tape	1
A.1.4	Noise Level Meter	1
A.1.5	Weighing Scale Capacity: at least 100 kg Resolution: 0.1 kg	1
A.1.6	AC/DC Power Meter/Multimeter	1
A.1.7	Camera	1
A.1.8	Graduated Cylinder Capacity: at least 500 mL	1

A.2	Laboratory test equipment and materials	Quantity
A.2.1	Digital Weighing Scale Resolution: 0.01 g	1
A.2.2	Air oven	1
A.2.3	Desiccators	1
A.2.4	Aluminum Moisture Cans	9
A.2.5	Sample Bags	20
A.2.6	Labeling Tags which include: Date of Test Cacao huller on Test Sample Source Variety Trial Number	20

Annex B
(informative)

Specifications of Cacao Huller

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

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

GENERAL INFORMATION

Make : _____ Type : _____
Serial No. : _____ Brand/Model : _____
Date of Manufacture: _____
Testing Agency : _____ Test Engineer: _____
Location of Test : _____ Date of Test : _____

No.	Item*	Manufacturer's Specification	Verification by the Testing Agency
B.1	**Main structure**		
B.1.1	Overall dimensions (mm)		
B.1.1.1	Length		
B.1.1.2	Width		
B.1.1.3	Height		
B.1.2	Weight (kg), if applicable without the engine		
B.2	**Rated output capacity (kg/h)**		
B.3	**Prime Mover**		
B.3.1	Electric motor		
B.3.1.1	Brand		
B.3.1.2	Model		
B.3.1.3	Serial Number		
B.3.1.4	Make		
B.3.1.5	Rated power (kW)		
B.3.1.6	Rated speed (rpm)		
B.3.1.7	Electrical Service Required		
B.3.1.8	Voltage (V)		
B.3.1.9	Current (A)		
B.3.1.10	Frequency (Hz)		
B.4	**Intake Hopper**		
B.4.1	Overall dimensions (mm)		
B.4.1.1	Length		
B.4.1.2	Width		
B.4.1.3	Height		
B.4.2	Height from the ground (mm)		

B.4.3	Material		
B.4.4	Location		
B.4.5	Means of attachment		
B.5	**Cacao nib outlet**		
B.5.1	Overall dimensions (mm)		
B.5.1.1	Length		
B.5.1.2	Width		
B.5.1.3	Height		
B.5.2	Height from the ground (mm)		
B.5.3	Material		
B.5.4	Location		
B.5.5	Means of attachment		
B.6	**Hull outlet**		
B.6.1	Overall dimensions (mm)		
B.6.1.1	Length		
B.6.1.2	Width		
B.6.1.3	Height		
B.6.2	Height from the ground (mm)		
B.6.3	Material		
B.6.4	Location		
B.6.5	Means of attachment		
B.7	**Cracking Mechanism**		
B.7.1	Type		
B.7.2	Dimension, L x W x T (mm)		
B.7.3	Means of attachment		
B.7.4	Material		
B.8	**Safety devices**		
B.9	**Special features**		

*The parameter will be checked upon availability.

B.10 Illustration of transmission system

Annex C
(normative)

Sampling Procedures

C.1 Sampling procedures for cacao beans or roasted cacao beans

The conditions of the dry cacao or roasted cacao beans such as moisture content and bean count to be used in each test shall be taken using three (3) “representative samples,” which represent the different conditions of cacao beans or roasted cacao beans input in the bulk. This is done by randomly taking samples at the top, middle and bottom portions of the bulk. Half of the sample shall be used for laboratory analysis and the other half shall be used for reference purposes or for an eventual second check in case of review. Samples representing the materials for each test trial shall be placed in appropriate containers for laboratory analysis.

C.2 Sampling from cacao nib outlet

During each test trial, three (3) samples, each weighing 100 g shall be collected from the cacao nib outlet of the cacao huller to be analyzed in the laboratory for the determination of purity and three (3) samples of at least 100 g each for hulling efficiency. The minimum amount of sample to be taken shall be twice as much as what is needed for a particular analysis.

C.3 Sampling from Blower Outlet

During the test, three samples shall be randomly taken from the shell outlet for duration of at least 15 seconds per collection. These samples shall be placed in appropriate containers and labeled as blower loss.

C.4 Handling of samples

All samples to be taken to the laboratory shall be placed in appropriate containers and properly labeled. If the samples are not to be immediately analyzed, it should be stored in proper condition and kept in dry and airtight containers.

Annex D
(informative)

Performance Test Data Sheet

Test Trial No. : _____ Date : _____
Test Engineers : _____ Location : _____
Assistants : _____ Machine : _____
Test Applicant : _____ Manufacturer : _____

No.	Items	Trial 1	Trial 2	Trial 3	Average
D.1	**Conditions of cacao beans or roasted cacao beans**				
D.1.1	Source				
D.1.2	Variety				
D.1.3	Moisture content (%)				
D.2	**Weight of input (kg)**				
D.3	**Input capacity (kg/h)**				
D.4	**Operating time (h)**	`			
D.5	**Output capacity (kg/h)**				
D.6	**Cacao nibs (kg)**				
D.7	**Speed of components (rpm)**				
D.7.1	Prime Mover				
D.7.1.1	Without load				
D.7.1.2	With load				
D.7.2	Cracker shaft				
D.7.2.1	Without load				
D.7.2.2	With load				
D.8	**Noise level [dB (A)]**				
D.8.1	Feeder				
D.8.1.1	Without load				
D.8.1.2	With load				
D.8.2	Bagger				
D.8.2.1	Without load				
D.8.2.2	With load				
D.9	**Power requirement**				
D.9.1	Power (kW)				
D.9.1.1	Without load				
D.9.1.2	With load				
D.9.2	Current (A)				
D.9.2.1	Without load				
D.9.2.2	With load				
D.9.3	Voltage (V)				
D.9.3.1	Without load				
D.9.3.2	With load				

D.10 Other observations

D.10.1 Ease of transporting the machine

_____
_____
_____

D.10.2 Ease of cleaning the machine

_____
_____
_____

D.10.3 Ease of adjusting and repairing of parts

_____
_____
_____

D.10.4 Ease of loading input and collecting output

_____
_____
_____

D.10.5 Safety

_____
_____
_____

D.10.6 Labor Requirements

_____
_____
_____

D.10.7 Failure or abnormalities that may be observed on the machine or its component parts during and after the cleaning operation.

_____
_____
_____

D.10.8 Others

_____
_____
_____

Annex E
(normative)

Laboratory Analysis

E.1 Purity determination of cacao nibs

Take three (3) 100 g samples of cacao nibs. Clean the samples to remove the impurities and other foreign matters, the clean sample shall be weighed and recorded.

E.2 Moisture content determination of dry cacao or roasted cacao beans

At least five (5) representative samples taken randomly at 25 g each shall be taken for moisture content determination preferably using the Air-Oven Drying Method or any calibrated moisture meter. It shall be determined prior to the cracking of the roasted cacao bean samples.

E.3 Blower loss determination

Three-100 g sample shall be taken from the shell outlet. It shall be cleaned and weighed. The total weight of the cacao nibs and hull shall be recorded for the computation of the blower loss.

E.4 Determination of input cacao nibs

Take three (3) 100 g samples from the dry cacao or roasted cacao beans input. Manually hull and record the weight of cacao nibs. This will be used for the computation of theoretical cacao nibs input and cacao nibs recovery index.

E.5 Determination of bean count

Bean count is carried out by the determination of the number of cacao beans to make a
weight of 100 g.

E.5.1 Preparation of the sample

The sample is obtained by the method described in ISO 1114:1977 and shall be thoroughly mixed.

E.5.2 Preparation of the test portion

The mixed samples shall be reduced by quartering or by means of a suitable dividing apparatus, to just over 300 beans per quarter. Then count the actual number of whole beans, after the removal of flat beans.

E.5.3 Determination

The whole beans shall then be weighed to the nearest 0.05 g.

E.5.4 Expression of result

The bean count shall be expressed as the number of beans per 100 g. The formula to be used is given in Annex G.

E.6 Determination of hulling efficiency

Three-100 g sample shall be taken from the cacao nib outlet. Manually separate the cacao nibs and unhulled beans to the cacao hull. Record the weight of the cacao nibs and unhulled beans and calculate the hulling efficiency. The formula to be used is given in Annex G.

Annex F
(informative)

Laboratory Analysis Data Sheet

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

F.1 Moisture content (% wet basis) of roasted cacao beans conditions

Average					

F.2 Purity determination of cacao nibs

ITEMS	**Trial 1**				**Trial 2**				**Trial 3**				**General Average**
	1	2	3	Ave	1	2	3	Ave	1	2	3	Ave	
Cleaned (g)													
Purity (%)													

F.3 Blower loss

TRIAL	**Blower Loss**	
	Duration:	
	Sample Wt. kg	**Total Kg**
1- a		
b		
c		
Ave.		
2- a		
b		
c		
Ave.		
3- a		
b		
c		
Ave.		

F.4 Hulling efficiency

ITEMS	Trial 1				Trial 2				Trial 3				General Average
	1	2	3	Ave	1	2	3	Ave	1	2	3	Ave	
Cacao nibs (g)													
Unhulled Beans (g)													
Total													

Annex G
(normative)

Formula Used During Calculations and Testing

G.1 Moisture content

$$MC_{wetbasis} = \frac{W_i - W_f}{W_i}\ x\ 100$$

where:

MC is the moisture content (%)
W_i is the initial weight of the sample (g)
W_f is the final weight of the sample (g)

G.2 Capacity

G.2.2 Input

$$C_i = \frac{W_{rc}}{T_i}$$

where:

C_i is the input capacity (kg/h)
W_{rc} is the weight of dry cacao or roasted cacao bean (kg)
T_i is the input time (h)

G.2.3 Output

$$C_o = \frac{W_{cn}}{T_o}$$

where:

C_o is the output capacity (kg/h)
W_{cn} is the total weight of cacao nibs (kg)
T_o is the output time (h)

G.3 Cacao nibs recovery

$$R_c = \frac{W_{cn}}{W_{rc}}\ x\ 100$$

where:

R_c is the cacao nibs recovery (%)
W_{cn} is the weight of cacao nibs (kg)
W_{rc} is the weight of dry cacao or roasted cacao beans (kg)

G.4 Blower loss

Amount

$$B_l = \frac{W_b}{T_c} T_o$$

where:

B_l is the blower loss (kg)
W_b is the weight of blown cacao nibs (kg)
T_c is the duration of collection (h)
T_o is the duration of operation (h)

Percentage

$$B_l = \frac{W_b}{I_{cn}} \; x \; 100$$

where:

B_l is the blower loss (%)
W_b is the weight of blown cacao nibs (kg)
I_{cn} is the input cacao nibs (kg)

G.5 Purity

$$P = \frac{W_{cn}}{W_h} \; x \; 100$$

where:

P is the purity (%)
W_{cn} is the weight of cacao nibs (g)
W_h is the weight of hull/ testa (g)

G.6 Bean count

$$BC = \frac{N_{wb}}{W_{wb}} \; x \; 100$$

where:

BC is the bean count, number of beans per 100 g
N_{wb} is the number of whole beans
W_{wb} is the weight of whole beans (g)

G.7 Hulling efficiency

$$E_h = \frac{W_{cn}}{W_{ub+cn}} \; x \; 100$$

where:

E_h is the hulling efficiency (%)
W_{cn} is the weight of cacao nibs collected at cacao nibs outlet/s (kg)
W_{ub+cn} is the weight of unhulled beans and cacao nibs at cacao nibs outlet/s (kg)

G.8 Cacao nibs recovery index

$$R_i = \frac{W_{cn}}{I_{cn}}$$

where:

R_i is the cacao nibs recovery index (decimal)
W_{cn} is the weight of cacao nibs collected at cacao nib outlet (kg)
I_{cn} is the input cacao nibs (kg)

G.9 Input cacao nibs

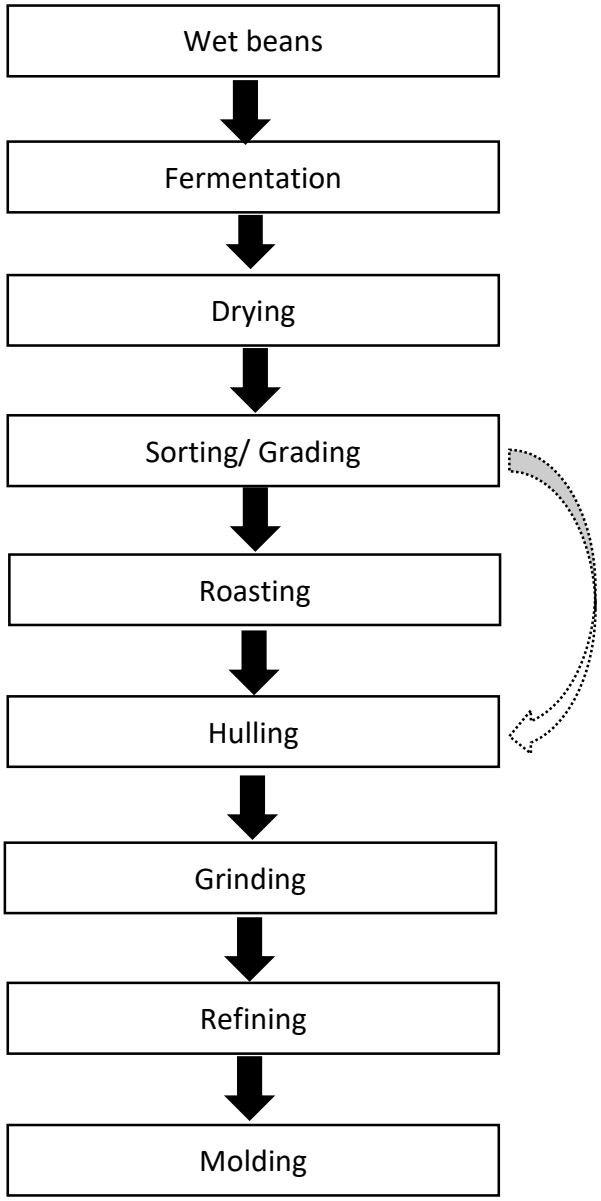
$$I_{cn} = \frac{W_m}{N} \; x \; W_{rc}$$

where:

I_{cn} is the input GCB (kg)
W_m is the weight of the manually hulled cacao nibs (g)
W_{rc} is the weight of input dry cacao or roasted cacao beans (kg)
N is the 100 gram sample

Annex H
(informative)

The Process Flow Chart in Making Philippine Tablea



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