

PHILIPPINE NATIONAL STANDARD

PNS/BAFS PAES 256:2018
ICS 65.060.99

Agricultural Machinery- Cacao Roaster- Methods of Test



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Foreword

The Philippine National Standards (PNS) for Agricultural Machinery- Cacao Roaster- Methods of Test (PNS/BAFS PAES 256:2018) 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 roasters. Specifically, it shall be used to:

- 1.1 verify the mechanisms, dimensions, materials and accessories of the cacao roaster 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.

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

PNS/BAFS PAES 255:2018, *Agricultural Machinery – Cacao Roaster – Specifications*

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

3 Terms and Definitions

For the purpose of this standard, the definitions given in PNS/BAFS PAES 255:2018 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

moisture content (wet basis)

amount of moisture in the dry cacao expressed as percent of the total weight of the sample

3.3

overall height

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

3.4

overall length

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

3.5

overall width

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

3.6

prime mover

used to run the cacao roaster

3.7

specific energy consumption

ratio of the electric/LPG consumption and the amount of roasted cacao beans, expressed in kilowatt-hour per kilogram or kilojoule per kilogram

3.8

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 roaster to be tested

Cacao roaster 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 roaster. 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 roaster 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 roaster for testing

The representative of the test applicant and testing agency shall check the cacao roaster 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 roaster 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 roaster 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

Cacao beans to be used shall be from commonly or locally grown cacao, dried and fermented with 6 – 8% moisture content wet-basis and bean count of less than 120. The amount of test material shall be sufficient for three (3) test trials. The excess amount shall be used for running-in prior to the actual conduct of test trials. However, if the test materials are beyond the recommended characteristics, the test engineer has the option not to pursue the test concurred by the representative of the test applicant.

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

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 roaster

The cacao roaster 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 agency 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 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 time the heat is introduced to the chamber with dry cacao and ends when the heat source is turned off.

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 and Energy consumption

7.4.3.1 Measurement of Power Requirement

Use a power meter to measure the voltage, current, and the total electric power requirement of the cacao roaster. There shall be three (3) sets of data with a minimum of five (5) observations per set taken with and without load.

7.4.3.2 Measurement of Energy Consumption (Heat Source)

7.4.3.2.1 Power Requirement

Use a power meter to measure the voltage, current, and the total electric power requirement of the cacao roaster. There shall be three (3) sets of data with a minimum of five (5) observations per set taken with and without load.

7.4.3.2.2 Fuel Consumption

The initial weight of the LPG tank, its weight after the test trial and the duration of the operation shall be recorded. This shall be done in all test trials.

7.4.4 Speed of components

The speed of the cylinder for drum roaster shall be taken using a tachometer. 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, bean count and uniformity of roast. 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. 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 Title

11.2 Summary of Results (including the performance compared with the criteria)

11.3 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 and Signature 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 Resolution: 0.1 second	2
A.1.3	Measuring Tape	1
A.1.4	Noise Level Meter Range: 30 – 130 dB (A)	1
A.1.5	Weighing Scale Capacity: 100 kg Resolution: 0.1 kg	1
A.1.6	Clamp-on AC/DC Power Meter 1000 V	1
A.1.7	Camera	1

A.2	Laboratory Test Equipment and Materials	Quantity
A.2.1	Digital Weighing Scale Resolution: 0.01 g Capacity: 2500 g	1
A.2.2	Moisture Meter	1
A.2.3	Labeling Tags which include: Date of Test Cacao Roaster on Test Sample Source Variety Trial Number	20

Annex B
(informative)

Specifications of Cacao Roaster

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 roasting capacity (kg/h)		
B.3	Heat Source		
B.4	Input Chute		
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	Output Chute		
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	Roasting Mechanism		
B.6.1	Type		
B.6.2	Material		
B.7	Safety devices		
B.8	Special features		

*The parameter will be checked upon availability.

B.9 Illustration of transmission system

Annex C
(normative)

Sampling Procedures

C.1 Sampling Procedures for Dry Cacao Input

The conditions of the input such as moisture content, bean count and uniformity of roast to be used in each test shall be taken using three (3) representative samples, which represent the different conditions of dry cacao 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 the Output Chute of cooling tray

During each test trial, three (3) samples weighing at least 500 g each shall be collected. The minimum amount of sample to be taken from the outlet of the cacao roaster to be analyzed in the laboratory for the determination of moisture content, bean count and uniformity of roast shall be twice as much as what is needed for a particular analysis.

C.3 Handling of Samples

All samples to be used must be properly labeled and kept in airtight, dry and food grade 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	Dry Cacao				
D.1.1	Source				
D.1.2	Variety				
D.1.3	Moisture content (%)				
D.2	Weight of input (kg)				
D.3	Weight of output (kg)				
D.4	Operating time (h)				
D.5	Roasting capacity (kg/h)				
D.6	Specific energy consumption (kW-h/kg)				
D.7	Speed of prime mover (rpm)				
D.7.1.1	Without load				
D.7.1.2	With load				
D.8	Noise level [dB (A)]				
D.8.1	Without load				
D.8.2	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	Fuel Consumption (kg/h)				

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 Moisture Content Determination

At least five (5) representative samples of 25 g each shall be taken randomly for moisture content determination, preferably using the Air-Oven Drying Method at $103 \pm 2 \text{ }^\circ\text{C}$ for 16 ± 1 hour.

E.2 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.2.1 Preparation of the sample

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

E.2.2 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.2.3 Determination

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

E.2.4 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.3 Determination of roasting efficiency

Randomly select ten (10) roasted cacao beans from the output chute of the cooling tray. Properly label each bean and get the initial weight of individual roasted cacao bean. Subject the beans to Air- Oven Method. Get the final weight of each beans and compute the average final weight. Compute the coefficient of variation using the formula given in Annex G.

Annex F
(normative)

Laboratory Analysis Data Sheet

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

F.1 Moisture Content (% wet basis)

Average					

F.2 Uniformity of Roast

Roasted Cacao Beans	Initial Weight	Final Weight
Bean 1		
Bean 2		
Bean 3		
Bean 4		
Bean 5		
Bean 6		
Bean 7		
Bean 8		
Bean 9		
Bean 10		
Average		

Annex G
(normative)

Formulas Used in Calculation and Testing

G.1 Moisture content

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

where:

MC_{wb}	is the moisture content (%)
W_i	is the initial mass of the dry cacao (g)
W_f	is the final mass of roasted cacao beans (g)

G.2 Roasting capacity

$$C_r = \frac{W_r}{T_o}$$

where:

C_r	is the roasting capacity (kg/h)
W_r	is the total weight of roasted cacao beans (kg)
T_o	is the total operating time (h)

G.3 Fuel consumption

$$FC = \frac{W_i - W_f}{T_t}$$

where:

FC	is the fuel consumption (kg/h)
W_i	is the initial weight of LPG tank (kg)
W_f	is the weight of LPG tank after test (kg)
T_t	is the duration of test trial (h)

G.4 Bean count

$$BC = \frac{N_{wb}}{W_{wb}} \times 100$$

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.5 Specific energy consumption

G.5.1 Using electricity as heat source

$$SEC = \frac{E_c \times T}{W_g}$$

where:

- SEC is the specific energy consumption (kW-h/kg)
- E_c is the electric power consumed (kW)
- T is the total roasting time (h)
- W_g is the initial weight of the dry cacao (kg)

G.5.2 Using LPG as heat source

$$SEC = \frac{F \times HV}{W_g}$$

where:

- SEC is the specific energy consumption (kJ/kg)
- F is the fuel consumed (kg)
- HV is the heating value of the LPG (h)
- W_g is the initial weight of the dry cacao (kg)

G.6 Coefficient of variation

$$CV = \frac{SD}{M} \times 100$$

where:

- CV is the Coefficient of Variation (%)
- SD is the Standard Deviation
- M is the Mean

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