

PHILIPPINE NATIONAL STANDARD

PNS/BAFS PAES 246:2018
ICS 65.060.99

Agricultural Machinery – Cassava Granulator – Methods of Test



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Foreword

The Philippine National Standard (PNS) for Agricultural Machinery – Cassava Granulator – Methods of Test (PNS/BAFS PAES 246:2018) has been prepared by the Technical Working Group (TWG) for various Agricultural Machinery as per approved Department of Agriculture Special Order (SO) 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 cassava granulators. Specifically, it shall be used to:

- 1.1 verify the mechanisms, dimensions, materials and accessories of the cassava granulator 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 result 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 document. 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 – Method of Sampling*

PNS/BAFS PAES 245:2018, *Agricultural Machinery – Cassava Granulator – Specifications*

3 Terms and Definitions

For the purpose of this standard, the definitions given in PNS/BAFS PAES 245:2018 and the following shall apply.

3.1

hopper

part of the machine where dried cassava chips or cassava tubers are loaded

3.2

output capacity

weight of cassava granules or granulated cassava collected at the product outlet per unit time, expressed in kilogram per hour

3.3

overall height

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

3.4

overall length

distance between the vertical planes at the right angles to the median plane of the granulator 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 granulator on its respective side

3.6

prime mover

source of power for the cassava granulator

3.7

running-in period

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

3.8

specific energy consumption

ratio of the electric, diesel, or liquefied petroleum gas (LPG) consumption and the amount of input, expressed in kilowatt hour per kilogram or kilojoule per kilogram

3.9

test applicant

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

4 General Conditions for Test and Inspection

4.1 Selection of cassava granulator to be tested

Cassava granulator submitted for testing shall be sampled in accordance to 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 cassava granulator. 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 cassava granulator 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 performance of the machine, 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 cassava granulator for testing

The representative of the test applicant and testing agency shall check the cassava granulator 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 cassava granulator 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 cassava granulator 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

The input test material shall either be freshly harvested cassava tubers (within 2 days after harvest) for wet granulation or dried cassava chips (at most 14% MC wet basis) for dry granulation. These test materials shall be from commonly or locally grown cassava. The cassava tubers shall be mature (8 to 12 months from planting). The amount of test material to be supplied shall be sufficient for the required test trials, running-in, and laboratory tests. However, 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 adjustment

The cassava granulator 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.

6.2 Test Samples

Random representative test samples shall be collected by the testing agency from the test material for determination of moisture content and condition. Sampling procedure is shown in Annex C.

7 Performance Test

7.1 Operation of the cassava granulator

The cassava granulator shall be operated for sufficient duration with load at the test site by the official representative of the test applicant using the recommended setting of the manufacturer. 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, with duration of at least fifteen (15) minutes per trial, shall be adopted.

7.3 Sampling

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

7.4 Data Collection

7.4.1 Duration of test

The duration of loading/input time shall start at the feeding of the dried cassava chips or cassava tubers from the intake hopper and ends when there is no more dried cassava chips or cassava tubers in the hopper.

The duration of the total operating time shall start at the feeding of the dried cassava chips or cassava tubers from the intake hopper and ends after the last discharge of the cassava granules or granulated cassava at the product outlet.

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/Fuel consumption

7.4.3.1 Using electric motor as prime mover

Use a power meter to measure the voltage, current, and the total electric power requirement of the cassava granulator. 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 Using engine as prime mover

To get the amount of fuel consumed, the tank shall be filled to full capacity before the test. After the test, fill the tank with measured fuel to the same level before the test. When filling up the tank, careful attention shall be paid to keep the tank horizontal and not to leave empty space in the tank.

7.4.4 Speed of components

The speed of the rotating shafts of the major components of the cassava granulator shall be taken using a tachometer with and without load. For each data to be collected, there shall be a minimum of five (5) observations.

Requirements for each data to be taken shall conform to 7.4.2.2.

7.4.5 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 and sizes of the input and output products. The laboratory procedure to be followed in the analysis is given in Annex E while the data sheet is given in Annex F.

9 Presentation of results

Machine specifications and the result of the tests 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 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

11.6 Methods of test

Table 1 – Machine specifications

11.7 Conditions of the Machine

11.8 Description of the Machine

11.9 Results and Discussions

Table 2 – Field performance test data

11.10 Observations (include pictures)

11.11 Name, 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

	Equipment/Material	Quantity
A.1.1	Hand-held Tachometer	1
A.1.2	Stop Watch	2
A.1.3	Measuring Tape	1
A.1.4	Sound Level Meter	1
A.1.5	Weighing Scale Capacity: 100 kg Resolution: 0.1 kg	1
A.1.6	Clamp-on AC/DC Power Meter (for electric motors) Maximum: 1000 V	1
A.1.7	Graduated Cylinder (for engines) Capacity: 500 mL	1
A.1.8	Camera	1
A.1.9	Vernier Caliper Accuracy: 0.1mm	1

A.2 Laboratory test equipment and materials

	Equipment/Material	Quantity
A.2.1	Digital Weighing Scale Resolution: 0.01 g Capacity: 2500 g	1
A.2.2	Sieve Shaker	1
A.2.3	Sieves Screen US Sieve Mesh 5/16, 3/8, and 1/2	1
A.2.4	Laboratory oven	1
A.2.5	Desiccator with desiccants	1
A.2.6	Aluminum Moisture Cans	9
A.2.7	Sample Bags (Resealable bags)	20
A.2.8	Labeling Tags which include: Date of Test Cassava granulatoron Test Sample Source Variety Trial Number	20

Annex B
(informative)

Specifications of Cassava Granulator

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 : _____

Items to be inspected*

No.	ITEMS	Specification of the Manufacturer	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 prime mover		
B.2	Granulating 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	Type		
B.3.1.5	Rated power (kW)		
B.3.1.6	Rated speed (rpm)		
B.3.1.7	Electric service required (single phase or 3-phase)		
B.3.1.8	Voltage (V)		
B.3.1.9	Current (A)		
B.3.1.10	Frequency (Hz)		
B.3.1.12	Weight (kg)		
B.3.2	Engine		
B.3.2.1	Brand		
B.3.2.2	Make or manufacturer		
B.3.2.3	Model		

No.	ITEMS	Specification of the Manufacturer	Verification by the Testing Agency
B.3.2.4	Serial Number		
B.3.2.5	Type		
B.3.2.6	Rated Power (kW)		
B.3.2.7	Rated Speed (rpm)		
B.3.2.8	Displacement (cm ³)		
B.3.2.9	Cooling system		
B.3.2.10	Starting system		
B.3.2.11	Weight (kg)		
B.4	Hopper		
B.4.1	Material		
B.4.2	Thickness (mm)		
B.4.3	Height from the ground (mm)		
B.4.4	Location		
B.4.5	Means of attachment		
B.5	Granulating mechanism		
B.5.1	Type		
B.5.2	Material		
B.5.3	Dimensions, if applicable		
B.5.3.1	Diameter (mm)		
B.5.3.2	Thickness (mm)		
B.5.3.3	Length (mm)		
B.5.4	Other Specifications		
B.6	Product Outlet		
B.6.1	Material		
B.6.2	Thickness (mm)		
B.6.3	Height from the ground (mm)		
B.6.4	Location		
B.6.5	Means of attachment		
B.7	Safety Devices		
B.8	Special Features		

*The parameter will be checked upon availability

B.9 Illustration of transmission system and sieve arrangement

Annex C
(normative)

Sampling Procedures

C.1 Sampling procedures for test material input

The conditions of the dried commodity input, to be used in each test, such as the moisture content and the dimensions shall be taken using three (3) “representative samples,” which represent the different conditions of the dried agricultural commodity 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 product outlet

During each test trial, three (3) samples, each weighing at least 125 g shall be collected from the product outlet of the cassava granulator to be analyzed in the laboratory for the determination of the size of cassava granules or granulated cassava. The minimum amount of sample to be taken shall be twice as much as what is needed.

C.3 Handling of samples

All samples to be taken to the laboratory shall be placed in appropriate containers and properly labeled. If the sample is to be used for determining moisture content, it must be kept in dry and airtight containers. Care should be taken so as to prevent alterations of the conditions of the test samples.

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 the test materials				
D.1.1	Crop				
D.1.2	Source				
D.1.3	Variety				
D.1.4	Moisture content (%)				
D.2	Weight of input (kg)				
D.3	Input capacity (kg/h)				
D.4	Operating time (h)				
D.5	Granulating capacity (kg/h)				
D.6	Granulated products (kg)				
D.7	Granulating recovery (%)				
D.8	Speed of components (rpm)				
D.8.1	Prime Mover				
D.8.1.1	Without load				
D.8.1.2	With load				
D.8.2	Granulator shaft				
D.8.2.1	Without load				
D.8.2.2	With load				
D.9	Noise level [dB (A)]				
D.9.1	Feeder				
D.9.1.1	Without load				
D.9.1.2	With load				
D.9.2	Collector				
D.9.2.1	Without load				
D.9.2.2	With load				
D.10	Power requirement				
D.10.1	Power (kW)				
D.10.1.1	Without load				
D.10.1.2	With load				
D.10.2	Current (A)				
D.10.2.1	Without load				
D.10.2.2	With load				
D.10.3	Voltage (V)				
D.10.3.1	Without load				

No.	Items	Trial 1	Trial 2	Trial 3	Average
D.10.3.2	With load				
D.11	Fuel Consumption				
D.11.1	Fuel time (h)				
D.11.2	Fuel consumed (L)				
D.12	Specific Energy Consumption (kg/kW-h or kg/L)				

D.12 Observations:

D.12.1 Ease of loading

D.12.2 Ease of cleaning parts

D.12.3 Ease of adjusting and repair of parts

D.12.4 Ease of collecting output

D.12.5 Ease of transporting the machine

D.12.6 Failure or abnormalities that may be observed on the implement or its component parts during and after the operation.

D.12.7 Safety

D.12.8 Labor Requirements

D.12.9 Others

Annex E
(normative)

Laboratory Analysis

E.1 Determination of the size of the test material

The largest diameter and length of the obtained representative samples of the test material shall be measured using a Vernier caliper. The measurements obtained shall be recorded in Annex F.

E.2 Moisture content determination of the test material

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

E.3 Sieve Analysis

In each test trial, take three 100 g samples from product outlet. Place the samples in a testing sieve shaker with a series of sieve screens, then shake the samples. After shaking, remove the samples from each sieve screen then weigh and record. Calculate the percent cassava granules or granulated cassava retained on each sieve screen. Also compute for the coefficient of variation and fineness modulus.

Annex F
(informative)

Laboratory Analysis Data Sheet

Machine Tested : _____ Date Tested : _____
 Analyzed by : _____ Date Analyzed : _____

G.1 Dimension of the Input Product

Trial No.	Diameter, mm	Length, mm
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Average		

G.2 Moisture content (% wet basis) of the test material

Trial No.	Input test material		
	Initial Weight (g)	Final Weight (g)	%MC
1			
2			
3			
Average			

G.3 Sieve Analysis

US Sieve Mesh	Sieve opening (mm)	Weight of Material Retained			Percent of Material Retained		
		Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
1/2	12.5						
3/8	9.5						
5/16	8						
pan	-						
Total	-						

Annex G
(normative)

Formula Used During Calculations and Testing

G.1 Input Capacity

$$C_i = \frac{W_i}{T_i}$$

where:

C_i is the input capacity (kg/h)
 W_i is the weight of input material (kg)
 T_i is the input time (h)

G.2 Granulating Capacity

$$C_P = \frac{W_o}{T_o}$$

where:

C_P is the granulating capacity (kg/h)
 W_o is the weight of the output product (kg)
 T_o is the total operating time (h)

G.3 Granulating Recovery

$$GR = \frac{W_o}{W_i} \times 100\%$$

where:

GR is the granulating recovery (%)
 W_o is the weight of the output product (kg)
 W_i is the weight of input material (kg)

G.4 Granulating Efficiency

$$Eff = \frac{FP}{GR} \times 100\%$$

where:

Eff is the granulating efficiency (%)
 FP is the acceptable output product (%)
 GR is the granulating recovery (%)

G.5 Moisture Content

$$MC = \frac{W_{is} - W_{fs}}{W_{is}} \times 100\%$$

where:

MC is the moisture content (%)
 W_{is} is the initial weight of the sample (g)
 W_{fs} is the final weight of the sample (g)

G.6 Electric energy consumption

$$E_c = P_c \times T_o$$

Where:

E_c is the electrical energy consumption (kW-h/kg)
 P_c is the power consumed (kW)
 T_o is the total operating time (h)

G.7 Fuel consumption

$$F_c = \frac{F_v}{T_o}$$

where:

F_c is the fuel consumption (L/h)
 F_v is the volume of fuel consumed (L)
 T_o is the total operating time (h)

Bibliography

PNS/BAFS 29:2017 Part II, *Dried Cassava Chips and Granules for Feeds and Industrial Use*

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