

# **PHILIPPINE NATIONAL STANDARD**

PNS/BAFS PAES 250:2018  
ICS 65.060.99

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## **Agricultural Machinery- Multicrop Grater - Methods of Test**



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## **Foreword**

The Philippine National Standard (PNS) for Agricultural Machinery – Multicrop Grater – Methods of Test (PNS/BAFS PAES 250:2018) 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.

Included in the project is the development of PNS/PAES for Cassava Grater, however, during the series of technical reviews, instead of the development of a standard specific to cassava, the standard shall include in its scope other crops that uses a grating machine for size reduction.

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 fabrication and performance requirements for multicrop grater used in grating of fresh papaya, cassava, carrots, sweet potato, arrow root, and other crops. Specifically, it shall be used to:

- 1.1** verify the mechanisms, dimensions, materials and accessories of the multicrop grater 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 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 – Methods of Sampling*

PNS/BAFS PAES 249:2018, *Agricultural Machinery – Multicrop grater – Specifications*

## **3 Terms and Definitions**

For the purpose of this standard, the following terms and definitions shall apply:

### **3.1**

#### **fresh crop**

includes the edible parts of all crops prepared for grating

### **3.2**

#### **grating efficiency**

ratio between the amount of acceptable grated products and fresh crop input, expressed in percentage

### **3.3**

#### **grating loss**

total weight of the grated products collected at the different parts of the multicrop grater other than the product outlet, including the partially grated products

**3.4**

**grating recovery**

ratio between the total weight of grated products collected at the products outlet excluding the partially grated products to the total weight of fresh crop loaded in the hopper of the machine, expressed in percent

**3.5**

**hopper**

part of the machine where fresh crops are loaded

**3.6**

**multicrop grater**

machine that reduces the size of the fresh crop into grated products

**3.7**

**overall height**

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

**3.8**

**overall length**

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

**3.9**

**overall width**

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

**3.10**

**running-in period**

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

**3.11**

**specific energy consumption**

ratio of the electric consumption and the amount of input fresh crop, expressed in kilowatt hour per kilogram or kilojoule per kilogram

## **4 General Conditions for Test**

### **4.1 Selection of multicrop grater to be tested**

Multicrop grater 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 multicrop grater. 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 multicrop grater 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. 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 multicrop grater for testing**

The representative of the test applicant and testing agency shall check the multicrop grater 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 multicrop grater 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 multicrop grater 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 test materials to be used should be of same variety, preferably of uniform sizes, cleaned and prepared for grating.

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 has the option not to pursue the test concurred by the representative of the test applicant.

### **5.4 Running-in and preliminary adjustments**

The multicrop grater 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**

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 multicrop grater**

The multicrop grater 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 fresh crops from the intake hopper and ends when there are no fresh crops in the hopper.

The duration of the total operating time shall start at the feeding of the fresh crops from the intake hopper and ends after the last discharge of the grated product at the product outlet.

The duration of output time shall start from the first discharge of the grated product at the product outlet and shall end after the last discharge of grated product.

### **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 (feeder and bagger). 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 the 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 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 multicrop grater. There shall be three (3) sets of data with a minimum of five (5) observations per set taken with and without load.



#### **7.4.4 Speed of components**

The speed of the rotating shafts of the major components of the multicrop grater 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 Clause 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 size and moisture content of the fresh crop. The laboratory procedures to be followed in the analysis is given in Annex E and the data sheet is given in Annex F.

### **9 Preparation of results**

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 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

**11.5** Purpose and scope of test

**11.6** Methods of test

**11.7** Conditions of the Machine

**11.8** Description of the Machine

**11.9** Results and Discussions

**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
<b>A.1.2</b> Tachometer	1
<b>A.1.3</b> Timers Accuracy: 0.1 sec	2
<b>A.1.4</b> Measuring Tape (at least 3m)	1
<b>A.1.5</b> Noise Level Meter	1
<b>A.1.6</b> Weighing Scale Capacity: 100 kg Resolution: 0.1 kg	1
<b>A.1.7</b> Clamp-on AC/DC Power Meter (for electric motors) Maximum: 1000 V	1
<b>A.1.8</b> Camera	1
<b>A.1.9</b> Vernier caliper	1

**A.2 Laboratory test equipment and materials**

Equipment/Material	Quantity
<b>A.2.1</b> Digital Weighing Scale Sensitivity: 0.01 g Capacity: 2500 g	1
<b>A.2.2</b> Vernier Caliper	
<b>A.2.3</b> Laboratory oven	1
<b>A.2.4</b> Desiccators with desiccants	1
<b>A.2.5</b> Aluminum Moisture Cans	9
<b>A.2.6</b> Basin	2
<b>A.2.7</b> Sample bags (resealable bags)	20
<b>A.2.8</b> Laboratory Sieves	5
<b>A.2.9</b> Labeling Tags which include: Date of Test Multicrop grater on Test Sample Source Variety Trial Number	20

**Annex B**  
(informative)

**Specifications of Multicrop Grater**

Name of Applicant : \_\_\_\_\_  
 Address : \_\_\_\_\_  
 Tel. No. : \_\_\_\_\_

Name of Manufacturer : \_\_\_\_\_  
 Address : \_\_\_\_\_  
 Tel. No. : \_\_\_\_\_

**GENERAL INFORMATION**

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

No.	Items*	Specification of the Manufacturer	Verification by the Testing Agency
<b>B.1</b>	<b>Main structure</b>		
<b>B.1.1</b>	Overall dimensions (mm)		
<b>B.1.1.1</b>	Length (mm)		
<b>B.1.1.2</b>	Width (mm)		
<b>B.1.1.3</b>	Height (mm)		
<b>B.1.2</b>	Weight (kg), if applicable without the engine		
<b>B.2</b>	Capacity (kg/h)		
<b>B.2.1</b>	<b>Rated Input Capacity (kg/h)</b>		
<b>B.2.2</b>	<b>Rated Output Capacity (kg/h)</b>		
<b>B.3</b>	<b>Prime Mover (Electric Motor)</b>		
<b>B.3.1</b>	Brand		
<b>B.3.2</b>	Model		
<b>B.3.3</b>	Serial Number		
<b>B.3.4</b>	Type		

\*The parameter will be checked upon availability.

No.	Items*	Specification of the Manufacturer	Verification by the Testing Agency
B.3.5	Rated power (kW)		
B.3.6	Rated speed (rpm)		
B.3.7	Electric service required (single phase or 3-phase)		
B.3.8	Voltage (V)		
B.3.9	Current (A)		
B.3.10	Frequency (Hz)		
B.3.11	Weight (kg)		
<b>B.4</b>	<b>Hopper</b>		
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>B.5</b>	<b>Product outlet</b>		
B.5.1	Material		
B.5.2	Thickness (mm)		
B.5.3	Height from the ground (mm)		
B.5.4	Location		
B.5.5	Means of attachment		
<b>B.6</b>	<b>Grating Chamber</b>		
B.6.1	Type		
B.6.2	Dimension, L x W x T (mm)		
B.6.3	Means of attachment		
B.6.4	Material		
<b>B.7</b>	<b>Safety devices</b>		
<b>B.8</b>	<b>Special features</b>		

\*The parameter will be checked upon availability.

#### B.11 Illustration of transmission system

**Annex C**  
(normative)

**Sampling Procedures**

**C.1 Sampling procedures for the test material**

The conditions of the fresh crop 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 100 g shall be collected from the product outlet of the multicrop grater to be analyzed in the laboratory for the determination of the moisture content and grating efficiency. 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.	Item	Data
<b>D.1</b>	<b>Conditions of the test materials</b>	
D.1.1	Crop	
D.1.2	Source	
D.1.2	Variety	
D.1.3	Moisture content (%)	

No.	Items	Trial 1	Trial 2	Trial 3	Average
<b>D.2</b>	<b>Weight of input (kg)</b>				
<b>D.3</b>	<b>Input capacity (kg/h)</b>				
<b>D.4</b>	<b>Grated products (kg)</b>				
<b>D.5</b>	<b>Grating recovery (%)</b>				
<b>D.6</b>	<b>Output capacity (kg/h)</b>				
<b>D.7</b>	<b>Grating Capacity (kg/h)</b>				
<b>D.8</b>	Total Operating time (h)				
<b>D.9</b>	<b>Speed of components (rpm)</b>				
D.9.1	Prime Mover				
D.9.1.1	Without load				
D.9.1.2	With load				
D.9.2	Grater shaft				
D.9.2.1	Without load				
D.9.2.2	With load				
<b>D.10</b>	<b>Noise level [dB (A)]</b>				
D.10.1	Operator/s				
D.10.1.1	Without load				
D.10.1.2	With load				
D.10.2	Collector/s				
D.10.2.1	Without load				
D.10.2.2	With load				

No.	Items	Trial 1	Trial 2	Trial 3	Average
<b>D.11</b>	<b>Power requirement</b>				
<b>D.11.1</b>	Power (kW)				
<b>D.11.1.1</b>	Without load				
<b>D.11.1.2</b>	With load				
<b>D.11.2</b>	Current (A)				
<b>D.11.2.1</b>	Without load				
<b>D.11.2.2</b>	With load				
<b>D.11.3</b>	Voltage (V) accommodation				
<b>D.11.3.1</b>	Without load				
<b>D.11.3.2</b>	With load				
<b>D.12</b>	<b>Specific Energy Consumption (kW-h/kg)</b>				

**D.13 Other Observations**

**D.13.1** Ease of loading

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**D.13.2** Ease of cleaning parts

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**D.13.3** Ease of adjusting and repair of parts

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**D.13.4** Ease of collecting output

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**D.13.5** Ease of transporting the machine

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**D.13.6** Failure or abnormalities that may be observed on the implement or its component parts during and after the operation.

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**D.13.7** Safety

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**D.13.8 Labor Requirements**

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**D.13.9 Others**

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**Annex E**  
(normative)

**Laboratory Analysis**

**E.1 Determination of the size of the fresh crop**

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 fresh crop input**

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 Determination of grating efficiency**

**E.3.1** At least three (3) samples of 100 g each shall be used for the determination of the grating efficiency using the wet sieve analysis:

**E.3.1.1** Place the samples on the sieve with the largest nominal diameter.

**E.3.1.2** Carefully shake the sieve with the samples in a horizontal circular motion while the sieve is partially submerged in a basin of water.

**E.3.1.3** For the succeeding sieve sizes, the basin of water with the samples shall be poured into the next sieve for another wet sieving.

**E.3.1.4** Let the wet product that retained in the sieve drip-dry for at least 5 minutes at room temperature to remove the water introduced by the submerging procedure.

**E.3.2** After drip drying, weigh the samples that retained in each sieve and then compute for the average size. Products that are ten (10) times larger than the average size shall be considered partially grated.

**E.3.3** Calculate the grating efficiency using the equation in Annex G.

**Annex F**  
(informative)

**Laboratory Analysis Data Sheet**

Machine Tested : \_\_\_\_\_ Date Tested : \_\_\_\_\_

Analyzed by : \_\_\_\_\_ Date Analyzed : \_\_\_\_\_

**F.1 Dimension of the Input**

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

**F.2 Moisture content (% wet basis) of the Fresh Crop**

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

**F.3 Grating Efficiency Determination**

US Sieve Mesh Size	Weight of Material Retained			Percent of Material Retained		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
pan						
Total						

Average Size: \_\_\_\_\_

**Annex G**  
(normative)

**Formula Used During Calculations and Testing**

**G.1 Moisture content**

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

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.2.1 Grating**

$$G_c = \frac{W_{ic}}{T}$$

where:

$G_c$	is the grating capacity (kg/h)
$W_{ic}$	is the weight of fresh crop input (kg)
T	is the total operating time (h)

**G.2.2 Input**

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

where:

$C_i$	is the input capacity (kg/h)
$W_{ic}$	is the weight of fresh crop input (kg)
$T_i$	is the input time (h)

### G.2.3 Output

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

where:

$C_o$	is the output capacity (kg/h)
$W_{gc}$	is the weight of grated products (kg)
$T_o$	is the output time (h)

### G.3 Grating recovery

$$G_r = \frac{W_{gc}}{W_{ic}} \times 100$$

where:

$G_r$	is the grating recovery (%)
$W_{ic}$	is the weight of fresh crop input (kg)
$W_{gc}$	is the weight of grated products (kg)

### G.4 Grating loss

$$L_t = 100 - G_r$$

where:

$L_t$	is the total grating loss (%)
$G_r$	is the grating recovery (%)

### G.5 Grating Efficiency

$$G_e = \left(1 - \frac{W_{pgc}}{W_{ic}}\right) \times 100$$

where:

$G_e$	is the grating efficiency (%)
$W_{pgc}$	is the weight of partially grated products (kg)
$W_{ic}$	is the weight of fresh crop input (kg)

**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 Specific Energy Consumption**

$$SEC = \frac{E_c \times T}{W_{ic}}$$

where:

- SEC is the specific energy consumption (kW-h/kg or kJ/kg)
- $E_c$  is the electric power consumed (kW)
- T is the total operating time (h)
- $W_{ic}$  is the weight of fresh crop input (kg)

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