PHILIPPINE NATIONAL STANDARD

PNS/BAFS 252:2021
ICS 65.0660.99

Corn Mill – Methods of Test

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Foreword

In 2020, the Philippine Center for Postharvest Development and Mechanization (PHilMech) requested the Bureau of Agriculture and Fisheries Standards (BAFS) to revisit PNS on Corn mill – Specifications (251:2018) and Methods of Test (252:2018) due to challenges in complying with the performance criteria stipulated in the standard. A Technical Working Group (TWG) was created under Special Order No. 817, series of 2021 (Addendum to Special Order No. 81 series of 2021 entitled, “Creation of Technical Working Groups (TWG) for the Development of Philippine National Standard (PNS) for Agriculture and Fishery Products, Machinery, and Equipment”), which is composed of representatives from government agencies, academe, and private sector. The final draft standards were discussed and reviewed through a stakeholder consultation and series of TWG meetings conducted via online platforms before it was endorsed to the DA Secretary for approval.

This PNS/BAFS edition includes the following significant changes compared to the previous PNS/BAFS 252:2018:

1. Addition of definition for "specific energy consumption" and its formula in Annex G;
2. Addition of provision for the "role of test engineer"; and
3. Inclusion of procedure and table for measuring "bulk density" and "grain dimension" in Annexes E and F.

This Standard cancel and replaces PNS/BAFS 252:2018 which has been technically amended. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2.

Contents

1 Scope

This standard specifies the corn mill methods of test and inspection for the production of corn grits for food using the dry milling process. Specifically, it shall be used to:

1.1 verify the mechanism, main dimensions, materials of construction, accessories of the corn mill, 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;

1.4 analyze the main product and by-products of corn milling through laboratory analysis; and

1.5 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 contents constitute 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.

Bureau of Agriculture and Fisheries Standards (BAFS) – Department of Agriculture (DA). (2018). Agricultural machinery – Corn mill – Specifications (PNS/BAFS PAES 251:2018). http://www.bafs.da.gov.ph/bafs_admin/admin_page/pns_file/PNS%20BAFS%20PAES%20251_2018%20-%20Corn%20Mill-%20Specification.pdf

International Organization for Standardization (ISO). (1980). Maize – Determination of moisture content (on milled kernels and whole kernels) (ISO 6540:1980).

Philippine Agricultural Engineering Standards (PAES) Task Force (2000). Agricultural machinery – Methods of sampling (PAES 103:2000). https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PAES-103-2000-Agricultural-Machinery-Method-of-Sampling.pdf

3 Terms and Definitions

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

3.1
aspirator
blower
cleaner that uses air to separate lower density material from the corn kernels/corn grits such as floured corn, bran, and other foreign matters

3.2
bulk density
ratio of the weight (kg) of the corn kernels to its volume, expressed in kilogram per cubic meter (kg/m^3)

3.3
corn grits
milled corn grains where the outer covering (pericarp), germ (embryo), and tip cap have been removed leaving only the endosperm that passed through different sieve sizes

3.4
corn kernel
whole grain of shelled corn

3.5
corn mill
machine that removes the pericarp, crushes the kernel, polishes the grits, and sorts the grits into different sizes

3.6
degermed corn kernels
cracked corn kernels where the germ, tip cap, and pericarp have been removed

3.7
degermer efficiency
ratio of the weight of degermed corn kernels to the initial weight of the degermer output sample, expressed in percent (%)

3.8
foreign matter
impurity
any matter which is not corn kernels/corn grits such as corn cobs, sand, gravel, dirt, pebbles, stones, lumps of earth, clay, mud, weeds, and other crop seeds

3.9
grinding assembly
part of the corn mill used to grind the degermed corn kernels into corn grits

3.10
grit size separation assembly
sifter
part of the corn mill permitting smaller particles to fall through the openings by means of oscillating or rotating screen, wire mesh, or perforated metal sheet

3.11
input capacity
weight of shelled corn kernels loaded to the hopper/intake pit per unit time, expressed in kilogram per hour (kg/h)

3.12
laboratory sieve shaker
equipment with shaking motion used to separate particles by passing them through a series of standard sieves

3.13
milling capacity
quantity of corn kernels that the corn mill can process to produce corn grits of desired size per unit of time, expressed in kilograms per hour (kg/h)

3.14
moisture content (wet basis)
amount of moisture in the corn kernels expressed as percent (%) of the total weight of the sample

3.15
output capacity
total weight of the main products collected per unit time, expressed in kilograms per hour (kg/h)

3.16
overall height
distance between the horizontal supporting plane surface and the horizontal plane touching the uppermost part of the corn mill

3.17
overall length
distance between the vertical planes perpendicular to the median plane of the machine, each plane touching the front and rear extremities of the machine

3.18
overall width
distance between the vertical planes parallel to the median plane of the corn mill, each plane touching the outermost point of the corn mill on its left and right sides

3.19
pre-cleaner
auxiliary device of the corn mill that removes foreign matter

3.20
prime mover
electric motor or engine used to run the corn mill

3.21
purity
ratio of the weight of clean corn kernels, to the total weight of unclean corn kernels, expressed in percent (%)

3.22
specific energy consumption
total energy or fuel consumed over total weight of corn kernel input, expressed in kilowatt-hour per kilogram (kW-h/kg) or liters per kilogram (L/kg)

3.21
test applicant
manufacturer, direct importer, technology generator or any legitimate distributor, dealer, or end-user of the machine that officially applied for a machine test

4 General Conditions for Test

4.1 Selection of corn mill to be tested

Corn mill submitted for testing shall be sampled in accordance to PAES 103:2000 (Agricultural machinery – Methods of sampling) 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 corn mill. 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 be skilled and be able to operate, demonstrate, adjust, repair as the case may be, and decide on matters related to the operation of the corn mill.

4.4 Role of test engineer

The certified test engineer shall lead the conduct of the performance testing in accordance with the provisions of this standard. Furthermore, the test engineer shall oversee other relevant activities prior to and after the conduct of the testing.

4.5 Test site conditions

The corn mill 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.

4.6 Suspension/Termination of test

If during the test run, the machine stops due to breakdown or malfunction that affects the machine’s performance, the test may be suspended. If the machine is unable to continue operation, the test shall be terminated.

5 Test Preparation

5.1 Preparation of the corn mill for testing

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

5.2 Test instruments and other materials

The suggested list of minimum field and laboratory test equipment and materials needed to carry out the corn mill test is shown in Annex A (Minimum list of field and laboratory test equipment and materials). These instruments shall be calibrated regularly. These instruments shall be physically checked for operation and shall be cleaned before and after each test. 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 corn kernels to be used shall be from commonly or locally grown white corn flint variety with at most 14% uniform moisture content (MC) (wet basis) and at least 95% purity. The amount of test material to be supplied shall be sufficient for at least one hour of milling operation. The excess amount shall be used for laboratory tests and running-in prior to the actual conduct of test trials. The test samples to be used for the running-in and in each test trial shall be prepared in such a way that they shall have identical characteristics in terms of moisture content, purity, and variety. If the test materials do not conform to the recommended quantity and characteristics, the test engineer shall not pursue the test.

5.4 Running-in and preliminary adjustments

The corn mill 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 (Specifications of corn mill) 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 (Sampling procedures).

7 Performance Test

7.1 Operation of the corn mill

The corn mill shall be operated for sufficient duration with load at the test site by the official representative of the test applicant using the manufacturer's recommended setting. 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 test trials, with duration of at least 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 (Sampling procedures).

7.4 Data collection

7.4.1 Duration of test

The input time shall start at the feeding of the corn kernels to the intake hopper/intake pit and ends when there is no more corn kernel in the hopper/intake pit.
The operating time shall start at the feeding of the corn kernels to the intake hopper/intake pit and ends after the last discharge of the main products at the main outlet/s.

The output time shall start from the first discharge of the corn grits at the main outlet/s and shall end after the last discharge of corn grits.

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 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 corn mill. There shall be three sets of data with a minimum of five observations per set taken with and without load.

7.4.3.2 Using engine as prime mover

To get the amount of fuel consumed, refill method shall be used. The tank shall be filled to full capacity or to a certain level before the test. After each test, the tank shall be filled with measured fuel to the same level before the test. When filling up the fuel tank, extra attention shall be paid to keep it horizontal and to ensure that empty space is not left inside.

7.4.4 Speed of components

The speed of the rotating shafts of the major components of the corn mill with and without load shall be taken using a tachometer.

Requirements for each data to be taken shall conform to Clause 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 (Performance test data sheet). Observations to be taken during the performance test should be recorded in this sheet.

8 Laboratory Analysis

This is carried out to analyze the kernel samples taken during the performance test.

8.1 Laboratory analysis shall be made to determine the degermer efficiency, losses, and percentage of corn grits of different sizes from each outlet. The laboratory procedures to be followed in the analysis are given in Annex E (Laboratory analysis) and the data sheet to be used is given in Annex F (Laboratory analysis data sheet).

8.2 The percentage of corn grits other than corn grits sizes no. 10 to 18 from each outlet shall be determined using a laboratory sieve shaker.

9 Presentation 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 (Specifications of corn mill) and D (Performance test data sheet). 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 formula to be used during calculations and testing are given in Annex G (Formulas used during calculations and testing).

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 Observations

11.6 Purpose and Scope of Test

11.7 Methods of Test

11.8 Description of the Machine

11.9 Specifications

11.10 Results

11.11 Observations (include pictures)

11.12 Names, Signatures, and Designation of Test Engineers

Annex A
(Informative)

Table A.1 Minimum list of field and laboratory test equipment and materials

A.1	Equipment	Quantity
A.1.1	**Performance Test**	
A.1.1.1	Grain Moisture Meter (duly calibrated using the standard method)	1
A.1.1.2	Tachometer (contact type or photo electric type	1
A.1.1.3	Timers Maximum Resolution: 0.1 sec	2
A.1.1.4	Measuring Tape (minimum: 5m)	1
A.1.1.5	Sound Level Meter Range: 30 to 130 dB(A)	1
A.1.1.6	Weighing Scale Minimum Capacity: 100 kg; Maximum Scale divisions: 0.2 kg	1
A.1.1.7	Graduated Cylinder (for engines) (500- mL capacity) or Clamp-on type Power Meter (for electric motors)	1
A.1.1.8	Digital Camera	1
A.1.2	**Laboratory Test**	1
A.1.2.1	Analytical balance (Minimum capacity of 1 kg, sensitivity of 0.01)	1
A.1.2.2	Magnifying Lens	1
A.1.2.3	Grain Sampler/Divider	1
A.1.2.4	US Standard Sieves (nos. 10, 12. 14. 16. 18, 20, 25 and pan)	
A.1.2.5	Laboratory Sieve Shaker	1
A.1.2.6	Grain Caliper	1
A.1.2.7	Bulk density tester/meter	1
A.1.2.8	Air oven	1
A.1.2.9	Aluminum moisture cans	1
A.1.2.10	Desiccator	1
A.1.2.11	Laboratory Aspirator	1
A.2	**Materials**	
A.2.1	Sample Bags	
A.2.2	Labeling Tags which include:	
A.2.2.1	Date of test	
A.2.2.2	Machine on test	
A.2.2.3	Sample source	
A.2.2.4	Variety	
A.2.2.5	Trial number	

Annex B
(Informative)

Specifications of corn mill

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	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, without engine (kg), if applicable		
B.2	**Prime mover**		
B.2.1	Electric motor		
B.2.1.1	Brand		
B.2.1.2	Type		
B.2.1.3	Make or manufacturer		
B.2.1.4	Serial number		
B.2.1.5	Rated power (kW)		
B.2.1.6	Rated speed (rpm)		
B.2.1.7	Phase		
B.2.1.8	Voltage (V)		
B.2.1.9	Current (A)		
B.2.1.10	Frequency (Hz)		
B.2.2	Engine		
B.2.2.1	Brand		
B.2.2.2	Model		
B.2.2.3	Make or manufacturer		
B.2.2.4	Type		
B.2.2.5	Serial number		

No.	Items	Manufacturer's Specification	Verification by the Testing agency
B.2.2.6	Rated power (kW)		
B.2.2.7	Rated speed (rpm)		
B.2.2.8	Displacement (cm^3)		
B.2.2.9	Cooling system		
B.2.2.10	Starting system		
B.3	**Power transmission system**		
B.4	**Intake Hopper/Loading Pit**		
B.4.1	Holding capacity (kg)		
B.4.2	Materials of construction		
B.4.3	Features		
B.5	**Pre-cleaner**		
B.5.1	Size (L x D), mm		
B.5.2	Materials of construction		
B.6	**Degermer**		
B.6.1	Type		
B.6.2	Size (L x D), mm		
B.6.3	Materials of construction		
B.7	**Elevator(s)**		
B.7.1	Type		
B.7.2	No. of units		
B.7.3	Size of buckets		
B.8	**Grinding Assembly**		
B.8.1	Type		
B.8.2	Dimensions, mm		
B.8.3	No. of units		
B.8.4	Materials of construction		
B.8.5	Other features		
B.9	**Grit size separation assembly**		
B.9.1	Type		
B.9.2	Dimensions, mm		
B.9.3	No. of screens		
B.9.4	Size of perforations, mm		
B.9.5	Length of stroke per RPM, mm/RPM		
B.9.6	Materials of construction		
B.10	**Type of cleaning device**		
B.11	**Safety devices**		
B.12	**Special features**		

*if applicable

B.12 Corn milling process flow diagram

Annex C
(Normative)

Sampling procedures

C.1 Sampling procedures for the corn kernel input

The crop conditions such as purity, bulk density, kernel dimensions and moisture content of corn kernel to be used in each test trial shall be taken using “representative samples”, each weighing at least three kg. This is done by taking samples, each at the top, middle, and bottom of the pile. Samples representing the materials for each test trial shall be placed in appropriate containers for laboratory analysis.

C.2 Sampling from different outlets

During each test trial, three samples each shall be collected from the outlets of the different components (degermer, grinder, sifter, aspirator etc.) of the corn mill to be analyzed in the laboratory. The minimum amount of sample to be taken shall be twice as much as what is needed for a particular analysis. The excess sample shall be used for reference purposes or for an eventual second check in case of review.

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 Test Sample				
D.1.1	Variety				
D.1.2	Source				
D.1.3	Moisture content (%)				
D.1.4	Bulk density (kg/m^3)				
D.1.5	Purity				
D.1.6	Kernel Dimensions				
D.1.6.1	Length				
D.1.6.2	Width				
D.1.6.3	Thickness				
D.2	Weight of input (kg)				
D.3	Weight of main products (kg)				
D.3.1	Grit #10				
D.3.2	Grit #12				
D.3.3	Grit #14				
D.3.4	Grit #16				
D.3.5	Grit #18				
D.4	Weight of by-products (kg)				
D.4.1	Floured corn (“tiktik”) and fine grits (grit 20 and 24)				
D.4.2	Bran (“tahop”)				
D.5	Loading time (h)				
D.6	Input capacity (kg/h)				
D.7	Output capacity (kg/h)				
D.8	Output time (h)				
D.9	Total operating time (h)				
D.10	Milling capacity (kg/h)				
D.11	Total milling recovery				
D.11.1	Main product recovery (%)				
D.11.2	By-product recovery (%)				
D.11	**Speed of components (rpm)**				
D.11.1	Prime mover				
D.11.1.1	Without load				
D.11.1.2	With load				
D.11.2	Degermer shaft				

No.	ITEMS	Trial 1	Trial 2	Trial 3	Average
D.11.2.1	Without load				
D.11.2.2	With load				
D.11.3	Aspirator/blower shaft				
D.11.3.1	Without load				
D.11.3.2	With load				
D.11.4	Grinder shaft(s)				
D.11.4.1	Without load				
D.11.4.2	With load				
D.11.5	Oscillating/rotary screen shaft				
D.11.5.1	Without load				
D.11.5.2	With load				
D.12	Noise level [dB(A)]				
D.12.1	Without load				
D.12.2	With load				
D.13	Power consumption				
D.13.1	Power (kW)				
D.13.1.1	Without load				
D.13.1.2	With load				
D.13.2	Current (A)				
D.13.2.1	Without load				
D.13.2.2	With load				
D.13.3	Voltage (V)				
D.13.3.1	Without load				
D.13.3.2	With load				
D.14	Fuel consumed (L)				
D.15	Fuel consumption rate (L/h)				
D.16	Specific Energy Consumption (kW-h/kg or L/kg/)				

D.16 Observations:

D.16.1 Ease of loading

_____
_____
_____

D.16.2 Ease of cleaning parts

_____
_____
_____

D.16.3 Ease of adjustments

_____
_____
_____

D.16.4 Ease of collecting output

_____
_____
_____

D.16.5 Safety

_____
_____
_____

D.16.6 Labor requirements

_____
_____
_____

D.16.7 Failure or abnormalities that may be observed on the corn mill or its component parts during and after the milling operation.

_____
_____
_____

D.16.8 Others

_____
_____
_____

Annex E
(Normative)

Laboratory analysis

E.1 Purity determination

Take three 500 g samples from the “representative samples” of the input. Clean the corn kernels to remove the impurities. The clean corn kernel shall be weighed and recorded.

E.2 Moisture content

This shall be taken using a calibrated moisture meter or by oven method. Five samples shall be taken for moisture content determination using a calibrated moisture meter. Using oven method based on ISO 6540:1980, three samples of not less than 100 g each is drawn from the bulk corn kernel sample. The mean value determined from the 100g samples shall be taken as the moisture content of the corn kernels.

E.3 Measurement of Corn Kernel Input Dimensions

E.3.1 Randomly take at least 10 pieces of corn kernels from the representative samples collected from the test material.

E.3.2 For each sample, measure the length, width, and thickness using a grain caliper. Record the measurement to the nearest 0.01 mm.

E.4 Determination of Bulk Density of Corn Kernel Input

Bulk density of kernel samples shall be measured using a calibrated bulk density tester/meter. There shall be at least three trials conducted.

E.5 Analysis of output to determine the degermer efficiency

Three 100g samples shall be taken from the degermer output samples. These samples shall be analyzed to determine the percent degermed, undegermed and impurities.

E.6 Analysis of product outlet

In each test trial, take three 100g samples from each main product outlet. Using laboratory sieve shaker with standard sieves, determine the percent of corn grit sizes present in the output from different main product outlets.

Annex F
(Informative)

Laboratory analysis data sheet

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

F.1 Purity Determination (500 g sample)

Item	Trial 1	Trial 2	Trial 3	Average
A. Cleaned sample (g)				
B. Purity (%)				

F.2 Moisture Content Determination

F.2.1 Using calibrated moisture meter

Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	Average

F.2.2 Oven Method (100 g sample)

Item	Trial 1	Trial 2	Trial 3	Average
A. Initial weight of sample (g)				
B. Weight of can (g)				
C. Final weight of sample (g)				
D. Moisture Content (%)				

F.3 Measurement of Corn Kernel Input Dimensions

Sample no.	Length, mm	Width, mm	Thickness, mm
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Average, mm			

F.4 Determination of Bulk Density of Corn Kernel Input

Sample no.	Bulk density, kg/m^3
1	
2	
3	
Average	

F.5 Analysis of output from degermer (100 g sample)

Item	Trial 1	Trial 2	Trial 3	Ave
A. Initial weight of sample (g)				
B. Weight of degermed corn kernels (g)				
C. Weight of undegermed corn kernels (g)				
D. Weight of impurities (g) E. Degermer efficiency (%)				

F.6 Analysis of main products (using laboratory sieve shaker) (100 g sample)

Item	Weight, g				Percentage Weight (%)
	Trial 1	Trial 2	Trial 3	Average	
A. Grit no. 10 outlet					
A.1 corn grits no. 10					
A.2 corn grits no. 12					
A.3 corn grits no. 14					
A.4 corn grits no. 16					
A.5 corn grits no. 18					
A.6 by-products					
B. Grit no. 12 outlet					
B.1 corn grits no. 10					
B.2 corn grits no. 12					
B.3 corn grits no. 14					
B.4 corn grits no. 16					
B.5 corn grits no. 18					
B.6 by-products					
C. Grit no. 14 outlet					
C.1 corn grits no. 10					
C.2 corn grits no. 12					
C.3 corn grits no. 14					
C.4 corn grits no. 16					
C.5 corn grits no. 18					
C.6 by-products					
D. Grits no. 16 outlet					
D.1 corn grits no. 10					
D.2 corn grits no. 12					
D.3 corn grits no. 14					
D.4 corn grits no. 16					

Item	Weight, g				Percentage Weight (%)
	Trial 1	Trial 2	Trial 3	Average	
D.5 corn grits no. 18					
D.6 by-products					
E. Grits no. 18 outlet					
E.1 corn grits no. 10					
E.2 corn grits no. 12					
E.3 corn grits no. 14					
E.4 corn grits no. 16					
E.5 corn grits no. 18					
E.6 by-products					

Annex G
(Normative)

Formulas used during calculations and testing

G.1 Wet-Basis Moisture Content

$$MC, \%w.b. = \frac{M_o - M_F}{M_o}\ x\ 100$$

where:

MC is the moisture content of sample (%)
M_o is the initial weight of the sample (g)
M_F is the weight of the dried sample (g)

G.2 Purity

$$P = \frac{M_c}{M_u}\ x\ 100$$

where:

P is the purity (%)
M_c is the weight of cleaned sample (g)
M_u is the weight of uncleaned sample (g)

G.3 Input capacity

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

where:

C_i is the input capacity (kg/h)
W_i is the weight of corn kernel input (kg)
T_I is the input time (h)

G.4 Output capacity

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

where:

C_o is the output capacity (kg/h)
W_o is the weight of main product (kg)
T_o is the output time (h)

G.5 Milling capacity

$$C_m = \frac{W_i}{T}$$

where:

C_m is the milling capacity (kg/h)
W_i is the weight of input corn kernels (kg)
T is the total operating time (h)

G.6 Main product recovery

$$R_m = \frac{W_o}{W_i}\ x\ 100$$

where:

R_m is the main product recovery (%)
W_o is the weight of main product (kg)
W_i is the weight of input corn kernels (kg)

G.7 By-product recovery

$$R_b = \frac{W_b}{W_i} x\ 100$$

where:

R_b is the by-product recovery (%)
W_b is the weight of by-product (kg)
W_i is the weight of input corn kernels (kg)

G.8 Degermer Efficiency

$$E_d = \frac{W_d}{W_{do}} x\ 100$$

where:

E_d is degermer efficiency (%)
W_d is the weight of degermed corn kernels (kg)
W_{do} is the initial weight of degermer output sample (kg)

G.9 Losses

$$L = 100\% - (R_m + R_b)$$

where:

L is the losses (%)
R_m is main product recovery (%)
R_b is by-product recovery (%)

G.10 Fuel or Electric energy consumption

G.10.1 Fuel consumption rate

$$F_{cr} = \frac{F_v}{T}$$

where:

F_{cr} is the fuel consumption rate (L/h)
F_v is the volume of fuel consumed (L)
T is the total operating time (h)

G.10.2 Electric energy consumption

$$E_c = P_c \; x \; T$$

where:

E_c is the electric energy consumption (kW-h)
P_c is the amount of power consumed (kW)
T is the total operating time (h)

G.11 Specific energy consumption

G.11.1 Based on fuel consumption rate

$$E_{sc} = \frac{F_v}{W_i}$$

where:

E_{sc} is the specific energy consumption (L/kg)
F_v is the volume of fuel consumed (L)
W_i is the weight of input corn kernels (kg)

G.11.2 Based on electric energy consumption

$$E_{SC} = \frac{E_c}{W_i}$$

where:

E_{sc} is the specific energy consumption (L/kg)
E_c is the electric energy consumption (kW-h)

Bibliography

Bureau of Agriculture and Fisheries Standards (BAFS)- Department of Agriculture. (2021). Corn mill – Specifications (PNS/BAFS 251:2021)

Gragasin, M., & Martinez, R. (2015). Development of corn mill for village-level of operation. Asian Journal of Applied Sciences 3(6), 897-902. https://www.ajouronline.com/index.php/AJAS/article/view/3446

International Organization for Standardization (ISO). (1980). Maize – Determination of moisture content (on milled kernels and whole kernels) (ISO 6540:1980).

National Food Authority (2002). Primer on Philippine grains standardization program. https://nfa.gov.ph/images/files/archive/pgspnew.pdf

Philippine Agricultural Engineering Standards (PAES) Task Force. (2000). Agricultural machinery – Methods of sampling (PAES 103:2000). https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PAES-103-2000-Agricultural-Machinery-Method-of-Sampling.pdf

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