

PHILIPPINE NATIONAL STANDARD

**PNS/BAFS PAES 251:2018
ICS 65.060.99**

Agricultural Machinery – Corn Mill – Specifications



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PNS/BAFS PAES 251:2018

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Foreword

The Philippine National Standard (PNS) for Agricultural Machinery – Corn Mill – Specifications (PNS/BAFS PAES 251:2018) has been prepared by the Technical Working Group (TWG) for Silo and Corn Mill as per approved Department of Agriculture Special Order (SO) No. 238 Series of 2017 and SO No. 554 Series of 2018.

This Standard cancels and replaces the provisions recommended by PAES 210:2000 Agricultural Machinery – Corn Mill – Specifications.

This edition includes the following significant changes compared to the previous edition:

- Harmonization of the definitions of similar terms with PNS/BAFS 15;
- Addition of “tip cap” as one of the by-products in the terms and definitions
- Addition of Figures 1 and 2
- Revision of term “degerminator” to “degermer”;
- Addition of “Classifications” clause;
- Revision of “Materials of Construction” to “Fabrication Requirements” and modification in the provision under it
- Addition of performance requirement that milling capacity shall meet manufacturer’s specification;
- Deletion of performance requirement of “main product recovery, percent minimum of the product input” and “grits of other sizes, percent, maximum”;
- Modification of maximum allowable noise level to 100 db(A)
- Revision of “Workmanship and Finish” to “Safety, Workmanship, and Finish” and modifications in the provisions under it
- Revision of “Warranty for Construction and Durability” to “Warranty for Fabrication and Services” and modification in the provision under it
- Modification in the provisions under “Maintenance and Operation”
- Modification in the provisions under “Marking and Labeling”
- Addition of Annex A

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 requirements for corn mill for production of corn grits for food using the dry milling process.

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 101:2000, *Agricultural Machinery – Technical Means for Ensuring Safety – General*

PAES 102:2000, *Agricultural Machinery – Operator’s Manual – Content and Presentation*

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

PNS/BAFS PAES 252:2018, *Agricultural Machinery – Corn Mill – Methods of Test*

PNS/BAFS/PAES 192:2016, *Agricultural Machinery – Guidelines on After-Sales Service*

3 Terms and Definitions

For the purpose of this Standard, the following terms and definitions shall apply.

3.1

by-product

combination of fine corn grits, floured corn, germ, pericarp or hull, and tip cap

3.1.1

corn grits no. 20

grits with particle size from 0.708 mm to 0.841 mm which passed through US Sieve No. 20 but are retained in US Sieve No. 25

3.1.2

corn grits no. 24

grits with particle size of 0.707 mm and smaller which passed through US Sieve No. 25

3.1.3

floured corn

finer

fine powder by-product of corn milling process

3.1.4

germ

embryo of the kernel removed during the degermination process

3.1.5

pericarp

hull

outer covering of the corn kernel removed during the milling process

3.1.6

tip cap

attachment of the kernel to the cob; the entryway of nutrients, water, etc. to the kernel

3.1.7

bran

combination of germ, tip cap, pericarp, or fine corn grits

3.2

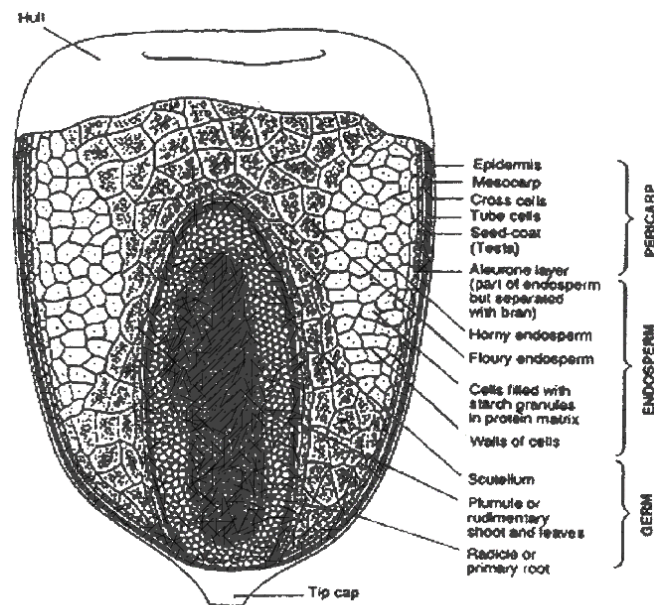
by-product recovery

ratio of the total weight of by-products to the total weight of corn kernel input, expressed in percent (%)

3.3

corn kernel

whole grain of shelled corn (see Figure 1)



(Diagram courtesy of the Wheat Flour Institute, Chicago, Illinois, 1964)

Figure 1 – Parts of a corn kernel

[SOURCE: Food and Agriculture Organization of the United Nations (1992)]

3.4

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

3.5

corn mill

machine that removes the pericarp, crushes the kernel, polishes the grits, and sorts the grits into different sizes (see Figure 2)

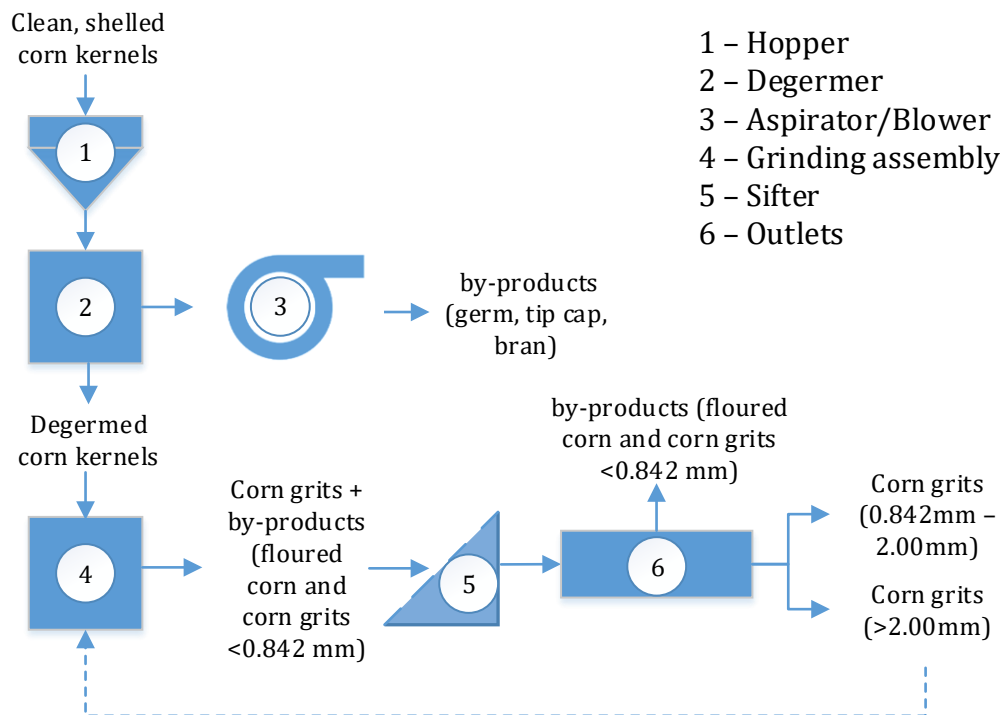


Figure 2 – Schematic diagram of a corn mill

3.6

degermer

used to remove the germ, tip cap, and pericarp from the corn kernel

3.7

degermer efficiency

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

3.8

dry milling

process of separating germ, pericarp and tip cap from the endosperm and reducing it into grits without soaking the corn kernels before milling

3.9

main product

refers to Corn Grit No. 10, 12, 14, 16, and 18

3.9.1

corn grits no. 10

grits with particle size from 1.69mm to 2.00mm which passed through US Sieve No. 10 but are retained in US Sieve No. 12

3.9.2

corn grits no. 12

grits with particle size from 1.42mm to 1.68mm which passed through US Sieve No. 12 but are retained in US Sieve No. 14

3.9.3

corn grits no. 14

grits with particle size from 1.20mm to 1.41mm which passed through US Sieve No. 14 but are retained in US Sieve No. 16

3.9.4

corn grits no. 16

grits with particle size from 1.01mm to 1.19mm which passed through US Sieve No. 16 but are retained in US Sieve No. 18

3.9.5

corn grits no. 18

grits with particle size from 0.842mm to 1.00mm which passed through US Sieve No. 18 but are retained in US Sieve No. 20

3.10

main product recovery

ratio of the total weight of main products to the total weight of corn kernel input, expressed in percent (%)

3.11

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)

3.12

sifter

oscillating or rotating screen, wire mesh, or perforated metal sheet, permitting smaller particles to fall through the openings

4 Classification

The classification of corn mill should be based but not limited to the following.

4.1 Degermer assembly

4.1.1 Emery stone

Shelled corn kernels are degermed by abrasion against emery stones.

4.1.2 Steel huller

It consists of a fluted steel shaft operating inside a perforated steel screen, which also carries a projecting strip of steel whose distance from the shaft can be varied.

4.2 Grinding assembly

4.2.1 Steel huller

4.2.2 Rotary blade/Hammer mill-type

It consists of metal blades that turn to cut degermed corn kernels into smaller sizes.

4.2.3 Steel roller

Corn kernels are ground using two rollers made of steel that rotate in different directions.

4.2.4 Attrition-type

It uses a pair of flat disks with series of grooves on the disk face. One disk rotates while the other disk remains stationary.

4.3 Sifting/Grit size separation Assembly

4.3.1 Oscillating

Corn grits are sorted into different sizes by passing through sieves of different mesh sizes that move back and forth.

4.3.2 Rotary

Corn grits are sorted into different sizes by passing through rotating sieves of different mesh sizes.

5 Fabrication Requirements

Steel bars, metal sheet or plate, or any appropriate materials should be used in the manufacture of the different components of corn mill.

6 Performance Requirements

- 6.1 Milling capacity shall meet the manufacturer’s specification.
- 6.2 The performance criteria for corn mill shall be as specified in Table 1.

Table 1 – Performance Criteria for Corn mill

CRITERIA	PERFORMANCE DATA
Main Product Recovery, percent, minimum	64
By-Product Recovery, percent, maximum	31
Losses, percent, maximum	5
Degermer Efficiency, percent, minimum	80

7 Safety, Workmanship, and Finish

- 7.1 The maximum allowable noise level shall be 100 dB(A).
- 7.2 Provisions for ear protection shall be provided.
- 7.3 Corn mill shall be free from any manufacturing defects that may be detrimental to its operation.
- 7.4 The base of the corn mill shall be rigid and durable without any noticeable cracks and weak joints.
- 7.5 The rotating components of corn mill should be dynamically balanced.
- 7.6 All metal surfaces shall be free from rust.
- 7.7 Parts of the corn mill that are exposed to the operator shall be free from sharp edges and rough surfaces. Warning notices shall be provided in accordance with PAES 101:2000.
- 7.8 Mechanism for emergency stop or immediate load disengagement of power shall be provided.
- 7.8 All moving parts shall be provided with safety features.
- 7.9 There should be a provision for dust collection.

8 Warranty for Fabrication and Services

Warranty shall be provided for parts and services except for normal wear and tear of expendable or consumable maintenance parts for at least one (1) year upon the acceptance of procuring entity of the corn mill. General requirements of the warranty shall conform to PNS/BAFS/PAES 192:2016.

9 Maintenance and Operation

9.1 Each unit of corn mill shall be provided with a set of manufacturer's standard tools required for maintenance.

9.2 Operator's manual based on PAES 102:2000, maintenance schedule, and list of the warrantable parts of the corn mill shall be provided.

9.3 The corn mill shall be easy to clean and operate. Basic components of the corn mill shall have provision for regular and ease of cleaning.

10 Sampling

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

11 Testing

The sampled corn mill shall be tested in accordance with PNS/BAFS PAES 252:2018.

12 Marking and Labeling

12.1 Each unit of corn mill shall be marked at the most visible place with the following information.

12.1.1 Registered trademark of the manufacturer

12.1.2 Brand

12.1.3 Model

12.1.4 Year of Manufacture

12.1.5 Serial number

12.1.6 Name, address, and contact details of the manufacturer/importer/distributor

12.1.7 Country of manufacture/origin (if imported)/ "Made in the Philippines" (if manufactured in the country)

12.1.8 Milling capacity, kg/h

12.1.9 Power requirement, kW

12.2 Safety/Precautionary markings shall be provided. It shall be stated in English and Filipino and printed in red color with a white background.

12.3 The markings shall be durably bonded to the base surface material. It shall be all weather resistant and under normal cleaning procedures. It shall not fade, discolor, peel, crack, or blister and shall remain legible.

ANNEX A
(informative)

US Sieve – Tyler Equivalent Matrix

US Sieve Size	Tyler Equivalent	Opening	
		mm	in
-	2½ Mesh	8.00	0.312
-	3 Mesh	6.73	0.265
No. 3½	3½ Mesh	5.66	0.233
No. 4	4 Mesh	4.76	0.187
No. 5	5 Mesh	4.00	0.157
No. 6	6 Mesh	3.36	0.132
No. 7	7 Mesh	2.83	0.111
No. 8	8 Mesh	2.38	0.0937
No.10	9 Mesh	2.00	0.0787
No. 12	10 Mesh	1.68	0.0661
No. 14	12 Mesh	1.41	0.0555
No. 16	14 Mesh	1.19	0.0469
No. 18	16 Mesh	1.00	0.0394
No. 20	20 Mesh	0.841	0.0331
No. 25	24 Mesh	0.707	0.0278

[SOURCE: AZO Materials (2002)]

Bibliography

- AZO Materials (2002). *Particle Size - US Sieve Series and Tyler Mesh Size Equivalents*. Retrieved April 2, 2018 from <https://www.azom.com/article.aspx?ArticleID=1417>
- Department of Science and Technology (1975). *The Philippine Recommends for Corn*. Los Baños, Laguna: Philippine Council for Agricultural Research
- Eckhoff, S. (2010). Correct Terminology Usage in Corn Processing. *Cereal Foods World* (55) 3. Retrieved June 6, 2017 from <http://www.aaccnet.org/publications/plexus/cfw/pastissues/2010/Documents/CFW-55-3-0144.pdf>
- Food and Agriculture Organization of the United Nations (1985). *Prevention of post-harvest losses: a training manual*
- Food and Agriculture Organization of the United Nations (1992). *Maize in human nutrition*
- PNS/BAFS/PAES 188:2018, *Agricultural Machinery – Coffee Grinder – Specifications*
- Gragasin M. and Martinez R. (2015). Development of Corn Mill for Village-Level of Operation. *Asian Journal of Applied Sciences* (3)6
- National Food Authority (2002). *Primer on Philippine Grains Standardization Program*

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