

# **PHILIPPINE NATIONAL STANDARD**

**PNS/BAFS 251:2021  
ICS 65.0660.99**

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## **Corn Mill – Specifications**



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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 251:2018:

1. Inclusion of figures in Section 4 (Classifications);
2. Deletion of classification for “Degermer Assembly”;
3. Modification on provision for Section 5 (Fabrication Requirements); and
4. Modification on parameters and data for Performance Criteria.

This Standard cancel and replaces PNS/BAFS 251:2018 which has been technically amended. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2.

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## **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 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). (2016). Agricultural machinery – Guidelines on after-sales service (PNS/BAFS 192:2016).

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<https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PAES-101-2000-Technical-Means-for-Ensuring-Safety-General.pdf>

## **3 Terms and Definitions**

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

### **3.1**

#### **by-product**

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combination of corn grits other than corn grits nos. 10 to 18 (e.g. corn grits no. 20, corn grits no. 24) floured corn and bran. Please see Annex A (US Sieve – Tyler Equivalent Matrix) for complete guide for US Sieve Nos.

**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****fines**

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**

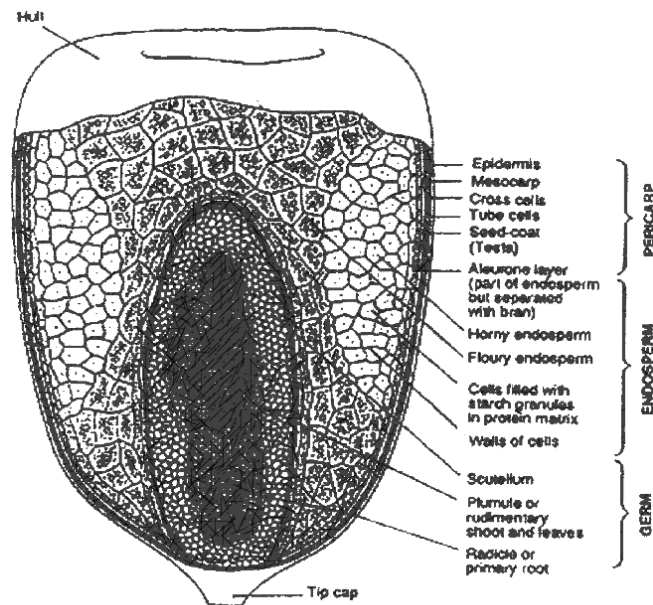
attachment of the kernel to the cob; the entryway of nutrients, water, etc. to the kernel

**3.1.7****bran**

combination of germ, tip cap, pericarp, and corn grits

**3.2****corn kernel**

whole grain of shelled corn, as shown in Figure 1



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

**Figure 1. Parts of a corn kernel**

Reference: Food and Agriculture Organization (FAO), 1992

### 3.3

#### corn grits

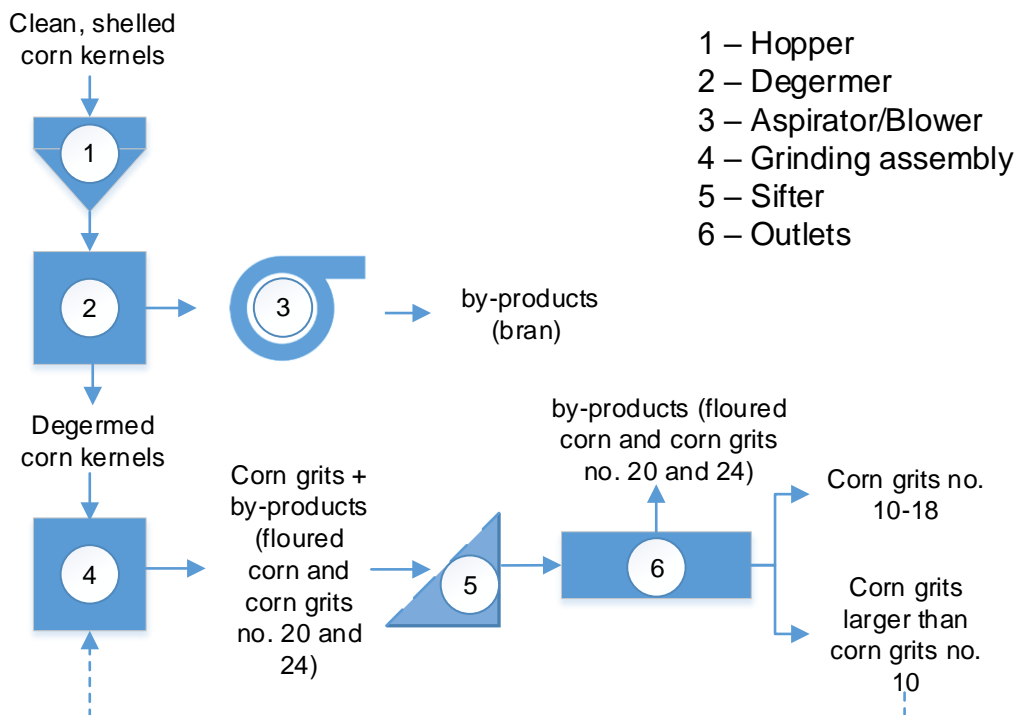
milled corn grains where the outer covering (pericarp), germ (embryo), and tip cap have been removed leaving only the endosperm that passed through different sieve sizes

### 3.4

#### corn mill

machine that removes the pericarp, crushes the kernel, polishes the grits, and sorts the grits into different sizes as shown in Figure 2

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**Figure 2. Schematic diagram of a corn mill**

### 3.5

#### **degermer**

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

### 3.6

#### **degermer efficiency**

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

### 3.7

#### **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

### 3.8

#### **grinding assembly**

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

### 3.9

#### **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

### 3.10

#### **main product**

refers to Corn Grit Nos. 10, 12, 14, 16, and 18

**3.10.1****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

**3.10.2****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

**3.10.3****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

**3.10.4****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

**3.10.5****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

**3.11****main product recovery**

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

**3.12****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)

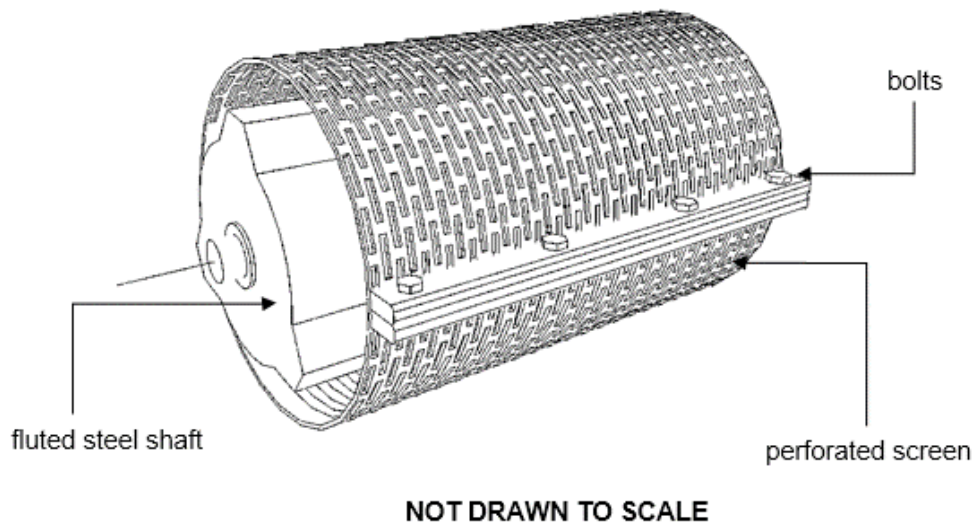
**4 Classification**

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

**4.1 Grinding assembly****4.1.1 Steel huller**

A grinder 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. A sample steel shaft is shown in Figure 3.

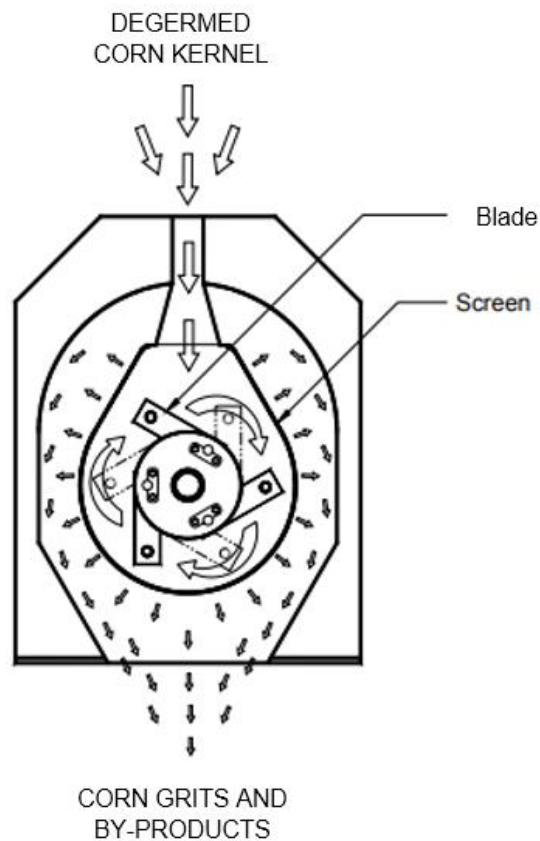




**Figure 3. Typical visual representation for steel huller component**

#### 4.1.2 Rotary blade/hammer mill-type

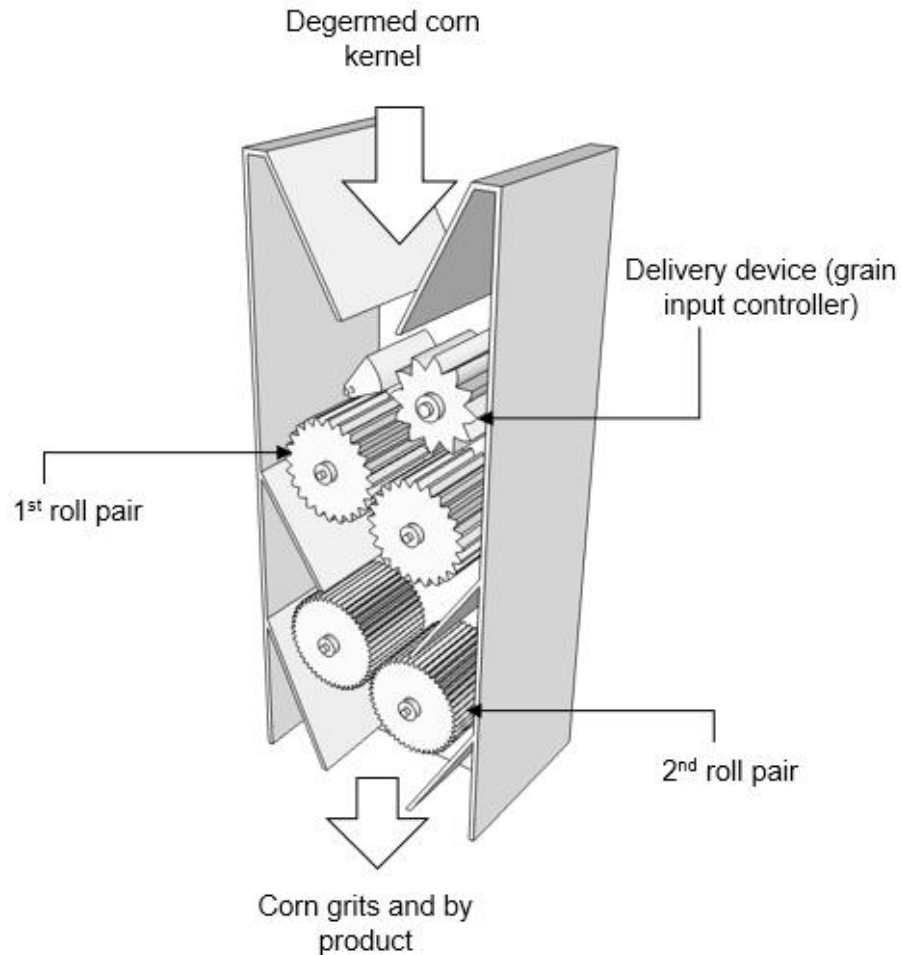
A grinder consists of rotating metal blades that reduce the size of degermed corn kernels as a result of impact. Typical representation is shown in Figure 4.



**Figure 4. Typical visual representation for rotary blade/hammer mill-type**

### 4.1.3 Steel roller

Degermed corn kernels are ground using pair/s of rollers made of steel that rotate in different directions. Sample figure is shown in Figure 5.



**Figure 5. Typical visual representation for steel roller grinding assembly**

### 4.1.4 Attrition-type

A grinder that uses a pair of flat disks with series of grooves on the disk face. One disk rotates while the other disk remains stationary. Examples of flat disks used are shown in Figure 6.

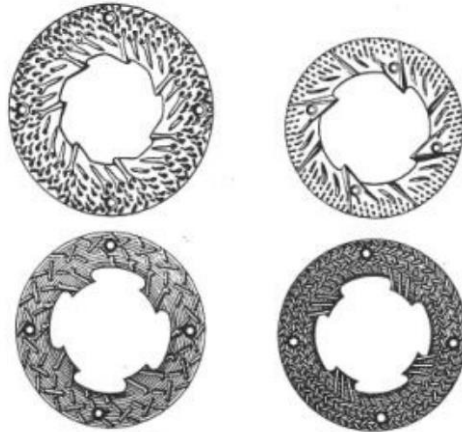


Figure 6. Typical visual representation of attrition-type disks

## 4.2 Grit size separation assembly

### 4.2.1 Oscillating

Corn grits are sorted into different sizes by passing through sieves of different mesh sizes by reciprocating motion. Example is shown in Figure 7.

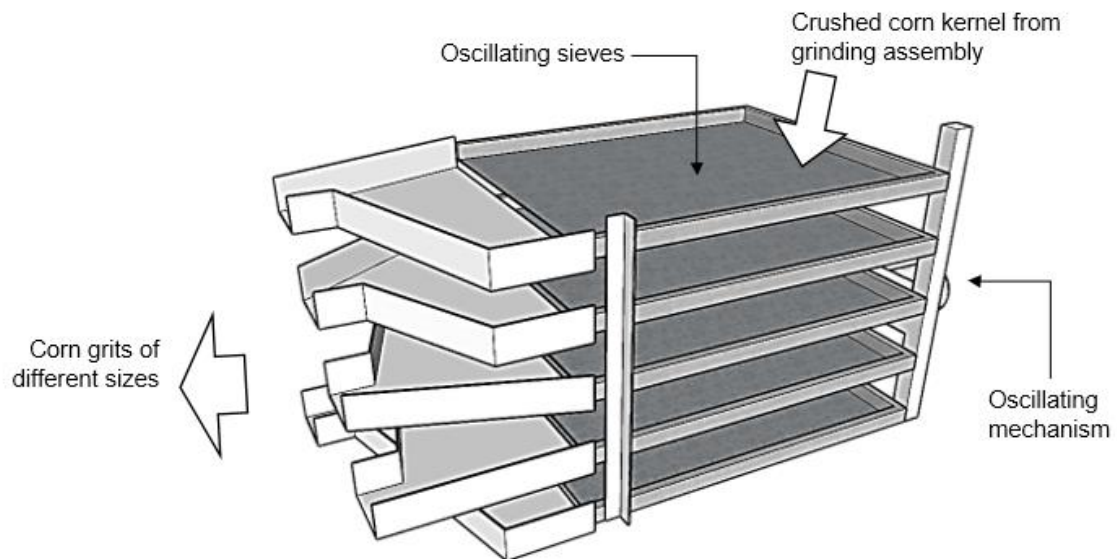


Figure 7. Typical visual representation of oscillating sifter

### 4.2.2 Rotary

Corn grits are sorted into different sizes by passing through rotating sieves of different mesh sizes. Sample figure is shown in Figure 8.

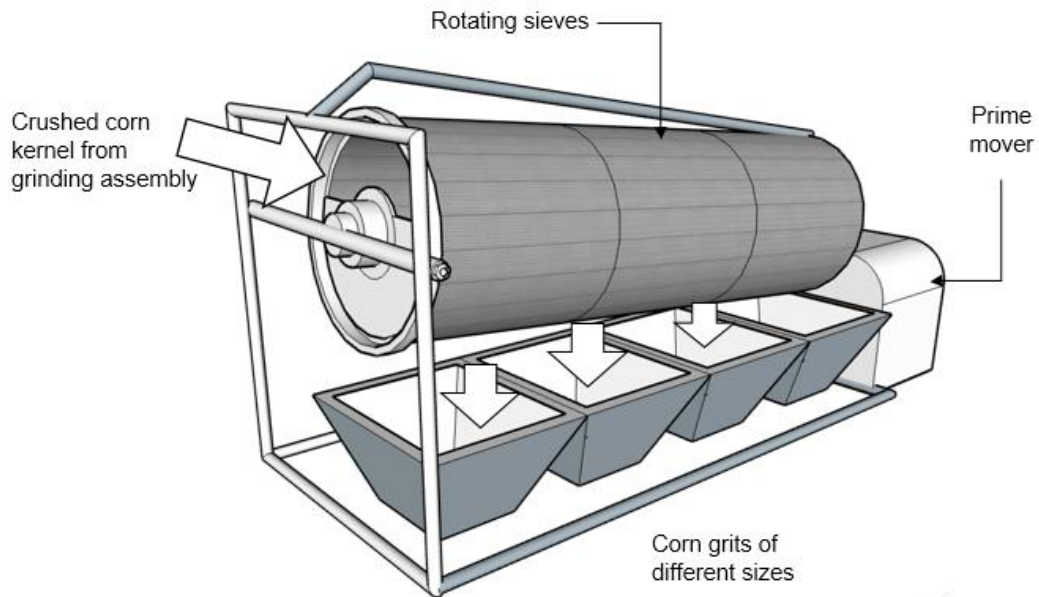


Figure 8. Typical visual representation of rotating sieve

**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. Materials that are directly in contact with the product shall be food grade.

**6 Performance Requirements**

- 6.1 The milling capacity specified by the manufacturer shall be attained.
- 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, minimum	55
Losses, maximum	5
Degermer Efficiency, minimum	80

**7 Safety, Workmanship, and Finish**

- 7.1 The maximum allowable noise level shall be 100 dB(A)<sup>1</sup>.

<sup>1</sup> OSHC-DOLE (2016). Occupational safety and health standard, Rule 1074:01-03 – 2013

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**7.2** All welded parts shall be in accordance with relevant criteria specified in American Welding Society (AWS) D1.1:2000 (Structural Welding Code – Steel) which specifically include the following:

**7.2.1** There shall be no crack on the welded area.

**7.2.2** There shall be fusion between adjacent layers of weld metal and base metal.

**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 the corn mill should be statically and dynamically balanced and shall have safety guards.

**7.6** All metal surfaces shall be free from rust and painted properly, if applicable.

**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 (Agricultural machinery – Technical means for ensuring safety – General).

**7.8** Mechanism for emergency stop or immediate load disengagement of power shall be provided.

**7.9** There should be a provision for dust collection.

**7.10** There shall be provision for the safety of the operators from the hopper inlet.

## **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 year upon the acceptance of procuring entity of the corn mill. General requirements of the warranty shall conform to PNS/BAFS/PAES 192:2016 (Agricultural machinery – Guidelines on after-sales service).

## **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.

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**9.2** Operator’s manual shall be based on PAES 102:2000 (Agricultural machinery – Operator’s manual – Content and presentation). Maintenance schedule and list of the non-warrantable parts of the corn mill shall be provided.

**9.3** Each basic component of the corn mill shall have provision for regular and ease of cleaning.

**9.4** The corn mill shall be easy to operate, maintain, and repair.

**10 Sampling**

Corn mill shall be sampled for testing in accordance with PAES 103:2000 (Agricultural machinery – Method of sampling) or any other suitable method of selection.

**11 Testing**

The sampled corn mill shall be tested in accordance with PNS/BAFS 252:20XX (Agricultural machinery – Corn mill – Methods of test).

**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** Brand;

**12.1.2** Model;

**12.1.3** Serial number;

**12.1.4** Country of manufacture/origin (if imported)/ “Made in the Philippines” (if manufactured in the country);

**12.1.5** Milling capacity, kg/h; and

**12.1.6** 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, including serial number, shall be embossed to the base surface material of the machine. 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)

**Table A.1. US sieve – Tyler equivalent matrix**

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

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