

PHILIPPINE NATIONAL STANDARD

PNS/PAES 246:2010
(PAES published 2010)
ICS 65.060.01

Agricultural machinery – Dehusked Corn Dryer – Specifications



BUREAU OF PRODUCT STANDARDS

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National Foreword

This Philippine Agricultural Engineering Standards PAES 246:2010, Agricultural machinery – Dehusked Corn Dryer – Specifications was approved for adoption as Philippine National Standard by the Bureau of Product Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center (AMTEC) and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development of the Department of Science and Technology (PCARRD-DOST).

Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) through the project “Development of Standards for Agricultural Production and Postharvest Machinery” funded by the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development of the Department of Science and Technology (PCARRD – DOST)

This standard has been technically prepared in accordance with BPS Directives Part 3:2003 – Rules for the Structure and Drafting of International Standards.

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.

In the preparation of this standard, the following documents/publications were considered:

PAES 201:2000 Agricultural Machinery – Heated-Air Mechanical Grain Dryer - Specifications

Belonio, Alexis T. *Agricultural engineering formula*. Department of Agricultural Engineering and Environmental Management, College of Agriculture, Central Philippine University, Iloilo City, Philippines. 2003.

SolarFlex fruit and vegetable Dryer. *Malnutrition Matters: Food Technology Solutions*. SolarFlex Dryers and Heaters. May 2008.

Islam, Md. Taufiqul, Marks, Bradley P. and Bakker-Arkema, Fred W. Optimization of commercial ear corn dryers. Department of Agricultural Engineering, Michigan State University. 2004

AMTEC Test Reports for Dehusked Corn Dryer

1 Scope

This standard specifies the manufacturing and performance requirements for batch type dehusked corn dryer only.

2 References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this National Standard:

AWS D1.1:2000	Structural Welding Code - Steel
PAES 102:2000	Agricultural Machinery – Operator’s Manual – Content and Presentation
PAES 103:2000	Agricultural Machinery – Method of Sampling
PAES 311:2001	Engineering Materials - Screws for Agricultural Machines – Specifications and Applications
PAES 313:2001	Engineering Materials – Bolts and Nuts for Agricultural Machines – Specifications and Applications
PAES 247:2010	Agricultural Machinery – Dehusked Corn Dryer – Methods of Test

3 Definitions

For the purpose of this standard the following definitions shall apply:

3.1

dehusked corn

ear corn

corn-on-cob

unshelled fruit of the corn plant where the husk has been removed mechanically or manually

3.2

husk

refers to the leafy outer/protective covering of an ear of corn as it grows on the plant

3.3

dehusked corn dryer

device for removing excess moisture from the ear of corn without husk, generally by forced or natural convection with or without addition of heat

3.4**fan****blower**

air moving device that is used to force heated air through the mass of materials to be dried at the desired air flow rate and pressure

3.5**moisture gradient**

difference between the maximum and the minimum moisture content randomly sampled after drying

3.6**plenum**

chamber wherein air pressure is developed for uniform distribution of the heated air through the material to be dried

3.7**safety device**

any device that is used to avoid human accident and/or damage to the parts and components of the dryer during the operation and automatically shuts-off the operation of the dryer in case of malfunction

4 Classification

The classification of dehusked corn dryer shall be based according to:

4.1 System Operation**4.1.1 Batch type**

Mechanical dryer wherein the corn in fixed volume is held in the drying chamber in batches until it reaches the desired moisture content. (see Figure 1 and 2)

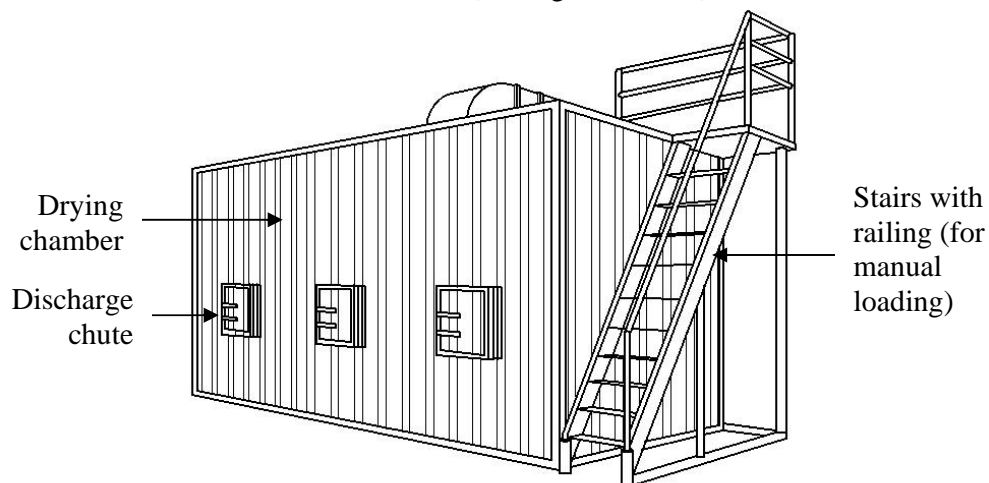


Figure 1. Dehusked corn dryer

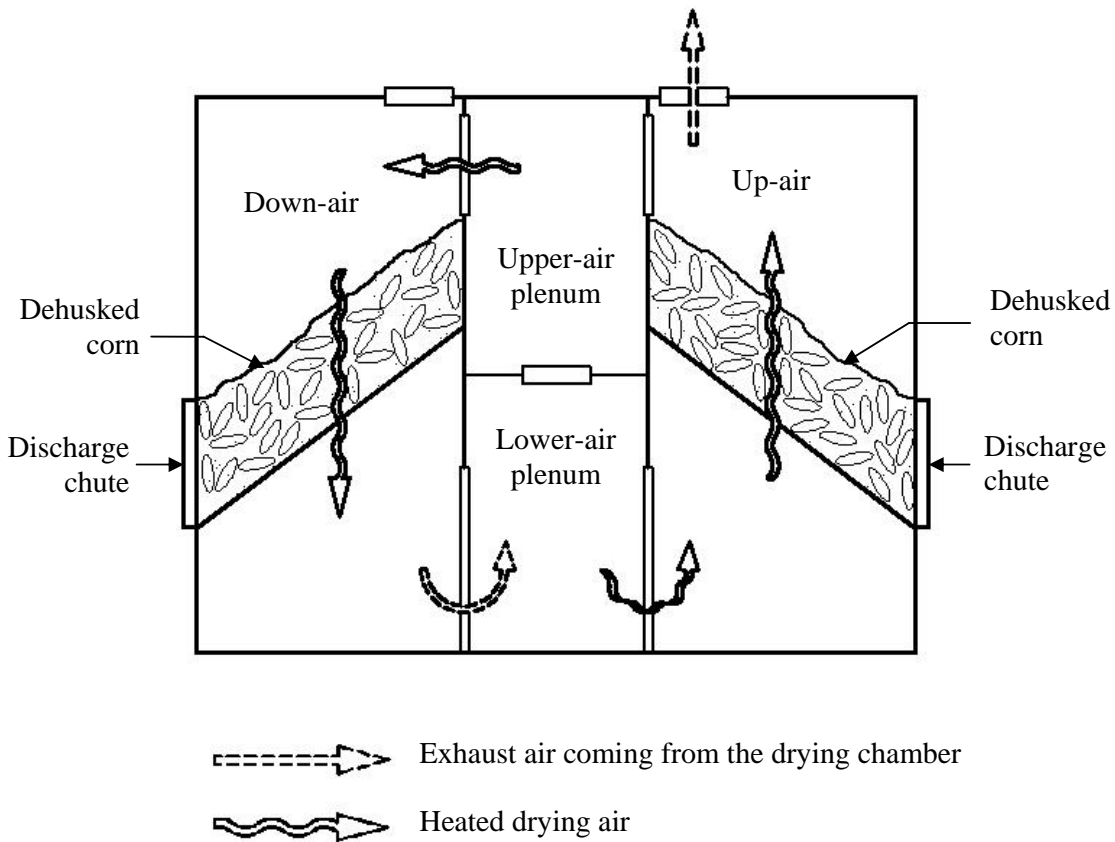


Figure 2. Flow diagram of drying air on dehusked corn dryer

4.2 Heating System

4.2.1 Method of heat introduction

4.2.1.1 Direct

Dryer in which the products of combustion come into direct contact with the product being dried. (see Figure 3)

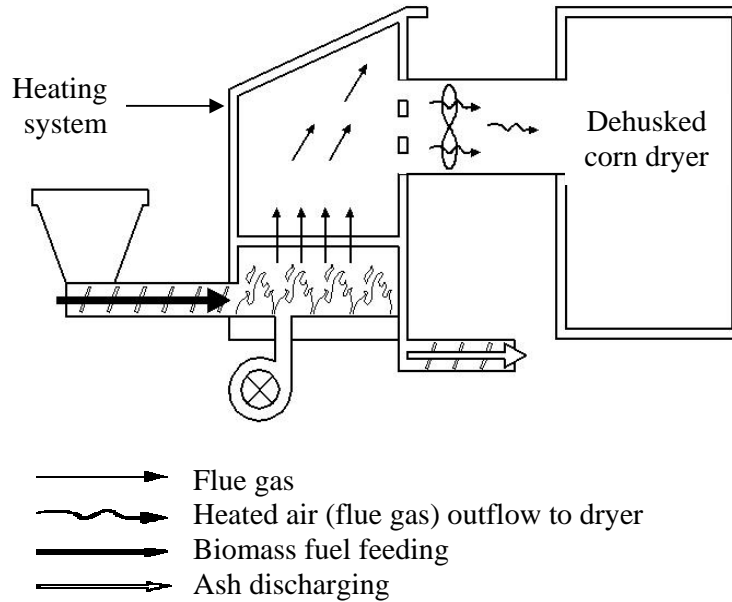


Figure 3. Direct heating system for dehusked corn dryer

4.2.1.2 Indirect

Dryer in which the products of combustion do not come in contact with the products being dried. This type enables the use of heat exchanger. (see Figure 4)

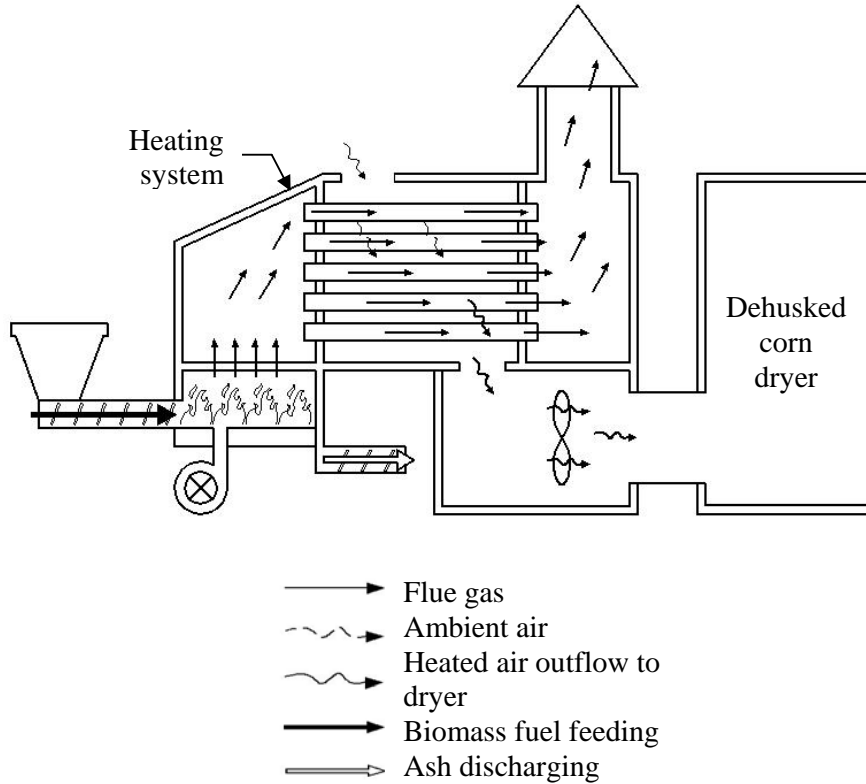


Figure 4. Dryer heated by indirect type of heating system

4.2.2 Fuel Source

4.2.2.1 Conventional

Source of energy which includes petroleum-based fuels such as kerosene, gasoline, Diesel oil and bunker fuel oil.

4.2.2.2 Non-conventional

Source of energy that includes non-petroleum fuels such as biomass fuel.
(see Figure 3 and 4)

5 Manufacturing Requirements

- 5.1** Dehusked corn dryer shall consist of drying bin(s), fan/blower, heating system, control panel, outlet chute, exhaust air outlet and safety features.
- 5.2** Steel bars, metal sheet or plate and/or heavy-duty mild steel shall be generally used for the manufacture of the different components of the dehusked corn dryer.
- 5.3** Walls shall be rigid to be able to support the maximum load capacity of the dehusked corn dryer to avoid bulging.
- 5.4** Flooring of the dryer shall be rigid of sufficient thickness to be able to support the maximum weight of dehusked corns to be dried. It shall have 5 mm perforations.
- 5.5** The drying bed or floor shall have angle of inclination depending on the angle of repose of dehusked corn (19°-22°) for ease of discharging.
- 5.6** Dehusked corn dryer shall have stairs with railings for manual loading and/or belt conveyor for mechanical loading.
- 5.7** On a case to case basis, there should be a provision for reversible flow of the drying air (up air and down air) to the dehusked corn dryer to achieve uniform moisture content.
- 5.8** Airflow rate of drying air for dehusked corn dryer shall be 15 to 40 m³/min per cubic meter of dehusked corn.
- 5.9** There shall be provision for minimum heat loss from the dryer and heating system during operation.
- 5.10** There shall be provision for emergency stop button near the equipment for safety of operations.
- 5.11** There shall be provision for sampling point in the middle of the drying bin for testing purpose.
- 5.12** There shall be provision for trash and grain collector for dehusked corn dryer.

- 5.13** There shall be provision for discharging the dehusked corn (e.g. discharge/outlet chute) after the drying process.
- 5.14** Bolts and screws to be used shall conform to PAES 311 and 313.
- 5.15** Sizes of the other parts of the dehusked corn dryer shall conform to the specifications of manufacturer.
- 5.16** Maximum drying capacity shall conform to the specifications of the manufacturer.

6 Performance Requirements

- 6.1** Drying temperature shall be uniform at any point on the drying chamber
- 6.2** The minimum heating system efficiency shall be the following:

Petroleum based fuel (direct-fired)	90%
Petroleum based fuel (indirect-fired)	75%
Biomass fuel (direct-fired)	65%
Biomass fuel (indirect-fired)	50%

- 6.3** The actual holding capacity of the dehusked corn dryer shall conform to the specification of the manufacturer.
- 6.4** The moisture content reduction rate shall be at least 0.25% per hour.
- 6.5** The dried corn shall have no additional discoloration due to drying, no traces of unburned fuel or ashes on its surface and no fermented or musty smell.
- 6.6** The dehusked corn dryer during operation shall have uniform and equally distributed drying air temperature to the drying chamber.
- 6.7** Depth of the dehusked corn to be dried should be dependent on the initial moisture content of the dehusked corn. (see Table 1)

Table 1. Depth and capacity of dehusked corn given the different values of moisture content for optimize drying efficiency (static pressure = 76 mmH₂O; drying temperature: up air = 41°C and down air = 46°C)

Initial Moisture Content of Dehusked Corn, %	Capacity, kg/m ² -h	Depth, m
20	35.2	3.3
25	25.1	3.3
30	20.3	3.3
35	17.2	2.9

Source: Optimization of Commercial Ear Corn Dryers by Islam, Md. Taufiqul, Marks, Bradley P. and Bakker-Arkema, Fred W.

7 Safety, Workmanship and Finish

- 7.1** All rotating components shall be statically and dynamically balanced.
- 7.2** The dehusked corn dryer shall have adequate protection from or for all moving parts.
- 7.3** The dehusked corn dryer shall be free from manufacturing defects that may be unsafe and shall be free from sharp edges and surfaces.
- 7.4** Metal parts should be machine pressed if necessary. Cut and weld method shall be avoided. All rough surfaces should be smooth.
- 7.5** All surfaces shall be coated with a suitable paint material.
- 7.6** There shall be adequate provision for fire control.
- 7.7** There shall be provision for access to parts during repair, maintenance and operation.
- 7.8** The noise emitted by the blower of the dryer shall not exceed 92 dB(A).
- 7.9** All welded parts shall be air-tight and smoothly polished and it shall pass visual inspection criteria (AWS D1.1:2000) for discontinuity of materials.
- 7.10** Welded joints shall not be less than 4 mm (1/8 inch) side fillet welded. Undercut shall not exceed 2 mm (1/16 inch) for any length of weld.

8 Warranty for Manufacture and Durability

- 8.1** Warranty against defective materials and workmanship shall be provided for parts and services except for normal wear and tear of consumable maintenance parts such as belts within one year from the date of purchase of the dehusked corn dryer.
- 8.2** The construction shall be rigid and durable without breakdown of its major components for at least one year from the date of purchase of end-user.

9 Maintenance and Operation

- 9.1** Every dehusked corn dryer unit shall be provided with basic tools, operation and parts manual containing full information on method of installation and operation. The manual which conforms to PAES 102 shall be provided.
- 9.2** Manufacturers/distributors shall provide after-sales service, identify wearing parts and should provide spare parts.

10 Sampling

Dehusked corn dryer shall be sampled for testing in accordance with PAES 103.

11 Testing

Dehusked corn dryer shall be tested in accordance with PAES 247.

12 Marking

12.1 Each dehusked corn dryer shall be marked in English with the following information using a stencil or by directly punching it on a plate and shall be positioned at a most conspicuous place:

12.1.1 Registered trademark of the manufacturer

12.1.2 Brand

12.1.3 Model

12.1.4 Serial number

12.1.5 Drying capacity, kg/h

12.1.6 Holding/Loading capacity, kg/batch

12.1.7 Rated power/voltage/frequency/phase, in metric units (if applicable)

12.1.8 Name and address of the manufacturer

12.1.9 Name and address of the distributor

12.1.10 Country of manufacture (if imported) / “Made in the Philippines” (if manufactured in the Philippines)

12.2 Safety/precautionary markings shall be provided when appropriate. Marking shall be stated in English and Filipino and shall be printed in red color with a white background.

12.3 The markings shall have a durable bond with the base surface material.

12.4 The markings shall be all weather resistant and under normal cleaning procedures, it shall not fade, discolor, crack or blister and shall remain legible.

Philippine Agricultural Engineering Standards

AMTEC-UPLB – PCARRD Project: “Development of Standards for Agricultural Production and Postharvest Machinery”

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