

PHILIPPINE NATIONAL STANDARD

PNS/PAES 201:2015
(PAES published 2015)
ICS 65.040.20

Agricultural machinery – Heated air mechanical grain dryer – Specifications



BUREAU OF PRODUCT STANDARDS*

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National Foreword

The Philippine Agricultural Engineering Standards PAES 201:2015, Agricultural machinery – Heated air mechanical grain dryer – Specifications was approved for adoption as Philippine National Standard by the Bureau of Philippine Standards upon the recommendation of the Agricultural Machinery Testing and Evaluation Center (AMTEC) and the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development of the Department of Science and Technology (PCAARRD-DOST).

This standard cancels and replaces PNS/PAES 201:2003 (PAES published 2000).

PHILIPPINE AGRICULTURAL ENGINEERING STANDARDS PNS/PAES 201:2015
Agricultural Machinery – Heated-Air Mechanical Grain Dryer – Specifications

Foreword

The revision of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled “Development of Standards for Rice Production and Postproduction Machinery” which was funded by the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) of the Department of Science and Technology (DOST).

This standard has been technically prepared in accordance with PAES 010-2 – 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 preparation of this standard, the following documents/publications were considered:

ASAE S248.3 MAR1976 (R2005) – Construction and Rating of Equipment for Drying Farm Crops

ANSI/ASABE S593 MAY2006 - Terminology and Definitions for Biomass Production, Harvesting and Collection, Storage, Processing, Conversion and Utilization

Bakker-Arkema, F.W. 1999.CIGR Handbook of Agricultural Engineering Volume 4.Agro-Processing Engineering. USA

Brooker, D.B. Bakker-Arkema, F.W. and Hall, C.W. 1974.Drying Cereal Grains. The AVI Publishing Company, Inc. Westport Connecticut, p. 166-176

Grain Storage and Techniques. Evolution and Trends in Developing Countries. Food and Agriculture Organization (<http://www.fao.org/docrep/t1838e/T1838E0w.htm>)

Hall, C. W. 1980. Drying and Storage of Agricultural Crops. AVI Publishing Company, Inc. Westport Connecticut

Paddy Drying. IRRI Rice Knowledge Bank
(<http://www.knowledgebank.irri.org/rkb/index.php/drying>)

Primer on Philippine Grains Standardization Program. 2002. National Food Authority. Quezon City, Philippines

1 Scope

This standard specifies the requirements for heated–air mechanical grain dryer used for commercial purposes. It does not include dryers for seeds.

The grain in this standard refers to paddy and corn.

2 References

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

- PNS/PAES 101:2000** Agricultural Machinery– Technical Means for Ensuring Safety – General
- PNS/PAES 102:2000** Agricultural Machinery – Operator’s Manual – Content and Presentation
- PNS/PAES 103:2000** Agricultural Machinery – Method of Sampling
- PNS/PAES 138:2004** Agricultural Machinery– Guidelines on After Sales Service
- PNS/PAES 202:2015** Agricultural Machinery – Heated–Air Mechanical Grain Dryer – Methods of Test

3 Definitions

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

3.1

batch type

mechanical grain dryer wherein the grain in fixed amount is held in the drying chamber in batches until the grain reaches the desired moisture content

3.1.1

flat bed type

batch type dryer wherein a fixed amount of grain is held stationary in a horizontal grain holding bin (Figure 1)

3.1.2

recirculating type

batch type dryer equipped to circulate and/or mixed fixed amount of grain during the drying operation (Figure 2)

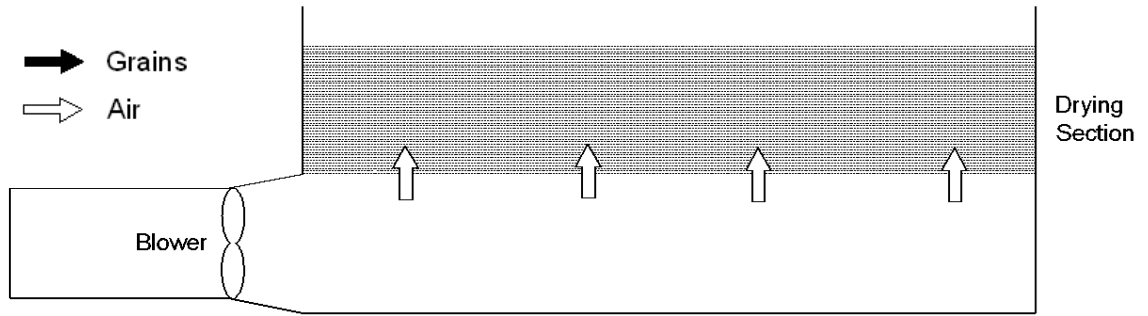


Figure 1 – Flatbed Dryer

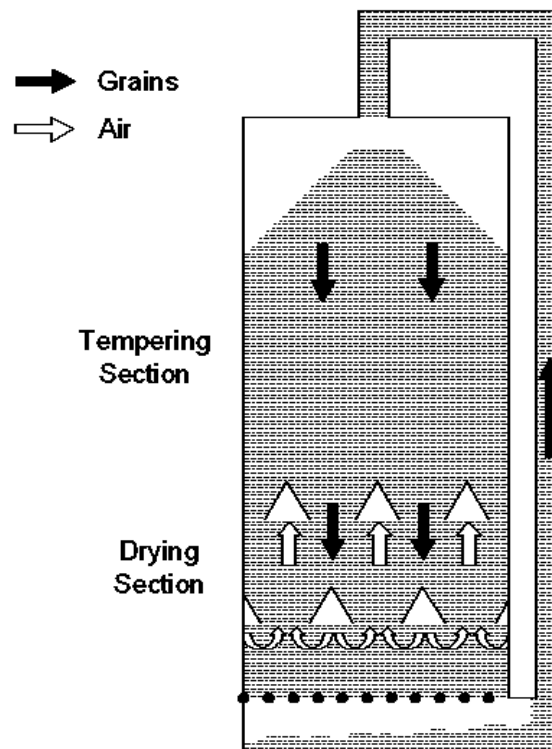


Figure 2 – Recirculating batch dryer

3.2

biomass

organic materials used as renewable source of energy including but not limited to agricultural crops, feed and fiber crop residues, aquatic plants, forestry and wood residues, agricultural wastes, processing by-products and other non-fossil organic materials.

3.3

broken grains

pieces of grains smaller than three-fourths ($3/4$) of the average length of the whole kernel

3.4
continuous flow dryer

dryer in which the material being dried moves through the drying chamber in a substantially continuous stream and is discharged without being recirculated and where the drying and tempering processes are accomplished in another holding bin or column (Figure 3)

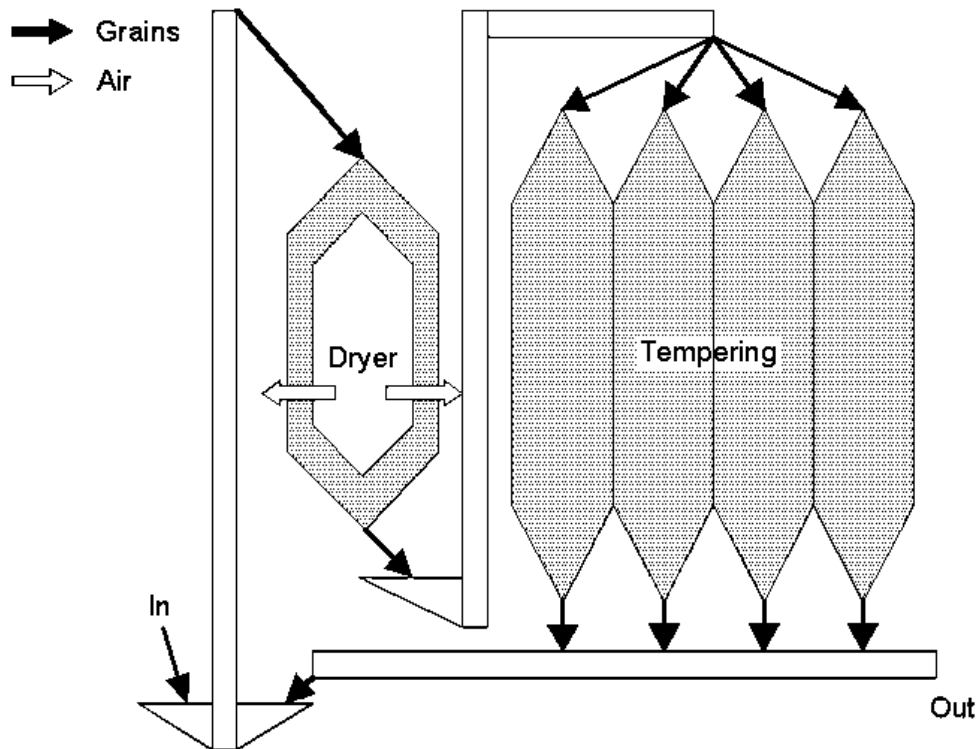


Figure 3 – Continuous flow drying plant

3.5
cracked grain

grains which show signs of fissures or fractures or splinters

3.6
dehusked corn

ear corn

corn on cob

unshelled fruit of the corn plant where husk has been removed

3.7
dryer, direct-fired

dryer in which the products of combustion come into direct contact with the product being dried

3.8
dryer, indirect-fired

dryer in which the products of combustion do not come in contact with the products being dried

3.9

drying efficiency

heat utilization efficiency

ratio of the total heat utilized to vaporize moisture in the material, to the amount of heat added to the drying air expressed in percent

3.10

dust collection system

device used to accumulate dust (i.e. consist of aspiration fan, cyclone, etc.)

3.11

fan

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

3.12

grain dryer

device for reducing excess moisture from the grain, with or without introduction of heat

3.13

head rice

grain or a piece of a grain with the length equal to or greater than three-fourths ($3/4$) of the average length of the whole kernel

3.14

heated-air mechanical grain dryer

device used to remove grain moisture by forcing heated air through the grain mass until the desired moisture content is attained

3.15

heating system efficiency

ratio of the amount of heat added in the air to the heat available in the fuel

3.16

moisture gradient

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

3.17

plenum

chamber maintained under pressure for uniform distribution of the heated air through the grain mass

3.18

safety device

any device that is used to avoid human accident related to drying operation 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

3.19

shelled corn

“maize”

corn grain

corn kernels, mainly of either dent or flint varieties of the plant *Zea mays*

3.20

tempering bin

chamber wherein the grains are temporarily held after drying chamber or to the storage bin

4 Classification

Heated-air mechanical grain dryers shall be classified as follows:

4.1 System of Operation

4.1.1 Batch type

4.1.1.1 Flat Bed

4.1.1.2 Recirculating

4.1.2 Continuous Flow

4.2 Heating System

4.2.1 Method of Heat Introduction

4.2.1.1 Direct

4.2.1.2 Indirect

4.2.2 Fuel Source

4.2.2.1 Renewable

4.2.2.2 Non-renewable

5 Requirements

5.1 Performance

5.1.1 The performance of heated-air mechanical grain dryers shall be as specified in Table 1.

Table 1 – Performance Criteria for Mechanical Grain Dryer

CRITERIA	Performance Data	
	Rice	Corn
1. Moisture gradient, %, max.		
- Batch type	4.0	4.0
- Recirculating type	2.0	2.0
2. Drying rate, %/h	0.8 (Batch Type) 1.0 (Continuous flow)	2.0 (Shelled Corn) 0.4 (Ear Corn)
3. Product quality*		
- Cracked grain, % increase, max.	3.0 (Batch Type) 2.0 (Continuous flow)	10
- Head rice, % decrease, max.	5.0	N/A
- Hulled/damaged grain, % increase, max.	2.0	N/A
- Broken/split kernels, % increase, max.	N/A	7
4. Drying Loss/Spillage, %, max.	1.0	1.0
5. Drying efficiency, % min.	75	75
6. Heating system efficiency, % min		
- Petroleum based fuel direct-fired	90	90
indirect-fired	75	75
- Biomass fuel direct-fired	65	65
indirect-fired	50	50
7. Blower flow rate, cmm/kg (cfm/ton)	0.05 (1750)	0.05 (1750)
8. Static pressure, mm H ₂ O (in.H ₂ O)	25 (1)	25 (1)

* allowable difference between the laboratory analysis and machine's performance

5.1.2 The indicated grain holding capacity at input must be attained.

5.1.3 The dried grain shall have no additional discoloration, no traces of unburned fuel or ashes on grain surface and no fermented or musty smell.

5.1.4 The dryer shall be provided with thermometer to measure the actual air temperature entering the grain mass and a pressure gauge to measure the working static pressure in the plenum.

5.2 Safety

5.2.1 It shall have adequate provision for fire control.

5.2.2 It shall have adequate protection from or for all moving parts.

5.2.3 It shall be provided with features for access to parts during repair, maintenance and operation.

5.2.4 The noise emitted by the heated-air mechanical grain dryer shall not exceed 92 dB (A).

5.2.5 Provision shall be made for dust control. Its dust emission shall be within the acceptable limits set by the Department of Environment and Natural Resources.

6 Workmanship and Finish

6.1 Mechanical grain dryer shall be free from defects that may be detrimental to its use and shall be free from sharp edges and surfaces that may hurt the operator. All metal parts should be machine bend, pressed and cut to avoid rough surfaces and all rough surfaces should be machine finished and smoothed. The warning notice shall be in accordance with PNS/PAES 101:2000 – Agricultural Machinery – Technical Means for Ensuring Safety – General.

6.2 Uniformity of parts and components for same brand and model must be maintained.

6.3 Provision shall be made so that it can withstand extreme weather conditions to which it can be exposed.

7 Warranty for Construction and Services

7.1 The construction shall be rigid and durable without major breakdown of the following major components: burner, fan, bin and conveying equipment within one (1) after the date of acceptance of the unit by the end-user.

7.2 Warranty shall be provided to parts and services within one (1) year after the date of acceptance of the unit by the end-user except on fast moving and easy to wear parts such as fan belts. General requirements of the warranty shall be in accordance with PNS/PAES 138:2004 – Agricultural Machinery – Guidelines on After Sales Service.

8 Maintenance and Operation

8.1 Every heated-air mechanical grain dryer unit shall be provided with basic tools, factory standard, operation and parts manual containing full information on method of installation and operation. The manual which conforms to PNS/PAES 102:2000 – Agricultural Machinery – Operator’s Manual – Content and Presentation shall be provided.

8.2 Manufacturer’s/ Dealers shall provide operation and maintenance training, after-sales service, identify wearing parts and should provide spare parts.

9 Sampling

The mechanical grain dryer shall be sampled for testing in accordance with PNS/PAES 103:2000 – Agricultural Machinery – Method of Sampling.

10 Test Methods

The sampled mechanical grain dryer shall be tested in accordance with PNS/PAES 202:2015 – Agricultural Machinery – Heated-Air Mechanical Grain Dryer – Methods of Test.

11 Markings and Labeling

Each unit of mechanical grain dryer shall be marked at a prominent place with the following information:

- 11.1** Registered trademark of the manufacturer
- 11.2** Name and address of the manufacturer
- 11.3** Name and address of the importer/distributor
- 11.4** Country of manufacture/ Made in the Philippines
- 11.5** Type; Serial number
- 11.6** Load capacity, metric tons
- 11.7** Rated power/voltage/ frequency/ phase, in metric units
- 11.8** Shipping information
 - 11.8.1** Dry weight in metric units
 - 11.8.2** Dimensions in metric units
 - 11.8.3** Safety/Precautionary markings

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