POSTHARVEST MACHINERY– RICE MILL – SPECIFICATIONS

PNS/BAFS PABES 303:2020

ILLUSTRATIVE GUIDE

Illustrative Guide

Postharvest Machinery - Rice mill - Specifications (PNS/BAFS PABES 303:2020)

Bureau of Agriculture and Fisheries Standards (BAFS)
Quezon City, 2021

Contributors: Ms. Kristine P. Lasac, Engr. Abraham L. Perez III, and Mr. Jan Vincent DR. Tecson

Editors: Dr. Vivencio R. Mamaril, and Ms. Mary Grace R. Mandigma

Layout and Design: Ms. Kristine P. Lasac, Engr. Abraham L. Perez III, and Mr. Jan Vincent DR. Tecson

Illustrations: Engr. Abraham L. Perez III, and Ms. Kristine P. Lasac

Published by: Bureau of Agriculture and Fisheries Standards
BAFS Building, BPI Compound, Visayas Avenue, Diliman, Quezon City
(+632) 8928 8756 to 65 local 3301 - 3325
info.dabafs@gmail.com | bafs@da.gov.ph
ISBN 978-621-455-277-1 (PDF)

The 2D/3D illustrations of rice mills and corresponding parts presented in this document were artist's interpretation using the photographs provided by the University of the Philippines - Agricultural Machinery Testing and Evaluation Center (AMTEC - UPLB) as reference. Any resemblance to a particular fabricated rice mill or its parts does not correspond to any promotion of any specific brand or company . The illustrations presented are purely for educational/information dissemination purposes only.

Director's Message

With the current farm mechanization level of 2.31 horsepower (hp) per hectare (ha), the Philippines still lags behind Japan's 7 hp/ha, South Korea's 4.11 hp/ha and China's 4.10 hp/ha.

According to Secretary William D. Dar, we have to mechanize Philippine agriculture to at least four (4) hp/ha as we look forward to a modernized and globally competitive Philippine rice industry in the next six (6) years.

In line with this goal, BAFS continues to develop and promote standard specifications and test procedures for agriculture and fishery machinery and equipment.

This year, we are proud to share this Illustrative Guide (IG), which will serve as a supplementary learning material of the Philippine National Standards for *Postharvest Machinery - Rice Mill - Specifications (PNS/BAFS PABES 303:2020)*. The document was developed to facilitate the adoption of modern, appropriate, cost-effective and environmentally-safe rice machinery and equipment.

I would also like to thank and congratulate Dr. Myer G. Mula, the former BAFS Director, who gave invaluable technical guidance on the initial stages of the development of the document.

The Bureau is optimistic that this document will help the Philippine AFMech industry in ensuring the quality of machinery and equipment to enhance farm productivity and effectiveness in order to achieve food security and safety and increase farmer's income.

To our Filipino farmers, padayon!

VIVENCIO R. MAMARIL, PhD
Director IV

Assistant Director's Message

For several years now, the Department of Agriculture has launched various interventions to attain rice self sufficiency. In 2020 and after three years of decline in production, the country improved its rice self-sufficiency to 85%. This would mean that the Philippines current postharvest losses in rice decreased to 10-20% compared to the recorded 25% losses from the past 10 years, thanks to PhilMech's interventions and technologies in the application of postharvest in the rice industry.

But the story does not end there, it is also important to modernize rice milling and standardize machinery in order to produce high quality and quantity of milled rice within a short period of time with minimal manpower.

As a response to this, the Bureau of Agriculture and Fisheries Standards (BAFS) developed the standard, *Postharvest Machinery - Rice Mill - Specifications (PNS/BAFS PABES 303:2020)*. Its accompanying illustrative guide is likewise developed to promote better understanding and comprehension of our relevant stakeholders.

We understand that rice milling is a good business and can be profitable not only to the machine fabricators but more so to the farmer organizations that will venture into the rice milling business.

We hope that through this Illustrative Guide, the fabricators will be guided on how to manufacture high quality machines, which will in turn result in a high milling recovery rate and high quality milled rice. On both spectrum, our rice farmers will be able to harvest gains from their hard labor.

MARY GRACE R. MANDIGMA
Assistant Director-Designate

Introductory Note

For years, the Department of Agriculture – Bureau of Agriculture and Fisheries Standards (DA-BAFS) developed Philippine National Standards (PNS), *i.e.* end-product quality standards, codes of practices, and guidelines, for agriculture and fishery products including agri-fishery machineries, tools and equipment. As of December 2021, DA-BAFS has developed a total number of 317 PNS for agriculture and fishery (AF) products, tools, machinery, equipment, and structures.

Disseminating information on adopted standards was identified as one of the strategies to encourage stakeholders' usage and implementation. To do this effectively, the standards developed need to be translated into Knowledge Products (KP) that will be easily understood by the intended stakeholders. One of the KPs is the Illustrative Guide (IG), which serves as supplementary PNS learning material aside from the usual learning and development activities conducted by the Bureau, *i.e.* seminars, workshops and trainings.

The development of the IG for PNS/BAFS PABES 303:2020 Postharvest Machinery – Rice mill – Specifications aims to aid stakeholders to have uniform understanding and interpretation of the rice mill related standards for its efficient adoption and implementation.

Furthermore, the photographs/images included in the document were either taken by the Technical Services Division (TSD) staff through field work, obtained from the internet, or provided by the Technical Working Group (TWG) members from the academe, government institutions and private sector organizations. To ensure that the IG is technically accurate, a series of TWG meetings were conducted.

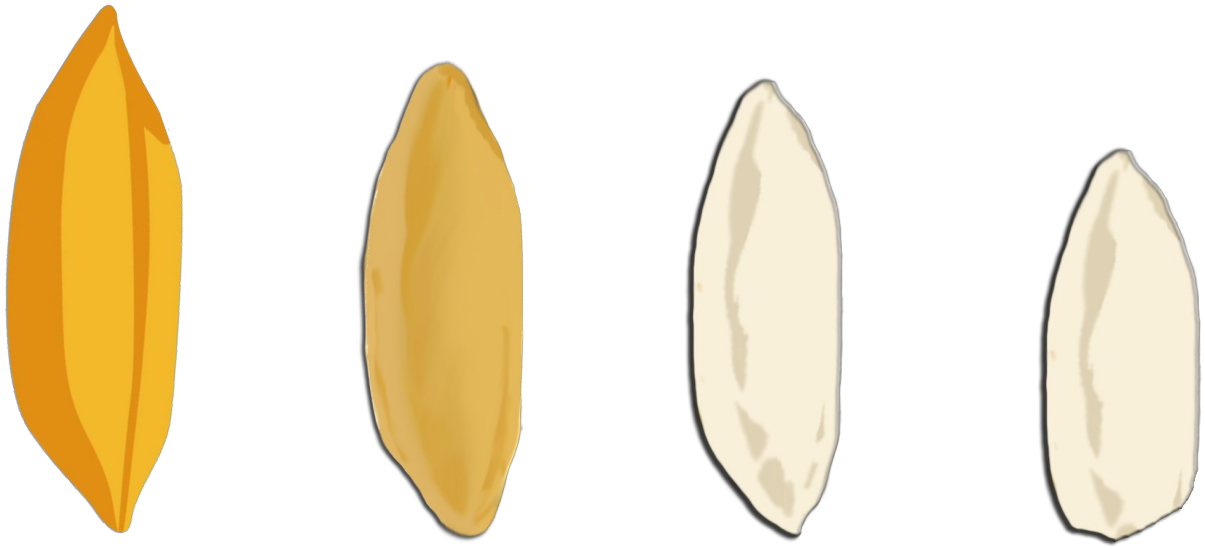
Table of Contents

Scope

This standard specifies the minimum requirements for rice mill.

Terms and Definitions

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

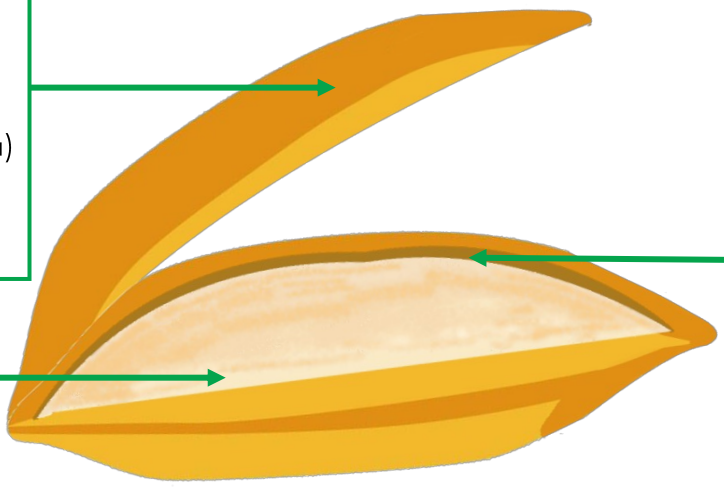


Paddy	Brown Rice	Milled Rice	Head Rice
(rough rice, *palay*) unhulled grain of *Oryza sativa*, which means grain with the glumes enclosing the kernel	(*Pinawa*, dehulled rice, cargo rice, dehusked rice) rice grains from which only the hull has been removed leaving the bran layer still intact	grains obtained after the removal of hull, bran, and germ	grain or a piece of a grain with its length equal to or greater than 75% of the average length of the whole grains

Rice Hull

(Rice husk)

outer most rough covering of the paddy grain (palea and lemma) consisting of the empty glumes, floral glumes, and awn

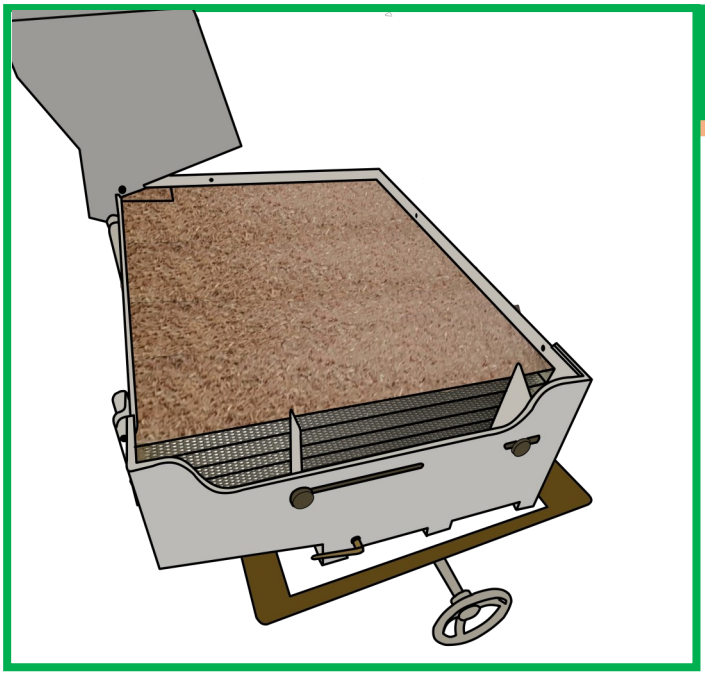


Starch Endosperm

Bran

outer layer of the brown rice consisting of the aleurone cells covering the endosperm of rice grain

ILLUSTRATIVE GUIDE

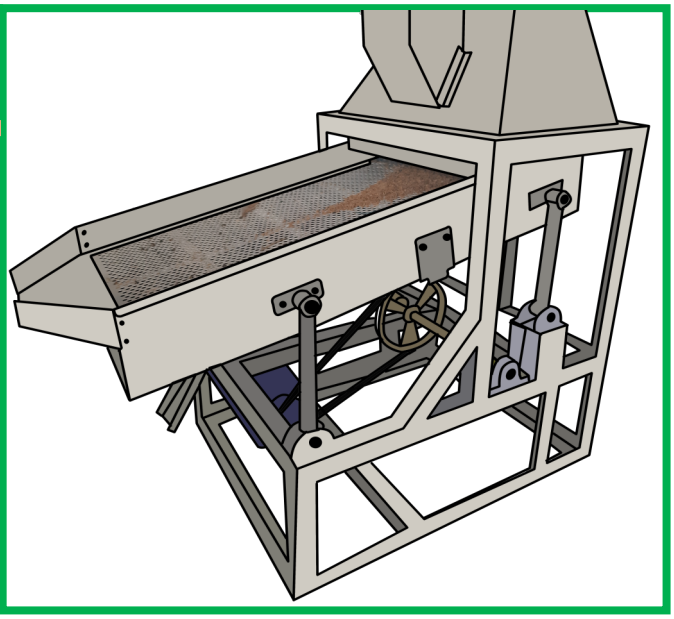


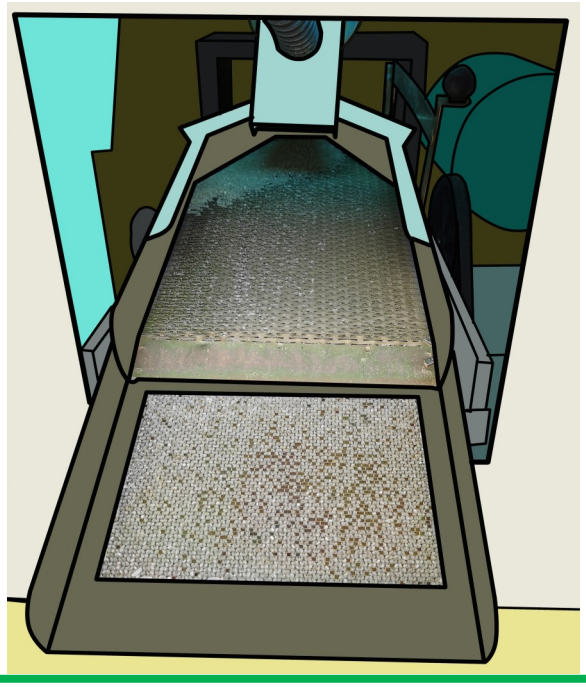
Paddy separator

ancillary device used to separate brown rice from a paddy mixture

Pre-cleaner

ancillary device used to remove foreign matter/impurities from the paddy before milling





Destoner

ancillary device used to separate stones from the paddy and/or brown rice

Rice mill

machine used to remove the hull and bran of the paddy to produce milled rice and consists mainly of hulling and whitening assembly

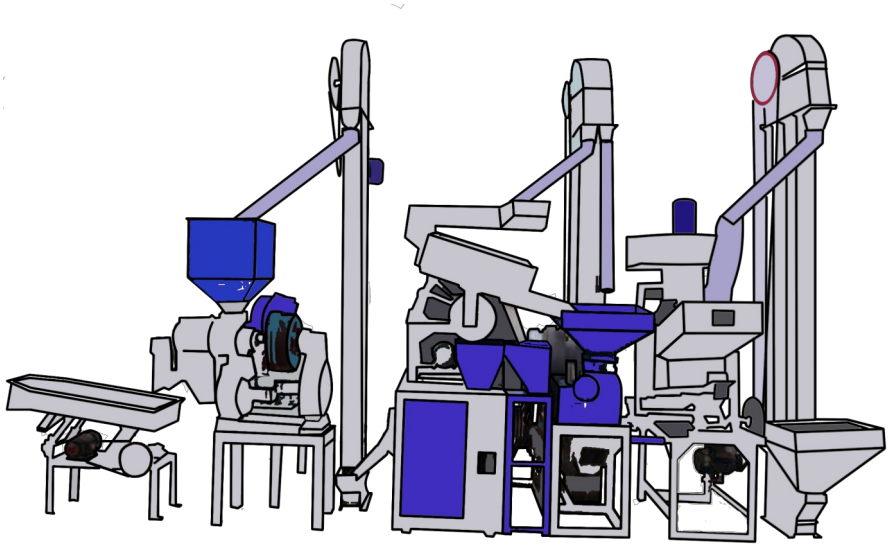
Types of Rice Mill

Single-pass rice mill

removes the husk and bran in one pass and produces white rice directly from the paddy

Multi-stage rice mill

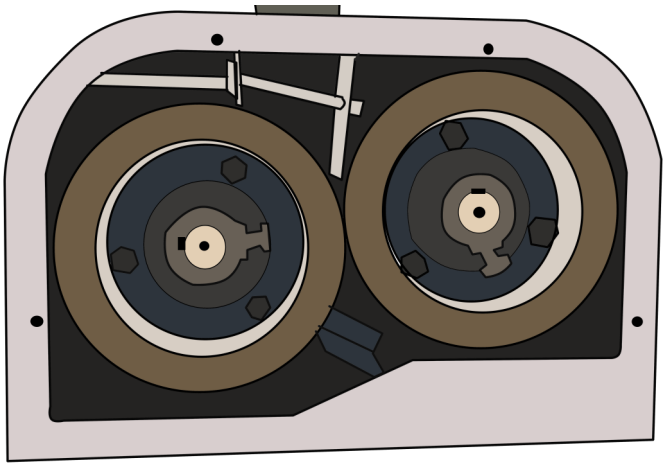
rice passes through a series of different processes and machines from paddy to desired output



Huller (or Husker)

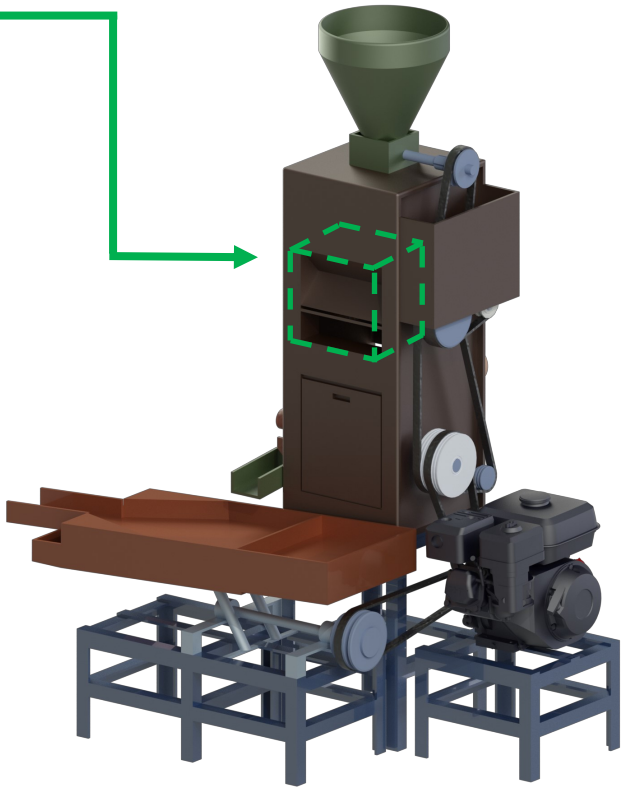
component of a rice mill that removes the hull (palea and lemma) from the grains

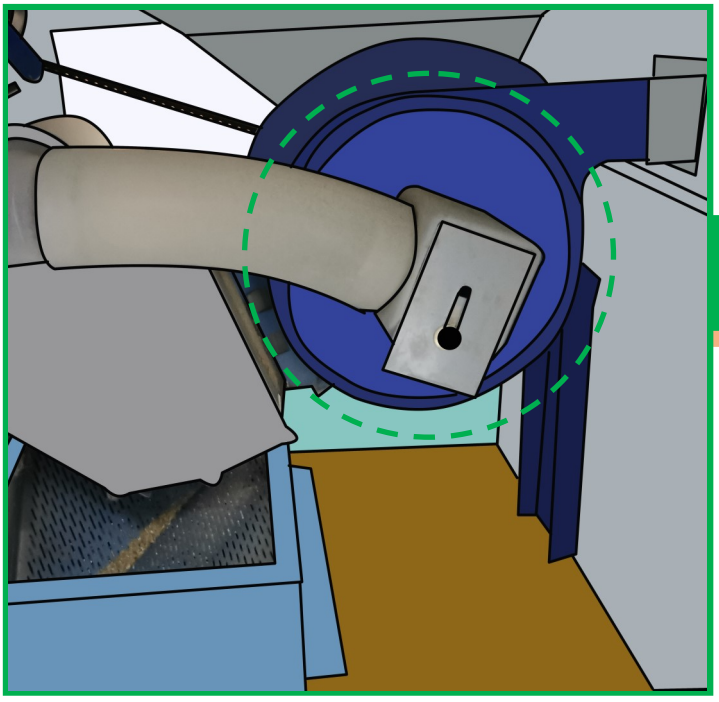
Types of Huller



Rubber roll huller

type of huller made of rubber bonded to an inner metal drum core used for hulling





Impeller-type huller

type of huller with rotating blades and utilizes pressure such as Coriolis' force, frictional force from the blades, or impact force at collision with the blades and the peripheral surface

ILLUSTRATIVE GUIDE

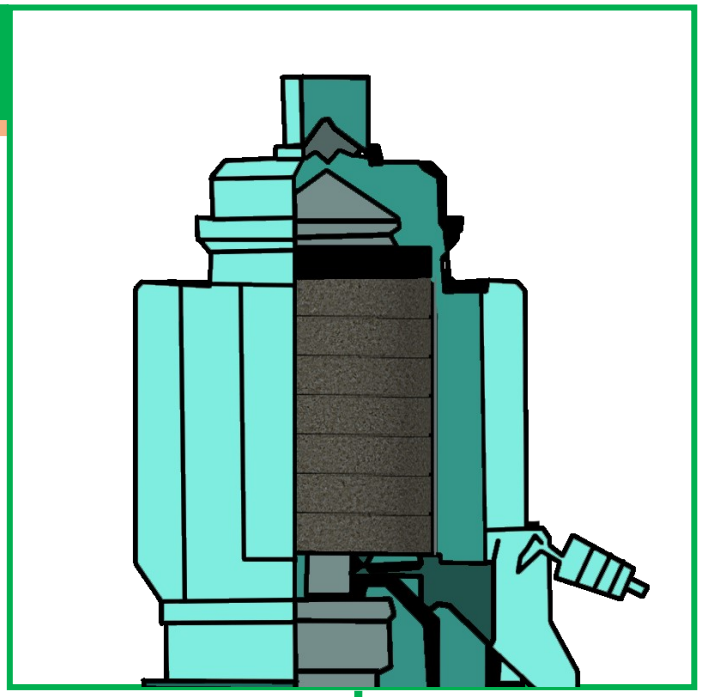
Whitener

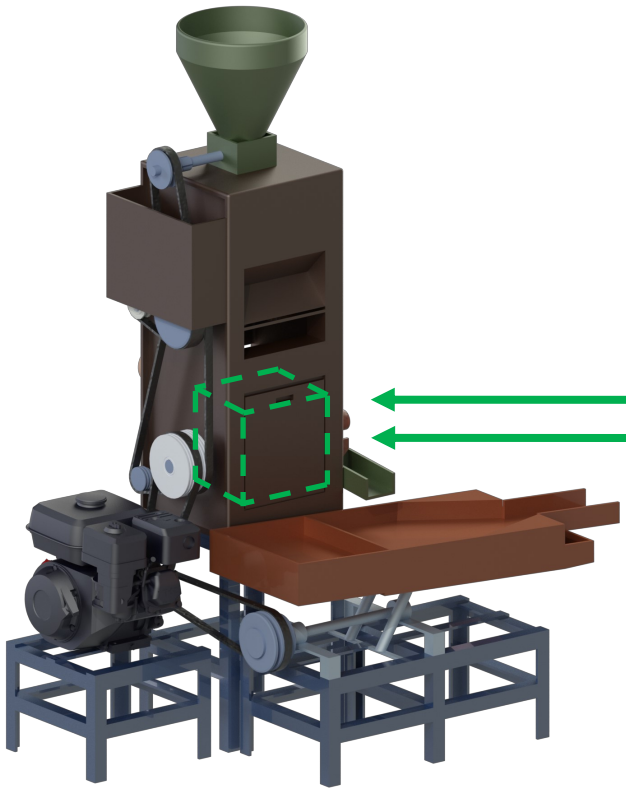
component of a rice mill that removes the bran in the brown rice

Types of Whitener

Abrasive whitener

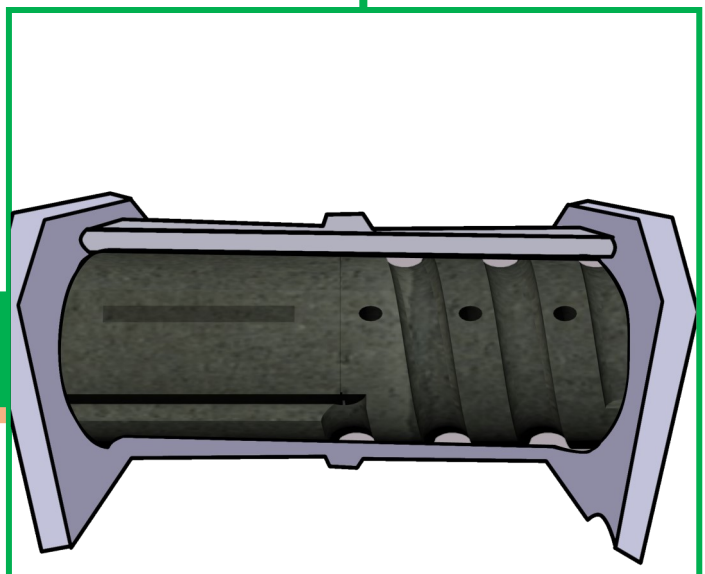
type of whitening machine consisting of a cylinder or cone coated with abrasive material such as emery stone or any similar materials and enclosed in a perforated steel housing





Friction type whitener

type of whitening machine consisting of a ridged cylinder enclosed in a perforated steel housing



ILLUSTRATIVE GUIDE

Other terms used in the document are the following:

Coefficient of hulling
ratio of the dehulled grains to the total amount of grain input

Coefficient of wholeness
ratio of the whole brown rice to the total amount of dehulled grains

Hulling efficiency
product of the coefficient of hulling and the coefficient of wholeness of grains, expressed in percent (%)

Input capacity
weight of paddy per unit loading time into the dumping pit/receiving hopper, expressed in metric tons per hour (MT/hr)

Milling capacity
weight of paddy that the rice mill can process per total milling time, expressed in metric tons per hour (MT/hr)

Milling recovery
ratio of the weight of milled rice to the total weight of paddy, expressed in percent (%)

Milling recovery index
ratio of the milling recovery obtained from the actual testing, to the milling recovery obtained from the laboratory test mill

Percent head rice
ratio of the weight of grains with a size of 75% or more of the whole grain to the total weight of milled rice, expressed in percent (%)

Percent head rice index
ratio of the percent head rice obtained from the actual testing, to the percent head rice obtained from the laboratory test mill

Well milled rice
rice grain from which the hull, germ, outer bran layer, and greater part of the inner bran layer have been removed, but part of the lengthwise streaks of the bran layer may still be present on more than 40% of the sample grains

The classification of rice mill should be based on the following:

2.1 Methods of operation

2.1.1. Single-pass Rice Mill

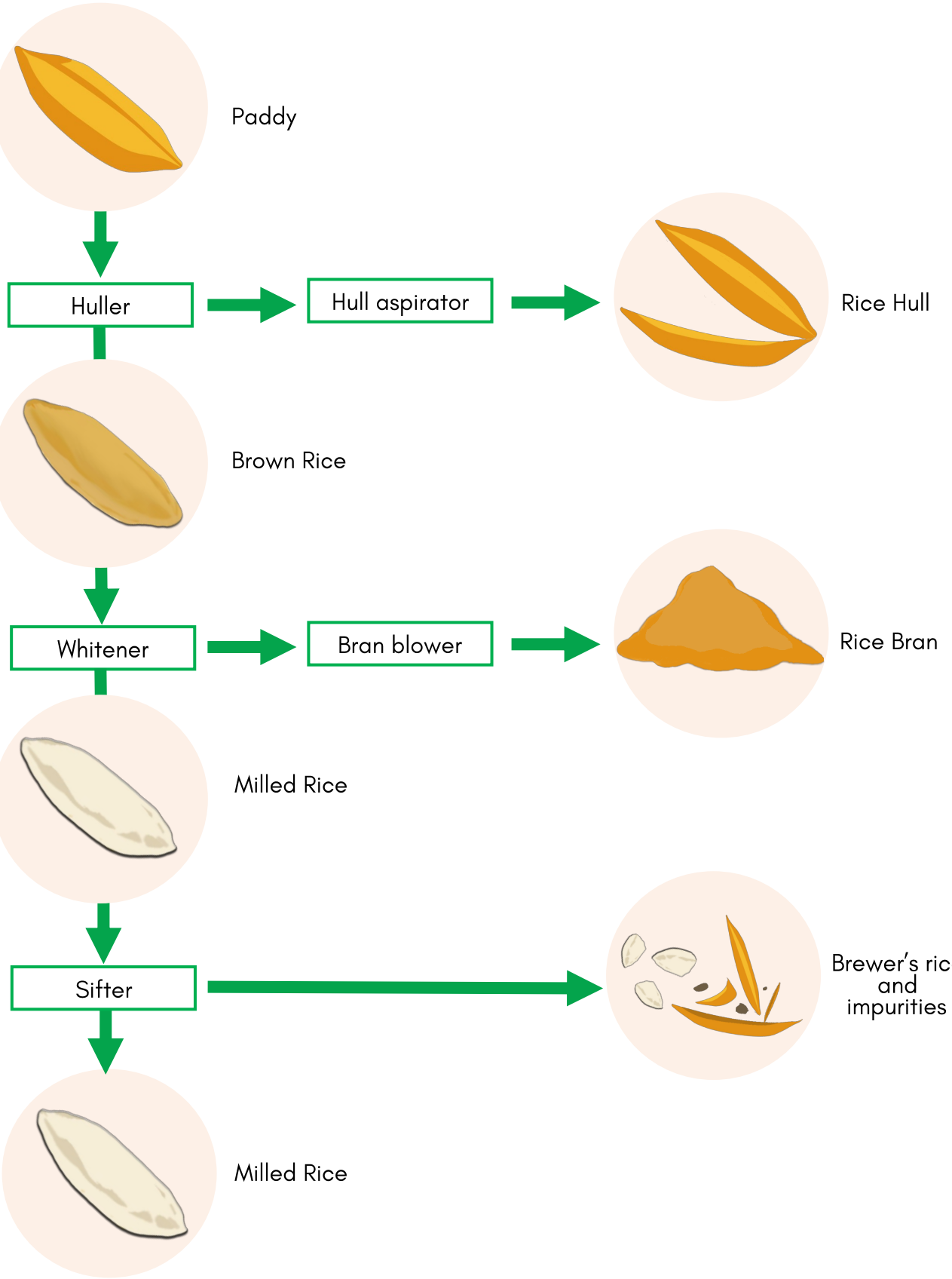
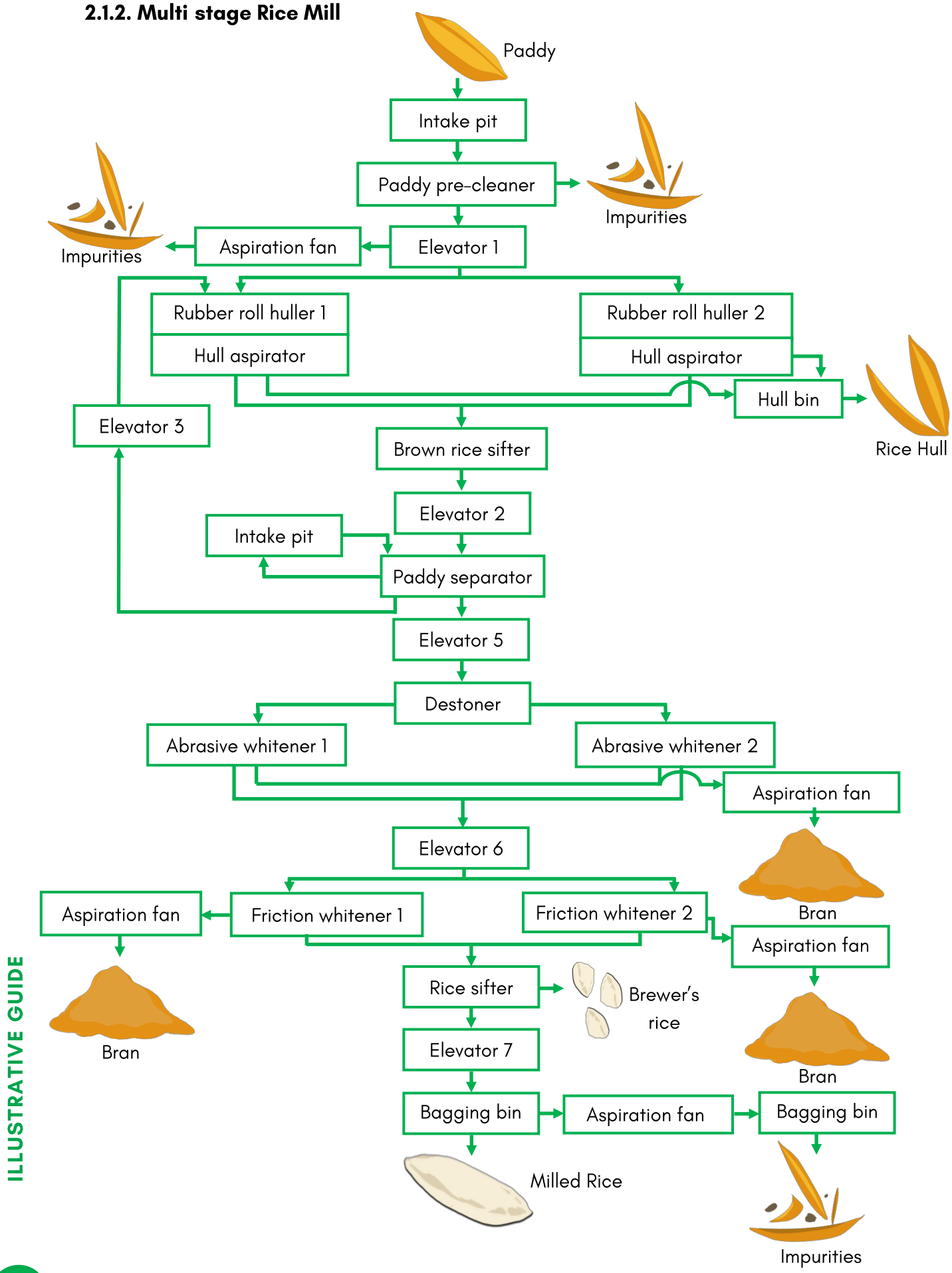


Figure 1. Typical process flow diagram of a single-pass rice mill

2.1.2. Multi stage Rice Mill



ILLUSTRATIVE GUIDE

Figure 2. Typical process flow diagram of a multi-stage rice mill

Types of Huller

Rubber roll huller

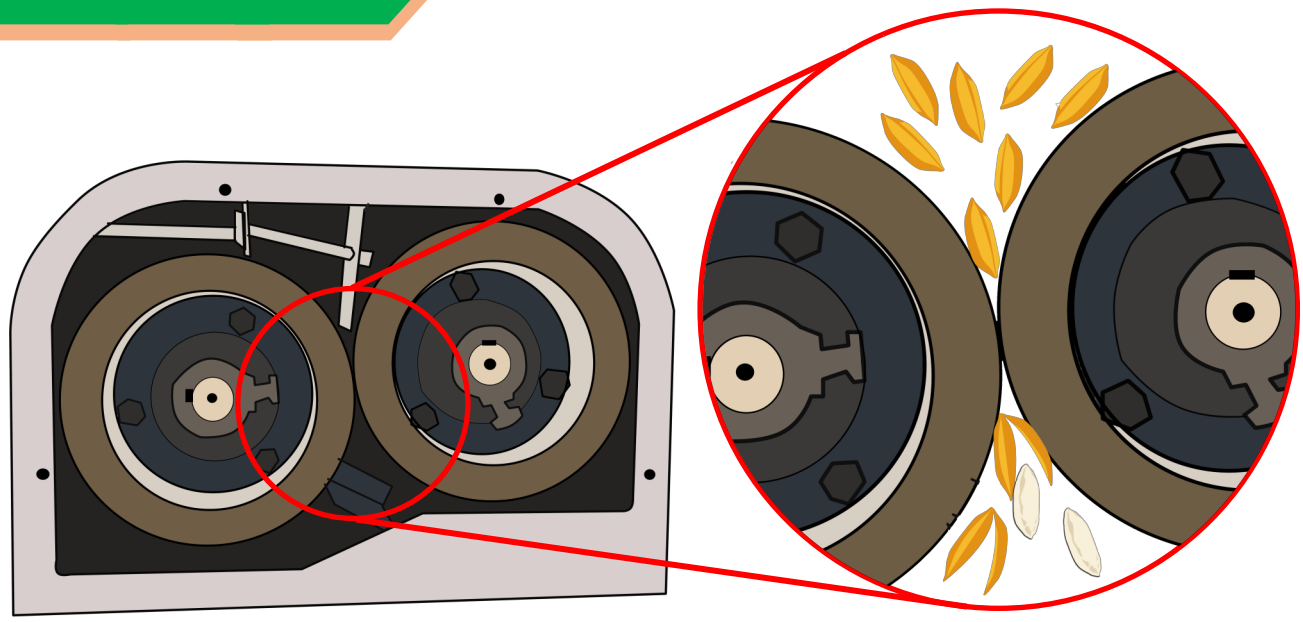


Figure 3. Hulling using rubber roll huller

Impeller-type huller

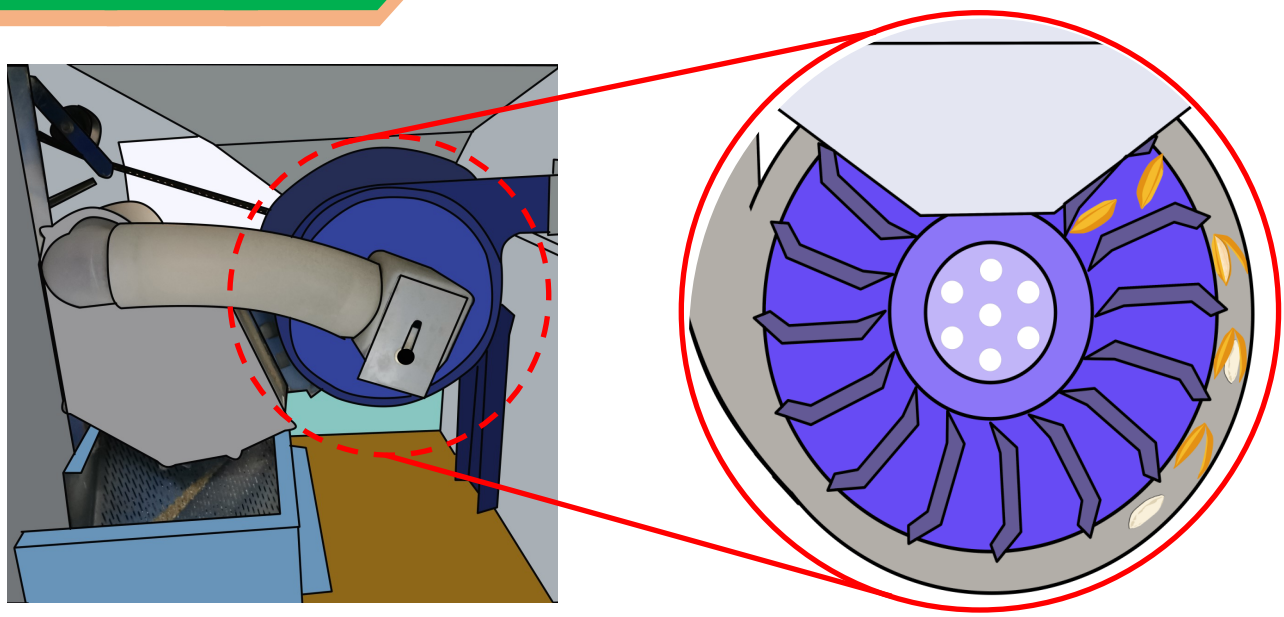


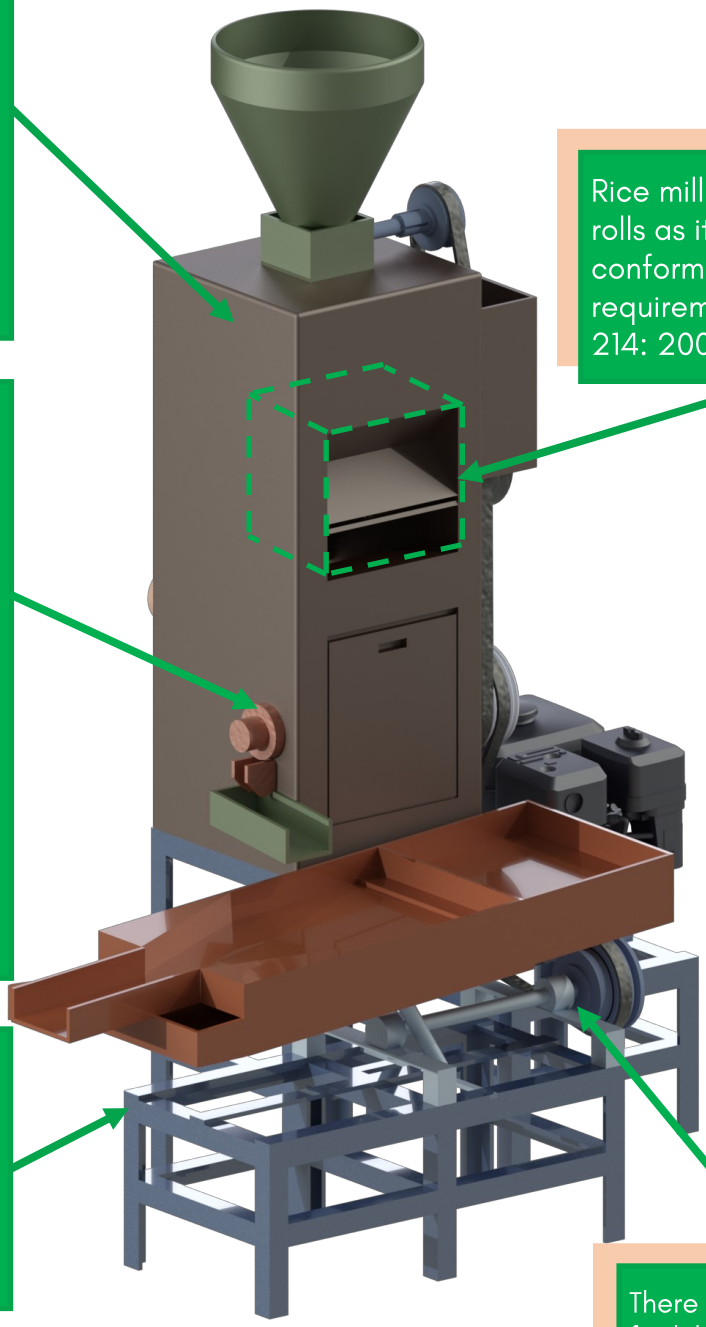
Figure 4. Hulling using impeller type huller (cross section)

ILLUSTRATIVE GUIDE

Steel bars, metal sheet or plate, or any appropriate materials should be used for the manufacture of the different components of rice mill. Parts that are in direct contact with the milled rice should be made of non- corrosive materials.

Rice mill that uses rubber rolls as its hulling unit shall conform with the requirements of PNS/PAES 214: 2004.

Bolts and nuts, screws, bearings, bushing and seals to be used for the fabrication of rice mill shall conform with the requirements of applicable Philippine Agricultural Engineering Standards (PAES) for engineering materials or other applicable international standards.



Frame and stand shall be able to support the whole rice mill assembly during operation. Means to minimize vibration shall be provided.

There shall be provisions for lubrication of non-sealed type bearings.

Figure 5. Fabrication requirements of rice mill

ILLUSTRATIVE GUIDE

4.1 The specified capacity of the machine shall be attained.

4.2 The rubber roll shall be able to process the input capacity as stated in PNS/PAES 214:2004.

4.3 The performance criteria for rice mill for milled rice and brown rice shall be as specified in Table 1 and 2, respectively.

Table 1. Performance Criteria of Rice Mill for Milled Rice

Criteria	Performance Data		
	Rubber roll		Impeller-type
	Single Pass	Multi-stage	
Hulling Efficiency, % minimum	75	79	68
Milling Recovery Index, minimum	0.90	0.95	0.95
Percent Head Rice Index, minimum	0.85	0.90	0.81
Milling Degree	Well milled	Well milled	Well milled
No. of Paddy per kilogram milled rice	15	15	15

Table 2. Performance Criteria of Rice Mill for Brown Rice

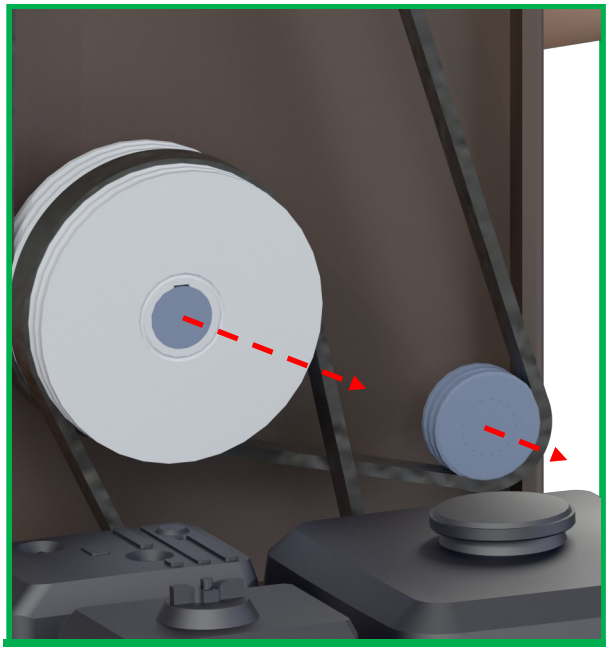
Criteria	Performance Data
Hulling efficiency, % minimum	75
No. of paddy per kilogram, maximum	20

Source: Conrad

The maximum allowable noise level shall be 92 dB.

Source: Jaybro

There shall be provision for ear protection.



The rotating components of the rice mill shall be statically and dynamically balanced.

Warning notice shall be in accordance with PAES:101:2000.

Any uncoated metallic surfaces of the rice mill and other components/appurtenances shall be free from rust and shall be painted properly.

The external part of the rice mill and other components/ appurtenances shall be from sharp edges and rough surfaces that may injure the operator.

The construction of rice mill and other components/ appurtenances shall be rigid, durable, and free from cracks and weak joints.

Rice mill and other components/ appurtenances shall be free from any manufacturing defects that may be detrimental to its operation.

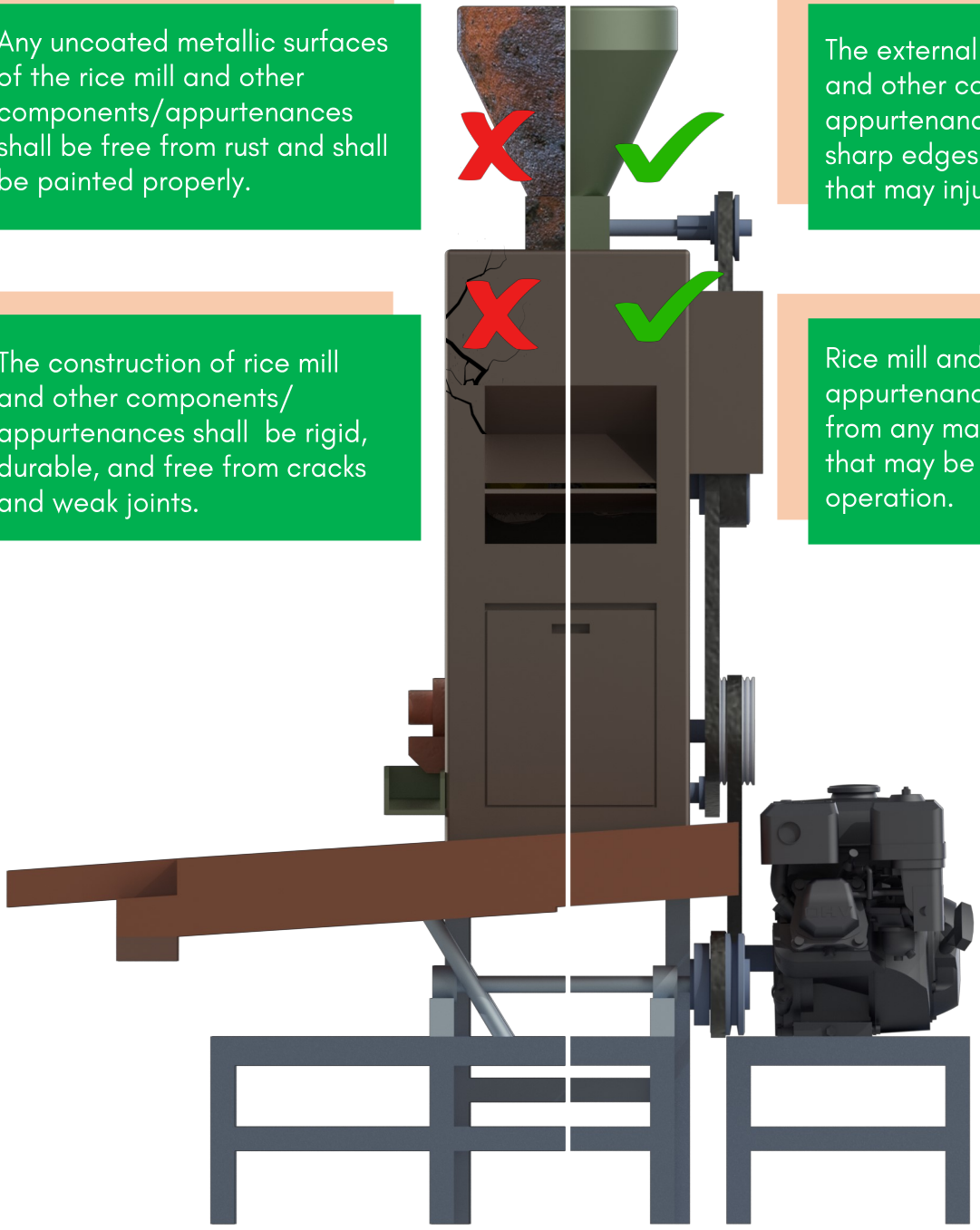
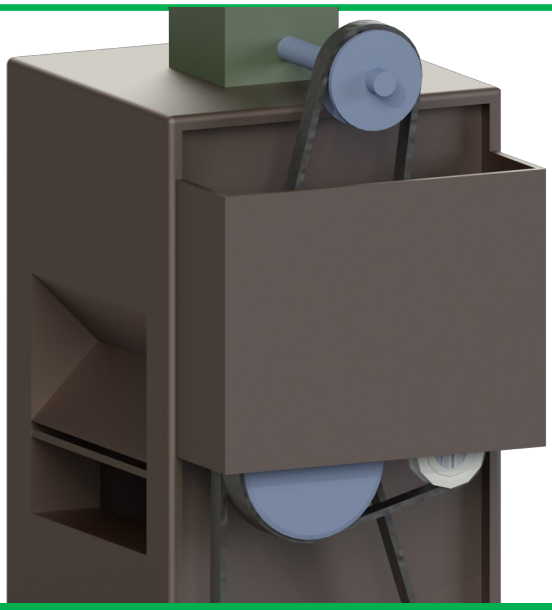


Figure 6. General requirements on safety, workmanship, and finish of rice mill

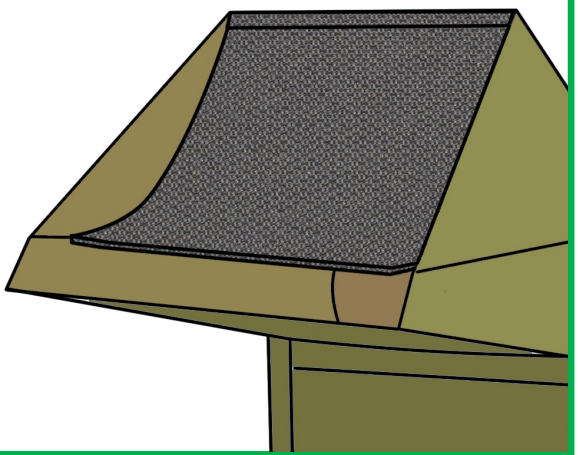
ILLUSTRATIVE GUIDE

Source: Chziri

Mechanism for immediate disengagement of power transmission shall be provided.



There shall be provisions for belt cover or guard, belt tightening, and adjustments.



There shall be provision for the safety of the operators in the feeding port.

Source: Alibaba

There shall be provision for dust collection system.

6.1 Warranty for Fabrication

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

6.2 Maintenance and Operation

6.2.1 Each rice mill shall be provided with at least three (3) pieces of dust masks and the basic tools as specified in the operator's manual.

Source: Michigan State University

Source: www.canva.com

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

6.2.3 The rice mill shall be easy to maintain and operate.

6.3 Sampling

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

6.4 Testing

Rice mill shall be tested in accordance with PNS/BAFS PABES 304:2020.

7.1 Each rice mill and other components/ appurtenances shall be marked at noticeable place with the following information.

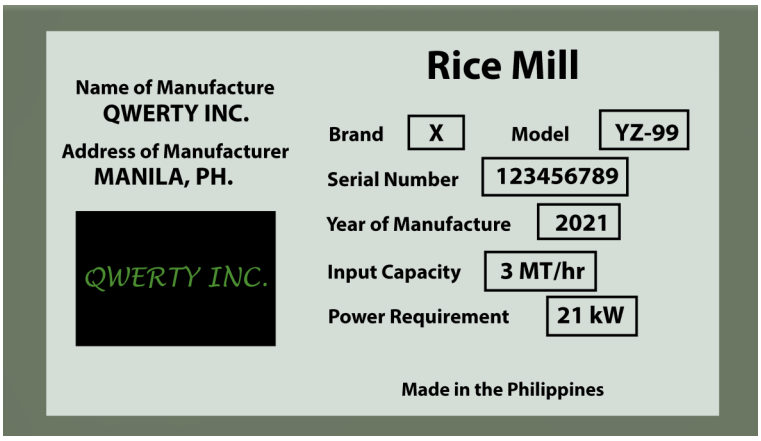


Figure 7. Sample Nameplate

7.1.1 Registered trademark of the manufacturer

7.1.2 Brand

7.1.3 Model

7.1.4 Year of manufacture

7.1.5 Serial number

7.1.6 Name and address of the manufacturer/importer/distributor

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

7.1.8 Input capacity, MT/hr

7.1.9 Power requirement, kW

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

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

Figure 8. Sample safety precaution marking

ANNEX A
(informative)

Other Terms and Definitions Relevant to Rice Milling

Broken grains
pieces of grains smaller than 75% of the average length of the whole grain

Degree of milling
extent to which the bran layers have been removed in hulled rice

Over milled rice
OMR
rice grain from which the hull, the germ, and the bran layers have been removed

Regular milled rice
RMR
rice grain from which the hull, germ, outer bran layers and greater part of the inner bran layers have been removed but part of the lengthwise streaks of the bran layers may still be present on 21% to 40% of the sample grains

Undermilled rice
UMR
rice grain from which the hull, germ, outer bran layer, and greater part of the inner bran layer have been removed, but part of the lengthwise streaks of the bran layer may still be present on more than 40 % of the sample grains

Polished rice
white rice that pass through a polisher

Special rice
rice variety (traditional or modern) with any special quality such as glutinous, aromatic,

DOCUMENT REFERENCES

Bureau of Agriculture and Fisheries Standards (2020). PNS/BAFS PABES 303:2020 Postharvest Machinery—Rice Mill—Specifications.

PHOTO REFERENCES

Cover page

Paddy rice and white rice wallpaper details Free Photo. (n.d.). Retrieved from https://www.freepik.com/free-photo/paddy-rice-white-rice-wallpaper-details_11406531.htm

Page 12 (Left to right)

Sauter Sound level meter Data logger SW 2000 25 - 136 dB 0.02 kHz - 12.5 kHz. (n.d.). Retrieved from https://www.conrad.com/p/sauter-sound-level-meter-data-logger-sw-2000-25-136-db-002-khz-125-khz-1676531 WT.srch=1&vat=true&utm_source=google&utm_medium=organic&utm_campaign=shopping

[Untitled image of ear muffs and ear plugs]. (n.d.). Retrieved from https://www.jaybro.com.au/personal-protection-equipment/hearing-protection/ear-muffs-ear-plugs.html

Page 14 (top to bottom)

Dol Starter Panel Chziri Control Panel for Rice Mill. (n.d.). Retrieved from https://chziri.en.made-in-china.com/productimage/HvhxdTcPbWVY-2f1j00rlRuqjKdMekF/China-Dol-Starter-Panel-Chziri-Control-Panel-for-Rice-Mill.html

Cyclone dust collector for rice mill. (n.d.). Retrieved from https://www.alibaba.com/product-detail/cyclone-dust-collector-for-rice-mill_62342129161.html?spm=a2700.7724857.normal_offer.d_image.10a73a25fujwAk

Page 15 (left to right)

Dust "nuisance" mask. (n.d.). Retrieved from https://ehs.msu.edu/occ/respirator/dustmask-vs-resp.html

[Untitled image of tool set]. Set (n.d.). Retrieved from https://www.canva.com

Technical Working Group

Members:

Agricultural Machinery Manufacturers and Distributors Association

Engr. Joel R. Panagsagan

Mr. Rodolfo H. Tamayo

Bureau of Agricultural and Fisheries Engineering (DA-BAFE)

Engr. Jessa Rica C. Pandiño

Engr. Francis Glenn M. Miro

International Rice Research Institute (IRRI)

Engr. Carlito B. Balingbing

Engr. Joseph M. Sandro

Philippine Rice Research Institute (PhilRice)

Mr. Joel A. Ramos

Dr. Manuel Jose C. Regalado

UPLB - Agricultural Machinery Testing and Evaluation Center (AMTEC)

Engr. Ray D. Alipio

Engr. Fatima Joy J. Raytana

UPLB-CEAT Institute of Agricultural and Biosystems Engineering (IABE)

Dr. Aurelio A. Delos Reyes Jr.

Project Managers:

Bureau of Agriculture and Fisheries Standards (DA-BAFS)

Engr. Abraham L. Perez III

Ms. Kristine P. Lasac

Project Overseers:

Ms. Mary Grace R. Mandigma

Mr. Jan Vincent DR. Tecson

Illustrative Guide (IG) serves as a supplementary Philippine National Standards (PNS) learning material to aid stakeholders to have uniform understanding and interpretation of the PNS for its efficient adoption and implementation.

The development of IG for PNS/BAFS PABES 303:2020 was initiated in 2021 to guide stakeholders on the standards for rice mills. Specifically, this IG for Rice Mill provides supplementary photographs or images pertaining to some provisions of the end-product quality standard for rice mill.

fb.com/da.bafs

instagram.com/da.bafs

www.bafs.da.gov.ph

bafs@da.gov.ph

(+632) 8928 8756 to 65 local 3301 - 3325

ISBN 978-621-455-277-1