POSTHARVEST MACHINERY– RICE MILL – METHODS OF TEST

PNS/BAFS PABES 304:2020

ILLUSTRATIVE GUIDE

Illustrative Guide

Postharvest Machinery – Rice mill – Methods of Test (PNS/BAFS PABES 304:2020)

Bureau of Agriculture and Fisheries Standards (BAFS)
Quezon City, 2022

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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 - Method of Test (PNS/BAFS PABES 304:2020)*. 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 – Methods of Test (PNS/BAFS PABES 304:2020)*. 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

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. To date, 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 Postharvest Machinery – Rice Mill – Methods of Test (*PNS/BAFS PABES 304:2020)* covers the standard procedures and methods to verify the mechanism, specifications and performance of the rice mill. It also serves as reference in determining the effect of milling on grain quality through laboratory analysis, as well as the evaluating the handling and safety procedures to ensure the safety of the machine operators.

Furthermore, the illustrations included in the document were done by the Technical Services Division (TSD) staff, while images used were 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

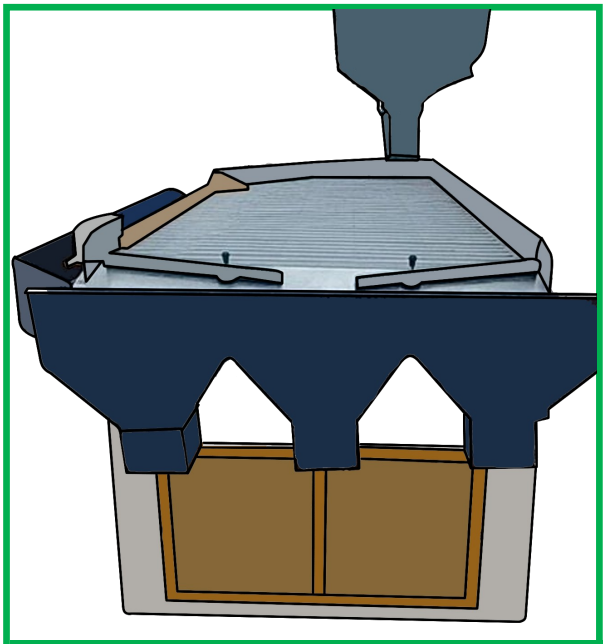
This standard specifies the methods of test for rice mill. Specifically, it shall be used to:

1. verify the mechanism, main dimensions, materials, accessories of the rice mill, and the list of specifications submitted by the manufacturer;
2. determine the performance of the machine;
3. evaluate the ease of handling and safety features;
4. determine the effect of milling on grain quality through laboratory analysis; and
5. report the result of tests.

Brewer's rice

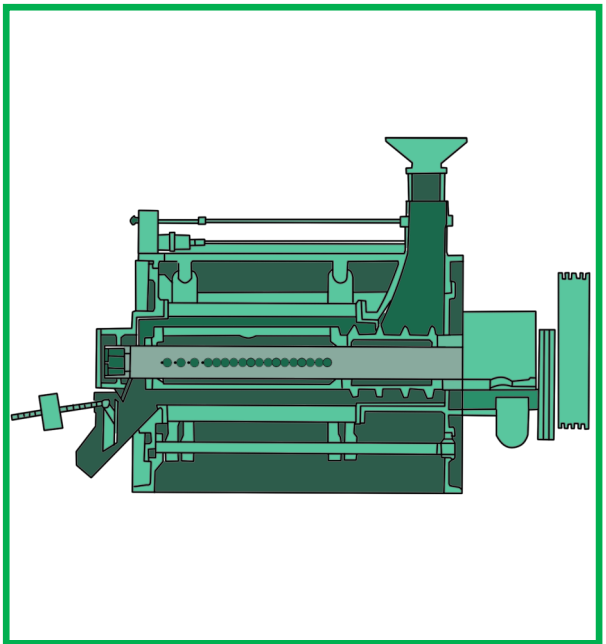
(*Binlid*, chips)

small pieces or particles of grains that pass through a sieve having round perforations of 1.4 mm in diameter



Paddy grader

ancillary device used to separate brown rice from paddy mixture



Polisher

(Pearler)

ancillary device of a rice mill used to remove the remaining bran particles on the milled rice giving it a glossy appearance

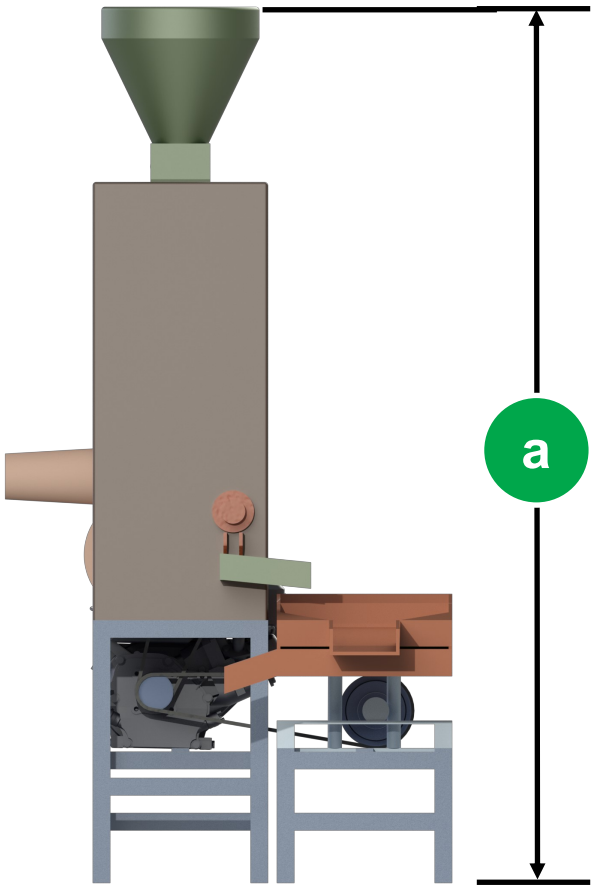


Figure 1. Side view of rice mill

a. Overall height

Distance between the horizontal supporting plane surface and the horizontal plane touching the uppermost part of the rice mill

b. Overall width

Distance between the vertical planes parallel to the median plane of the machine, each plane touching the outermost point of the rice mill on its respective side

c. Overall length

Distance between the vertical planes at the right angles to the median plane of the rice mill and touching its front and rear extremities

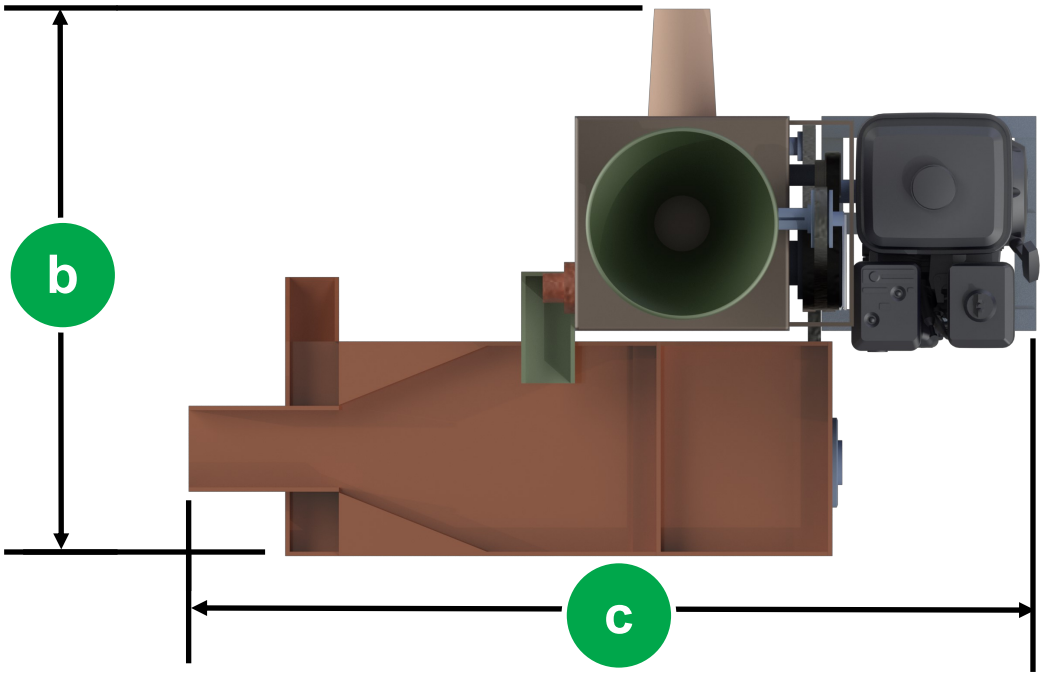


Figure 2. Top view of rice mill

Running-in period

Preliminary operation of the machine make various adjustments prior to the conduct of the test until the operation is stable

Test applicant

Manufacturer, direct importer, or any distributor, dealer, researcher, inventor, or end-user of the machine

Before the start of the test, the rice mill should have undergone a breaking-in period.

The rice mill shall be operated at the test site by the official representative of the test applicant for a sufficient duration with and without load.

During the running-in period, the various adjustments of the rice mill shall be made according to the recommendation of the test applicant.

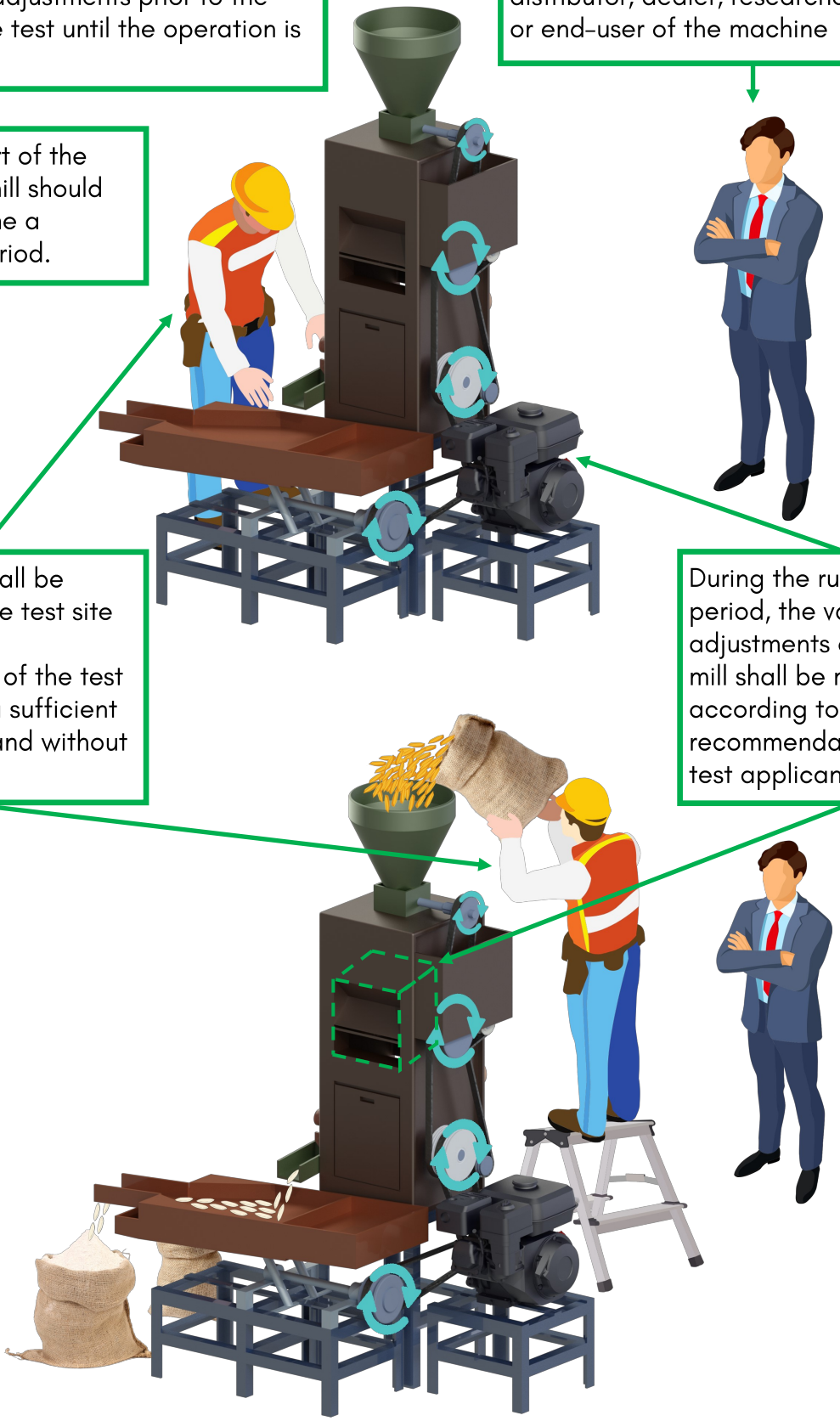


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Figure 3. Running in and preliminary adjustments

2.1 Selection of rice mill to be tested

Rice mill submitted for testing shall be sampled in accordance with PAES 103:2000 Agricultural Machinery – Method of Sampling or any other suitable method of selection.

The sample shall be selected at random from the lot using the following procedure:

Determine the value of r using the following equation:

$$\text{Let } r = \frac{N}{n}$$

where:

r is the upper limit of the set of numbers which will be used in selecting the components or equipment in the sample.

N is the size of the lot

n is the size of the sample for a given lot size (see Table 1)

Table 1. Scale of Sampling

Lot Size N	For Visual and Dimensional Tests	For other tests
	Sample size n	Sample size n
Up to 10		
11 to 25		
26 to 50		
51 to 100	5	
101 to 300	13	
301 to 500	32	5
501 to 1000	50	8
1001 to above	80	13

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Example:
For instance, a lot size (N) equal to 20 shall have a sample size (n) equal to 2 from Table 1. Therefore,

$$\mathbf{r} = \frac{\mathbf{N}}{\mathbf{n}} = \frac{20}{2} = 10$$

Draw any number from 1 to r at random. Let say from 1 to 10, the number drawn is 8 which is our z. Since the component H is the 8th component, it shall be the first sample to be considered.

Starting from component I, count them in order up to 10. The 10th component is component **P**. Therefore; it is the second sample to be considered.

Components	A	B	C	D	E	F	G	**H**	I	J	K	L	M	N	O	P	Q	**R**	S	T
Step B	1	2	3	4	5	6	7	8												
Step C									1	2	3	4	5	6	7	8	9	10	1	2

The samples from each lot shall be tested for ascertaining the conformity of the lot to the requirements of the relevant product specification. The number of samples from each lot shall be taken according to columns 1 and 2 of Table 2.

Table 2. Scale of sampling and permissible number of defectives

Lot Size N	For Visual and Dimensional Tests		For other tests	
	Sample size n	Permissible Number of Defectives	Sample size n	Permissible Number of Defectives
Up to 10		0		0
11 to 25		0		0
26 to 50		0		0
51 to 100	5	0		0
101 to 300	13			0
301 to 500	32		5	0
501 to 1000	50	5	8	
1001 to above	80	7	13	

2.2 Role of the test applicant

The test applicant shall submit specifications and other relevant information about the rice mill. They shall abide with the terms and conditions set forth by the official testing agency.

2.3 Role of the official representative of the test applicant

An officially designated representative of the test applicant shall operate, demonstrate, adjust, repair as the case maybe, and decide on matters related to the operation of the rice mill.

2.4 Test site conditions

The rice mill shall be tested and installed for normal operation. The site should be suitable for normal working condition and have ample provisions for material handling, temporary storage, and workspace. Adequate ventilation and lighting shall be provided in the area.

2.5 Suspension/Termination of test

If during the test run, the rice mill stops due to malfunction affecting the machine's performance, the test may be suspended. If the machine will not be able to continue operation due to breakdown, the test shall be terminated.

3.1 Preparation of the rice mill for testing

The official representative of the test applicant and the official testing agency shall check the rice mill to ensure that it has been assembled and installed in accordance with the instruction of the manufacturer. The official testing agency will test the rice mill according to the specifications of the test applicant.

3.2 Test instruments and other materials

The suggested minimum field and laboratory test equipment and materials needed to carry out the rice mill test are shown below. A list indicating the quantity and some specifications of these equipment and materials can be seen in Annex A.

These instruments shall be calibrated regularly. Before and after each test, these instruments shall be physically checked for operation and shall be cleaned respectively. A checklist of instruments and materials to be used before departure to and from the testing area shall be prepared.

A. Field equipment and materials used for testing

Source: Amazon

Grain moisture meter

Source: Instrumentchoice

Tachometer

Source: DD Biolab

Timer

Source: Keson

Measuring tape

Source: Conrad

Noise level meter

Source: Basic Civil Engineering

Weighing scale

Source: BrandTech

Graduated cylinder

Source: Improve Photography

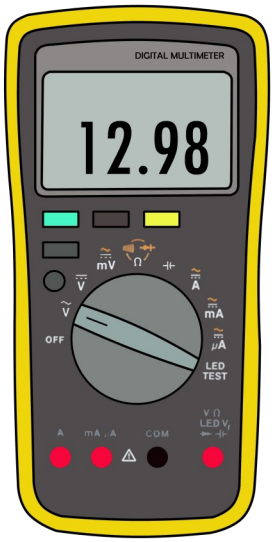
Camera

Source: Seedburo

Bulk density meter

Source: Indiamart

Indented trays of laboratory grader



Power meter

B. Laboratory equipment and materials used for testing

Source: Monotaro.ph

Digital Weighing Scale

Source: Sealandair

Magnifying lens

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Source: Indiamart

Grain sample cleaner

Source: DragLab

Laboratory oven

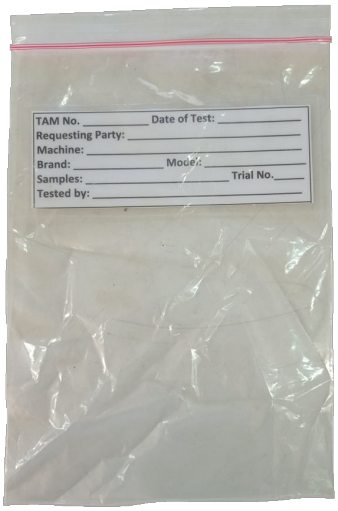
Source: Kouei Trading

Whiteness meter

Source: Amazon

Grain sampler/divider

Grain caliper



Source: UPLB-AMTEC

Sample bags with labeling tag

3.3 Test materials

The test material to be used shall be a single variety paddy. It shall be dried to a uniform moisture content of 14% ± 1% and a minimum purity of 95%.

The amount of test material to be supplied shall be sufficient for one and a half hour of continuous milling operation for the test of single-pass rice mill. Three test trials shall be conducted within the specified time. The excess amount shall be used for running in prior the actual conduct of test trials.

For the test of multi-stage rice mill, the amount of test material to be supplied shall be sufficient for the specified milling capacity (MT/hr) at continuous milling operation. A minimum of two test trials shall be conducted.

If the test materials are not conforming to the recommended quantity and characteristics, the test engineer shall not pursue the test.

4 Pre Test Observation

4.1 Verification of specifications

The specifications claimed by the manufacturer and the physical details given in Annex B shall be verified by the testing agency. A stable and level surface shall be used as reference plane for verification of dimensional specifications of rice mill.

4.2 Test samples

Representative test samples shall be collected from the test material by the official testing agency for analysis. Sampling procedure is shown in Annex C.

5.1 Operation of the rice mill

The rice mill shall be operated at the test applicant's recommended setting of its components. The same setting recommended shall be maintained during the test run. The official testing agency shall make all measurements, which form part of the test and take the prescribed samples. The recommended feeding rate shall be maintained during the test run with a duration of at least 30 minutes.

After the test run, the area shall be cleaned and prepared for the next test trial. This procedure shall be repeated for the succeeding test trials.

No other adjustments shall be permitted during the test.

5.2 Test trials

A minimum of three (3) test trials, with the duration of at least thirty (30) minutes per trial for single- pass and at least one (1) hour per trial for multi- stage rice mill, shall be adopted.

5.3 Sampling

5.3.1 Sampling procedures for input

The conditions of the paddy input such as bulk density, moisture content, purity and percentage cracked grains to be used in each test shall be taken using three (3) "representative samples" each weighing 1.5 kg which represent the different conditions of paddy input in the bulk. This can be done by taking samples each at the top, middle and bottom portions of the bulk. Samples representing the materials for each test trial shall be placed in appropriate containers for laboratory analysis.

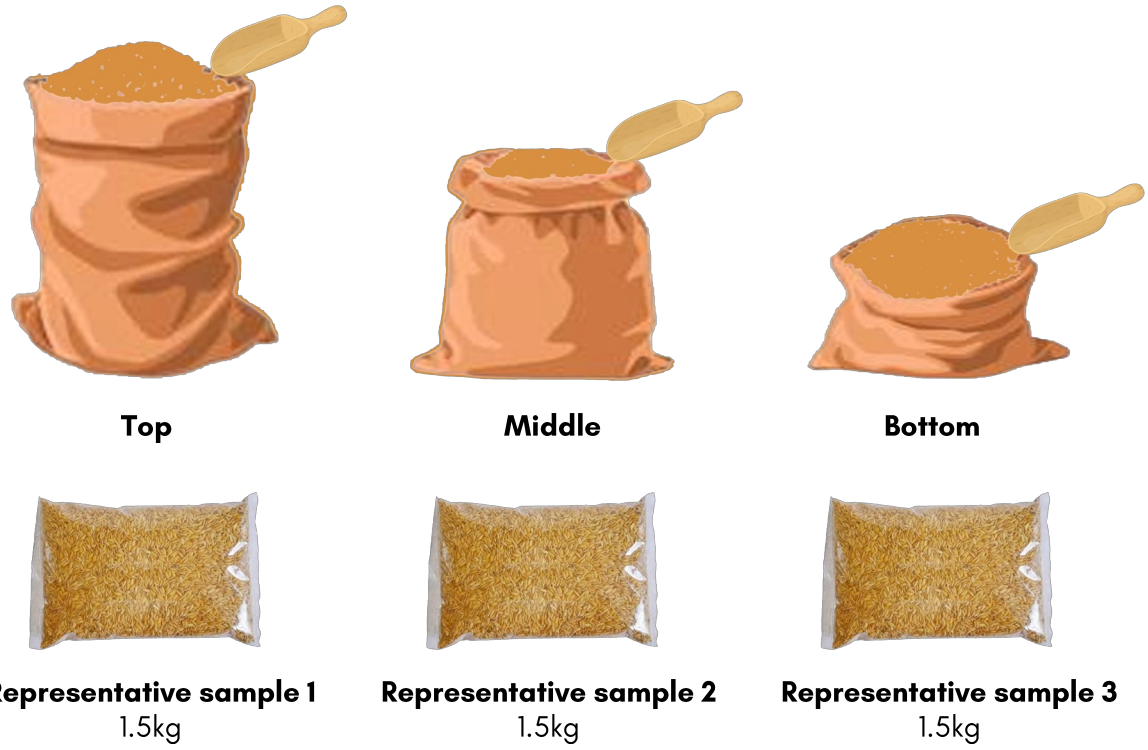


Figure 4. Sampling procedure for input

5.3.2 Sampling from Different Outlets

During each test trial, three (3) sets of samples shall be randomly collected from the outlets of the different components (huller, paddy separator, destoner, whitener, etc.) of the rice mill to be analyzed in the laboratory. The minimum amount of sample to be taken shall be twice as much as what is needed for a particular analysis. The excess sample shall be used for reference purposes or for an eventual second check in case of review.

Figure 5. Sampling from different outlets

5.3.3 Handling of Samples

All samples to be taken to the laboratory shall be placed in appropriate containers with proper labels. Samples that will not be analyzed immediately should be air-dried, and if necessary, treat samples with chemicals such as insecticide in order to prevent the samples from possible damage. If the sample is to be used for determining moisture content, it shall be kept in dry and airtight containers.

3 kilograms each trial

600 grams each trial

Figure 6. Handling of samples

5.4 Data Collection

5.4.1 Duration of Test

The duration of each test trial shall start with the loading of the paddy into the dumping pit/receiving hopper (first drop) and shall end at the last drop of the desired output.

5.4.2 Noise level

5.4.2.1 The sound emitted by the rice mill, with and without load, shall be measured using a sound level meter at the location of the operator/s. The noise level, expressed in decibel [dB (A)], shall be measured 50 mm away from the ear level of the operator/s.

5.4.2.2 For each data to be taken, there shall be a minimum of five (5) observations. Before taking data, it should be ensured that the feed rate, speed, and other functional characteristics have stabilized. The time of recording shall be properly spaced during the whole duration of the test trial.

Figure 7. Measuring of Noise Level at Operator's ear

5.4.3 Power Requirement/Fuel Consumption

5.4.3.1 For rice mill using engine as prime mover

To get the amount of fuel consumed, the tank shall be filled with fuel to a certain marked level before the test. After the test, the tank shall be filled with measured fuel to the same level before the test. When filling up the tank, careful attention shall be given to keep the tank horizontal and not to leave an empty space in the tank.

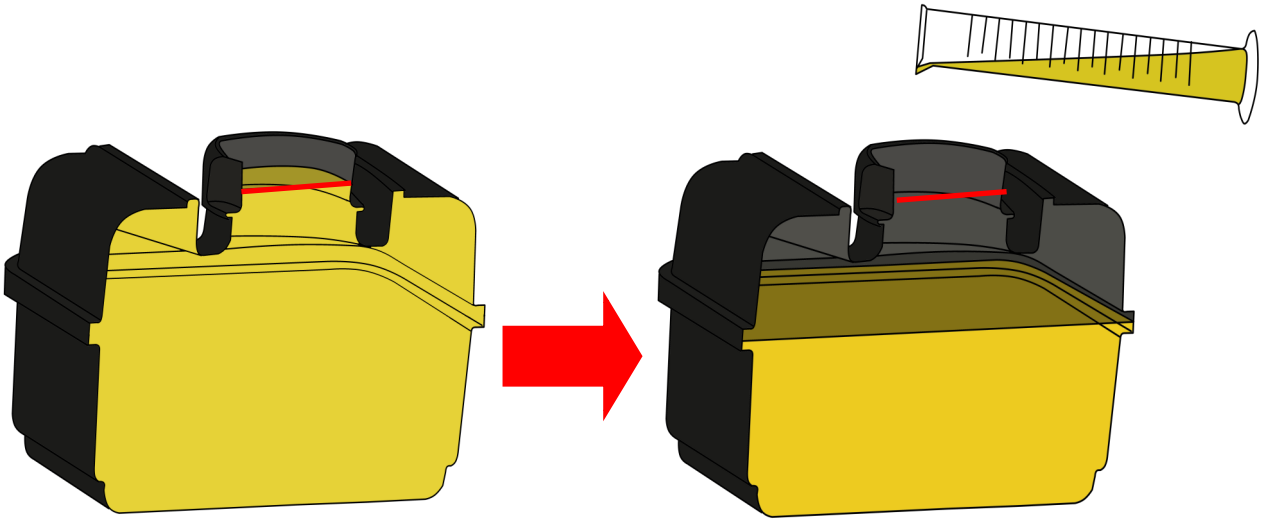


Figure 8. Measuring the amount of fuel consumed in engine powered rice mill

5.4.3.2 For rice mill using electric motors as prime mover

Use a power meter to measure the voltage, current, and the total energy requirement of the rice mill. There shall be three (3) sets of data with a minimum of five (5) observations per set taken with and without load.

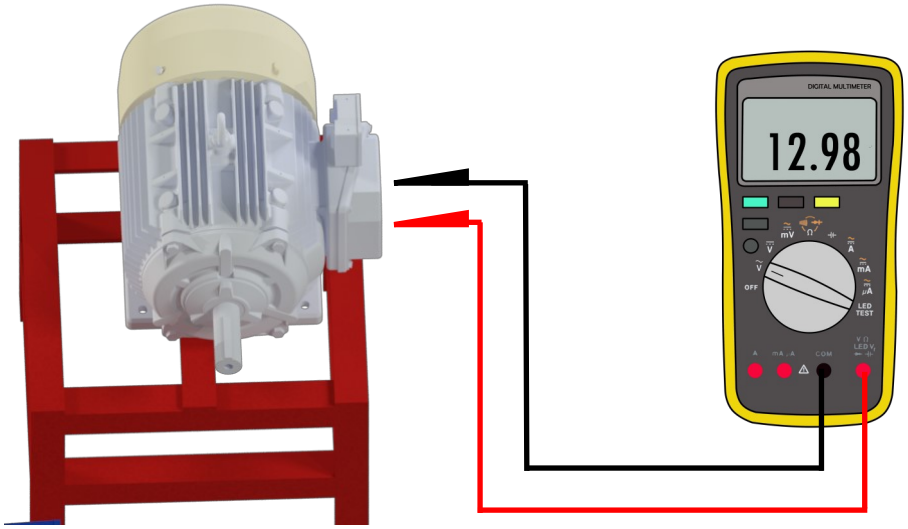


Figure 9. Measuring the power requirement of an electric motor-powered rice mill

5.4.4 Speed of components

The speed of the rotating shafts of the rice mill's major components shall be taken using a tachometer. The requirements for each data to be taken shall conform to 5.4.2.2.

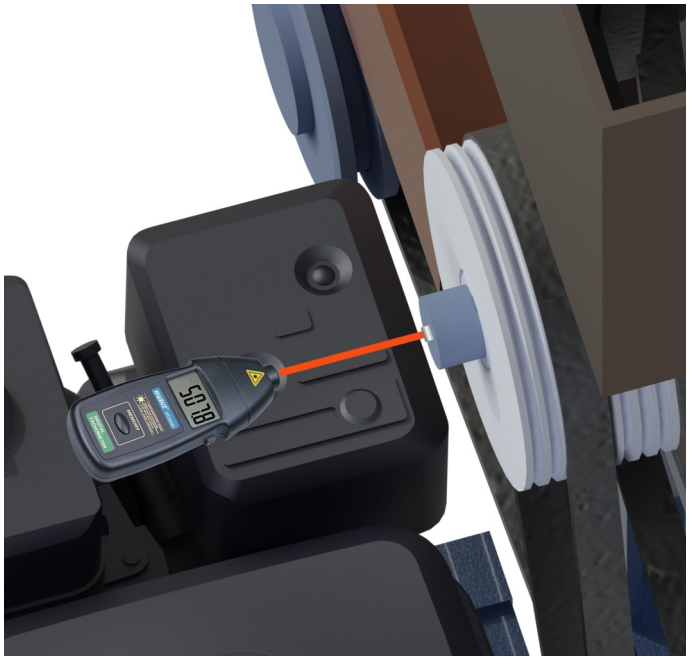


Figure 10. Measuring the speed of the rotating shafts

5.4.5 Data recording and observations

The record sheet for all data and information during the test is given in Annex C. Observations to be taken during the performance test should be recorded in this sheet.

Laboratory analysis shall be made to determine the grain moisture content, purity, bulk density, coefficient of hulling, coefficient of wholeness, cracked grains, milling degree, head rice, brewer's rice, and broken rice. The laboratory procedure to be followed in the analysis and the schematic flow diagram of the conduct of the laboratory analysis are given below and in Figure 9 while the data sheet is given in Annex D.

The quality of milled rice samples from the rice mill shall be compared to the quality of milled rice using the laboratory rubber roll husker/huller and a laboratory whitener.

6.1 Input paddy

The steps in sampling input paddy for processing in the laboratory huller and laboratory whitener as well as determining the grain parameters are shown in Figure 9.

6.1.1 Purity

Each of the three sets of 0.5 kg test paddy sample shall be cleaned. The paddy and impurities obtained from cleaning the paddy samples shall be separated for weighing.

6.1.2 Moisture content

This shall be taken using a calibrated moisture meter or by oven method. At least five (5) representative samples at 500 g each shall be taken randomly for moisture content determination. Refer to PNS/PAES 203:2000.

6.1.3 Cracked grains

Three 100 grains of paddy sample are drawn for manual hulling to determine the percentage of cracked brown rice. Each grain shall be hulled carefully by hand, making sure not to use undue rubbing force or high pressure to minimize mechanical stress on the grain. Each hulled grain or brown rice grains shall be examined for cracks under a magnifying lens against a backlight through a translucent plate or light diffuser. Grains which show cracks or which have been broken during the process of manual hulling shall be counted as cracked grains. Broken grains due to manual hulling shall be counted as broken grains. The mean value determined from the three 100-grain samples shall be taken as the percentage cracked hand-hulled brown rice.

Figure 11a. Sample of grains with crack

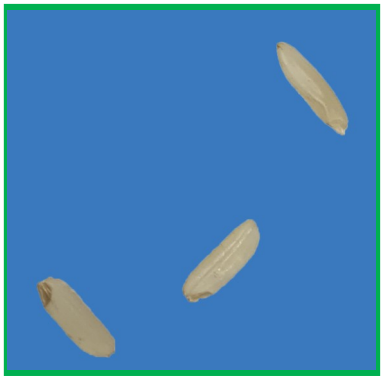


Figure 11b. Sample of grains without crack

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6.1.4 Milled rice grain parameters

Three sets of 100-grams samples of milled rice from the laboratory whitener shall be weighed. Head rice, broken rice, and brewer's rice shall be separated and weighed individually to determine the percentage by weight basis.

6.1.5 Damaged grain

Three sets of 100-grain head milled rice samples shall also be drawn from the head milled rice component and shall be examined under a magnifying lens for grain damage. The percentage of grain damage is taken as the mean value from three sets of 100-grain samples.

6.2 Laboratory analysis of samples from test rice mill

The steps in sampling brown rice and milled rice from test rice mill for analysis of grain parameters are the same as in Figure 12.

6.2.1 Coefficient of hulling

Three sets of samples, each weighing 100g, shall be taken from the huller output. Brown rice and unhulled paddy shall be separated for the determination of coefficient of hulling.

6.2.2 Coefficient of wholeness

Three samples sets of 100-g brown rice shall be taken. The broken brown rice and head brown rice shall be separated. The coefficient of wholeness is determined from the weight of the components and shall be taken as the mean of the three samples.

6.2.3 Grain parameters

The head milled rice recovery, total milling recovery, and percentage by weight basis of broken milled rice and brewer's rice shall be determined from the nominal 200-g milled rice sample.

6.2.4 Milling degree

Milling degree shall be determined using the simple Alcohol-Alkali Bran Staining Method or any other comparable method that can be developed in the future. The method to be used shall be certified by an authorized agency. A procedure for determining the milling degree using the Alcohol-Alkali Bran Staining Method is

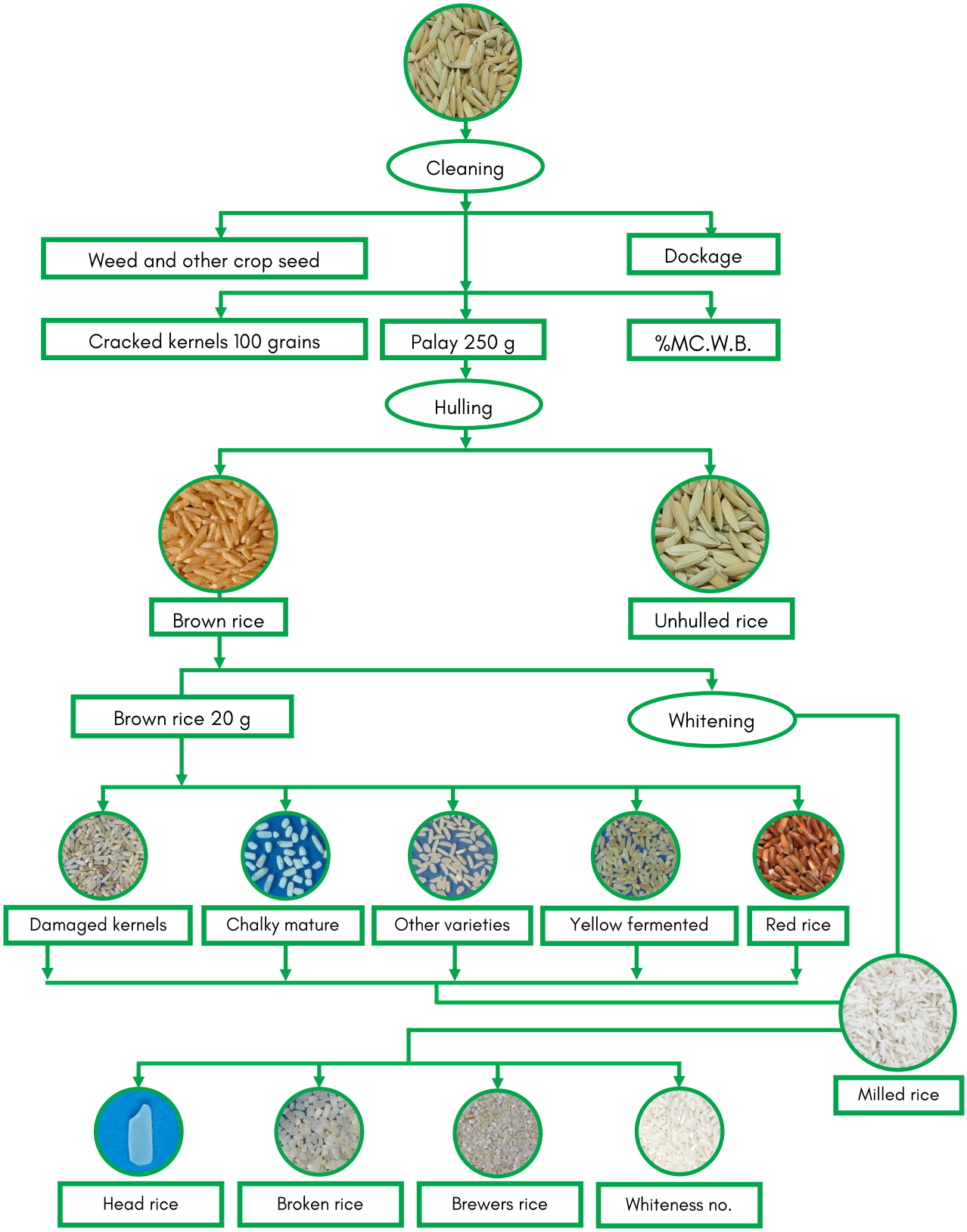

Figure 12. Standard laboratory method in assessing milling quality of paddy

7.1 Presentation of Results

Rice mill specifications and the results of the test shall be presented in tabular form. A schematic diagram of the power transmission system shall also be included. Observations made on the machine while in operation shall be supported with photographs.

7.2 Formula

The formula to be used during calculations and testing is given in Annex F.

7.3 Test Report

The test report shall include the following information in the order given:

1. Title
2. Summary of Results (including the performance compared with the criteria)
3. Purpose and Scope of Test
4. Methods of Test
5. Conditions of the Machine
6. Description of the Machine
7. Results and Discussions
8. Observations (include pictures)
9. Names and Signatures of Test Engineers

Annex A

Minimum List of Field and Laboratory Test Equipment and Materials

Table A.1. Field equipment and materials used for testing

A.1	Field Test Equipment and Materials	Quantity
A.1.1	Grain moisture meter (duly calibrated using the standard method) Range: 12% to 24% (for paddy)	1
A.1.2	Tachometer, contact type, range: 0–5000 rpm; or Photoelectric, range: 0–5000 rpm	1
A.1.3	Timers Capacity: 60 minutes Accuracy: 0.1 second	2
A.1.4	Measuring tape Capacity: 5m	1
A.1.5	Noise level meter Range: 30 to 130 dB(A)	1
A.1.6	Noise level meter Range: 30 to 130 dB(A)	1
A.1.7	Graduated cylinder (for engines) 500 mL capacity	1
A.1.8	Camera	1
A.1.9	Bulk density meter	1
A.1.10	Indented trays of laboratory grader	1
A.1.11	Power meter	1

Table A.2 . Laboratory equipment and materials used for testing

A.2	Laboratory Test Equipment and Materials	Quantity
A.2.1	Digital weighing scale Resolution: 0.01 g	1
A.2.2	Magnifying lens (minimum of 10 magnifications)	1
A.2.3	Grain sample cleaner	1
A.2.4	Laboratory oven	1
A.2.5	Whiteness meter	1
A.2.6	Grain sampler/ divider	1
A.2.7	Grain caliper	1
A.2.8	Sample bags	50
A.2.9	Labeling tags which include: Date of test Rice mill on test Sample source Variety Trial number	

Annex B

Specifications of Rice Mill

Name of Applicant : _____
Address : _____
Tel. No. : _____

Name of Manufacturer : _____
Address : _____
Tel. No. : _____

GENERAL INFORMATION

Make : _____ Type : _____
Serial No. : _____ Brand/Model : _____
Date of Manufacture: _____
Testing Agency : _____ Test Engineer: _____
Location of Test : _____ Date of Test : _____

Table B. List of rice mill specifications for verification

No.	Item*	Manufacturer's Specification	Verification by the Testing Agency
B.1	**Dimensions (mm)**		
B.1.1	Overall length		
B.1.2	Overall width		
B.1.3	Overall height		
B.2	**Prime mover**		
B.2.1	Electric motor		
B.2.1.1	Brand		
B.2.1.2	Type		
B.2.1.3	Make of manufacturer		
B.2.1.4	Serial number		
B.2.1.5	Rated power (kW)		
B.2.1.6	Rated speed (rpm)		
B.2.1.7	Phase		
B.2.1.8	Voltage (V)		
B.2.1.9	Current (A)		
B.2.1.10	Frequency (Hz)		
B.2.2	Engine		
B.2.2.1	Brand		
B.2.2.2	Model		
B.2.2.3	Type		
B.2.2.4	Make of manufacturer		

Table B.1. Continued

B.2.2.5	Serial number		
B.2.2.6	Rated power (kW)		
B.2.2.7	Rated speed (rpm)		
B.2.2.8	Displacement (cm^3)		
B.2.2.9	Cooling system		
B.2.2.10	Starting system		
B.2.2.11	Condition (brand new/re-manufactured)		
B.3	**Dumping pit/Receiving hopper**		
B.3.1	Type		
B.3.2	Holding capacity (kg)		
B.3.3	Materials of construction		
B.3.4	Features		
B.4	**Pre-cleaner**		
B.4.1	Type		
B.4.2	Size (mm)		
B.4.3	Materials of construction		
B.5	**Hulling unit**		
B.5.1	Type		
B.5.2	Size (mm)		
B.5.3	Materials of construction		
B.5.4	Motor		
B.5.4.1	Rated power (kW)		
B.5.4.2	Rated speed (rpm)		
B.6	**Paddy separator**		
B.6.1	Type		
B.6.2	No. of trays/compartments		
B.6.3	Motor		
B.6.3.1	Rated power (kW)		
B.6.3.2	Rated speed (rpm)		
B.7	**Destoner**		
B.7.1	Type		
B.7.2	Motor		
B.7.2.1	Power (kW)		
B.7.2.2	Speed (rpm)		

Table B.1. Continued

B.8	**Whitener**		
B.8.1	Type		
B.8.2	Motor		
B.8.2.1	Power (kW)		
B.8.2.2	Speed (rpm)		
B.9	**Polisher**		
B.9.1	Type		
B.9.2	Motor		
B.9.2.1	Power (kW)		
B.9.2.2	Speed (rpm)		
B.10	**Elevator(s)**		
B.10.1	Type		
B.10.2	No. of units		
B.10.3	Size of buckets		
B.10.4	Motor		
B.10.4.1	Power (kW)		
B.10.4.2	Speed (rpm)		
B.11	**Rice sifter**		
B.11.1	Type		
B.11.2	Size (mm)		
B.11.3	No. of screen		
B.11.4	Sizes of perforations (mm)		
B.11.5	Material of construction		
B.12	**Bagging bin**		
B.12.1	Capacity (kg)		
B.12.2	Material of construction		
B.13	**Safety devices**		
B.14	**Special features**		

*The parameter will be checked upon availability

B.15 Illustration of transmission system

Annex C

Performance Test Data Sheet

Test Trial No.: _____ Date: _____
Test Engineers: _____ Location: _____
Assistants: _____ Machine: _____
Test Requested By: _____ Manufacturer: _____

Table C. Data sheet for the determination of rice mill performance

No.	Items	Trial 1	Trial 2	Trial 3	Average
C.1	Conditions of crop				
C.1.1	Crops				
C.1.2	Source				
C.1.3	Variety				
C.1.4	Moisture content (%)				
C.2	Weight of input (T)				
C.3	Input time (hr)				
C.4	Input capacity (MT/hr)				
C.5	Weight of milled rice (T)				
C.6	Output time (hr)				
C.7	Output capacity (MT/hr)				
C.8	Milling time (hr)				
C.9	Milling capacity (MT/hr)				
C.10	Speed of components (rpm)				
C.10.1	Paddy cleaner motor				
C.10.1.1	Without load				
C.10.1.2	With load				
C.10.2	Paddy cleaner motor				
C.10.2.1	Without load				
C.10.2.2	With load				
C.10.3	Rubber roll (fixed)				
C.10.3.1	Without load				
C.10.3.2	With load				
C.10.4	Rubber roll (adjustable)				
C.10.4.1	Without load				
C.10.4.2	With load				
C.10.5	Rubber roll motor				
C.10.5.1	Without load				
C.10.5.2	With load				

Table C. Continued

C.10.6	Paddy separator				
C.10.6.1	Without load				
C.10.6.2	With load				
C.10.7	Abrasive whitener				
C.10.7.1	Without load				
C.10.7.2	With load				
C.10.8	Friction whitener				
C.10.8.1	Without load				
C.10.8.2	With load				
C.10.9	Rice sifter				
C.10.9.1	Without load				
C.10.9.2	With load				
C.10.10	Main drive				
C.10.10.1	Without load				
C.10.10.2	With load				
C.11	Noise level, (dB(A))				
C.11.1	Operator				
C.11.1.1	Without load				
C.11.1.2	With load				
C.11.2	Bagger				
C.11.2.1	Without load				
C.11.2.2	With load				
C.12	Power consumption				
C.12.1	Power (kW)				
C.12.1.1	Without load				
C.12.1.2	With load				
C.12.2	Current (A)				
C.12.2.1	Without load				
C.12.2.2	With load				
C.12.3	Voltage (V)				
C.12.3.1	Without load				
C.12.3.2	With load				
C.13	Fuel consumed (L)				
C.14	Fuel consumption (L/hr)				

C.15 Other Observations

C.15.1 Ease of transporting the machine

_____
_____
_____

C.15.2 Ease of cleaning of parts

_____
_____
_____

C.15.3 Ease of adjustment

_____
_____
_____

C.15.4 Ease of loading input and collecting output

_____
_____
_____

C.15.5 Safety

_____
_____
_____

C.15.6 Labor requirements

_____
_____
_____

C.15.7 Failure or abnormalities that may be observed on the machine or its component parts during and after the cleaning operation

_____
_____
_____

C.15.8 Others

_____
_____
_____

Annex D

Laboratory Analysis Data Sheet

Table D. List of Rice Mill Specifications for Verification

No.	Item*	Trial						Mean	
		1		2		3			
		Control[1]	Test[2]	Control[1]	Test[2]	Control[1]	Test[2]	Control[1]	Test[2]
D.1	Test paddy								
D.1.1	Purity								
D.1.2	Moisture content, wet basis								
D.1.3	Cracked hand-hulled brown rice								
D.1.4	Bulk density								
D.2	Brown rice								
D.2.1	Chalky and immature (%)								
D.2.2	Yellow and fermented (%)								
D.2.3	Red rice (%)								
D.2.4	Coefficient of hulling								
D.2.5	Coefficient of wholeness								
D.2.6	Hulling efficiency (%)								
D.3	Milled rice								
D.3.1	Weight of 1000 whole milled rice (g)								
D.3.2	Damaged milled rice (%)								
D.3.3	Broken milled rice (%)								
D.3.3.1	Based on input paddy								
D.3.3.2	Based on total milled rice								
D.3.4	Brewer's rice (%)								
D.3.4.1	Based on input paddy								
D.3.4.2	Based on total milled rice								
D.3.5	Head milled rice recovery (%)								
D.3.5.1	Based on input paddy								
D.3.5.2	Based on total milled rice								
D.3.6	Total milling recovery (%)								
D.3.7	Milling degree (%)								

Annex E

Determining the Milling Degree of Milled Rice (Alcohol-Alkali Bran Staining Method)

Alcohol-Alkali Bran Staining is a method of determining the milling degree which involves dipping the rice kernels in a 2% KOH-EtOH (Potassium Hydroxide-Ethyl Alcohol) solvent where the residual bran layers shown up as brown patches or streaks against a background of light yellow endosperm.

Alcohol-Alkali Staining Solvent is a solution of 2% KOH-EtOH (Potassium Hydroxide-Ethyl Alcohol) in a volume ratio of 1:3.

Bran Streaks (BS) are longitudinal bran layers remaining in the dorsal grain grooves after milling.

Methodology

1. Preparation of the Alcohol-Alkali Staining Solution
   a. Prepare 2% KOH (Potassium Hydroxide)
      i. Weigh 20 grams of KOH
      ii. Dissolve in 1.0 L of distilled water
   b. Mix the 2% KOH with ethyl alcohol (EtOH) in a volume ratio of 1:3 to form the 2% KOH-EtOH solution. Shake or mix well.

2. Preparation of Rice Samples
   a. Separate the head rice from the broken grains with the use of indented plates. Discard the brokens.
   b. Mix thoroughly the head rice kernels.
   c. Prepare the working sample for three (3) trials consisting of 100 pieces per trial, using a grain counter.

3. Staining Procedure
   a. Place the kernels (100) pieces in a petri dish and pour twenty milliliters (20 mL) of 2% KOH-EtOH solvent into the dish.
   b. Cover the dish. Allow to stand for 15 minutes.
   c. Pour off and discard the staining solution.
   d. Transfer the stained head rice sample on a piece of white bond paper and air dry for about 5 minutes.

4. Determination of Milling Degree
   a. Using either a grain picker or finger, separate the stained kernels with residual bran streak/s whose length is at least 2 mm or aggregate of 2 mm. Residual bran streaks are highlighted distinctly brown against a background of light yellow endosperm.
   b. Count the separated kernels with bran streaks. The count corresponds to the percentage of kernels with bran streaks (BS) in a working sample, Present the result as number of kernel with bran streak per 100 grain sample.

NOTE: Adopted from the Procedure for Determining the Milling Degree of Milled Rice by the National Food Authority (NFA).

Figure 13. Rice kernels with bran streaks

Annex F

Formula Used During Calculations and Testing

	Formula	where:
Input capacity	$C_i = \frac{W_i}{T_l}$	C_i is the input capacity (T/hr) W_i is the weight of input paddy (T) T_l is the total loading time (hr)
Milling capacity	$C_m = \frac{W_i}{T_m}$	C_m is the milling capacity (T/hr) W_i is the weight of input paddy (T) T_m is the total milling time (hr)
Milling recovery	$M_r = \frac{W_{cmr}}{T_{mmr}} \times 100$	M_r is the milling recovery (%) W_{cmr} is the weight of clean milled rice (kg) W_{cp} is the weight of clean paddy (kg)
Hulling efficiency	$H_e = (H_c \times W_c)100$	H_e is the hulling efficiency (%) H_c is the coefficient of hulling W_c is the coefficient of wholeness
Coefficient of hulling	$H_c = \frac{W_{br}}{W_{br+up}}$	H_c is the coefficient of hulling W_{br} is the weight of brown rice (kg) W_{br+up} is the weight of brown rice and unhulled paddy (kg)
Coefficient of wholeness	$W_c = \frac{W_s}{t_s}$	W_c is the coefficient of wholeness W_s is the weight of whole brown rice (kg) t_s is the weight of the total hulled samples (kg)
Percent head rice	$H_r = \frac{W_{hr}}{W_{mr}} \times 100$	H_r is the percent head rice (%) W_{hr} is the weight of head rice (g) W_{mr} is the weight of milled rice (g)
Percent broken rice	$B_r = \frac{W_r}{W_{mr}} \times 100$	B_r is the percent broken rice (%) W_r is the weight of broken rice (g) W_{mr} is the weight of milled rice (g)
Percent brewers rice/ *binlid*/ chips	$R_b = \frac{W_{bc}}{W_{mr}} \times 100$	R_b is the percent brewers rice (%) W_{bc} is the weight of brewers rice (g) W_{mr} is the weight of milled rice (g)
Milling recovery index	$MR_i = \frac{MR_a}{MR_l}$	MR_i is the milling recovery index (decimal) MR_a is the milling recovery obtained from actual testing (%) MR_l is the milling recovery obtained from laboratory test (%)
Percent head rice index	$HR_i = \frac{HR_a}{HR_l}$	HR_i is the percent head rice recovery index (decimal) HR_a is the percent head rice obtained from actual testing (%) HR_l is the percent head rice obtained from laboratory test (%)

DOCUMENT REFERENCES

Bureau of Agriculture and Fisheries Standards (2020). PNS/BAFS PABES 304:2020 Postharvest Machinery - Rice Mill - Methods of Test.

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 7 (Left to right)

ZZQQ Digital Grain Moisture Meter MD7822 LCD Display Humidity Tester Contains Wheat Corn Rice Moisture Test Meter. (n.d.). Retrieved from https://www.amazon.com/Digital-Moisture-Display-Humidity-Contains/dp/B07ZKKC4QJ

Digital Laser Non-Contact Photo Tachometer. (n.d.) Retrieved from https://www.instrumentchoice.com.au/dm-6234p-digital-laser-non-contact-photo-tachometer-rpm-measurer-with-led-laser-for-hvac-automotive-

Page 8 (Left to right; top to bottom)

Digital stopwatch 1 Display line. (n.d.). Retrieved from https://www.ddbiolab.com/frontoffice/product?produitId=0D-17-59

[Untitled image of tape measure]. (n.d.). Retrieved from https://www.keson.com/reading-between-the-lines-measuring-tape-edition/

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

Weighing Scale or Platform weighing scale. (October 27, 2017). Retrieved from https://basiccivilengineering.com/2017/10/lab-equipment-used-civil-engineering.html

Page 9 (Left to right; top to bottom)

Graduated Cylinders - Class A, USP, Certified. (n.d.). Retrieved from https://brandtech.com/product/graduated-cylinders/

[Untitled image of DSLR Camera]. (n.d.). Retrieved from https://improvephotography.com/227/differences-canon-vs-nikon-dslr-cameras/

Hand Type Density Testers. (n.d.). Retrieved from https://seedburo.com/products/3191

Rice Broken Separator. (n.d.). Retrieved from https://www.indiamart.com/proddetail/rice-broken-separator-22977759588.html

Page 10 (Left to right; top to bottom)

V300 digital scale waterproof type. (n.d.). Retrieved from https://www.monotaro.ph/p/16336662.html?utm_medium=cpc&utm_source=googleps&ef_id=Cj0KCQiAubmPBhCyARIsAJWNpiM5XvophZIx3-No8bqxHnyzDwlf-H9ktiji2vLl0PSw0jBPTrVw2I4aAsooEALw_wcB:G:s&gclid=Cj0KCQiAubmPBhCyARIsAJWNpiM5XvophZIx3-No8bqxHnyzDwlf-H9ktiji2vLl0PSw0jBPTrVw2I4aAsooEALw_wcB

MAGNIFYING GLASS 75 mm. (n.d.). Retrieved from https://sealandair.gr/en/chart-instruments/668-magnifying-glass-75-mm.html

Page 11 (Left to right; top to bottom)
Osaw Plastic Laboratory Aspirator (n.d.) Retrieved from https;//www.indiamart.com/proddetail/laboratory-aspirator-bates-type-6726-6220625297.html

Oven for Universal labs. (n.d.). Retrieved from https://www.drag-lab.de/oven.php

Kett C-600 Rice Whiteness Tester. (n.d.). Retrieved from https://koueitrading.com/global/product/kett-c-600-rice-whiteness-tester/

BOERNER DIVIDER OR SAMPLE DIVIDER BY KRISCI. (n.d.). Retrieved from https://www.amazon.in/KRISCI-SEED-AND-SAMPLE-DIVIDER/dp/B06WVBTMMV

Page 12
[Untitled image of sample bag with labeling tag]. (nd.). Retrieved from the University of the Philippines—Agricultural Machinery Testing and Evaluation Center (UPLB AMTEC)

Page 14 (Top to bottom)
Textile sacks full of rice cartoon illustration Free Vector. (n.d.) Retrieved from https://www.freepik.com/free-vector/textile-sacks-full-rice-cartoon-illustration_14625712.htm?query=rice%20sack

Dhavesai Good Rice Paddy Seeds Bird Food for All Type of Birds - 250 Grams. (n.d.) Retrieved from https://www.amazon.in/Dhavesai-Good-Paddy-Seeds-Birds/dp/B08KNW9TW3/ref=pd_lpo_3?pd_rd_i=B08KNW9TW3&psc=1

Page 15
Top View Rice Packed in Plastic Bag. (n.d.) Retrieved from https://www.shutterstock.com/image-photo/top-view-rice-packed-plastic-bag-663127219

Page 21
[Untitled image of brown rice]. (n.d.). Retrieved from: https://www.agrifarming.in/brown-rice-farming-cultivation-practices-benefits

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