AMTEC METHODS OF TEST

AM 004:2023

Postharvest Machinery – Paddy Sorter

AGRICULTURAL MACHINERY TESTING AND EVALUATION CENTER

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Foreword

The formulation of this AMTEC Methods of Test (AM) was initiated by the Agricultural Machinery Testing and Evaluation Center-University of the Philippines Los Baños (AMTEC-UPLB) in response to the need for a reference standard for the testing of paddy sorter. It was made in collaboration with the Bureau of Agricultural and Fisheries Engineering (BAFE)-Department of Agriculture (DA) as the regulatory agency for agriculture and fisheries machinery and infrastructures.

The draft AM underwent a series of reviews and online circulations among AMTEC engineers and stakeholder consultation on June 23, 2022 via online platform before its finalization and endorsement to the BAFE-DA.

This AM was drafted in accordance with the Bureau of Agriculture and Fisheries Standards (BAFS)-Standards Development Division (SDD) Standardization Guide No. 1: Writing the Philippine National 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.

1 Scope

This standard specifies the methods of test and inspection for paddy sorter. Specifically, it shall be used to:

1.1 verify the mechanism, dimensions, materials, accessories of the machine, and the list of specifications submitted by the test applicant;

1.2 determine the performance of the machine;

1.3 evaluate the ease of handling and safety features; and

1.4 prepare the report for the test results.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. The latest edition of the referenced documentS (including any amendments) applies.

AMTEC-UPLB. (2021). Agricultural and fishery machinery – Methods of test (AMTEC Standard 001:2021)

AMTEC-UPLB. (2000). Agricultural machinery – Methods of sampling (PAES 103:2000)

3 Terms and Definitions

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

3.1
blower loss
ratio of the weight of paddy blown with the impurities by the fan or blower to the total weight of the input paddy, expressed in percent (%)

3.2
bulk density
weight per unit volume of the sample, expressed in kilogram per cubic meter (kg/m^3)

3.3
coefficient of variation
ratio of the standard deviation to the mean, expressed in percent (%)

3.4
impurity
all matters other than paddy (BAFS-DA, 2022, *modified*)

3.5
fuel consumption
amount of fuel consumed per unit time, expressed in liter per hour (L/h)

3.6
mechanically damaged grain
grain that were broken, crushed, or dehulled (partially or fully) as a result of machine operation

3.7
overall height
distance between the horizontal supporting plane surface and the horizontal plane touching the uppermost part of the machine

3.8
overall length
distance between the vertical planes perpendicular to the median plane of the machine, each plane touching the front and rear extremities of the machine

3.9
overall width
distance between the vertical planes parallel to the median plane of the machine, each plane touching the outermost point of the machine on its left and right sides

3.10
paddy
rough rice
palay
unhulled grain of *Oryza sativa*, which means grain with the glumes enclosing the kernel (BAFS-DA, 2020)

3.11
paddy sorter
machine which separates the paddy into different size categories (e.g. small, medium, and large); it can be classified based on the sorting mechanism (oscillating sieves, rotary sieves) and may or may not equipped with a cleaning mechanism

3.11.1
cleaning device
component of the paddy sorter that removes impurities prior to sorting

3.11.2
oscillating sieve
sorting mechanism wherein grains are sorted into different sizes by passing through sieves of different mesh sizes that are arranged in parallel rows or any orientation and move in reciprocating motion (BAFS-DA, 2022, *modified*)

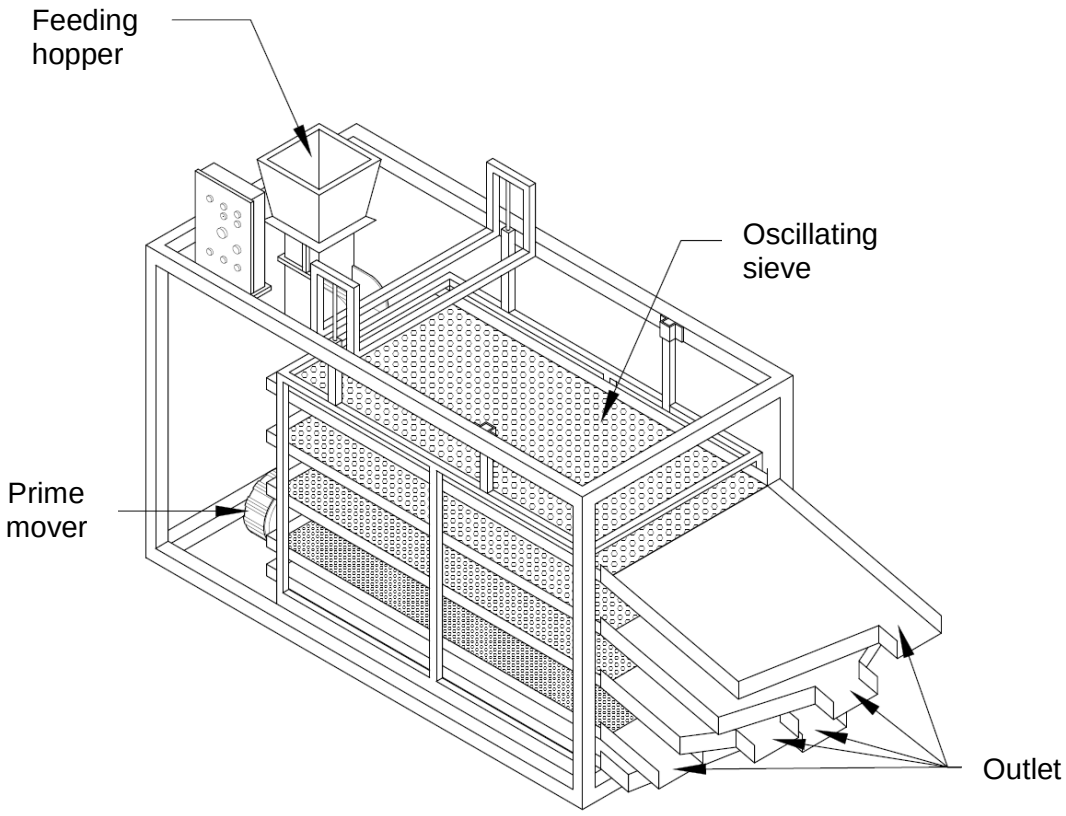

Figure 1. Paddy sorter with parallel, oscillating sieves (Chungcharoen et al., 2019, cited by BAFS-DA, 2022)

3.11.3
prime mover
electric motor or internal combustion engine used to run the paddy sorter

3.11.4
rotary sieve
sorting mechanism wherein grains are sorted into different sizes by passing through sieves of different mesh sizes that are arranged in series, concentric or any orientation and move in circulating motion along an axis (BAFS-DA, 2022, *modified*)

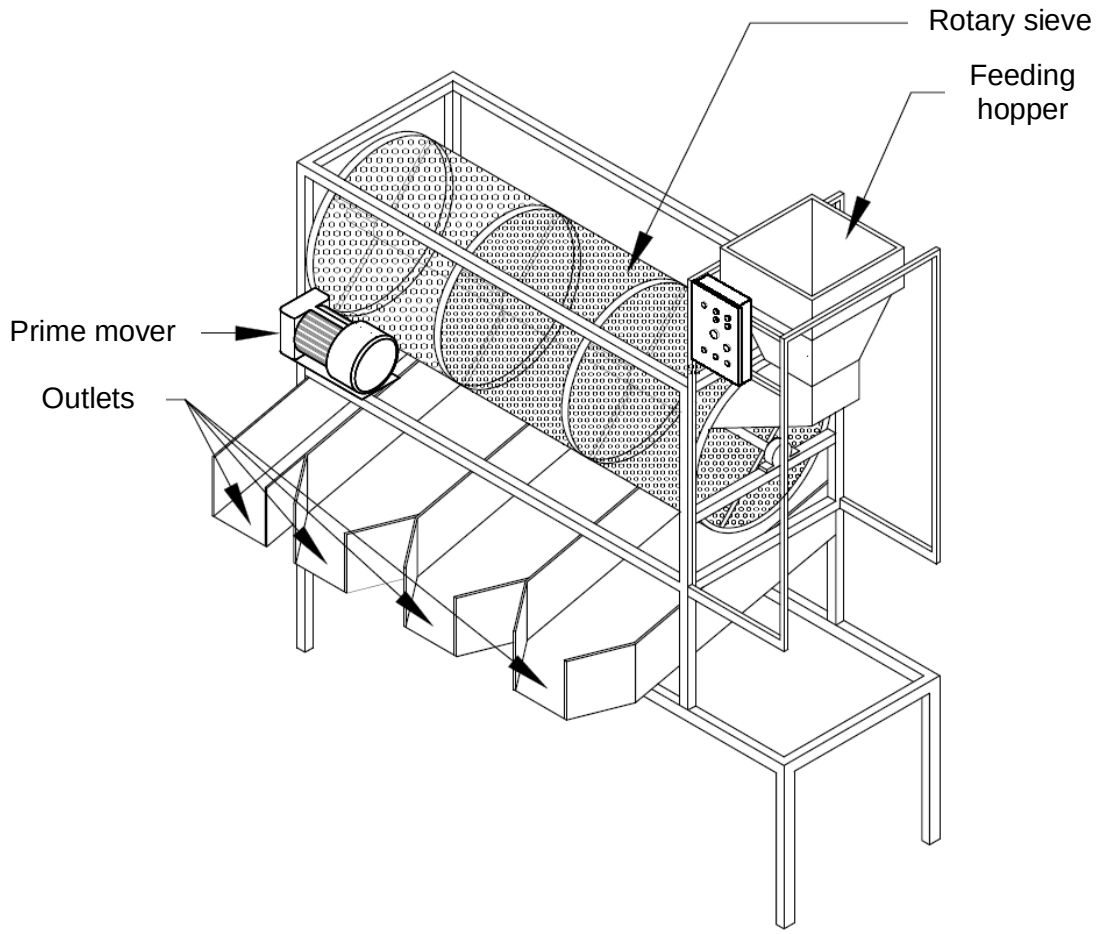

Figure 2. GCB sorter with rotary sieves in series (Chungcharoen et al., 2019, cited by BAFS-DA, 2022)

3.12
purity
ratio of the weight of cleaned samples to the total weight of uncleaned samples, expressed in percent (%)

3.13
running-in period
preliminary operation conducted before the actual testing of the machine to make various adjustments until the operation is stable

3.14
scattering loss
ratio of the weight of paddy that fell out from the machine during operation to the total weight of the input paddy, expressed in percent (%)

3.15
sorting capacity
total weight of the input paddy per unit total operating time, expressed in kilogram per hour (kg/h) (BAFS-DA, 2022, *modified*)

3.16
sorting recovery
ratio of the total weight of sorted paddy collected at the different outlet/s to the total weight of input paddy, expressed in percent (%) (BAFS-DA, 2022, *modified*)

3.17
test applicant
manufacturer, fabricator, inventor, direct importer, legitimate distributor, dealer, or end-user of the machine that officially applied for a test (BAFS-DA, 2022)

3.18
wet basis moisture content
weight of moisture over the fresh weight of the sample, expressed in percent (%)

4 General Conditions for Test

4.1 Selection of machinery to be tested

The paddy sorter submitted for testing shall be sampled in accordance to PAES 103:2000 or any other suitable method of sampling.

4.2 Role of the test applicant

The test applicant shall provide the necessary information or documents on the specifications of the machine to be tested. They shall abide with the terms and conditions set forth by the AMTEC, provide test materials, and shoulder other variable costs to carry out the test.

4.3 Role of the representative of the test applicant

An official representative from the test applicant shall operate, demonstrate, adjust, repair as the case maybe, and decide on matters related to the operation of the machine.

4.4 Role of the test engineer

The certified test engineer shall lead the conduct of the performance testing in accordance with the provisions of this Standard. Furthermore, the test engineer shall oversee other relevant activities prior and subsequent to the conduct of the testing.

4.5 Test site conditions

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

4.6 Suspension/Termination of test

4.6.1 During the testing operation, the test may be suspended if the machine stops or cannot operate or cannot be tested due to the conditions listed below. At such instances, the AMTEC may allow the representatives of the test applicant to repair and/or replace with similar specifications an assembly of a machine and to change a test material or test plot with a new one that conforms to the recommended size, characteristics, quality, and/or conditions. The AMTEC may also await such instances until they are resolved to continue the test operation.

Item No.	Conditions for Suspension
4.6.1.1	Minor breakdown or malfunction
4.6.1.2	Insufficient amount of test material
4.6.1.3	Nonconformity of the test material to the recommended characteristics and quality
4.6.1.4	Unmatched prime mover or tractor used
4.6.1.5	Clogged or choked part/s of the machine
4.6.1.6	Absence of power source for the machine due to power outage or brownout
4.6.1.7	Accident and injury of the personnel/representatives of test applicant or AMTEC
4.6.1.8	Poor and severe weather conditions that may affect the test

4.6.2 During the testing operation, the test shall be terminated if the machine cannot continue its operation due to the conditions listed below.

Item No.	Conditions for Termination
4.6.2.1	Three breakdowns during the whole duration of all test trials
4.6.2.2	Three clogging or choking during the whole duration of all test trials
4.6.2.3	Major malfunction, breakdown, or damage affecting performance of the machine

5 Test Preparation

5.1 Preparation of the machine for testing

The official representatives of both the test applicant and AMTEC shall check the machine to ensure that it has been assembled and installed in accordance with the

instruction of the manufacturer. The AMTEC shall test the machine according to the specifications and conditions set by the manufacturer.

5.2 Test instruments and other materials

The suggested list of minimum field and laboratory test equipment and materials needed to carry out the paddy sorter test is shown 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.

5.3 Test material

Paddy to be used shall be commonly or locally grown, of single variety, and 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 the required test trials, running-in period, and laboratory tests. Specifically, the amount of test material shall be sufficient for at least 15 minutes of operation per test trial. The test materials shall be prepared in such a way that they shall have identical characteristics when they are used for running-in period and in each test trial. If the test materials are not compliant with the recommended quantity and characteristics, the AMTEC test engineer shall not proceed with or shall suspend the test.

5.4 Running-in and preliminary adjustments

The machine shall have undergone a running-in period before starting the test. During the running-in period, the various adjustments of the machine shall be made accordingly to the recommendation of the manufacturer. No adjustments shall be permitted during the test proper.

6 Pre-test observation

6.1 Verification of specifications

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

6.2 Test sample conditions

The crop conditions including source, variety, and grain bulk density, moisture content and purity shall be obtained and recorded. Representative test samples shall be collected by the AMTEC from the test material for analysis. Sampling procedure is shown in Annex C.

7 Performance Test

7.1 Operation of the paddy sorter

The paddy sorter shall be operated, with and without load, by the official representative of the test applicant using the recommended setting of the manufacturer and/or test applicant. The same recommended setting shall be maintained during the test operation. As part of the test, the AMTEC shall make all measurements and shall take the prescribed samples. After each test trial, the machine and area shall be cleaned and then 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.

7.2 Test trial

A minimum of three (3) test trials should be conducted.

7.3 Data collection

7.3.1 Duration of test

The duration of each test trial or the total operating time shall start with the feeding of the input paddy into the inlet or feeding hopper and shall end after the last discharge of sorted paddy at the different outlets.

7.3.2 Noise level

7.3.2.1 The sound emitted by the machine, with and without load, shall be measured using a sound level meter at the zone of the operator/s' ear level.

7.3.2.2 There shall be a minimum of five observations for each data to be taken. It should be ensured that the feed rate, speed, and other functional characteristics have stabilized before taking data. The time of recording shall be properly spaced during the whole duration of the test trial. There shall be at least ten (10) data or readings obtained.

7.3.3 Speed of components

The shaft speed of the major rotating components of the paddy sorter, with and without load, shall be measured using a tachometer in rpm. Requirements for each data to be taken shall conform to 7.3.2.2.

7.3.4 Air velocity

The air velocity generated by the paddy sorter's fan or blower, without load, shall be measured using an air velocity meter in m/s.

7.3.5 Power Requirement/Fuel Consumption

7.3.5.1 For paddy sorter using engine as prime mover

7.3.5.1.a The total operating time of the engine from the time it started until the time it stopped shall be recorded.

7.3.5.1.b To get the amount of fuel consumed, refill method shall be used. Fill the tank to full capacity or to a certain level before the test. After the test, fill the tank with measured fuel to the same level before the test. When filling up the fuel tank, extra attention shall be paid to keep it horizontal and to ensure that empty space is not left inside.

7.3.5.2 For paddy sorter using electric motor as prime mover

The input power requirement of paddy sorter powered by an electric motor shall be measured using a power meter. Connect a power meter to the input terminals or wires of the motor to measure the voltage, current, and the total electric power requirement of the machine. Requirements for each data to be taken shall conform to 7.3.2.2.

7.3.6 Sorting capacity and recovery

The total operating time, total weight of input, and total weight of sorted paddy collected from the different outlets shall be recorded. The sorting capacity and sorting recovery shall be calculated using the formula in Annex G.

7.4 Sampling

Samples shall be collected at different outlets during each test trial. The sampling procedure is shown in Annex C.

7.5 Data recording and observations

The record sheet for all data and information during the test is given in Annex D. Necessary observations to be taken during the performance test shall also be recorded in this sheet.

8 Laboratory Analysis

Laboratory analysis shall be made to determine the moisture content, coefficient of variation of size (L × W × t) per outlet, bulk density, purity, mechanically damaged grains, and losses (blower, scattering). The laboratory procedure to be followed in the analysis is given in Annex E, while the data sheets are given in Annex F.

9 Presentation of Results

Machine specifications and the results of the test shall be presented in tabular form in which data shall be taken from Annexes B and D. Observations made on the machine while in operation shall be supported with photographs.

10 Formula

The formula to be used during calculations and testing are given in Annex G.

11 Test Report

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

11.1 Name of Testing Agency

11.2 Test Report Number

11.3 Title

11.4 Summary of Results

11.5 Purpose and Scope of Test

11.6 Methods of Test

11.7 Description of the Machine

11.8 Specifications

11.9 Results

11.10 Other Observations (include pictures)

11.11 Names, Signatures, and Designation of Test Engineers and AMTEC Director

Annex A
(informative)

Minimum List of Field and Laboratory Test Equipment and Materials

A.1	**Field Test Equipment and Material**	**Quantity**
A.1.1	Moisture meter (duly calibrated using the standard method)	1
A.1.2	Air velocity meter Range: 0-30 m/s	1
A.1.3	Tachometer (contact type or non-contact type)	1
A.1.4	Sound level meter Range: 30 dB(A) to 130 dB(A)	1
A.1.5	Stopwatch Minimum resolution: 0.1 sec	2
A.1.6	Measuring tape (at least 5m)	1
A.1.7	Camera	1
A.1.8	Weighing scale Capacity: at least 100 kg Resolution: 0.5 kg	1
A.1.9	Graduated cylinder Capacity: at least 500 mL	1
A.1.10	Clamp-on type power meter/Multimeter	1
A.1.11	Catching material Dimensions: 4 m × 8 m	1
A.1.12	Nylon-catch bag Dimensions: 1.5 m × 1.5 m × 0.5 m	1
A.1.13	Caliper	1
A.1.14	Sample bags	42
A.1.15	Labeling tags which include: Date of test Paddy sorter on test (Brand and Model) Trial number Sample source	42
A.2	**Laboratory Test Equipment and Materials**	**Quantity**
A.2.1	Digital weighing scale Resolution: 0.01 g	1
A.2.2	Bulk density meter	1
A.2.3	Bates aspirator	1
A.2.4	Sampler/Divider	1
A.2.5	Magnifying lens (minimum of 10 magnifications)	1
A.2.6	Grain caliper	1
A.2.7	Air oven	1
A.2.8	Desiccator	1
A.2.9	Aluminum moisture cans	

Annex B
(informative)

Specifications of Paddy Sorter

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 : _____

Item		Manufacturer's Specification	AMTEC Verification
B.1	Main structure		
B.1.1	Overall dimensions, mm		
B.1.1.1	Length		
B.1.1.2	Width		
B.1.1.3	Height		
B.1.2	Overall weight without prime mover (kg)		
B.2	Rated sorting capacity, kg/h		
B.3	Inlet/Feeding hopper		
B.3.1	Dimensions of bottom opening, L × W, mm		
B.3.2	Height from the ground		
B.3.3	Material/s		
B.3.4	Feature/s		
B.4	Cleaning device		
B.4.1	Sieve		
B.4.1.1	Type		
B.4.1.2	Dimensions, L × W, mm		
B.4.1.3	Material/s		
B.4.2	Fan/Blower		
B.4.2.1	Type		
B.4.2.2	Dimensions, mm		
B.4.3.3	Number of blades		

Item		Manufacturer's Specification	AMTEC Verification
B.4.2.4	Size of inlet port, mm		
B.4.2.5	Material/s		
B.4.3.6	Adjustment (if any)		
B.5	Sorting mechanism		
B.5.1	Oscillating sieve		
B.5.1.1	Number of sieves		
B.5.1.2	Oscillating sieve 1		
B.5.1.2.1	Dimensions, L × W, mm		
B.5.1.2.2	Size of perforations, mm		
B.5.1.2.3	Angle of inclination, °		
B.5.1.2.4	Material/s		
B.5.1.3	Oscillating sieve 2		
B.5.1.3.1	Dimensions, L × W, mm		
B.5.1.3.2	Size of perforations, mm		
B.5.1.3.3	Angle of inclination, °		
B.5.1.3.4	Material/s		
B.5.1.4	Oscillating sieve 3		
B.5.1.4.1	Dimensions, L × W, mm		
B.5.1.4.2	Size of perforations, mm		
B.5.1.4.3	Angle of inclination, °		
B.5.1.4.4	Material/s		
B.5.2	Rotary sieve		
B.5.2.1	Rotary sieve 1		
B.5.2.1.1	Dimensions, L × D, mm		
B.5.2.1.2	Size of perforations, mm		
B.5.2.1.3	Material/s		
B.5.2.2	Rotary sieve 2		
B.5.2.2.1	Dimensions, L × D, mm		
B.5.2.2.2	Size of perforations, mm		
B.5.2.2.3	Material/s		
B.5.2.3	Rotary sieve 3		
B.5.2.3.1	Dimensions, L × D, mm		
B.5.2.3.2	Size of perforations, mm		
B.5.2.3.3	Material/s		
B.6	Outlet		
B.6.1	Number of outlets		
B.6.2	Outlet 1		
B.6.2.1	Material/s		
B.6.2.2	Dimensions of opening, L × W, mm		
B.6.2.3	Angle of inclination		
B.6.2.4	Height from the ground, mm		
B.6.3	Outlet 2		

Item		Manufacturer's Specification	AMTEC Verification
B.6.3.1	Material/s		
B.6.3.2	Dimensions of opening, L × W, mm		
B.6.3.3	Angle of inclination		
B.6.3.4	Height from the ground, mm		
B.6.4	Outlet 3		
B.6.4.1	Material/s		
B.6.4.2	Dimensions of opening, L × W, mm		
B.6.4.3	Angle of inclination		
B.6.4.4	Height from the ground, mm		
B.7	Type of power transmission system		
B.7.1	_____ to _____		
B.7.2	_____ to _____		
B.7.3	_____ to _____		
B.7.4	_____ to _____		
B.7.5	Others (specify)		
B.8	Safety device(s)		
B.9	Special feature(s)		

Annex C
(normative)

Sampling Procedures and Measurements

C.1 Sampling Procedures for Input Paddy

The conditions of the input paddy such as moisture content, bulk density, purity, and mechanically damaged grains shall be taken using three (3) “representative samples”, which represent the different conditions of the input paddy in the bulk. This shall be done by randomly taking samples at the top, middle, and bottom portions of the bulk. Half of the sample shall be used for laboratory analysis and the other half shall be used for reference purposes or for an eventual second check in case of review. Samples representing the materials for each test trial shall be placed in appropriate containers for laboratory analysis

C.2 Sampling from Different Outlets

C.2.1 During each test trial, samples shall be collected from different outlets to be analyzed in the laboratory for moisture content, coefficient of variation of size (L × W × t) per outlet, purity, bulk density, mechanically damaged grains, and losses (blower, scattering, and other losses). 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. The sampling procedures shall be undertaken at the following outlets:

C.2.1.1 Sorted paddy outlets

Using a plastic bag or an appropriate container, randomly collect three samples of at least 500 g. This shall be done for each outlet.

C.2.1.2 Blower outlet

During the test, three samples shall be randomly taken from the fan or blower outlet for a duration of at least 15 seconds per collection using a nylon-catch bag with a dimension of 1.5 m × 1.5 m × 0.5 m. These samples shall be placed in appropriate containers and labeled as blower loss.

C.3 Collection of scattered grains

Grains scattered beyond 1.0 m from the base of the machine shall be collected. Spread catching material or canvas sheets around the sorting floor area to catch the scattered grains after each test trial. The collected grains shall be placed in appropriate containers and labelled as scattered grains.

C.4 Collection of other losses

Losses other than blower and scattering losses shall be collected, weighed, and labeled as other losses.

C.5 Handling of Samples

All samples to be taken to the laboratory shall be placed in appropriate containers and shall be properly labeled. If the sample is to be used for determining moisture content, it shall be kept in dry and airtight containers. Extra precaution should be taken to prevent alterations of the conditions of the test samples.

Annex D
(informative)

Performance Test Data Sheet

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

Item		Trial 1	Trial 2	Trial 3	Average
D.1	Crop condition				
D.1.1	Variety				
D.1.2	Source				
D.1.3	Purity, %				
D.1.4	Bulk density, kg/m^3				
D.1.5	Moisture content, %$_{wb}$				
D.2	Performance test				
D.2.1	Weight of input paddy, kg				
D.2.2	Total operating time, min				
D.2.3	Sorting capacity, kg/h				
D.2.4	Weight of sorted paddy, kg				
D.2.4.1	Outlet 1				
D.2.4.2	Outlet 2				
D.2.4.3	Outlet 3				
D.2.5	Sorting recovery, %				
D.2.6	Speed of components, rpm				
D.2.6.1	Prime mover				
D.2.6.1.1	Without load				
D.2.6.1.2	With load				
D.2.6.2	Oscillating/Rotary sieve shaft				
D.2.6.2.1	Without load				
D.2.6.2.2	With load				
D.2.6.3	Fan/Blower shaft				
D.2.6.3.1	Without load				
D.2.6.3.2	With load				
D.2.7	Fan air velocity, without load, m/s				
D.2.8	Noise level, dB(A)				
D.2.8.1	Feeding operator				
D.2.8.1.1	Without load				
D.2.8.1.2	With load				
D.2.8.2	Bagger				
D.2.8.2.1	Without load				
D.2.8.2.2	With load				

Item		Trial 1	Trial 2	Trial 3	Average
D.2.9	Fuel consumed, L				
D.2.10	Total fuel consuming time, h				
D.2.11	Fuel consumption (L/h)				
D.2.12	Power consumption				
D.2.12.1	Input power (kW)				
D.2.12.2	Line voltage (V)				
D.2.12.3	Load current (A)				

D.3 Other Observations

D.3.1 Ease of transporting the machine

_____
_____

D.3.2 Ease of adjusting and repairing of parts

_____
_____

D.3.3 Safety features

_____
_____

D.3.4 Ease of cleaning the sorting components

_____
_____

D.3.5 Number of operators

_____
_____

D.3.6 Failure or abnormalities that shall be observed on the sorter or its component parts during and after the sorting operation.

_____
_____

D.3.7 Other remarks

_____
_____

Annex E
(normative)

Laboratory Analysis

E.1 Analysis of Input Paddy

E.1.1 Determination of purity

E.1.1.1 Randomly take three (3) 500 g samples from the representative samples of the input paddy.

E.1.1.2 Clean each sample to remove the impurities. Weigh the clean sample and record the resulting weight. Calculate the purity using the formula in Annex G.

E.1.2 Determination of bulk density

E.1.2.1 Randomly obtain samples from the representative samples of the input paddy samples. The bulk density of each sample shall be measured using a bulk density tester/meter.

E.1.2.2 Fill the bulk density meter's measuring cup with samples at a standard height. Level the heap above the cup using a blunt ruler. Weigh the samples inside the cup and record the bulk density. Replicate these steps five (5) times.

E.1.3 Moisture content determination by air oven method

E.1.3.1 Manually remove all foreign matter from the sample. Randomly obtain three (3) 100 g of representative samples and place them in moisture cans. Ensure that no moisture is lost or gained by the sample between the time it was collected until it is weighed in a moisture can. Weigh and record all the initial weights.

E.1.3.2 Dry the samples in the oven with a temperature 100 ± 3 °C for 72 hours.

E.1.3.3 After removing the samples from the oven, place the moisture can with samples in a desiccator and allow them to cool in the ambient temperature.

E.1.3.4 Weigh the moisture can with the dried sample. Record the final weight. Calculate the moisture content using the formulas in Annex G.

E.1.4 Moisture content determination by air

E.1.4.1 Randomly obtain at least five (5) representative samples. Ensure that no moisture is lost or gained by the sample between the time it was collected until its moisture content is determined.

E.1.4.2 Measure the moisture content of the samples using a calibrated moisture meter.

E.2 Analysis of Sorted Paddy

E.2.1 Determination of purity

E.2.1.1 Randomly take three (3) 500 g samples from the representative samples of the sorted paddy.

E.2.1.2 Clean each sample to remove the impurities. Weigh the clean sample and record the resulting weight. Calculate the purity using the formula in Annex G.

E.2.2 Measurement of sorted paddy dimensions

E.2.2.1 Randomly take at least 30 pieces of grains from the sorted paddy samples collected from each outlet.

E.2.2.2 For each sample, measure the length, width, and thickness using a caliper. Record the measurement to the nearest 0.01 mm. Calculate the average length, width, and thickness; and their coefficient of variation using the formula in Annex G.

E.3 Determination of Net Percent Mechanically Damaged Grains

Three samples shall be taken for analysis from the input paddy sample and sorted paddy sample per outlet. Each sample shall consist of 100 g. Separate and weigh the grains that were broken and/or crushed. Compute for the percentage of mechanically damaged grains and net mechanically damaged grains using the formula in Annex G.

E.4 Determination of Losses

E.4.1 Blower loss

Three samples shall be taken at the fan or blower outlet to collect blown grains. Each sample shall be cleaned and weighed. The total weight of the clean grains and the total time of collection shall be recorded for the computation of blower loss using the formula in Annex G.

E.4.2 Scattering loss

Grains scattered beyond 1.0 m from the base of the machine shall be collected after each trial, cleaned, and weighed for the determination of scattering loss using the formula in Annex G.

E.4.3 Other losses

Other losses shall be determined using the formula in Annex G.

Annex F
(informative)

Laboratory Analysis Data Sheet

Machine Tested: _____ Date Tested: _____
Analyzed by: _____ Date Analyzed: _____

F.1 Analysis of Input Paddy

F.1.1 Purity

Initial weight of samples (uncleaned) = 500 g

Item	Test trial I				Test trial II				Test trial III				Gen. ave.
	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	
Cleaned sample, g													
Purity, %													

F.1.2 Bulk density

Sample no.	Bulk density, kg/m^3
1	
2	
3	
4	
5	
Average	

F.1.3 Moisture content (wet-basis)

F.1.3.1 Using air oven method

Test trial no.	Sample no.	Initial weight, g	Final weight, g	Moisture content, $\%_{wb}$
I	1			
	2			
	3			
	Ave.			
II	1			
	2			
	3			
	Ave.			
III	1			
	2			
	3			
	Ave.			

F.1.3.2 Using moisture meter

Item	Test trial I					Test trial II					Test trial III				
Sample no.	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Moisture content, $\%_{wb}$															
Average, $\%_{wb}$															

F.2 Analysis of Sorted Paddy

F.2.1 Purity

F.2.1.1 Outlet 1

Initial weight of samples (uncleaned) = 500 g

Item	Test trial I				Test trial II				Test trial III				Gen. ave.
	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	
Cleaned sample, g													
Purity, %													

F.2.1.2 Outlet 2

Initial weight of samples (uncleaned) = 500 g

Item	Test trial I				Test trial II				Test trial III				Gen. ave.
	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	
Cleaned sample, g													
Purity, %													

F.2.1.3 Outlet 3

Initial weight of samples (uncleaned) = 500 g

Item	Test trial I				Test trial II				Test trial III				Gen. ave.
	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	
Cleaned sample, g													
Purity, %													

F.2.2 Measurement of sorted paddy dimensions per outlet

F.2.2.1 Outlet 1

Sample no.	Length, mm	Width, mm	Thickness, mm
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
Average, mm			
Standard deviation, mm			
Coefficient of variation, %			

F.2.2.2 Outlet 2

Sample no.	Length, mm	Width, mm	Thickness, mm
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
Average, mm			
Standard deviation, mm			
Coefficient of variation, %			

F.2.2.3 Outlet 3

Sample no.	Length, mm	Width, mm	Thickness, mm
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
Average, mm			
Standard deviation, mm			
Coefficient of variation, %			

F.3 Net Percent Mechanically Damaged Grains

F.3.1 Before sorting

Initial weight of samples = 100 g

Item	Test trial no. I				Test trial no. II				Test trial no. III				Gen. Ave.
	1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	
Weight of damaged grains, g													
Percent damaged grains, %													

F.3.2 After sorting

Initial weight of samples = 100 g

Sample	Item	Test trial no. I				Test trial no. II				Test trial no. III				Gen. Ave.
		1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.	
Outlet 1	Weight of damaged grains, g													
	Percent damaged grains, %													
Outlet 2	Weight of damaged grains, g													
	Percent damaged grains, %													
Outlet 3	Weight of damaged grains, g													
	Percent damaged grains, %													
Net percent mechanically damaged grains, %														

F.4 Loss Determination

Test trial no.	Sample no.	Blower loss			Scattering loss		Other losses	
		Duration:						
		Sample wt., g	Total wt., kg	%	Total wt., kg	%	Total wt., kg	%
I	1							
	2							
	3							
	Ave.							
II	1							
	2							
	3							
	Ave.							
III	1							
	2							
	3							
	Ave.							
Gen Ave.								

Annex G
(normative)

Formulas Used During Calculations and Testing

G.1 Purity

$$P = \frac{W_c}{W_u} \times 100$$

where:

P is the purity, %
W_u is the weight of uncleaned sample, g
W_c is the weight of cleaned sample, g

G.2 Moisture Content (Wet-basis)

$$MC = \frac{w_i - w_f}{w_i} \times 100$$

where:

MC is the moisture content, $\%_{wb}$
w_i is the initial weight of sample, g
w_f is the final weight of sample, g

G.3 Percent Mechanically Damaged Grains

$$D_b = \frac{W_d}{W_p} \times 100$$

where:

D_b is the percent mechanically damaged grains, %
W_d is the weight of mechanically damaged grains, g
W_p is the weight of sample equal to 500 g

G.4 Net Percent Mechanically Damaged Grains

$$ND_b = D_{bb} - D_{bf}$$

where:

ND_b is the net percent mechanically damaged grains, %
D_{bb} is the percent mechanically damaged input paddy, %
D_{bf} is the percent mechanically damaged sorted paddy, %

G.5 Losses

G.5.1 Summation of all losses, kg (L_T)

$$L_T = L_b + L_s + L_o$$

where:

L_T is the summation of all losses, kg
L_b is the blower loss, kg
L_s is the scattering loss, kg
L_o is the other losses, kg

G.5.2 Blower loss

G.5.2.1 Amount

$$L_b = \frac{W_b}{T_c} \times T_o$$

where:

L_b is the blower loss, kg
W_b is the weight of blown grains sample, kg
T_c is the duration of collection, kg
T_o is the duration of operation, kg

G.5.2.2 Percentage

$$\%L_b = \frac{L_b}{W_s + L_T} \times 100$$

where:

$\% L_b$ is the blower loss, %
L_b is the blower loss, kg
W_s is the weight of sorted paddy, kg
L_T is the summation of all losses, kg

G.5.3 Scattering loss

$$\%L_s = \frac{L_s}{W_s + L_T} \times 100$$

where:

$\% L_s$ is the scattering loss, %
L_s is the weight of scattered grains, kg
W_s is the weight of sorted paddy, kg
L_T is the summation of all losses, kg

G.5.4 Other losses

G.5.4.1 Amount

$$L_o = W_i - W_s - L_b - L_s$$

$$\%L_o = \frac{L_o}{W_s + L_T} \times 100$$

where:

% L_o is the other losses, %
L_o is the weight of other losses, kg
L_b is the blower loss, kg
L_s is the weight of scattered grains, kg
W_i is the weight of cleaned input paddy, kg
W_s is the weight of sorted paddy, kg

G.6 Sorting Capacity

$$C_s = \frac{W_i}{T}$$

where:

C_s is the sorting capacity, kg/h
W_i is the weight of input paddy, kg
T is the total operating time, h

G.7 Coefficient of Variation

$$CV = \frac{s}{\bar{x}} \times 100$$

$$s = \sqrt{s^2}$$

$$s^2 = \frac{\sum(x_j{}^2) - n(\bar{x}^2)}{n - 1}$$

where:

x_j is the dimension (length, width, thickness) of individual sample, mm
n is the total number of samples
$\bar{x}$ is the mean size or dimension, mm
s^2 is the variance of dimension, mm^2
s is the standard deviation of sorted paddy dimension, mm
CV is the coefficient of variation of sorted paddy dimension, %

G.8 Sorting Recovery

$$R_s = \frac{W_s}{W_i} \times 100$$

where:

R_s is the sorting recovery, %
W_s is the weight of sorted paddy, kg
W_i is the weight of input paddy, kg

G.10 Fuel Consumption

$$F_{ct} = \frac{F_v}{T_e}$$

where:

F_{ct} is the fuel consumption rate (L/h)
F_v is the volume of fuel consumed (L)
T_e is the total fuel consuming time of engine (h)

G.11 Electric Power Requirement

G.11.1 For Single-Phase

$$P_r = \frac{V\ x\ I\ x\ PF}{1000}$$

where:

P_r is the electric power requirement (kW)
V is the voltage (V)
I is the current (A)
PF is the power factor

G.11.2 For Three-Phase

$$P_r = \frac{V\ x\ I\ x\ \sqrt{3}\ x\ PF}{1000}$$

where:

P_r is the electric power requirement (kW)
V is the voltage (V)
I is the current (A)

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