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PHILIPPINE NATIONAL STANDARD

PNS/BAFS 342:2022
ICS 65.060.99

Green Coffee Bean Sorter — Methods of Test

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Foreword

In 2020, the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARD) of the Department of Science and Technology (DOST) launched the “Testing and Evaluation of Machinery Generated from PCAARRD-funded Projects Phase 2” as a continuing funding program to develop new models of agricultural machines specifically for high-value crops. The project involved the development of standards for specific machines including Green Coffee Sorter — Specifications and Methods of Test. The development of these standards was in collaboration with the Agricultural Machinery Testing and Evaluation Center (AMTEC)-University of the Philippines Los Baños (UPLB) and the Bureau of Agriculture and Fisheries Standards (BAFS) - Department of Agriculture (DA) as the standard-setting agency for the development of Philippine National Standards (PNS) for agriculture and fisheries machinery and infrastructures under Republic Act No. 10601 (Agriculture and Fisheries Mechanization or AFMech Law).

As part of the standards development process, the PNS proposals were endorsed to the Task Force on the Identification and Prioritization of PNS/Philippine Agricultural and Biosystems Engineering Standards (PABES) for Development, Review, and Revision of the Philippine Council for Agriculture and Fisheries (PCAF)-Committee on Agriculture and Fisheries Mechanization (CAFMech) in 2021. The draft standards were officially endorsed to BAFS-DA through CAFMech Resolution No. 6, series of 2021 (Recommending to BAFS the prioritization of the development or revision of the PNS for various PCAARRD-funded machinery projects).

The Technical Working Group (TWG) tasked to develop the PNS was created through Special Order (SO) No. 617, series of 2022 (Amendment to Special Order No. 487, series of 2022 [Addendum to Special Order 103, series of 2022 entitled, "Creation of TWG for the development of PNS for Agriculture and Fishery Products, Machineries, and Infrastructures”). The TWG was composed of representatives from the relevant government agencies, academe, and research institutions. The draft PNS underwent a series of TWG meetings and stakeholder consultations via online platforms before their endorsement to the DA Secretary for approval.

The PNS were drafted in accordance with the BAFS-Standards Development Division (SDD) Standardization Guide No. 1: Writing the PNS.

Table of Contents

1 Scope

This Standard specifies the methods of test and inspection for green coffee bean (GCB) sorter according to size. Specifically, it shall be used to:

a) Verify the mechanism, main dimensions, materials, accessories of the GCB sorter, and the list of specifications submitted by the manufacturer;
b) Determine the performance of the machine;
c) Evaluate the ease of handling and safety features; and
d) Report the results of the tests.

2 Normative References

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

Agricultural Machinery Testing and Evaluation Center (AMTEC)- University of the Philippines Los Baños (UPLB). (2000). Agricultural machinery – Methods of sampling (PAES 103:2000). https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PAES-103-2000-Agricultural-Machinery-Method-of-Sampling.pdf

Bureau of Agriculture and Fisheries Standards (BAFS) – Department of Agriculture (DA). (2022). Green coffee bean sorter – Specifications (PNS/BAFS 341:2022).

3 Terms and Definitions

For this Standard, the definitions given in PNS/BAFS 341:2022 (Green coffee bean sorter — Specifications) and the following shall apply:

3.1
blower loss
ratio of the weight of the green coffee beans blown by the blower to the input green coffee beans, expressed in percent (%) (BAFS-DA, 2021, *modified*)

3.2
bulk density
weight of clean green coffee beans per unit volume, expressed in kg/m^3 (BAFS-DA, 2021, *modified*)

3.3
moisture content (wet basis)
amount of moisture in the GCB expressed as percent of the total weight of the sample (BAFS-DA, 2017, *modified*)

3.4
overall height
distance between the horizontal supporting plane surface and the horizontal plane touching the uppermost part of the sorter (BAFS-DA, 2017, *modified*)

3.5
overall length
distance between the vertical planes perpendicular to the median plane of the sorter, each plane touching the front and rear extremities of the machine (BAFS-DA, 2017, *modified*)

3.6
overall width
distance between the vertical planes parallel to the median plane of the sorter, each plane touching the outermost point of the machine on its left and right sides (BAFS-DA, 2017, *modified*)

3.7
running-in period
preliminary operation conducted before the actual testing of the machine to make various adjustments until the operation is stable (BAFS-DA, 2018, *modified*)

3.8
scattering loss
ratio of the weight of GCB that fell out from the machine during sorting operation to the total weight of the input GCB, expressed in percent (%) (BAFS-DA, 2021, *modified*)

3.9
test applicant
manufacturer, fabricator, inventor, direct importer, legitimate distributor, dealer, or end-user of the machine that officially applied for a test (BAFS-DA, 2021, *modified*)

4 Principle of the Test

The test shall be carried out to verify the actual specification of the GCB sorter. Its specifications shall be validated with PNS/BAFS 341:2022 (Green coffee bean sorter – Specifications).

5 Test Instruments and Materials

5.1 Test Instruments

The suggested list of minimum field and laboratory test equipment and materials needed to carry out the GCB sorter test is shown in Annex A

(Minimum list of field and laboratory test equipment and materials). The instruments to be used shall be calibrated regularly and physically checked before and after each test.

5.2 Test materials

5.2.1 The GCB to be used shall conform to the following:

a) Moisture content of 9 % to 12%;
b) Free from musty, moldy, other foreign odor and taste;
c) Not more than 10% shall pass through sieve no. 12 ½ round with apertures having nominal diameter of 5 mm as described in Annex B (Characteristics of perforated metal plate test sieves with round holes);
d) Homogenous variety; and
e) Minimum purity of 97%.

5.2.2 The amount of test material to be supplied shall be sufficient for the required test trials, running-in, and laboratory tests.

5.2.3 The sample shall be prepared in such a way that the test sample to be used in each test trial have identical characteristics in terms of variety, moisture content, and purity. If the test materials are not conforming to the recommended quality and characteristics, the test engineer shall not pursue the test.

6 General

6.1 Conditions for the test

6.1.1 Test site conditions

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

6.1.2 Selection of GCB sorter to be tested

GCB sorter submitted for testing shall be sampled in accordance with PAES 103:2000 (Agricultural machinery – Methods of sampling) or any suitable method of selection.

6.1.3 Suspension/termination of test

During the test run, if the GCB sorter stops due to breakdown or malfunction affecting its performance, the test shall be suspended. If the GCB sorter will not be able to continue the operation, the test shall be terminated.

6.2 Pre-test activities

6.2.1 Running-in and preliminary adjustments

The GCB sorter shall have undergone a running-in period before starting the test. It shall be operated for sufficient duration with and without load at the test. During the running-in period, the various adjustments of the GCB sorter shall be made according to the recommendation of the manufacturer.

6.2.2 Verification of specifications

The specifications claimed by the manufacturer and the physical details given in Annex C (Specifications of green coffee bean sorter) shall be verified by the testing agency. A stable and level surface shall be used as reference plane for verification of dimensional machine specifications when fully assembled and ready for use.

6.2.3 Preparation of the GCB sorter for testing

The GCB sorter shall be checked to ensure that the machine has been assembled and installed in accordance with the instruction of the manufacturer. It shall be test according to the manufacturer's specifications.

6.2.4 Sampling of test materials

Random representative test samples shall be collected from the test material for the determination of moisture content, bulk density, mechanically damaged beans, and purity. Sampling procedure is shown in Annex D (Sampling procedures and measurements).

7 Performance Test and Procedures

7.1 Performance test

7.1.1 Operation of the GCB sorter

The GCB sorter shall be operated with and without load by the official representative of the applicant using the manufacturer's recommended setting of its components. The same recommended setting shall be maintained during the test run. The testing agency shall make all measurements, which form part of the test and take the prescribed samples. After the test run, the 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.

7.1.2 Test trial

A minimum of three trials, each with a minimum duration of 15 minutes, shall be carried out at similar operational setting.

7.1.3 Sampling

Samples shall be collected during each test trial. Sampling procedure is shown in Annex D (Sampling procedures and measurements).

7.1.4 Data collection

7.1.4.1 Duration of test

The duration of each test trial or the total operating time shall start from the feeding of the test material into the feeding hopper and shall end after the last discharge of sorted GCB at the different outlets.

7.1.4.2 Noise level

a) The noise emitted by the GCB sorter, with and without load, shall be measured using a sound level meter at the location of the operator/s. The noise level, expressed in dB (A), shall be measured 50 mm away from the ear level of the operator/s standing near the edge of the feeding hopper and the bagger/s.

b) 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.

7.1.4.3 Power requirement/fuel consumption

a) Using electric motor as prime mover

Use a power meter to measure the voltage, current, and the total electric power requirement of the GCB sorter. Three sets of data shall be taken. Requirements for each data to be taken shall conform to 7.1.4.2b.

b) Using engine as prime mover

To get the amount of fuel consumed, the fuel tank shall be filled to full capacity before the test. After the test trial, the fuel tank shall be filled back to full capacity and the fuel used shall be measured. When filling up the tank, careful attention shall be paid to keep the tank horizontal and not to leave empty space in the tank.

7.1.4.4 Speed of components

The speed of the rotating shafts of the major components of the GCB sorter expressed in rpm, with and without load, shall be measured using a tachometer. Requirements for each data to be taken shall conform to 7.1.4.2b.

7.1.4.5 Air velocity

The air velocity generated by the blower/aspirator, without load, shall be measured using an air velocity meter in m/s.

7.1.5 Data recording and observations

Record sheet for all data and information during the test is given in Annex E (Performance test data sheet). Observations to be taken during the performance test shall be recorded in this sheet.

7.2 Laboratory analysis

Laboratory analysis shall be made to determine the moisture content, coefficient of variation of size (L × W × t) per outlet, sorting recovery, mechanically damaged beans (before and after operation), purity, bulk density, sieve analysis of input GCB and sorted beans, and losses (blower, scattering, and other losses). The laboratory procedure to be followed in the analysis is given in Annex F (Laboratory analysis), while data sheets are given in Annex G (Laboratory analysis data sheet).

8 Formula

The formulas to be used are given in Annex H (Formulas used during calculations and testing).

9 Test Report

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

a) Name of testing agency;
b) Test report number;
c) Title;
d) Summary of results;
e) Purpose and scope of test;
f) Methods of test;
g) Description of the machine;
h) Specifications;
i) Results;
j) Observations (include pictures); and

k) Names, signatures, and designation of test engineers.

Annex A
(Informative)

Minimum list of field and laboratory test equipment and materials

No.	Equipment/material	Quantity
A.1	**Field test**	
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	Hand-held tachometer	1
A.1.4	Sound level meter Range: 30 dB(A) to 130 dB(A)	1
A.1.5	Stopwatch	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	6
A.1.13	Caliper	1
A.1.14	Sample bags	35
A.2	**Laboratory test**	
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	Sieves (Refer to Table 1 and Annex B)	1 per each size
A.2.6	Laboratory sieve shaker	1
A.2.7	Magnifying lens	1
A.2.8	Caliper	1
A.2.9	Air oven	1
A.2.10	Desiccator	1
A.2.11	Aluminum moisture cans	9
A.2.12	Labeling tags which include: Date of test GCB sorter on Test Sample source Variety Trial number	35

Annex B
(Normative)

Characteristics of perforated metal plate test sieves with round holes

Aperture size, mm		Sieve No.
Nominal diameter (w)	Tolerance	
9.50	-	-
8.00	±0.09	20
7.50	±0.09	19
7.10	±0.09	18
6.70	±0.08	17
6.30	±0.08	18
6.00	±0.08	15
5.60	±0.07	14
5.00	±0.07	12 ½
4.75	±0.07	12
4.00	±0.06	10
2.80	±0.05	7

Annex C
(Informative)

Specifications of green coffee bean sorter

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

General Information:
Serial No. :_____ Brand/Model: _____
Classification:_____ Make:_____
Production date of the machine to be tested: _____

No.	Items[1]	Manufacturer's specification	Verification by the testing agency
1	Main structure		
1.1	Overall dimensions, mm		
1.1.1	Length		
1.1.2	Width		
1.1.3	Height		
1.2	Overall weight without prime mover, kg		
2	Sorting capacity, kg/batch or kg/h		
3	Prime mover		
3.1	Electric motor		
3.1.1	Brand		
3.1.2	Model		
3.1.3	Make or Manufacturer		
3.1.4	Serial number		
3.1.5	Rated power, kW		
3.1.6	Rated speed, rpm		
3.1.7	Electric service required		
3.1.8	Voltage, V		
3.1.9	Current, A		
3.1.10	Frequency, Hz		
3.2	Engine		
3.2.1	Brand		
3.2.2	Model		
3.2.3	Make		
3.2.4	Serial number		
3.2.5	Type		

No.	Items[1]	Manufacturer's specification	Verification by the testing agency
3.2.6	Rated power, kW		
3.2.7	Rated speed, rpm		
3.2.8	Piston displacement, cm^3		
3.2.9	Cooling system		
3.2.10	Starting system		
4	Type of clutch system		
5	Feeding hopper		
5.1	Dimensions of bottom opening of the feeding hopper, L × W × H, mm		
5.2	Height from the ground, mm		
5.3	Material/s		
5.4	Feature/s		
6	Cleaning device		
6.1	Sieve		
6.1.1	Type		
6.1.2	Dimensions, L × W × H, mm		
6.1.3	Material/s		
6.2	Blower/Aspirator		
6.2.1	Type		
6.2.2	Dimensions, mm		
6.2.3	Number of blades		
6.2.4	Size of inlet port, mm		
6.2.5	Material/s		
6.2.6	Adjustment (if any)		
7	Sorting mechanism		
7.1	Oscillating sieve		
7.1.1	Number of sieves		
7.1.2	Oscillating sieve 1		
7.1.2.1	Dimensions, L × W, mm		
7.1.2.3	Size of perforations, mm		
7.1.2.4	Angle of inclination, °		
7.1.2.5	Material/s		
7.1.3	Oscillating sieve 2		
7.1.3.1	Dimensions, L × W, mm		
7.1.3.2	Size of perforations, mm		
7.1.3.3	Angle of inclination, °		
7.1.3.4	Material/s		
7.1.4	Oscillating sieve 3		
7.1.4.1	Dimensions, L × W, mm		
7.1.4.2	Size of perforations, mm		
7.1.4.3	Angle of inclination, °		
7.1.4.4	Material/s		
7.2	Rotary sieve		
7.2.1	Rotary sieve 1		

No.	Items[1]	Manufacturer's specification	Verification by the testing agency
7.2.1.1	Dimensions, L × D, mm		
7.2.1.2	Size of perforations, mm		
7.2.1.3	Material/s		
7.2.2	Rotary sieve 2		
7.2.2.1	Dimensions, L × D, mm		
7.2.2.2	Size of perforations, mm		
7.2.2.3	Material/s		
7.2.3	Rotary sieve 3		
7.2.3.1	Dimensions, L × D, mm		
7.2.3.2	Size of perforations, mm		
7.2.3.3	Material/s		
8	Outlet		
8.1	Number of outlets		
8.2	Outlet 1		
8.2.1	Material/s		
8.2.2	Dimensions of opening, L × W, mm		
8.2.3	Angle of inclination		
8.2.4	Height from the ground, mm		
8.3	Outlet 2		
8.3.1	Material/s		
8.3.2	Dimensions of opening, L × W, mm		
8.3.3	Angle of inclination		
8.3.4	Height from the ground, mm		
8.4	Outlet 3		
8.4.1	Material/s		
8.4.2	Dimensions of opening, L × W, mm		
8.4.3	Angle of inclination		
8.4.4	Height from the ground, mm		
9	Type of power transmission system		
9.1	_____ to _____		
9.2	_____ to _____		
9.3	_____ to _____		
9.4	_____ to _____		
9.5	Others (specify)		
10	Safety device(s)		
11	Special feature(s)		
[1]The parameter will be checked upon availability			

12 Illustration of transmission system

Annex D
(Normative)

Sampling procedures and measurements

D.1 Sampling procedures for input GCB

The conditions of the input GCB to be used such as moisture content, bulk density, purity, percent GCB that passed through sieve no. 12 ½ (nominal diameter 5 mm), and mechanically damaged beans shall be taken using three "representative samples", which represent the different conditions of the input GCB 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

D.2 Sampling from different outlets

D.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, sorting recovery, mechanically damaged beans (before and after operation), 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:

D.2.1.1 Sorted GCB 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.

D.2.1.2 Blower outlet

During the test, three samples shall be randomly taken from the fan outlet for a duration of at least 15 seconds per collection using a nylon net 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.

D.3 Collection of scattered GCB

GCB scattered beyond 1.0 m from the base of the machine shall be collected. Spread canvas sheets around the sorting floor area to catch the scattered beans after each test trial. The collected beans shall be placed in appropriate

containers and labelled as scattered GCB. Care should be taken to prevent alterations of the conditions of the test samples.

D.4 Collection of other losses

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

D.5 Handling of samples

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

Annex E
(Informative)

Performance test data sheet

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

No.	Items	Trial 1	Trial 2	Trial 3	Average
1	Crop condition				
1.1	Variety				
1.2	Source				
1.3	Moisture content, %				
1.4	Purity, %				
1.5	Bulk density, kg/m^3				
2	Performance test				
2.1	Weight of input GCB, kg				
2.2	Total operating time, min				
2.3	Sorting capacity, kg/h				
2.4	Weight of sorted GCB, kg				
2.4.1	Outlet 1				
2.4.2	Outlet 2				
2.4.3	Outlet 3				
2.5	Sorting recovery, %				
2.6	Speed components, rpm				
2.6.1	Prime mover				
2.6.1.1	Without load				
2.6.1.2	With load				
2.6.2	Oscillating/Rotary sieve shaft				
2.6.2.1	Without load				
2.6.2.2	With load				
2.6.3	Blower/Aspirator shaft				
2.6.3.1	Without load				
2.6.3.2	With load				
2.7	Fan air velocity, m/s				
2.7.1	Without load				
2.7.2	With load				
2.8	Noise level, dB(A)				
2.8.1	Feeding operator				
2.8.1.1	Without load				
2.8.1.2	With load				
2.8.2	Bagger				
2.8.2.1	Without load				
2.8.2.2	With load				

No.	Items	Trial 1	Trial 2	Trial 3	Average
2.9	Fuel consumed, L				
2.10	Fuel consumption, L/h				
2.11	Power consumption				
2.11.1	Input power, kW				
2.11.2	Line voltage, V				
2.11.3	Load current, A				

3 Other observations

3.1 Ease of transporting the machine

_____
_____
_____
_____
_____
_____

3.2 Ease of adjusting and repairing of parts

_____
_____
_____
_____
_____
_____

3.3 Safety features

_____
_____
_____
_____
_____
_____

3.4 Ease of cleaning the sorter components

_____
_____
_____
_____
_____
_____

3.5 Labor requirement

_____
_____
_____
_____

_____
_____

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

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3.7 Level of vibration

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3.8 Dynamic balance

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3.9 Others

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Annex F
(Normative)

Laboratory analysis

F.1 Analysis of input GCB

F.1.1 Determination of purity

Take three 500 g samples of input GCB. Clean the GCBs to remove the impurities. The cleaned GCBs shall be weighed and recorded. Calculate the purity using the formula in Annex H (Formulas used during calculations and testing).

F.1.2 Determination of bulk density of input GCB

F.1.2.1 At least five representative samples shall be randomly obtained from the input GCB samples. The bulk density of each GCB samples shall be measured using a bulk density tester/meter.

F.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 three times.

F1.3 Measurement of moisture content

F.1.3.1 Using air oven method

F.1.3.1.1 Randomly obtain three 100 g from the input GCB samples.

F.1.3.1.2 Place each sample in separate moisture can. The moisture can shall be sealed to ensure that no moisture is lost or gained by the sample between the time it was collected and when it is weighed. Record the initial weight.

F.1.3.1.3 Dry the samples in the oven with a temperature of 105 °C for 16 ± 0.5 h.

F.1.3.1.4 After removing the samples from the oven, moisture can with samples should be placed in a desiccator and be allowed to cool to the ambient temperature.

F.1.3.1.5 Weigh the moisture can with the dried sample and record the final weight. Calculate moisture content (wet-basis) of GCB using the formula in Annex H (Formulas used during calculations and testing).

F.1.3.2 Using moisture meter

At least five representative samples shall be randomly obtained from the input GCB samples. The moisture content of each sample shall be measured using a calibrated moisture meter specific for different variety of GCB.

F.1.4 Sieve analysis

F.2.3.1 For each test trial, three 100 g sample shall be taken from the input GCB.

F.2.3.2 Manually sieve the input GCB sample using sieve no. 12 ½ (with nominal diameter or 5 mm).

F.2.3.4 The samples retained on and passed through the sieve shall be weighed.

F.2 Analysis of sorted GCB

F.2.1 Determination of purity

Take three 500 g of sorted GCB sample collected from each outlets. Clean the GCB to remove the impurities. The cleaned GCB shall be weighed and recorded. Calculate the purity using the formula in Annex H (Formulas used during calculations and testing).

F.2.2 Measurement of sorted GCB dimensions

F.2.2.1 Randomly take at least 30 pieces of GCB from the sorted GCB samples collected from each outlet.

F.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 H (Formulas used during calculations and testing).

F.2.3 Sieve analysis

F.2.3.1 For each test trial, three 100 g sample shall be taken from the sorted GCB sample for each outlet.

F.2.3.2 Select the sieves to be used according to Table 1 and Annex B (Characteristics of perforated metal plate test sieves with round holes).

Table 1. Sieve sizes to be used for classifying different GCB varieties by size (BAFPS-DA, 2012, *modified*)

Size	Diameter of perforations, mm			
	Arabica	Robusta	Liberica	Excelsa
Large	7.93	7.5	9.52	7.93
Medium	6.73	6.5	7.93	6.73
Small	6.35	5.5	6.7	6.35

F.2.3.3 Place the sieves with the samples in the sieve shaker in descending order (biggest size to smallest size). The sieve shaker shall be operated for five minutes.

F.2.3.4 The samples retained in each sieve shall be taken and weighed. Based on the maximum percent beans retained in each sieve, the size classification shall be determined based on Table 1. An example of classifying GCB is presented in Table 2.

Table 2. An example of classifying Arabica GCB based on maximum percent beans retained

Source of sorted GCB	Sieve Size, mm	Percentage Retained on Each Sieve, %	Size Classification
Outlet 1 (large)	7.93	**94.02**	Large
	6.73	4.47	
	6.35	1.39	
	Pan	0.12	
Outlet 2 (Medium)	7.93	0.24	Medium
	6.73	**98.52**	
	6.35	1.23	
	Pan	0.01	
Outlet 3 (Small)	7.93	4.58	Small
	6.73	0.29	
	6.35	**93.68**	
	Pan	1.45	

F.3 Determination of net percent mechanically damaged GCB

Three samples shall be taken for analysis from the input GCB sample and sorted GCB sample per outlet. Each sample shall consist of 100 g. Separate and weigh the GCB that were broken and/or crushed. Compute for the percentage of mechanically damaged GCB and net mechanically damaged GCB using the formula in Annex H (Formulas used during calculations and testing).

F.4 Determination of losses

F.4.1 Blower loss

Three samples shall be taken at the blower outlet to collect blown GCB. Each sample shall be cleaned and weighed. The total weight of the clean GCB and the total time of collection shall be recorded for the computation of blower loss using the formula in Annex H (Formulas used during calculations and testing).

F.4.2 Scattering loss

GCB 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 H (Formulas used during calculations and testing).

F.4.3 Other losses

Other losses shall be determined using the formula in Annex H (Formulas used during calculations and testing).

Annex G
(Informative)

Laboratory analysis data sheet

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

1 Analysis of input GCB

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 Beans, g													
Purity, %													

1.2 Bulk density

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

1.3 Moisture content (wet-basis)

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.			

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, $\%_{wb}$															

1.4 Sieve analysis

Initial weight of samples = 100 g

Item	Weight, g				Percent, %
	Sample 1	Sample 2	Sample 3	Average	
Retained on sieve no. 12 ½ (nominal diameter 5 mm)					
Passed through sieve no. 12 ½ (nominal diameter 5 mm)					

2 Analysis of sorted GCB

2.1 Purity

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 Beans, g													
Purity, %													

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 Beans, g													
Purity, %													

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 Beans, g													
Purity, %													

2.2 Measurement of GCB dimensions per outlet

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, %			

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, %			

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, %			

2.3 Sieve analysis of sorted GCB

Initial weight of samples = 100 g

Source of sorted GCB	Sieve size	Weight of beans retained, g												Gen. ave.	Percent beans retained, %
		Test trial 1				Test trial 2				Test trial 3					
		1	2	3	Ave.	1	2	3	Ave.	1	2	3	Ave.		
Outlet 1															
	Pan														
Outlet 2															
	Pan														
Outlet 3															
	Pan														

3 Net Percent mechanically damaged GCB

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 GCB, g													
Percent damaged GCB, %													

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 GCB, g													
	Percent damaged GCB, %													
Outlet 2	Weight of damaged GCB, g													
	Percent damaged GCB, %													
Outlet 3	Weight of damaged GCB, g													
	Percent damaged GCB, %													
Net percent mechanically damaged GCB, %														

4 Loss determination

Test trial no.	Sample no.	Blower loss Duration:			Scattering loss		Other losses	
		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 H
(Normative)

Formulas used during calculations and testing

H.1 Purity

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

where:

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

H.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 GCB sample, g
w_f is the final weight of GCB sample, g

H.3 Percent mechanically damaged GCB

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

where:

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

H.4 Net percent mechanically damaged GCB

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

where:

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

H.5 Losses

H.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

H.5.2 Blower loss

H.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 GCB sample, kg
T_c is the duration of collection, kg
T_o is the duration of operation, kg

H.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 GCB, kg
L_T is the summation of all losses, kg

H.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 GCB, kg
W_s is the weight of sorted GCB, kg
L_T is the summation of all losses, kg

H.5.4 Other losses

H.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 GCB, kg
W_i is the weight of cleaned GCB input, kg
W_s is the weight of sorted GCB, kg

H.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 GCB, kg
T is the total operating time, h

H.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 GCB dimension, mm^2
s is the standard deviation of GCB dimension, mm
CV is the coefficient of variation of GCB dimension, %

H.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 GCB, kg
W_i is the weight of input GCB, kg

H.9 Fuel and electric energy consumption

H.9.1 Fuel consumption

$$F_{cr} = \frac{F_v}{T_f}$$

where:

F_{cr} is the fuel consumption rate, L/h
F_v is the volume of fuel consumed, L
T_f is the total fuel consuming time, h

H.9.2 Electric energy consumption

H.9.2.1 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

H.9.2.2 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
PF is the power factor

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