

PHILIPPINE NATIONAL STANDARD

PNS/BAFS 214:2023
ICS 65.060.99

Green Coffee Bean (GCB) Roaster — Specifications



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Specifications PNS/BAFS 214:2023
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Foreword

In 2017, the Department of Agriculture (DA)-BAFS developed the Philippine National Standards (PNS) on Coffee Roaster — Specifications (PNS/BAFS 214:2017) and Methods of Test (PNS/BAFS 215:2017) with the objective of setting the minimum parameters of the machine to achieve quality roasted coffee. According to the Cavite State University (CvSU) in 2022, over the course of its implementation, there were issues with some of the major provisions on the PNS, such as performance criteria and its methods of test. In light of these concerns, CvSU proposed a thorough review and potential revisions to the existing standards. The suggestion aims to go beyond merely providing guidance to suppliers and manufacturers but primarily intends to ensure product safety and market equity, in the interest of protecting the end-users. The proposed amendment of the PNS was endorsed through the issuance of DA-Philippine Council for Agriculture and Fisheries (PCAF)-National Sectoral Committee on Agricultural and Fisheries Mechanization (CAFMech) Resolution No.12, series of 2022 (Recommending to the BAFS the Prioritization of the Revision of the Existing PNS on Coffee Roaster [PNS 214:2017 and PNS 215:2017]).

In response, the DA-BAFS officially created a Technical Working Group (TWG) to amend the PNS under Special Order (SO) No. 146, series of 2023 (Creation of TWG for the Development of PNS for Agricultural and Fishery Products, Machinery, and Infrastructures) and SO No. 532, series of 2023 (Addendum to SO No. 146 series of 2023 entitled, “Creation of TWG for the Development of PNS for Agricultural and Fishery Products, Machinery, and Infrastructures”). The TWG was composed of relevant stakeholders from the government sector, academe/research institutions, private sector organizations, and Civil Society Organizations (CSO). The draft PNS underwent a series of TWG meetings and stakeholder consultations, facilitated through physical and online platforms, from February to September 2023 prior to its endorsement to the DA Secretary for approval.

This standard includes the following significant changes compared to the PNS on Coffee Roaster — Specifications (PNS/BAFS 214:2017)

1. Modification of title from “Coffee Roaster” to “Green Coffee Bean (GCB) Roaster”;
2. Modification on the scope to include other types of heat and energy sources;
3. Modifications on the terms and definitions;
4. Inclusion of level of control in the classifications;
5. Modifications on the manufacturing requirements (previously fabrication requirements) specifically to consider the innovations on GCB roasters;
6. Modifications on the performance criteria in the performance parameters;
7. Inclusion of maximum roasting time per input per load in the performance parameters;
8. Harmonization of noise level requirement with Department of Labor and Employment (DOLE) Occupational Safety and Health (OSH) standards; and
9. Inclusion of the speed of drum and maximum temperature in the marking and labeling.

This document was written in accordance with the formatting and editorial rules of the Standardization Guide No. 1 (Writing the PNS) developed by the Standards Development Division (SDD) of the BAFS-DA.

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1 Scope

This Standard specifies the manufacturing, performance, and other requirements for green coffee bean (GCB) roasters driven by an electric motor or an engine with liquefied petroleum gas (LPG), electric heating element or diesel as heat sources. GCB roasters utilizing renewable energy are also covered by this Standard.

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).
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3 Terms and Definitions

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

3.1

air roaster

GCB roaster that utilizes forced hot air to simultaneously agitate and roast GCB through convection (Botazzi, 2012, *modified*)

3.2

by-product

chaff, silver skin, and other wastes after roasting (AMTEC-UPLB, 2023)

3.3

coffee sampler

coffee trier

metal scoop used to inspect small portion of roasted coffee bean (RCB) during roasting (Folmer, 2017, *modified*)

3.4**damaged beans**

broken RCB damaged by the machine during the roasting process (BAFS-DA, 2023)

3.5**degree of roast**

color-based roast classification that can be measured using Agtron roast color guide/Specialty Coffee Association roast color guide, spectrophotometer, colorimeter, or any other appropriate equipment or method (Leme, et al., 2019, *modified*)

3.5.1**very light roast**

first crack (stage of coffee roasting where complex chemical reactions occur as the RCB reach 190-205 °C that causes an audible cracking sound), delicate with a bit of acidity and grassy taste (O'Connor, 2023, *modified*)

3.5.2**light roast**

light brown in color, no oil on the surface of the RCB (Davids, 2023, *modified*)

3.5.3**moderately light roast**

moderately light brown in color, surface of bean remains dry without oil in the surface (Davids, 2023, *modified*)

3.5.4**light medium roast**

light brown in color, green coffee distinction is clear, and with dry surface (Davids, 2023, *modified*)

3.5.5**medium roast**

medium brown in color, no oil on the surface of the RCB (Davids, 2023, *modified*)

3.5.6**moderately dark roast**

with richer, darker color having some oil beginning to show on the surface of the RCB. The beans are roasted to the beginning or in the middle of the second crack (stage of roasting where GCB are dehydrated and becomes brittle resulting to cracking and carbonization which usually occurs at 225-235 °C; produces the burnt characteristics of dark roasts) (Davids, 2023, *modified*)

3.5.7**dark roast**

dark brown in color with RCB covered in oil. The beans are roasted with, at about the end of second crack (Davids, 2023, *modified*)

3.5.8**very dark roast**

black in color with bean surface covered brightly with oil (Davids, 2023, *modified*)

3.6**drum roaster**

GCB roaster where the beans are agitated inside a metal drum. The heat is applied through the surface of the drum mainly by conduction (Bolka and Emire, 2020, *modified*)

3.7**green coffee bean (GCB)**

dried bean of the coffee plant, disengaged from their external envelopes (exocarp, mesocarp, and endocarp) after hulling (BAFS-DA, 2012, *modified*)

3.8**green coffee bean (GCB) roaster**

machine used to roast GCB (Wibowo, et al., 2022, *modified*)

3.9**heat source**

supplies heat to the roasting chamber (BAFS-DA, 2018, *modified*)

3.10**input capacity**

total amount of GCB over the roasting time, expressed in kilogram per hour (kg/h) (BAFS-DA, 2017, *modified*)

3.11**input per load**

total amount of GCB input per load, expressed in kilogram (kg) (BAFS-DA, 2023)

3.12**output capacity**

total amount of RCB over the roasting time, expressed in kilogram per hour (kg/h) (BAFS-DA, 2017, *modified*)

3.13**output per load**

total amount of RCB per load, expressed in kilogram (kg) (BAFS-DA, 2017, *modified*)

3.14**retained RCB**

remaining beans inside the roasting chamber (BAFS-DA, 2023)

3.15**roast profile**

temperature and time curve that determines the transformation of a GCB to RCB (Ovian, 2023, *modified*)

3.16**roasted coffee bean (RCB)**

palatable coffee beans derived by subjecting GCB to dry heat, whether from an open flame, oven, or other heating source, to achieve the desired degree of roast (Franca et al., 2009, *modified*)

3.17**roasting**

process used to produce chemical and physical changes in the structure and composition of GCB by heat treatment resulting in the darkening of GCB and development of the characteristic flavor and aroma (Folmer, 2017, *modified*)

3.18**roasting temperature**

temperature inside the roasting chamber during operation, expressed in °C (BAFS-DA, 2023)

3.19**roasting losses**

RCB that were not collected from the main outlet except for retained RCB inside the roasting chamber (AMTEC-UPLB, 2023)

3.20**scorched RCB**

produced when the charge temperature (i.e., starting temperature) is too high and the speed of the drum is too slow; dark burnt stains appear on the coffee bean surface (Rusinek, 2022)

3.21**sight glass**

inspection window

a viewing window to see the color change process during the roasting process (Wibowo, et al., 2022)

3.22**unroasted bean**

coffee beans which show a lighter color compared to the whole batch except for quakers (BAFS-DA, 2023)

4 Classifications

Classification of GCB roaster shall be based on but not limited to the following:

4.1 Heating method

4.1.1 Conduction

Transfer of heat to the coffee bean occurs through the surface of a hot metal drum or container. This heating method usually employs drum roasters as shown in Figure 1.

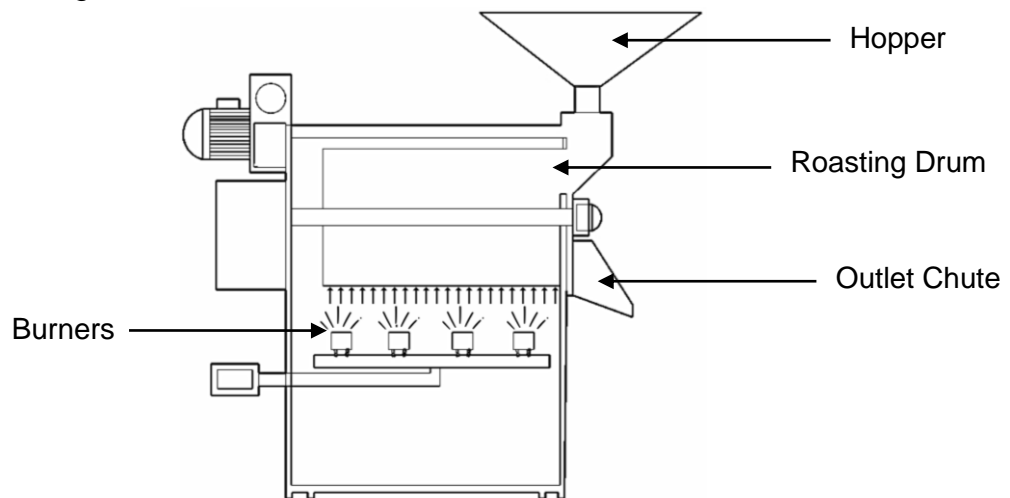


Figure 1. Conduction-type GCB Roaster (Source: Shopshire Coffee Ltd)

4.1.2 Convection

Transfer of heat to the coffee bean occurs through heated air. Convection is the heating method utilized by recirculating hot air as shown in Figure 2.

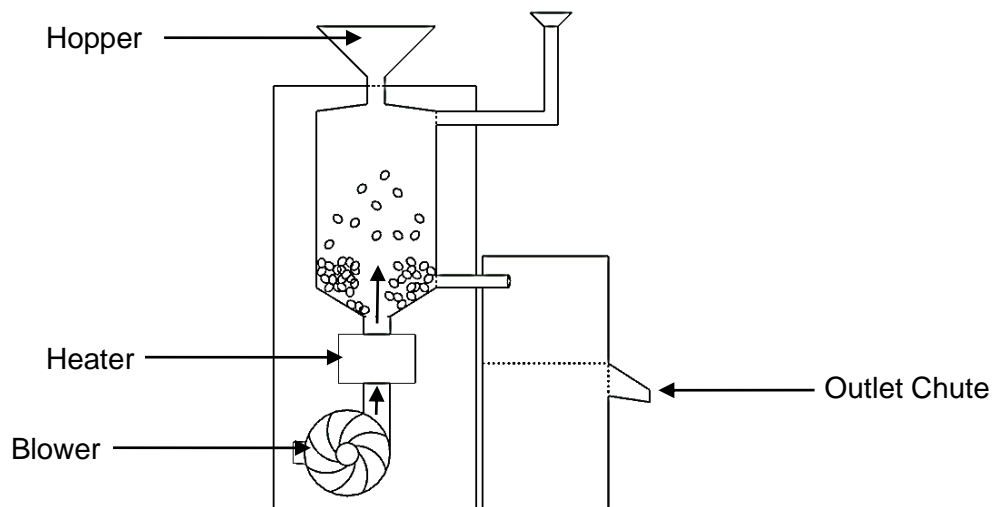


Figure 2. Convection-type GCB roaster (adapted from Basilio, 2023)

4.2 Roasting mechanism

4.2.1 Horizontal drum roaster

Coffee beans are axially mixed along the horizontal drum by spiral flights as shown in Figure 3.

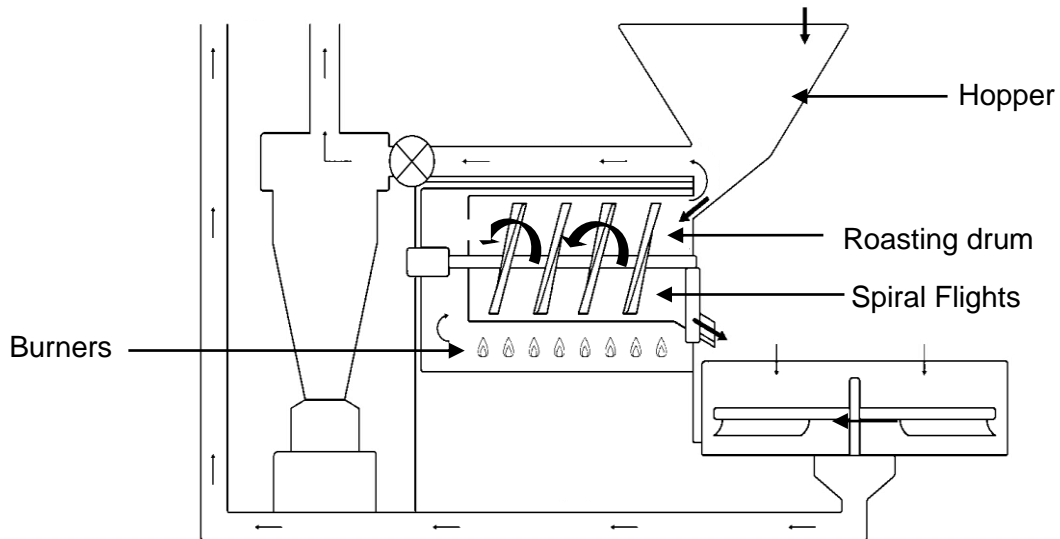


Figure 3. Horizontal drum-type GCB roaster (adapted from Pereira et al., 2020)

4.2.2 Vertical drum roaster

Movement of the coffee beans inside the chamber is facilitated by paddles or auger. A typical vertical drum roaster is illustrated in Figure 4.

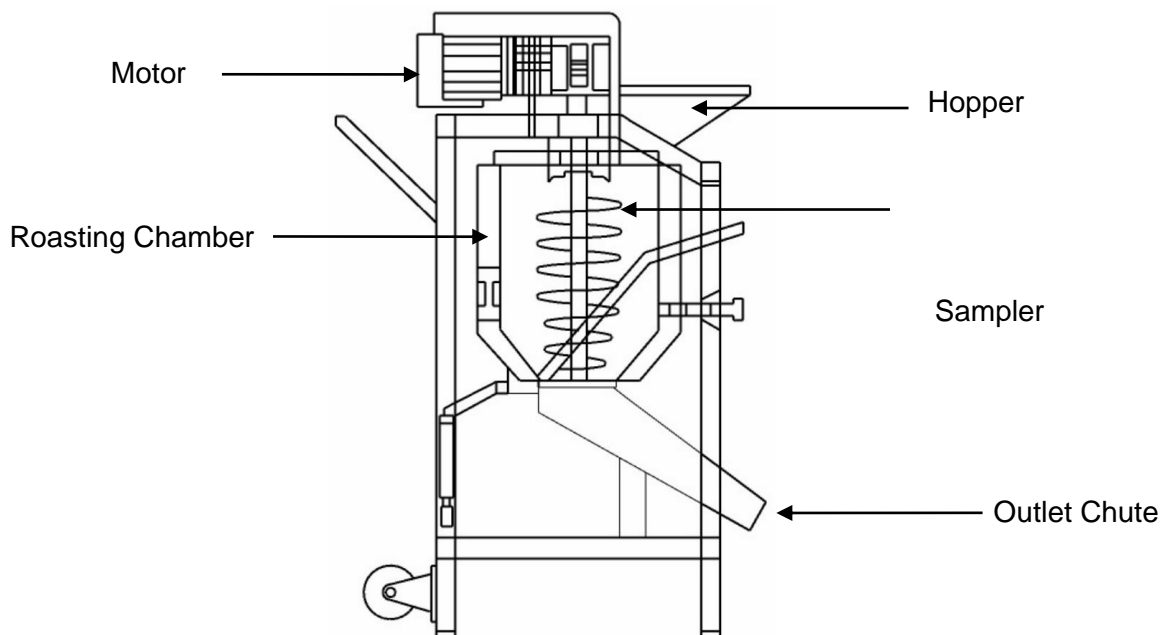


Figure 4. Vertical drum-type GCB roaster (adapted from Mojica, 2023)

4.2.3 Rotating bowl

GCB are fed into the center of the rotating horizontal bowl with a vertical shaft and are carried to the sides of the bowl by centrifugal force supported by high-temperature air. A typical rotating bowl roaster is shown in Figure 5.

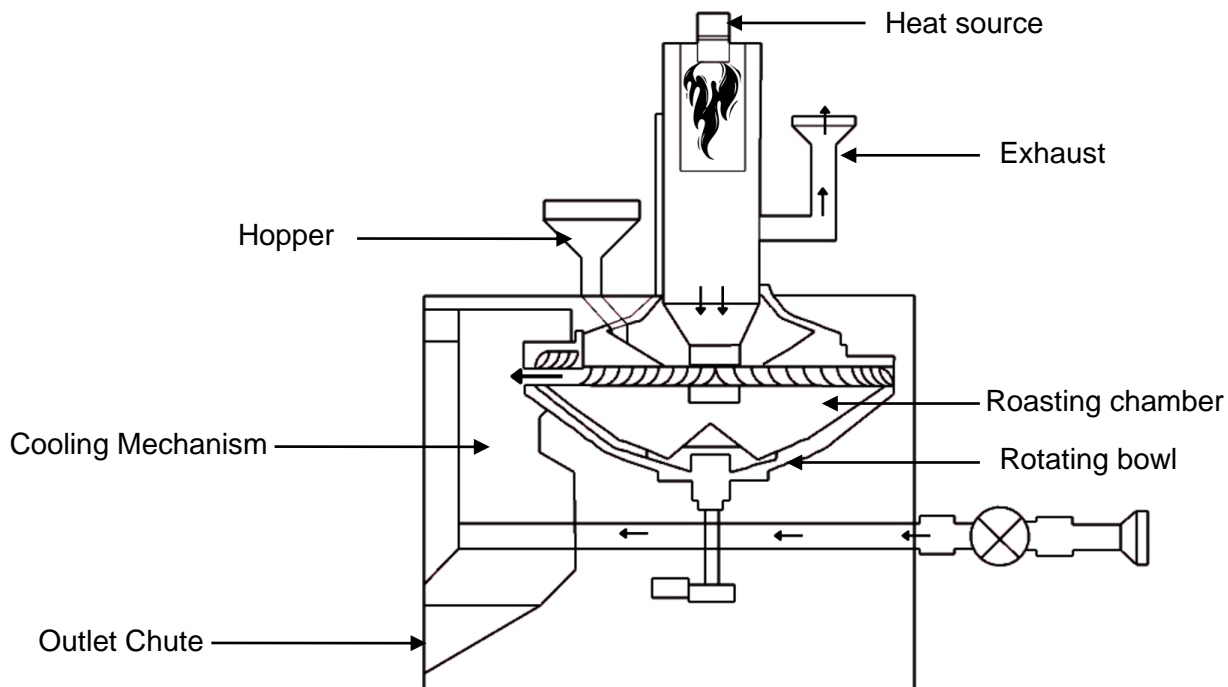


Figure 5. Rotating bowl-type GCB roaster (Source: Probat SE, 2023)

4.3 System of operation

4.3.1 Batch roaster

A definite amount of GCB is roasted at a time. Batch roasters have a specific time to start and finish each roasting process. Bean temperatures change with time. Likewise, the roasting time per batch varies depending on the degree of roast and the amount of GCB.

4.3.2 Continuous roaster

A type of GCB roaster that operates continuously and is specifically designed to roast GCB, with RCB being discharged at the other end simultaneously. Bean temperature changes with axial position.

4.4 Heat Source

4.4.1 Fuel

GCB roaster which uses fuel as heat source such as LPG and diesel.

4.4.2 Electricity

GCB roaster which uses electricity as heat source (e.g., heating coil, etc.).

4.4.3 Renewable energy

GCB Roaster which uses renewable energy as heat source including but not limited to solar energy, biomass, and others.

4.5 Level of Control

4.5.1 Manually-Controlled

A type of GCB roaster which features a knob or dial to control the heat source.

4.5.2 Semi-Automatic

GCB are roasted using the integration of manual and automatic control system. Operator/s set the temperature using a computer or a controller.

4.5.3 Fully-Automatic

GCB roaster which was manufactured with advance sensors and software for temperature, airflow, time and capacity control.

5 Manufacturing Requirements

5.1 The GCB roaster shall be provided with an appropriate temperature digital display or gauge (preferably built-in with a tolerance of ± 1 °C), a cooling mechanism, and a sight glass. Its cooling mechanism shall be sufficient enough to hold its capacity.

5.2 The GCB roaster shall be provided with an appropriate temperature control system (automated or analog) to attain the desired roast profile.

5.3 For drum roasters, a coffee sampler shall be provided.

5.4 GCB roaster should be powered by either LPG, fossil-based fuel, electricity, or other renewable energy sources as stated in 4.4.3. To avoid the risk of contamination, heat exchanger or other appropriate mechanisms shall be provided for GCB roaster utilizing fossil-based fuel or biomass sources.

5.5 Frame and stand assembly shall be provided to minimize vibrations and movements. It shall be stable to support the load and components during operation.

- 5.6** GCB roaster shall have adjustment mechanisms for heat, airflow and drum speed, as applicable.
- 5.7** Bolts and nuts, belts and pulleys, chains and sprockets, screws, bearings, and bushing and seals to be used should conform to the following local and/or other international standards as applicable.
- a) PAES 311:2001 (Engineering materials – Bolts and nuts for agricultural machines – Specifications and applications);
 - b) PAES 301:2000 (Engineering materials – V-belts and pulleys for agricultural machines – Specifications and applications);
 - c) PAES 303:2000 (Engineering materials – Roller chains and sprockets for agricultural machines – Specifications and applications); and
 - d) PAES 313:2000 (Engineering materials – Screws for agricultural machines – Specifications and applications).
- 5.8** The parts that are in direct contact with the coffee beans shall be made of food-grade material.
- 5.9** The roasting chamber shall be accessible for cleaning and easy retrieval of the retained beans after roasting.
- 5.10** The GCB roaster should have an airflow control system.

6 Performance Requirements

- 6.1** The input per load or input capacity specified by the manufacturer shall be attained.
- 6.2** The performance criteria for GCB roaster shall be attained as specified in Table 1.

Table 1. Performance criteria for GCB roaster (AMTEC-UPLB, 2023)

Criteria	Performance data, %, max
Roasting losses and retained beans	3
Damaged RCB	5
Scorched RCB	3
Unroasted coffee bean	None

- 6.3** The GCB roasters shall attain dark roast (except for specialty roaster) within a roasting time specified in Table 2.

Table 2. Maximum roasting time per input per load (Helena Coffee Processing and Export, 2022)

Input per load, kg	Maximum Roasting Time, min
2 to 5	18
>5 to ≤10	25
>10 to ≤50	45

7 Safety, Workmanship and Finish

- 7.1** GCB roaster shall be free from any manufacturing defects that may be detrimental to its operation.
- 7.2** Any uncoated metallic surfaces shall be free from rust upon inspection.
- 7.3** Noise level shall conform to Rule 1074.01 to 1074.03 of Occupational Safety and Health Standards of Occupational Safety and Health Center-Department of Labor and Employment (OSHC-DOLE), as shown in Annex A. If the noise level of roaster exceeds 95 dB(A) during a four-hour operation, earmuffs or other ear protective device shall be provided.
- 7.4** Guards, insulation, or any similar protective mechanism shall be provided for exposed parts with surface temperature exceeding 60°C to protect the operator.
- 7.5** The external parts of the GCB roaster shall be free from sharp edges and rough surfaces that may be accessed by the operator/s.
- 7.6** Mechanism for immediate disengagement of power shall be provided in conformance with Clause 12.5.4 of PNS/BAFS 330:2022 (Technical means for ensuring safety – Guidelines).
- 7.7** All moving parts shall be provided with safety features.
- 7.8** The GCB roaster should be compliant with Clause 4.C of the Department of Health (DOH) Administrative Order No. 153 series of 2004 (*Revised Guidelines on Current Good Manufacturing Practice in Manufacturing, Packing, Repacking, or Holding Food*).
- 7.9** In case of engine-driven GCB roaster, there shall be provisions to avoid contamination of RCB from the engine operation (e.g., orienting the exhaust gas away from the RCB).
- 7.10** Warning notices shall be provided in conformance with Clause 10.2 of PNS/BAFS 330:2022 (Technical means for ensuring safety – Guidelines).
- 7.11** The power transmission system shall be provided with guard in conformance with Clause 14 of PNS/BAFS 330:2022 (Technical means for ensuring safety – Guidelines).

7.12 There shall be provision for belt tightening and adjustments tools, bars and equipment.

8 After-sales Requirements

Requirements for after-sales services of the GCB roaster shall conform to PNS/BAFS/PAES 192:2016 (Guidelines for after-sales service).

9 Maintenance and Operation

9.1 The GCB roaster shall be easy to operate, repair and maintain.

9.2 By-product collector, impeller fan, cooling tray, cyclone and all the ducting and piping parts shall be accessible for cleaning

9.3 Each unit of GCB roaster shall be provided with a set of manufacturer's standard tools required for repair and maintenance.

9.4 Operator's manual shall be provided in conformance with PAES 102:2000 (Agricultural machinery — Operator's manual — Content and presentation) including maintenance schedule.

10 Sampling

GCB roaster shall be sampled for testing in conformance with PAES 103:2000 (Agricultural machinery – Method of sampling).

11 Testing

GCB roaster shall be tested in conformance with PNS/BAFS 215:2023 (GCB roaster — Methods of test).

12 Marking and Labeling

12.1 Each unit of GCB roaster shall be engraved or embossed with the following information, either in the body of the roaster or in a non-removable nameplate, attached in the clearly visible place:

- a) Registered trademark of the manufacturer;
- b) Brand;
- c) Model;
- d) Serial Number;
- e) Manufacturer/importer/distributor Information:

- i. Name;
- ii. Address; and
- iii. Contact details.
- f) Country of manufacture/origin (if imported) / “Made in the Philippines” (if manufactured in the country);
- g) Input capacity (kg/h) and input per load (kg/batch) for continuous-type and batch-type roaster, respectively;
- h) Maximum roasting temperature, °C; and
- i) Speed of drum (rpm)

12.2 In addition, marking and labeling shall comply with the applicable regulation set by the competent authority.

Annex A (Informative)

Occupational safety and health standards (Rule 1074.01–1074.03)

A.1 Threshold limit values for noise

A.1.1 The threshold limit values refer to sound pressure that represents conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect on their ability to hear and understand normal speech.

A.1.2 Feasible administrative or engineering controls shall be utilized when workers are exposed to sound levels exceeding those specified in Table A.1 hereof when measured on a scale of a standard sound level meter at slow response. If such controls fail to reduce sound within the specified levels, ear protective devices capable of bringing the sound level to permissible noise exposure shall be provided by the employer and used by the worker.

Table A.1. Permissible noise exposure

Duration per day, h	Sound levels (slow response), dB(A)
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼	115

A.2 Permissible noise exposure

A.2.1 The values specified in Table A.1 apply to total time of exposure per working day regardless of whether this is one continuous exposure or a number of short-term exposures but does not apply to impact or impulsive type of noise.

A.2.2 If the variation in noise level involves maximum intervals of one second or less, it shall be considered as continuous. If the interval is over one second, it becomes impulse or impact noise.

A.2.3 When the daily noise exposure is composed of two or more periods noise exposure of different levels, their combined effect should be considered rather than the effect of each.

A.2.4 If the sum of the fraction in Equation A exceeds one, then the mixed exposure should be considered to exceed the threshold limit value. C indicates the total time exposure at a specified noise level, and T indicates the total time of

exposure permitted at the level. However, the permissible levels indicated in Table A.1 shall not be exceeded for the corresponding number of hours per day allowed. Noise exposures of less than 90 dB(A) are not covered by Equation A.

$$X = C_1T_1 + C_2T_2 + C_3T_3$$

where:

X is the sum of the ratios of C and T
C is the total time of exposure at a specified noise level
T is the total time of exposure permitted at the level

A.2.5 Exposures to impulsive or impact noise shall not exceed 140 decibels peak sound pressures level (ceiling value).

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