

PHILIPPINE NATIONAL STANDARD

PNS/BAFS 335:2022
ICS 65.060.20

Rotary Tiller — Specifications



BUREAU OF AGRICULTURE AND FISHERIES STANDARDS

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Foreword

Since 2011, a significant number of rotary tillers have been tested by Agricultural Machinery Testing and Evaluation Center (AMTEC)-University of the Philippines Los Baños (UPLB) without an existing reference standard. In August 2021, AMTEC-UPLB formally proposed for the development of Philippine National Standards (PNS) on Rotary Tiller – Specifications and Methods of Test to the Philippine Council for Agriculture and Fisheries Council (PCAF)-Committee on Agriculture and Fisheries Mechanization (CAFMech). The proposed PNS intend to set minimum requirements for the specification and testing of rotary tiller which will be used as reference not just by AMTEC-UPLB but also by the Bureau of Agricultural and Fisheries Engineering (BAFE)-Department of Agriculture (DA), as the regulatory agency for agriculture and fisheries machinery and infrastructures. PCAF-CAFMech formally endorsed the proposal of AMTEC-UPLB to the Bureau of Agriculture and Fisheries Standards (BAFS)-DA for prioritization through the issuance of PCAF-CAFMech Resolution No. 6, series of 2021 (Recommending to the BAFS the Prioritization of the Development or Revision of the PNS of Various Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development [PCAARRD]-Funded Machinery Projects). In November 2021, BAFS-DA subjected the proposals through a prioritization process, which resulted to their prioritization in 2022.

A Technical Working Group (TWG) was created to develop the PNS under Special Order No. 103, series of 2022 (Creation of TWG for the Development of PNS for Agriculture and Fishery Products, Machineries, and Infrastructures). The establishment of the TWG was amended through Special Order No. 350, series of 2022 (Addendum to Special Order No. 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 relevant government agencies, academe/research institution, Civil Society Organizations (CSO), and private sector. The draft PNS developed by BAFS-DA and the TWG underwent a series of TWG meetings and stakeholder consultations conducted via online platforms before their finalization and endorsement to the DA Secretary for approval.

This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2.

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1 Scope

This Standard specifies the minimum requirements for rotary tillers mounted or trailed to four-wheel or track-type tractors.

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 — Method of sampling (PAES 103:2000).

<http://amtec.ceat.uplb.edu.ph/wp-content/uploads/2019/07/PAES-103-2000-Agricultural-Machinery-Method-of-Sampling.pdf>

AMTEC-UPLB. (2000). Agricultural machinery — Operator’s manual — Content and presentation (PAES 102:2000).

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<https://amtec.ceat.uplb.edu.ph/wp-content/uploads/2020/06/PNS-PAES-311-2001-Engineering-Materials-Bolts-and-Nuts-Specifications-and-Applications.pdf>

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BAFS-DA. (2022). Rotary tiller — Methods of test. (PNS/BAFS 336:2022)

BAFS-DA. (2022). Technical means for ensuring safety — Guidelines. (PNS/BAFS 330:2022).

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3 Terms and Definitions

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

3.1

dry preparation

method of land preparation wherein the soils are not puddled and there is no freestanding water in the field; typically practiced for upland fields but can also be done for lowland fields (AMTEC-UPLB, 2022)

3.2

field efficiency

ratio of the actual or effective field capacity to the theoretical field capacity, expressed in percent (%) (AMTEC-UPLB, 2022)

3.3

hitch point

portion of the rotary tiller used to mount or trail itself to the tractor (AMTEC-UPLB, 2022, *modified*)

3.4

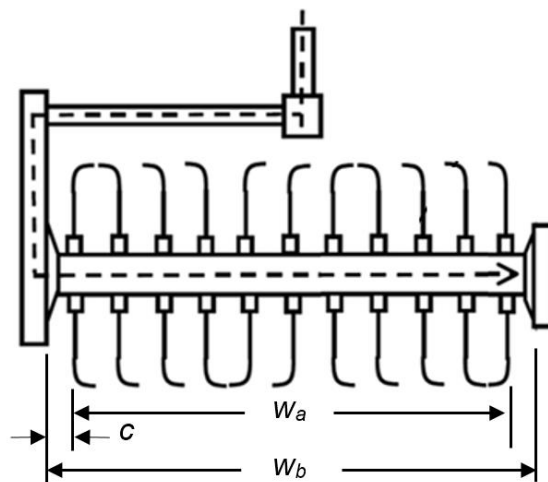
implement

any agricultural tool mounted or trailed to the tractor (AMTEC-UPLB, 2000, *modified*)

3.5

operating width

horizontal distance perpendicular to the direction of travel within which an implement performs its intended function, expressed in meter (m). The operating width is measured as shown in Figure 1 (AMTEC-UPLB, 2010, *modified*)



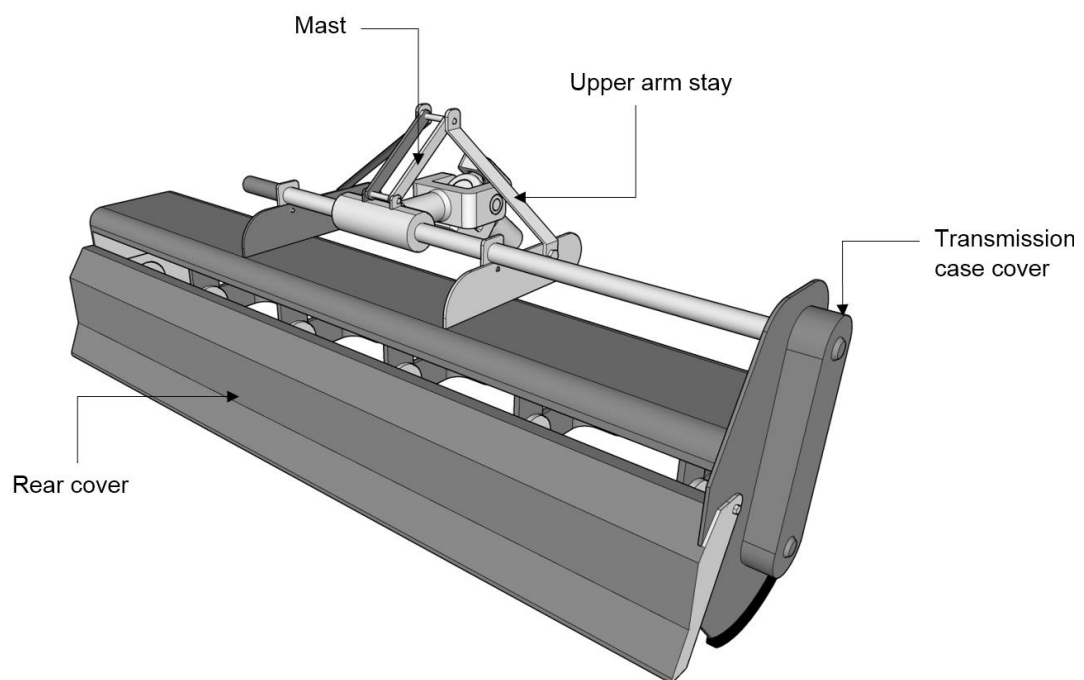
Key

- c clearance between cover and blade
- w_a operating width of the tiller, if c is greater than or equal to 50 mm
- w_b operating width of the tiller, if c is less than 50 mm

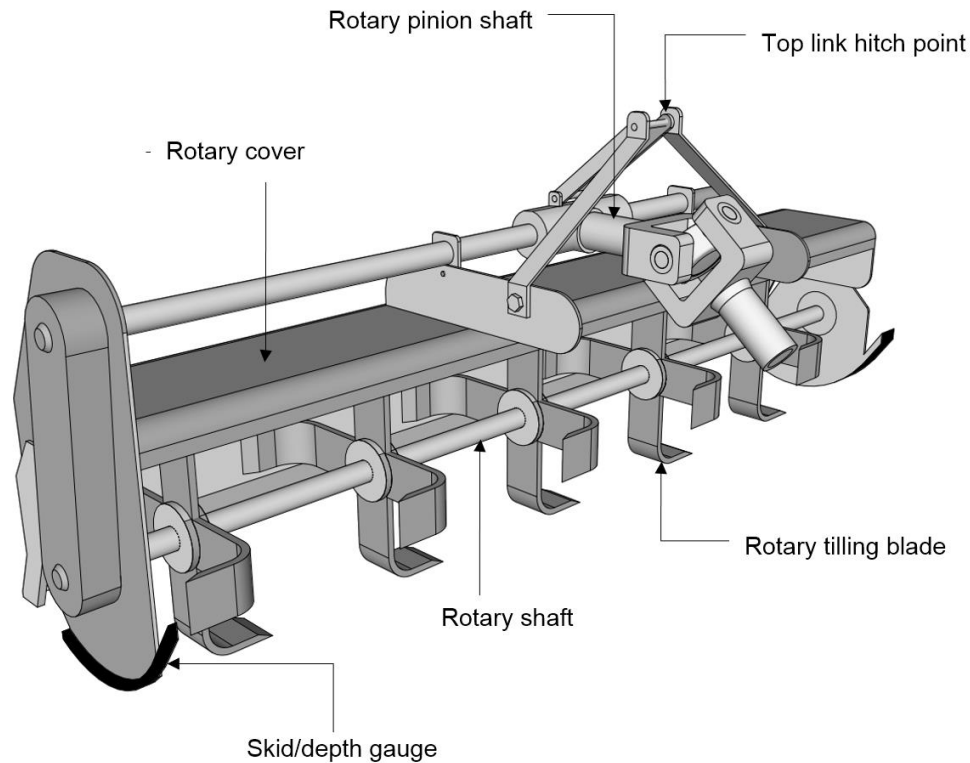
Figure 1. Operating width of the rotary tiller (Adapted from AMTEC-UPLB, 2022)

**3.6
rotary tiller**

implement used for broadcast tillage (i.e., tillage of an entire area in contrast with partial tillage which is tillage in bands or strips) or strip tillage. It is also used as chemical incorporator and as row crop cultivator. It is also referred to as rotary cultivator. It consists of power-driven shaft, parallel or perpendicular to the land surface, moving transverse to the direction of travel, equipped with blades that cut and pulverize the soil, and incorporate all materials in the disturbed layer of the soil. The typical basic components parts of the rotary tiller are shown in Figure 2.



a) Rear view of the horizontal rotary tiller



b) Front view of the horizontal rotary tiller

Figure 2. Typical rotary tiller and its basic components

3.6.1

depth gauge

part of the rotary tiller responsible for setting different depths of rotary tilling

3.6.2

frame

structure on which the whole assembly of the rotary tiller are fitted

3.6.3

cover

protective device designed and fitted so that alone or with other parts of the machine, prevents the dangerous part from being reached (AMTEC-UPLB, 2022)

3.6.4

power train

mechanism that transmits the drive from the Power-Take-Off (PTO) shaft to the rotary shaft (AMTEC-UPLB, 2022)

3.6.5

power-take-off (PTO) shaft

external shaft usually at the rear of the tractor providing rotational power to implements and machines (AMTEC-UPLB, 2001)

3.6.6

rear cover

adjustable cover found at the rear of the rotary tiller which blocks the cut soil, further breaks down the soil through impact force at collision, and simultaneously levels the soil surface after tillage. It is also referred to as rear hood or rear shield

3.6.7

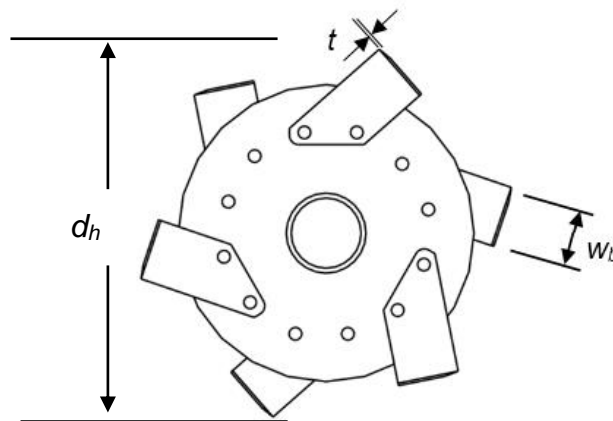
rotary shaft

structure on which the rotary blades are attached

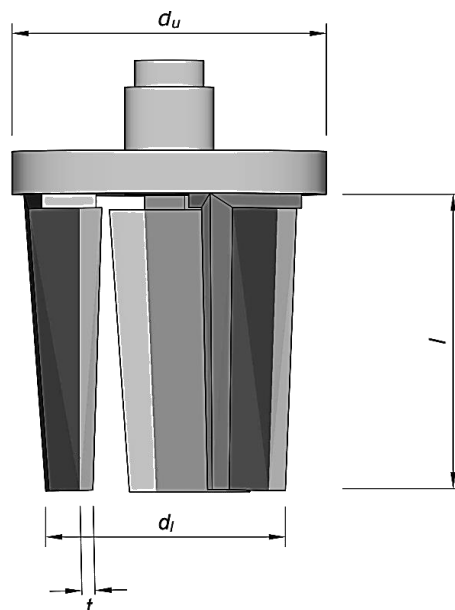
3.6.8

rotary tilling blade

soil-working tool of the rotary tiller, consisting of an edge and a surface, which is primarily designed to cut, loosen, and pulverize the soil. Dimensions of the tilling blade are shown in Figure 3.



a) Dimension for horizontal rotary tilling blade



b) Dimension for vertical rotary tilling blade

Key

- d_h diameter of the horizontal rotary tilling blade assembly; (measured from tip to tip of the opposite blades)
- d_l lower diameter of the vertical rotary tilling blade assembly
- d_u upper diameter of the vertical rotary tilling blade assembly
- l length of the vertical blade
- t thickness of blade (cutting part)
- w_b width of blade (the widest cutting part)

Figure 3. Dimension of a) horizontal and b) vertical type rotary tilling blades (adapted from Azadbakht et al., 2014)

3.6.9 rotary tilling blade assembly

consists of a set of blades attached to the rotary shaft, also referred to as rotor assembly

3.7 rotary tilling

combined primary and secondary tillage operation employing power-driven rotary action to cut, break up, pulverize, level and mix soil and agricultural residues (AMTEC-UPLB, 2000, *modified*). It is also referred to as rotary tillage

3.8 tractor

self-propelled, wheeled or tracked vehicle designed to carry, pull or propel agricultural implements, and machines (AMTEC-UPLB, 2000, *modified*)

3.9

wet preparation

method of land preparation wherein the soils is tilled in a saturated or flooded condition, which is the most common way of preparing lowland fields (AMTEC-UPLB, 2022)

4 Classification

The classification of rotary tiller should be based but not limited to the following:

4.1 Types of rotary shaft

4.1.1 Horizontal-shaft type

A rotary tiller where the rotary shaft is parallel to the ground surface and perpendicular to the direction of tillage with the shaft rotating the same direction as the drive wheel of the tractor. A sample tilling blade for horizontal shaft is shown in Figure 4.

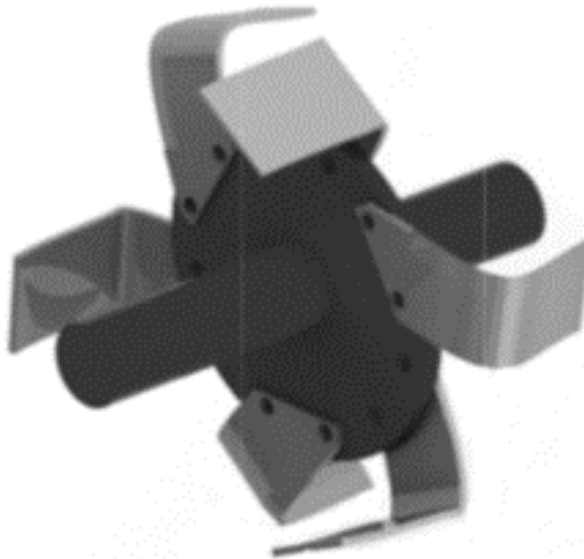


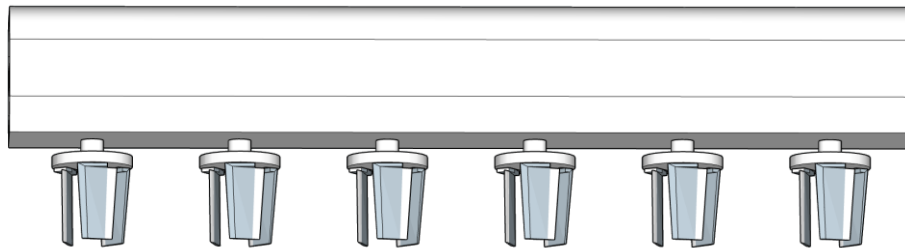
Figure 4. Rotary tilling blade assembly for horizontal shaft type (Azadbakht et al., 2014)

4.1.2 Vertical-shaft type

A rotary tiller where the rotary shaft is perpendicular to the ground surface. A sample tilling blade and blade assembly for vertical shaft is shown in Figure 5.



a) rotary tilling blade for vertical shaft type (Azadbakht et al., 2014)



b) typical vertical rotary tilling blade assembly

Figure 5. Rotary tilling blade and assembly for vertical-shaft type

4.2 Types of power train

4.2.1 Center-drive power train

A type of power train with the drive taken from the center of the rotary shaft, as shown in Figure 6.

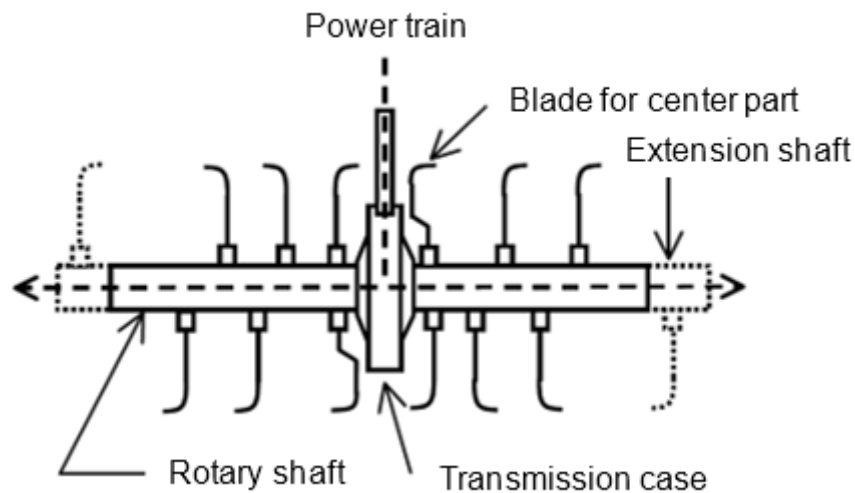


Figure 6. Center-drive power train (AMTEC-UPLB, 2022)

4.2.2 Side-drive power train

A type of power train with the drive taken from one side of the rotary shaft. Figure 7 illustrates a side-drive power train.

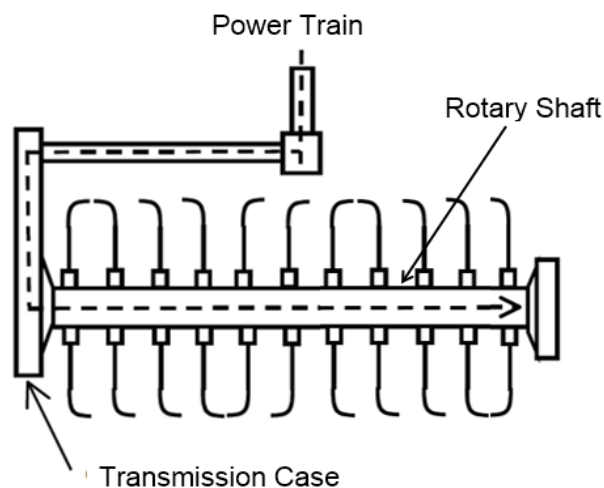


Figure 7. Side-drive power train (AMTEC-UPLB, 2022)

4.3 Types of rotary tilling blade

Sample types of blades are shown in Figure 8. The rotary tilling blade shall be classified as, but not limited to the following:

4.3.1 Pick-shaped blade

A curved blade with a tapered tip.

4.3.2 C-shaped blade

A type of blade which is flat straight with a tip following a trochoidal curve.

4.3.3 I-shaped blade

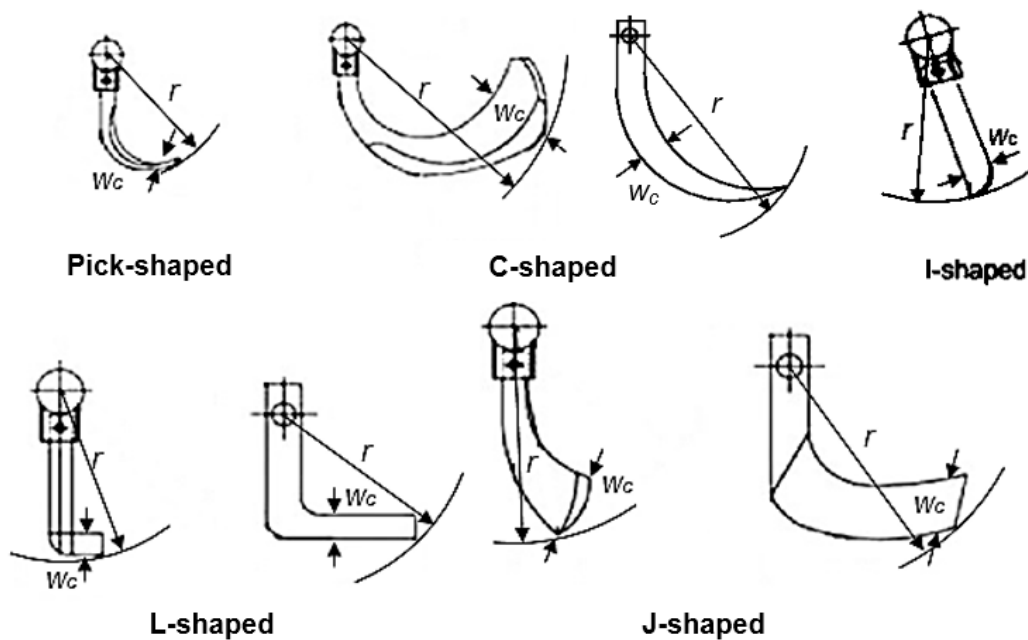
A straight blade with a short-curved tip.

4.3.4 L-shaped blade

An angled blade ranging from 90° to 120°.

4.3.5 J-shaped blade

A blade that curves gently until the tip flattens.



Key

W_c width of the blade

r radius of the rotary tilling blade assembly

Figure 8. Types of rotary tilling blades (AMTEC-UPLB, 2022)

5 Fabrication Requirements

- 5.1** The rotary tiller shall be generally made of steel material. Mild steel shall be used in the manufacture of the frame and hitch point.

- 5.2 Chain and sprocket and/or gears should be used to transmit power from the transmission drive shaft to the rotary shaft.
- 5.3 High speed tool steel with equivalent alloy steel shall be used in the manufacture of the rotary tilling blades. It shall have a minimum hardness of 61 Hardness Rockwell C (HRC). Materials shall be provided with a certificate from a recognized material testing agency.
- 5.4 The rotary tilling blades shall be replaceable.
- 5.5 The frame shall have a provision for attaching the tractor as specified in PNS/BAFS PABES 301:2020 (Agricultural machinery – Four-wheel tractor – Specifications).
- 5.6 Bolts and nuts, screws, bearings, bushing, and seals to be used shall conform to PAES 311:2001 (Engineering materials — Bolts and nuts for agricultural machines – Specifications and applications) or other international standards.
- 5.7 The rear cover shall be made of steel sheet with a minimum thickness of 2 mm and should be replaceable.

6 Performance Requirements

- 6.1 The field capacity specified by the manufacturer shall be attained.
- 6.2 The performance criteria for rotary tiller shall be specified in Table 1.

Table 1. Rotary tiller performance criteria (AMTEC-UPLB, 2022)

Criteria	Performance data, %
Field efficiency, minimum (wet and dry preparation)	80

- 6.3 The rotary tiller shall have no breakdowns or malfunctions (i.e., failure of components, etc.) during operation.

7 Safety, Workmanship, and Finish

- 7.1 There shall be earmuffs or other ear protective devices provided for the operators to use when the noise level exceeds 92 decibels (dB[A]) during operation.
- 7.2 The rotary tiller shall be free from any manufacturing defects that may be detrimental to its operation.

- 7.3 With the exception of the rotary tilling blades, any uncoated metallic surfaces shall be free from rust and shall be painted properly.
- 7.4 The rotary tiller, except for the tilling blades, shall be free from external sharp edges and surfaces that may injure the operator. Tilling blades shall have a safety provision so as not to harm the operator. Warning notices shall be provided in accordance with PNS/BAFS 330:2022 (Technical means for ensuring safety – Guidelines).
- 7.5 Rotating parts shall be dynamically balanced.
- 7.6 Each rotary tilling blade shall be fastened securely to the rotary shaft.
- 7.7 Uniformity of parts and components for the same brand and model shall be maintained.
- 7.8 The frame shall be rigid and durable without any noticeable cracks and weak joints.
- 7.9 All sets of moving parts shall be provided with guard.
- 7.10 Adequate arrangement for lubrication of bearings shall be provided. The bearings shall be reasonably dust-proof and shall be properly aligned.
- 7.11 There shall be provision for access to parts during repair, maintenance, and operation.

8 Warranty for Fabrication and Services

Warranty shall be provided for parts and services, except for normal wear and tear of expendable or consumable maintenance parts, for at least one year upon the acceptance of the procuring entity of the rotary tiller. General requirements of the warranty shall conform to PNS/BAFS PAES 192:2016 (Agricultural machinery – Guidelines on after-sales service).

9 Maintenance and Operation

- 9.1 Each unit of rotary tiller shall be provided by the manufacturer with a set of standard tools, including specialized tools required for maintenance of the implement.
- 9.2 Operator's manual shall be based on PAES 102:2000 (Agricultural machinery – Operator's manual – Content and presentation).
- 9.3 Maintenance schedule for re-tightening of bolts and nuts for blade and list of the non-warrantable parts of the rotary tiller shall be provided.

10 Sampling

The rotary tiller shall be sampled for testing in accordance with PAES 103:2000 (Agricultural machinery – Method of sampling).

11 Testing

Sampled rotary tiller shall be tested in accordance with PNS/BAFS 336:2022 (Rotary tiller – Methods of test).

12 Marking and Labeling

12.1 Each unit of rotary tiller shall have a metal nameplate, which is either engraved or embossed, attached to the body of the implement. The metal nameplate shall be placed in the most conspicuous place with the following information:

- a) Brand;
- b) Manufacturer;
- c) Country of manufacture;
- d) Model; and
- e) Serial number.

12.2 The metal nameplate shall be durably bonded, riveted, and/or welded to the base surface material. It shall be all weather-resistant and cleaned under normal cleaning procedures.

12.3 Basic operation reminder shall be stated in the operator's manual.

12.4 Basic safety/precautionary markings shall be provided and shall be visible to the operator.

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