

PHILIPPINE NATIONAL STANDARD

PNS/BAFS 375:2023
ICS 65.060.40

Agricultural Power Sprayer — Specifications



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Foreword

In 2022, the Philippine Council for Agricultural and Fisheries (PCAF)-National Sectoral Committee on Agricultural and Fisheries Mechanization (CAFMech) issued Resolution No. 34, series of 2022 (Recommending to the Bureau of Agriculture and Fisheries Standards [BAFS] the Prioritization of the Amendment of the Philippine National Standards [PNS] for Specifications and Methods of Test of the Power Sprayer for Mango), endorsing the revision of PNS/Philippine Agricultural Engineering Standards (PAES) on Power Sprayer for Mango — Specifications (PNS/PAES 157:2011) and Methods of Test (PNS/PAES 158:2011). The purpose of the proposed amendment aims to expand the coverage of the PNS for power sprayer for mango to include other crops and agricultural uses, as well as the revision of its several manufacturing and performance requirements to address procurement challenges.

In response, the BAFS-Department of Agriculture (DA) officially created a Technical Working Group (TWG) to develop the PNS under the following Special Orders (SO):

1. SO No. 146, series of 2023 (Creation of TWG for the Development of PNS for Agricultural and Fishery Products, Machinery, and Infrastructures);
2. 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”); and
3. SO No. 954, series of 2023 (Addendum to SO No. 532, 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 an extensive series of TWG meetings and stakeholder consultations from January to October 2023 prior to its endorsement to the DA Secretary for approval.

This standard includes the following significant changes compared to the PNS/PAES 157:2011:

1. Modification on the title and scope to include its suitability for other crops and agricultural uses;
2. Modifications on the terms and definitions to include various parts of the agricultural power sprayer (APS);
3. Inclusion of illustrations for frame-mounted and wheel-mounted APS to consider other design;
4. Transfer of principle of operation to the PNS/BAFS xxx:2023;
5. Modification on the provisions of manufacturing requirements to consider other types of pump;
6. Modification on the performance requirement to include reference for determination of droplet size classification;
7. Inclusion of Rule 1074.01 to 1074.03 of Occupational safety and health standards for the requirement on permissible noise exposure; and

8. Inclusion of after-sales services requirements to cover provision for warranty of performance and other requirements.

This Standard cancel and replaces PNS/PAES 157:2011 (Power sprayer for mango — Specifications). 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.

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1 Scope

This Standard specifies the minimum requirements for manufacturing and performance of an agricultural power sprayer (APS) which delivers liquid such as chemical solution and/or water to be used specifically for agricultural crop protection.

2 Normative References

The following documents are referred to in the text in such a way that some or all their contents constitute the requirement 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).

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

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https://bafs.da.gov.ph/bafs_admin/admin_page/pns_file/PNS.BAFS%20330.2022_PNS%20Technical%20Means%20for%20Ensuring%20Safety%20-%20Guidelines.pdf

BAFS-DA. (2023). Agricultural power sprayer — Methods of test (PNS/BAFS xxy:2023).

Department of Labor and Employment (DOLE). (2020). Occupational safety and health standards. Occupational Safety and Health Center (OSHC).

<https://oshc.dole.gov.ph/wp-content/uploads/2020/02/OSH-Standards-2020-Edition.pdf>

3 Terms and Definitions

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

3.1

Agricultural Power Sprayer (APS)

equipment powered by electricity or engine used to spray liquid such as chemical solution and/or water to a certain height (AMTEC-UPLB, 2011, *modified*)

3.2

centrifugal pump

non-volumetric pump in which the flow of the liquid is achieved by means of one or more impellers (International Organization for Standardization [ISO], 2020)

3.3

cut-off valve

shut-off valve

valve used to regulate the flow of liquid as shown in Figure 1 (AMTEC-UPLB, 2011, *modified*)

3.4

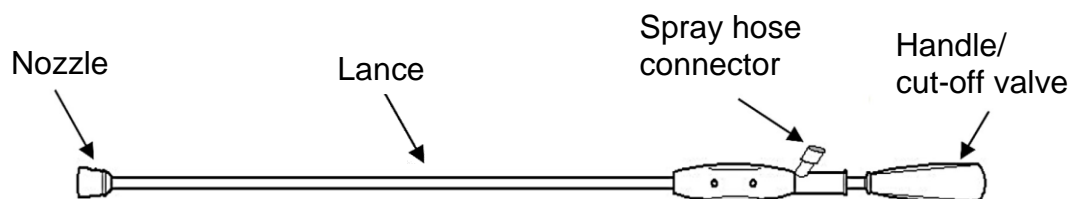
lance

metallic tube that connects the nozzle to the spray hose of APS as shown in Figure 1 (AMTEC-UPLB, 2011, *modified*)

3.5

nozzle

device on the tip of lance where the chemical solution and/or water is sprayed out as shown in Figure 1 (AMTEC-UPLB, 2011, *modified*)



NOTE This type of spray gun utilizes knob-type cut-off valve which also serves as the handle for the device.

Figure 1. Components of a spray gun (AMTEC-UPLB, 2011)

3.6

positive displacement pump

volumetric pump in which the flow of the liquid is achieved by means of the positive displacement (ISO, 2020, *modified*)

3.7

pressure relief valve

valve which opens automatically when the spraying pressure reaches a pre-determined value (ISO, 2020)

3.8

prime mover

electric motor or internal combustion engine used to run or power the machine (AMTEC-UPLB, 2021)

3.9

spray gun

lance with handle and quick acting cut-off valve (ISO, 2020, *modified*)

3.10

spray tank

liquid tank

container or chamber of the sprayer which contains the spray liquid (ISO, 2020, *modified*)

3.11

strainer

filter

device which separates materials larger than a pre-determined mesh size from the spray liquid (ISO, 2020, *modified*)

3.12

volume median diameter (VMD)

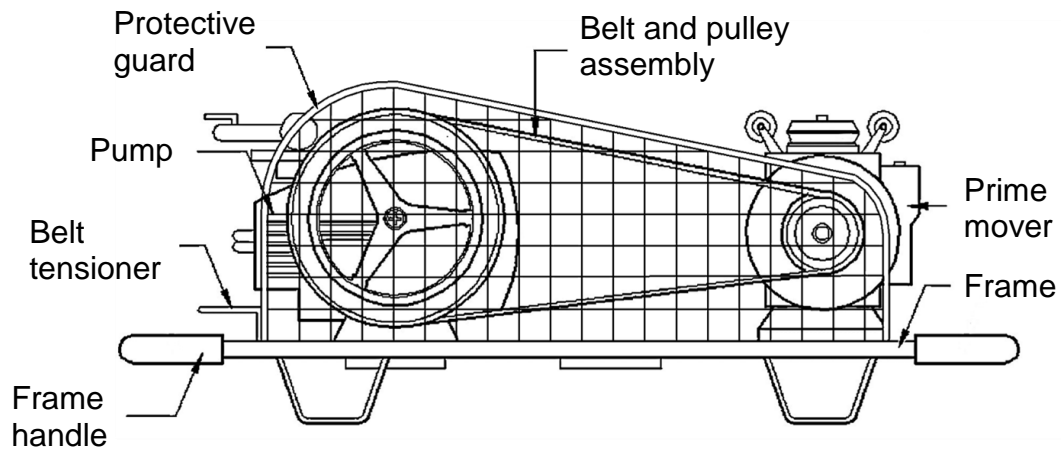
droplet size where half of the volume of the spray is in larger droplet sizes and half in smaller droplet sizes (ISO, 2020)

4 Classifications

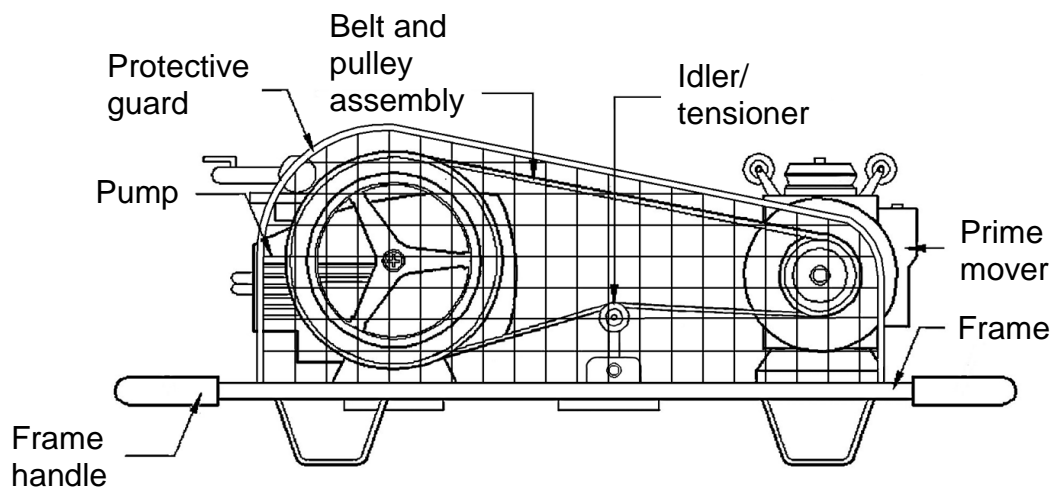
The classifications of an APS shall be based on, but not limited to the following:

4.1 Frame-mounted APS

Type of APS mounted on a platform which is manually carried for mobility. The prime mover of the pump can be an electric motor or engine. A typical frame mounted APS with different belt tensioning mechanism is shown in Figure 2.



a) Belt tensioning mechanism by component adjustment

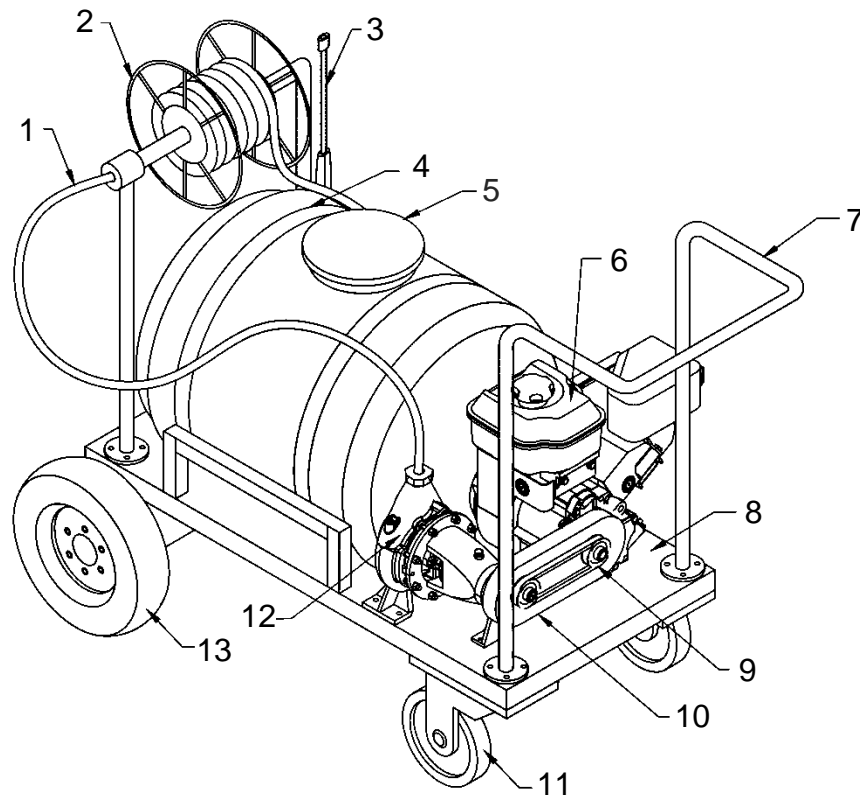


b) Idler/tensioner as belt tensioning mechanism

Figure 2. Typical frame-mounted APS with a) belt tensioning mechanism by component adjustment and b) idler/tensioner as belt tensioning mechanism (AMTEC-UPLB, 2011)

4.2 Wheel-mounted APS

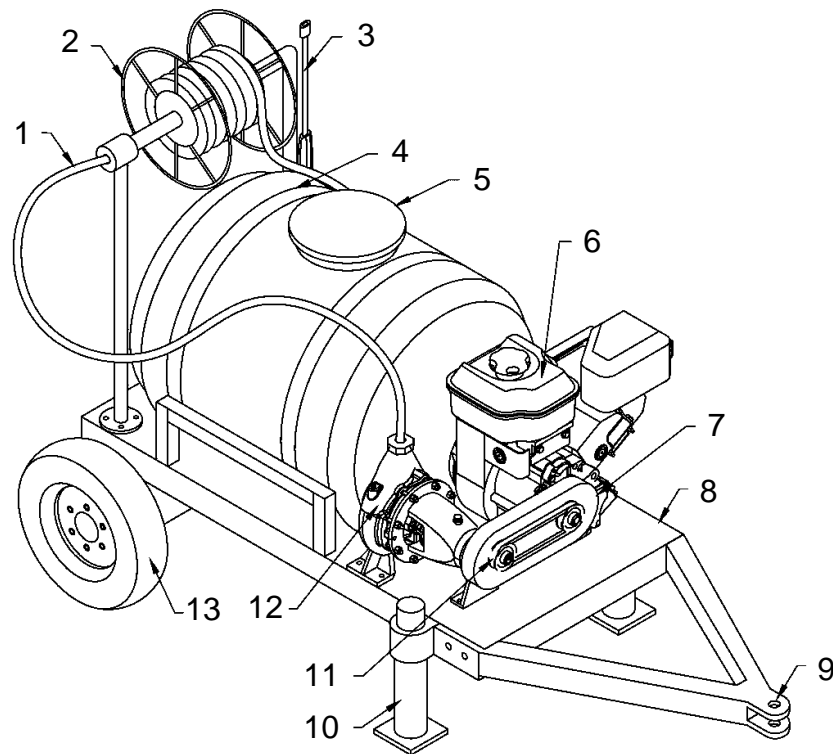
Type of power sprayer mounted on wheels, either pushed manually or towed. The prime mover of the pump can be an electric motor or engine. A typical wheel-mounted APS is illustrated in Figure 3.



a) Hand-pushed

Key:

- | | | | |
|---|------------------|----|--------------------------|
| 1 | Spray hose | 8 | Main frame |
| 2 | Hose reel | 9 | Belt and pulley assembly |
| 3 | Spray gun | 10 | Protective guard |
| 4 | Spray tank | 11 | Swivel wheel |
| 5 | Spray tank cover | 12 | Pump |
| 6 | Prime mover | 13 | Fixed wheel |
| 7 | Frame handle | | |



b) Towed

Key:

1	Spray hose	8	Main frame
2	Hose reel	9	Tow hitch
3	Spray gun	10	Adjustable stand
4	Spray tank	11	Belt and pulley assembly
5	Spray tank cover	12	Pump
6	Prime mover	13	Fixed wheel
7	Protective guard		

Figure 3. Wheel-mounted a) hand-pushed and b) towed APS (Lanzuela, 2023)

5 Manufacturing Requirements

5.1 General

5.1.1 Generally, the APS shall consist of main frame, prime mover (engine or electric motor), pump, spray hose, spray gun, nozzle, and pressure gauge.

5.1.2 The main frame shall be able to support the load of the APS.

5.1.3 The prime mover and pump shall be mounted on the main frame and it shall be properly tightened.

- 5.1.4** The spray hose shall be made of chemical resistant material with an inside diameter of at least 10 mm and minimum length of 10 m that shall withstand the maximum operating pressure of the pump. If rubber, it shall have minimum of one ply of fiber reinforcement.
- 5.1.5** The spray hose should have the appropriate fittings attached to the pump and lance.
- NOTE** Fittings are not included in the measurement of the spray hose length.
- 5.1.6** The lance, nozzle, hose clamps, and strainers shall be made of chemical and corrosion resistant material.
- 5.1.7** The spray lance shall have a minimum length of 0.5 m from the handle to the tip of the nozzle.
- 5.1.8** The nozzle shall be detachable from the lance to allow replacement or cleaning. It should be adjustable to produce the desired mist. It should have a nozzle strainer to prevent plugging.
- 5.1.9** The pressure gauge should have a maximum resolution of 10% of the maximum operating pressure.
- 5.1.10** Cut-off valve shall be installed on the handle of the spray gun to allow automatic stopping of the spray.
- 5.1.11** The frame handle shall be covered with non-slip material.
- 5.1.12** For positive displacement pumps, a pressure relief valve shall be installed to regulate pressure of the pump.
- 5.1.13** For positive displacement pumps, it shall have a line strainer located ahead of the pump, while for centrifugal pumps, it shall be placed on the pressure side to protect the spray nozzle.
- 5.1.14** The strainers shall allow easy cleaning, maintenance, and/or replacement. The mesh size shall be according to the specifications of the manufacturer.
- 5.2 Frame-mounted APS**
- 5.2.1** The intake hose shall be made of chemical resistant material with an inside diameter of at least 16 mm. If rubber, it shall have minimum of one ply of fiber reinforcement.
- 5.2.2** Spray hoses shall be retained on connectors and couplings preferably by clamps or clips of the worm drive type. For threaded connections, it shall allow thumb-tightening connection at the APS maximum operating pressure, regardless of design, strength, and size.

5.2.3 The APS shall be equipped with belt tensioning mechanism.

5.3 Wheel-mounted APS

5.3.1 The spray tank, spray tank cover, and gaskets shall be made of any corrosion and chemical resistant material.

5.3.2 The thickness of the spray tank shall conform with the manufacturer’s specification. It shall have no leakage.

5.3.3 The fill openings of the spray tank shall be fitted with a tank-filler strainer.

5.3.4 The spray tank should have a liquid level indicator or any similar indicator.

5.3.5 For towed APS, it shall have an adjustable stand for loading and unloading, storage, hitching and unhitching, maintenance and repairs, and leveling of the machine.

6 Performance Requirements

6.1 The APS shall attain at least two different droplet classification depending on the intended use, by either using one adjustable nozzle or at least two fixed-typed nozzles. Droplet size classification shall be based on Table 1.

Table 1. Droplet size classification (American Society of Agricultural and Biological Engineers [ASABE], 2020).

VMD, μm	Droplet classification	Used for
<60	Extremely fine	-
61-105	Very fine	-
106-235	Fine	Better coverage
236-340	Medium	Most products
341-403	Coarse	Systemic herbicides
404-502	Very coarse	Soil herbicides
503-665	Extremely coarse	Liquid fertilizer
>665	Ultra coarse	Liquid fertilizer

NOTE Based on the ASABE spray droplet size classification system, most agrochemical applications recommend a fine, medium, or coarse spray.

- a. *Fine spray* provides enhanced retention for directed spraying on the target including post-emergence weed control and contact fungicide and insecticide applications.
- b. *Medium sprays* are the most widely used spray type, e.g., for systemic-acting fungicides, insecticides, and herbicides. Used by default when spray quality is not defined by the label of the product.
- c. *Coarse sprays* are used with systemic, residual, and soil-applied herbicides.

6.2 The APS shall attain the maximum operating pressure and total discharge rate specified by the manufacturer.

7 Safety, Workmanship, and Finish

7.1 The APS shall be free from defects that may be detrimental to its use and shall be free from sharp edges and surfaces that may harm the operator. All metal parts should be machine bent, pressed and cut and all rough surfaces should be machine finished and smoothed.

7.2 Warning notices shall be provided in conformance with PNS/BAFS 330:2022 (Technical means for ensuring safety — Guidelines).

7.3 The noise level shall conform to Rule 1074.01 to 1074.03 of Occupational safety and health standards of Occupational Safety and Health Center (OSHC)-Department of Labor and Employment (DOLE), as shown in Annex A (Occupational safety and health standard [Rule 1074.01– 1074.03]).

7.4 Valves for the control on the flow of liquid shall have no leakage when fully closed.

7.5 For frame-mounted type APS, mufflers shall have protective guard to protect the operator from burns.

7.6 Belt and pulley transmission assembly shall have protective guards.

8 After-Sales Services Requirements

Requirements for after-sales services shall be in conformance with PNS/BAFS/PAES 192:2016 (Guidelines on after-sales service).

9 Maintenance and Operation

9.1 Each unit of APS shall be provided with set of standard tools for operation and basic maintenance prescribed by the manufacturer.

9.2 An operator's manual shall be provided in conformance with PAES 102:2000 (Operator's manual — Content and presentation). The operator manual shall

include emphasis on the safety and health hazards specially the use of basic personal protective equipment.

9.3 The spray tank of the APS shall be equipped with drain valve.

10 Sampling

The APS shall be sampled for testing in conformance with PAES 103:2000 (Methods of sampling) or other suitable method of selection validated by the testing authority.

11 Testing

The sampled APS shall be tested in conformance with PNS/BAFS xxy:2023 (Agricultural power sprayer — Methods of test).

12 Markings and Labeling

12.1 Each unit of APS shall be engraved or embossed with the following information, either in the body or in a metal nameplate attached at the most conspicuous place:

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

12.2 Basic safety and operation reminder shall be stated in the operator's manual.

12.3 In addition, marking and labeling should comply with the applicable regulations 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 1 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 B.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 1.

$$X = \frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} \quad (1)$$

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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