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ICS 65.060.40

Agricultural and Fishery Pumpset — Specifications

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Foreword

In 2023, the University of the Philippines Los Baños (UPLB)-Agricultural Machinery Testing and Evaluation Center (AMTEC) proposed the development of Philippine National Standards (PNS) on Agricultural and Fishery Pumpset — Specifications and Methods of Test. The proposal was submitted to and reviewed by the Philippine Council for Agricultural and Fisheries (PCAF)-National Sectoral Committee on Agricultural and Fisheries Mechanization (CAFMech).

In the same year, the Committee issued Resolution No. 19, series of 2023 (Recommending to the Bureau of Agriculture and Fisheries Standards [BAFS] the Prioritization of the Review and/or Amendment of the Standards for Small Engines and Agricultural Pumpsets) for the development of this Standard to the Department of Agriculture (DA)-BAFS. The development aims to cover different types of pumpset used for agricultural and fishery purposes. Further, it also aims to ensure and improve the quality of the machine by setting various performance parameters to be included as a requirement for the manufacturing of the pumpset.

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

1. SO No. 305, series of 2024 (Creation of TWG and Project Management Team [PMT] for the Development of PNS for Agricultural and Fishery Products and Machinery);
2. SO No. 905, series of 2024 (Addendum to SO No. 305, series of 2024 entitled, “Creation of TWG and Project Management Team [PMT] for the Development of PNS for Agricultural and Fishery Products and Machinery”); and
3. SO No. 29, series of 2024 (Authority to Conduct and Attend the DA-BAFS Standards Development Division [SDD] Activities for the 2nd Semester CY 2024).

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, facilitated through physical and online platforms, from January to October 2024 prior to its endorsement to the DA Secretary for approval. Through these activities, the TWG reached a consensus to retain the existing Philippine Agricultural Engineering Standard (PAES) 114:2000 (Agricultural machinery — Centrifugal pump — Specifications), which is applicable to bare pumps.

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 DA-BAFS.

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1 Scope

This Standard specifies the minimum requirements for manufacturing and performance of a pumpset with a maximum size of 200 mm x 200 mm used for agricultural and fishery purposes.

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 documents (including any amendments) applies.

Bureau of Agriculture and Fisheries Standards (BAFS)-Department of Agriculture (DA). (2022). Technical means for ensuring safety — Guidelines (PNS/BAFS 330:2022).

BAFS-DA. (2024). After-sales service — Guidelines (PNS/BAFS 192:2024).

BAFS-DA. (2024). Agricultural and fishery pumpset — Methods of test (PNS/BAFS 393:2024).

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3 Terms and Definitions

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

3.1
corrosion resistant material
substances that are able to withstand the damaging effects of acids, salts, and bases, as well as the corrosive action of gaseous and liquid products. These materials, such as cast iron, stainless steels, brass, aluminum, nickel alloys, titanium, ceramics, and plastics, are specifically designed to resist corrosion under certain conditions (Ferreira-Pinto et.al, 2019, *modified*)

3.2
prime mover
machine supplying mechanical energy to power the pump, such as internal combustion engines, motors, and turbines (International Organization for Standardization [ISO], 2012a)

3.3
pump
mechanical device for moving liquids, including the inlet and outlet connections as well as, in general, its shaft ends (ISO, 2012a)
admitted term: water pump

3.3.1
axial flow pump
pump in which the head is developed by the propelling or lifting action of the vanes on the liquid which enters the impeller axially and discharges axially (Bureau of Indian Standards [BIS], 2011)

3.3.2
centrifugal pump
pump in which the head is developed by the action of centrifugal force upon liquid which enters the impeller axially at the center and flows radially to the periphery (BIS, 2011)
admitted term: radial pump

3.3.3
mixed flow pump
pump in which the head is developed partly by the action of centrifugal force and partly by axial propulsion as a result of which the liquid entering the impeller axially at the center is discharged in an angular direction (BIS, 2011)

3.3.4
reciprocating pump
pump in which liquid is trapped in confined volumes and transported from an inlet connection to an outlet connection by the reciprocating movement of pistons or plungers. The reciprocating motion is derived from a rotating shaft (ISO, 2003, *modified*)

3.3.5
rotary pump
pump in which the head is developed by running the impeller in an eccentric position related to the auxiliary liquid which rotates in concentric alignment with the casing. The liquid is forced in and out of the impeller cells, rather, like a piston, thus, creating pressure or vacuum (BIS, 2011)

3.4
pumpset
assemblage of mechanical devices, including the pump and the prime mover, together with transmission elements, frame, and any auxiliary equipment (ISO, 2012a, *modified*)
admitted term: agricultural and fishery pumpset

3.5
pumpset performance curve
representation of the pumpset head, system efficiency, and input power plotted against the discharge (ISO, 2012b, *modified*)

4 Classifications

The classifications of a pumpset shall be based on, but not limited to the following:

4.1 Type of pump

4.1.1 Variable displacement pump

Type of pumpset that is used to transfer liquid from one place to another by converting mechanical energy from a prime mover into kinetic energy in the liquid. The classification chart for variable displacement pumps is shown in Figure 11 of Annex A (Classification of pumps).

NOTE Some unique variable displacement pumps induce velocity in a liquid through specialized means other than an impeller. These include jet ejector, gas lift, hydraulic ram, and electromagnetic pumps.

4.1.1.1 Classes

a) Centrifugal

Type of pump in which the head is developed by the action of centrifugal force upon liquid which enters the impeller axially at the center and flows radially to the periphery as shown in Figure 1.

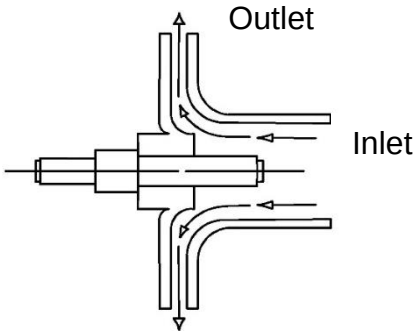

Figure 1. Typical illustration for centrifugal type of variable displacement pump (adapted from Haouam, 2021)

b) Mixed flow

Type of pump in which the head is developed partly by the action of centrifugal force and partly by axial propulsion as a result of which the liquid entering the impeller axially at the center is discharged in an angular direction as shown in Figure 2.

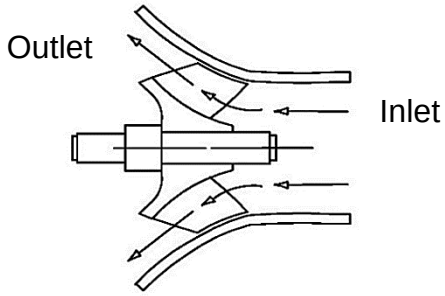

Figure 2. Typical illustration for mixed flow type of variable displacement pump (adapted from Haouam, 2021)

c) Axial flow

Type of pump in which the head is developed by the propelling or lifting action of the vanes on the liquid which enters the impeller axially and discharges axially as shown in Figure 3.

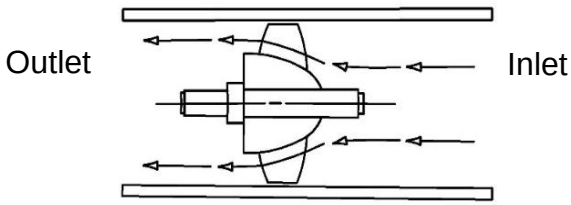

Figure 3. Typical illustration for axial flow type of variable displacement pump (adapted from Haouam, 2021)

4.1.1.2 Number of stages

a) Single stage

Type of pump in which the total head is developed by only one impeller that engages with the liquid to move it from the suction side to the discharge side.

b) Multi-stage

Type of pump in which the total head is developed by more than one impeller that engages with the liquid to move it from the suction side to the discharge side.

4.1.1.3 Type of impeller

a) Open

Type of impeller in which vanes are directly fixed on the web and have no shroud as shown in Figure 4.

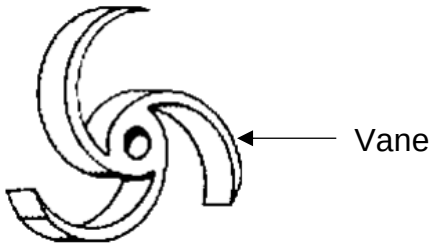

Figure 4. Typical design for open type impeller (adapted from Kumar, 2016)

b) Semi-open

Type of impeller which vanes are fixed on one shroud only as shown in Figure 5.

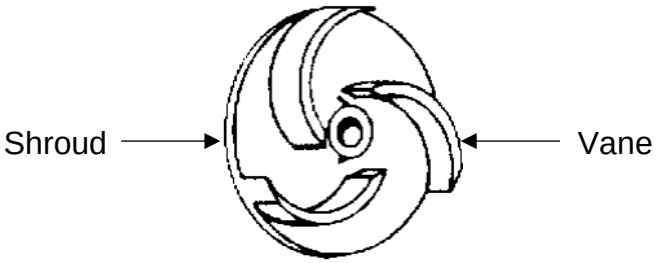

Figure 5. Typical design for semi-open type impeller (adapted from Kumar, 2016)

c) Closed

Type of impeller that contains two shrouds or side walls in which plain or curved vanes are inserted as shown in Figure 6.

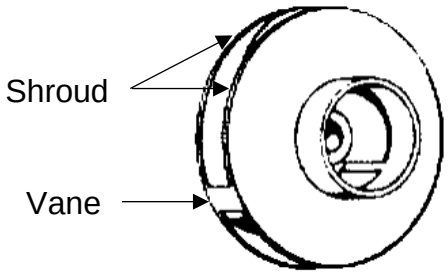

Figure 6. Typical design for closed type impeller (adapted from Kumar, 2016)

4.1.1.4 Method of priming

For centrifugal type of pumps, the method of priming shall be based on the following:

a) Self-priming

Pump with a valve to retain a liquid inside the pump chamber without the need for external priming assistance.

b) Non-self-priming

Pump that requires manual or external priming in the suction line and fill the pump chamber with the liquid to be pumped.

4.1.1.5 Type of casing by hydraulic design

For centrifugal type of pumps, the classification for type of casing by hydraulic design shall be based on the following:

a) Volute pumps

Type of centrifugal pump in which the velocity head is converted into pressure head in the casing made in the form of a spiral or a volute as shown in Figure 7.

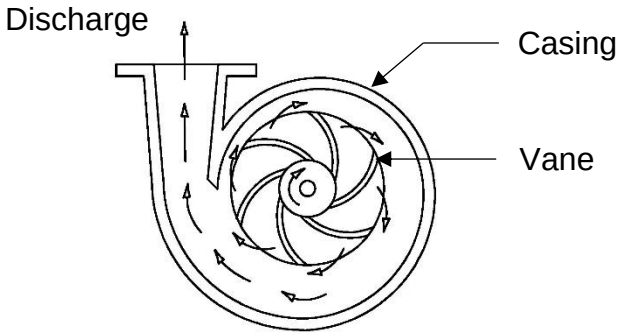

Figure 7. Typical design for volute type of centrifugal pump (adapted from UPLB-AMTEC, 2000)

b) Diffuser pumps

Type of centrifugal pump equipped with diffuser vanes which convert the velocity head into pressure head as shown in Figure 8.

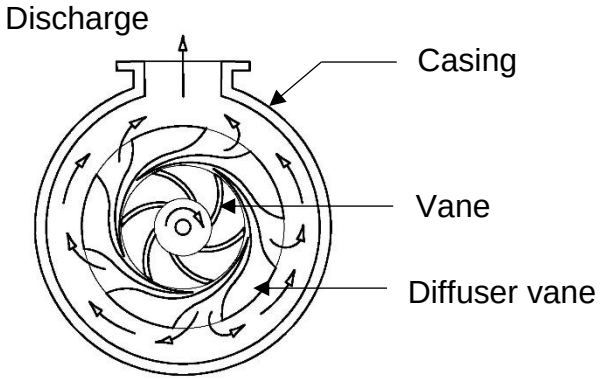

Figure 8. Typical design for diffuser type of centrifugal pump (adapted from UPLB-AMTEC, 2000)

4.1.2 Positive displacement pump

Type of pumpset that moves a fixed volume of liquid with each cycle of its operation. The classification chart for positive displacement pumps is shown in Figure 12 of Annex A (Classification of pumps).

4.1.2.1 Classes

a) Reciprocating

Type of pump in which liquid is trapped in confined volumes and transported from an inlet connection to an outlet connection by the

reciprocating movement of pistons or plungers. The reciprocating motion is derived from a rotating shaft as shown in Figure 9.

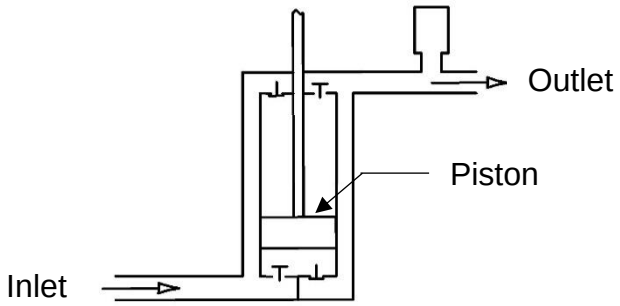

Figure 9. Typical illustration for reciprocating type (piston pump) of positive displacement pump (adapted from Khalid, 2021)

b) Rotary

Type of pump in which the head is developed by running the impeller in an eccentric position related to the auxiliary liquid which rotates in concentric alignment with the casing. The liquid is forced in and out of the impeller cells, rather, like a piston, thus creating pressure or vacuum as shown in Figure 10.

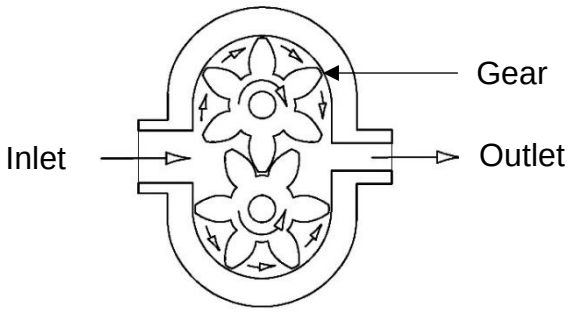

Figure 10. Typical illustration for rotary type (gear pump) of positive displacement pump (adapted from Khalid, 2021)

4.1.2.2 Number of pistons and rod assemblies

For reciprocating type of pumps, the classification for number of pistons and rod assemblies shall be based on the following:

a) Simplex

Type of reciprocating pump with one piston and rod assembly.

b) Duplex

Type of reciprocating pump with two pistons and rod assemblies.

c) Triplex

Type of reciprocating pump with three pistons and rod assemblies.

d) Multiplex

Type of reciprocating pump with four or more pistons and rod assemblies.

4.1.2.3 Type of action

For piston or plunger type of pumps, the classification for type of action shall be based on the following:

a) Single-acting

Type of piston or plunger pump where the liquid is discharged on either forward or return stroke.

b) Double-acting

Type of piston or plunger pump where the liquid is discharged on both the forward and return stroke.

4.1.2.3 Number of rotors

For rotary type of pumps, the classification for number of rotors shall be based on the following:

a) Single rotor

Type of rotary pump with only one rotating pumping element in the casing.

b) Multiple rotor

Type of rotary pump with two or more rotating pumping elements in the casing.

4.2 Casing by mechanical construction

4.2.1 Integral casing

Type of pumpset where the pump is equipped with a casing made in a single piece.

4.2.2 Horizontally split casing

Type of pumpset where the pump is equipped with a casing split on the horizontal center line.

4.2.3 Vertically split casing

Type of pumpset where the pump is equipped with a casing split on the vertical center line.

4.2.4 Diagonally split casing

Type of pumpset equipped with a casing split diagonally.

4.2.5 Segmented casing

Type of pumpset equipped with a casing made up of segments. These may either be of the band type for multipurpose pumps or of the bowl type for turbine pumps.

4.3 Prime mover

4.3.1 Engine

Type of pumpset that is driven by an internal combustion engine, such as gasoline or diesel engines.

4.3.2 Motor

Type of pumpset driven by electric motors such as alternating current (single-phase or three-phase) and direct current motors.

4.4 Power source

4.4.1 Fuel

Type of pumpset which uses fuel to operate the machine such as gasoline, diesel, kerosene, and natural gas.

4.4.2 Electricity

Type of pumpset which uses electricity to operate the machine.

4.4.3 Renewable energy

Type of pumpset which uses renewable energy to operate the machine such as hydropower, solar, wind, and biomass energy.

4.5 Power transmission

4.5.1 Direct drive

Type of pumpset where the pump is directly connected to the prime mover with a single shaft (close-coupled) or the use of flexible coupling (directly-coupled).

4.5.2 Indirect drive

Type of pumpset where the pump is connected to a prime mover using a transmission assembly such as belt and pulley, chain and sprocket, and gear transmission system.

4.6 Installation

4.6.1 Surface

Type of pumpset where the pump is designed to operate above the water surface.

4.6.2 Submersible

Type of pumpset where the pump is designed to operate fully submerged in the pumped liquid.

5 Manufacturing Requirements

5.1 Major parts such as casing components and bearing housings shall have accurate alignment on reassembly.

5.2 The casing, suction and discharge side, rotor, piston, plunger, shaft, and frame shall be made of chemical and corrosion resistant material or other better materials.

5.3 The casing should be constructed durably to prevent leakage and withstand the pressure at maximum discharge capacity with a factor of safety.

5.4 The rotating components should be dynamically balanced.

5.5 The bearing housing shall be sealed to prevent the entry of contaminants and the escape of lubricant under the normal operating conditions.

5.6 For positive displacement pumpset, it shall have a pressure relief valve to control or limit the pressure.

5.7 For belt-driven pumpset:

5.7.1 The pump and prime mover shall be mounted on a frame which should be able to stabilize and minimize the vibration of the pumpset during the operation.

5.7.2 The pump and engine pulley ratio should not be greater than 1.5. The engine pulley diameter should not be less than 100 mm.

5.7.3 It shall be equipped with belt tensioning mechanism and protective guard for the transmission assembly.

6 Performance Requirements

6.1 For engine driven pumpset, it shall attain a minimum system efficiency of 10% for self-priming and 15% for non-self-priming.

6.2 For electric motor driven pumpset, it shall attain a minimum system efficiency of 50%.

6.3 The pumpset shall attain the rated discharge capacity at the maximum efficiency as indicated in the nameplate.

7 Safety, Workmanship, and Finish

7.1 The machine 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 use of pumpset in terms of operator’s exposure on permissible noise level shall conform to Rule 1074.01 to 1074.03 of Occupational safety and health standards of OSCH-DOLE as shown in Annex B (Occupational safety and health standard [Rule 1074.01– 1074.03]).

7.4 If the machine exceeds the noise level of 90 dB(A), an ear protective device shall be provided by the manufacturer.

8 After-sales Service Requirements

Requirements for after-sales services shall be in conformance with PNS/BAFS 192:2024 (After-sales service — Guidelines).

9 Maintenance and Operation

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

9.2 An operator's manual for the pumpset shall be provided in conformance with PNS/BAFS 390:2024 (Operator's manual for agricultural and biosystems power and machinery — Guidelines). The operator's manual shall include emphasis on the safety and health hazards especially the use of basic personal protective equipment.

9.3 The pumpset performance curve shall be provided by the manufacturer.

9.4 The valves, fittings, seals, and pipes should have no leakage.

9.5 For electric motor driven pumpset, it shall be provided with properly rated wirings and circuit breaker.

10 Sampling

The pumpset shall be sampled for testing in conformance with PNS/BAFS 391:2024 (Methods of sampling for agricultural and biosystems power and machinery — Guidelines) or other suitable method of selection validated by the testing authority.

11 Testing

The sampled pumpset shall be tested in conformance with PNS/BAFS 393:2024 (Agricultural and fishery pumpset — Methods of test).

12 Markings and Labeling

12.1 Each unit of pumpset shall be engraved or embossed with the following information, either on the body or on a metal nameplate/s permanently attached at the most conspicuous place:

a) Brand;
b) Model;
c) Serial number;
d) Date of manufacture;
e) Country of manufacture/origin;
f) Voltage, ampere, frequency, and power requirement (if applicable); and
g) Pumpset information:
    i. Discharge capacity at maximum efficiency (L/s);
    ii. Total head at maximum efficiency (m); and

iii. Operating shaft speed (rpm).

12.2 Other markings and labeling shall comply with the applicable regulations set by the competent authority.

Annex A
(Informative)

Classification of pumps

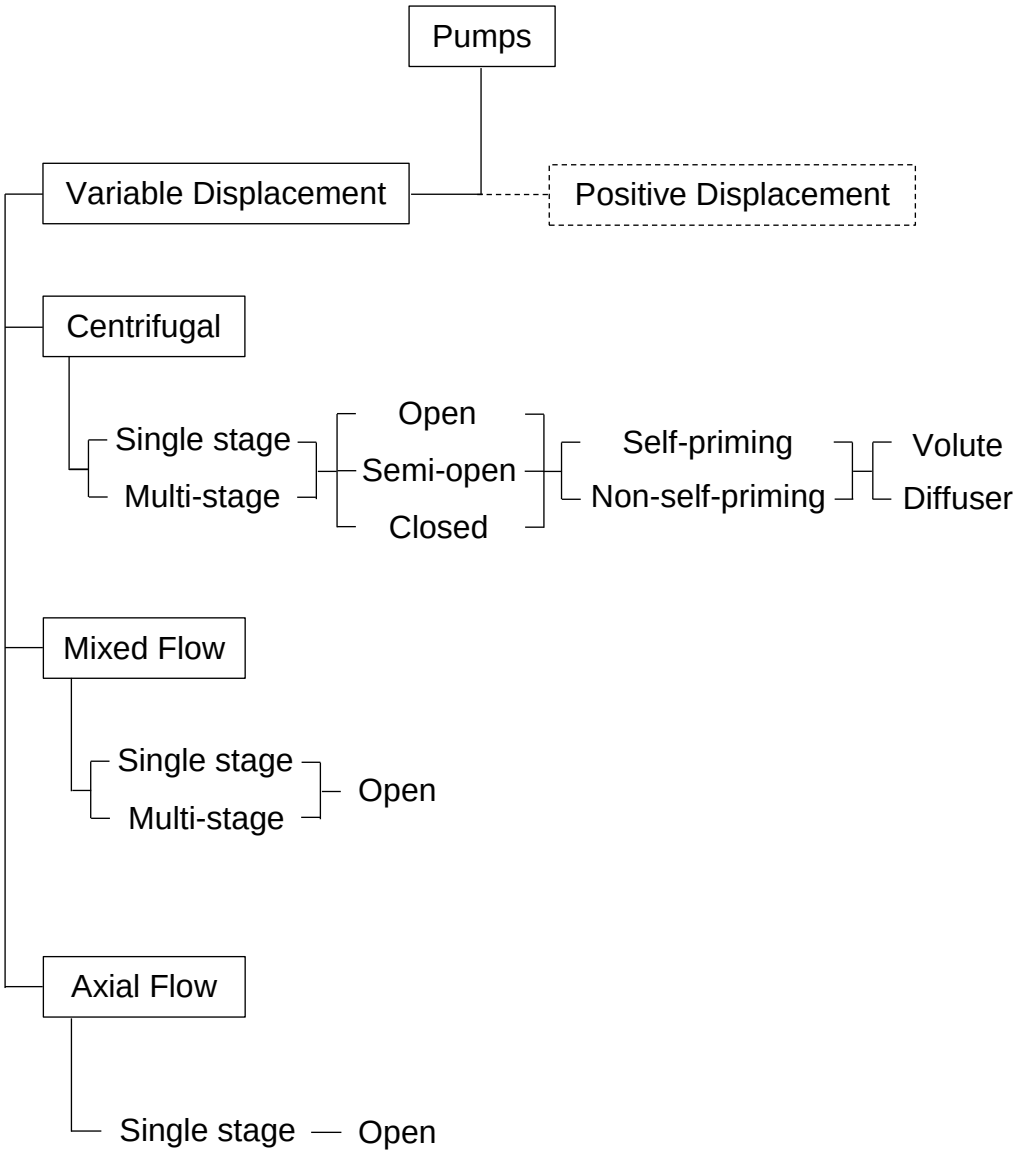

Figure 11. Classification chart for variable displacement type of pumps (adapted from Karassik et al., 2008)

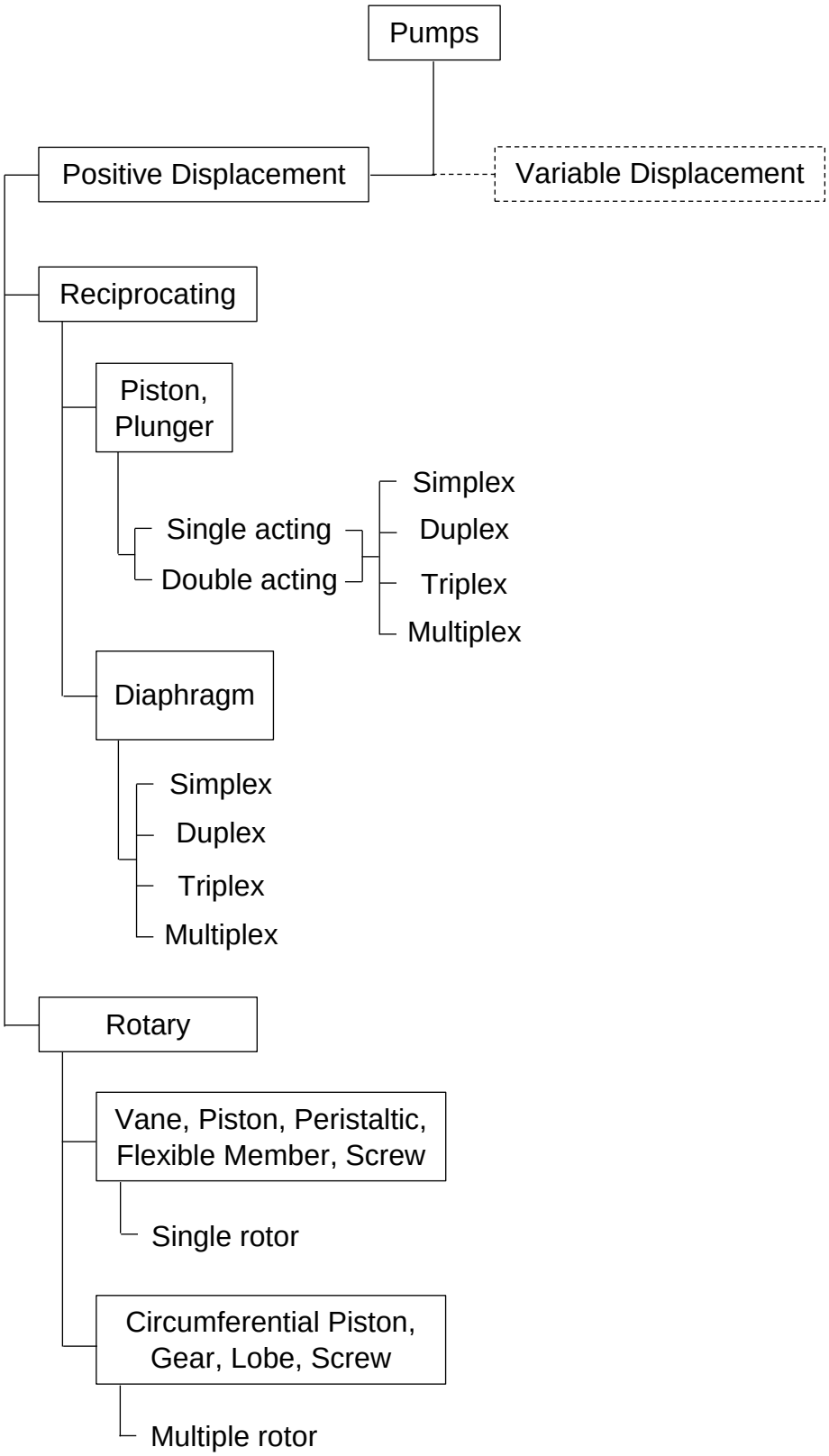

Figure 12. Classification chart for positive displacement type of pumps (adapted from Karassik et al., 2008)

Annex B
(Informative)

Occupational safety and health standards (Rule 1074.01–1074.03)

B.1 Threshold limit values for noise

B.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.

B.1.2 Feasible administrative or engineering controls shall be utilized when workers are exposed to sound levels exceeding those specified in Table B.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 B.1. Permissible noise exposure (OSHC-DOLE, 2020)

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

B.2 Permissible noise exposure

B.2.1 The values specified in Table B.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.

B.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.

B.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.

B.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.

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

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

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

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