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Vacuum technology — Vocabulary —

Part 2:
Vacuum pumps and related terms

Technique du vide — Vocabulaire —

Partie 2: Pompes à vide et termes associés

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 112, *Vacuum technology*.

This second edition cancels and replaces the first edition (ISO 3529-2:1981), which has been technically revised. The main changes compared to the previous edition are as follows:

— under positive displacement pumps are added diaphragm-, peristaltic-, scroll-, screw-, claw- and trochoid vacuum pumps;

— under kinetic vacuum pumps are added regenerative- and compound turbo vacuum pump;

— under gas entrapment or capture vacuum pumps different types of condensers are added;

— under parts, categories and characteristics of vacuum pumps are added some new actual used definitions.

A list of all parts in the ISO 3529 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Vacuum technology — Vocabulary —

Part 2:
Vacuum pumps and related terms

1 Scope

This document gives definitions of vacuum pumps and related terms. It is a continuation of ISO 3529-1 which defines general terms used in vacuum technology.

2 Normative references

ISO 3529-1:2019, *Vacuum technology — Vocabulary — Part 1: General terms*

ISO 21360-1:2012, *Vacuum technology — Standard methods for measuring vacuum-pump performance — Part 1: General description*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Vacuum pumps

3.1.1
vacuum pump
device for creating, improving and/or maintaining a vacuum

Note 1 to entry: Two basically distinct categories may be considered: *gas transfer pumps* (3.1.2) and *gas gathering vacuum pumps* (3.1.32)

Note 2 to entry: Some definitions given in ISO 3529-1 are repeated in this document in deferent terms to adapt to vacuum pumps.

Note 3 to entry: Vacuum is defined in ISO 3529-1.

Note 4 to entry: A classification table for vacuum pumps is described in Annex A.

3.1.2
gas transfer vacuum pumps
vacuum pump (3.1.1) that transports gas molecules from the inlet to the *outlet* (3.2.3) of the vacuum pump by means of positive displacement or transfer of kinetic momentum

3.1.3
positive displacement vacuum pump
vacuum pump (3.1.1) in which a volume filled with gas is cyclically isolated from the inlet, the gas being then transferred to an *outlet* (3.2.3)

Note 1 to entry: In most types of positive displacement vacuum pumps the gas is compressed before exhausted. Two categories can be considered: reciprocating or oscillating positive displacement vacuum pumps (3.1.4–3.1.6) and rotary positive displacement vacuum pumps with single (3.1.7–3.1.13) or double (3.1.14–3.1.16) rotor principle.

Note 2 to entry: Positive displacement vacuum pump are often equipped with a gas ballast system, to admit a controlled quantity of a suitable non-condensable gas during the compression part of the cycle so as to reduce or avoid the extent of condensation within the vacuum pump.

Note 3 to entry: An oil-sealed (liquid-sealed) vacuum pump is a rotary positive displacement vacuum pump in which oil (liquid) is used to seal the gap between parts which move with respect to one another and to reduce the residual free volume in the pump chamber at the end of the compression part of the cycle.

Note 4 to entry: A dry positive displacement vacuum pump is a device, where the pumping chambers are not oil-sealed (liquid-sealed).

Note 5 to entry: All types of positive displacement vacuum pumps can be combined as multi-stages of the same or differing.

3.1.4
diaphragm vacuum pump
dry *positive displacement vacuum pump* (3.1.3) in which the gas is compressed and expelled due to the movement of a reciprocating or oscillating action of a diaphragm by using suitable valves

3.1.5
piston vacuum pump
positive displacement vacuum pump (3.1.3) in which the gas is compressed and expelled due to the movement of a reciprocating piston moving in a cylinder by using suitable valves

3.1.6
linear peristaltic vacuum pump
vacuum pump (3.1.1) which uses linear placed actuators forcing or compress the gas through a flexible tube

3.1.7
scroll vacuum pump
vacuum pump (3.1.1) which uses two interleaving circular involute spirals to compress gases before exhausted

Note 1 to entry: Depending on the application scroll pump may or may not have an inlet valve, isolation valve for fault conditions or power losses.

3.1.8
rotary vane vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which an eccentrically placed rotor is turning tangentially to the fixed surface of the stator

Note 1 to entry: The swept compressed gas is expelled to atmosphere via a discharge valve.

Note 2 to entry: Two or more vanes sliding in slots of the rotor (usually radial) and sliding along on the internal wall of the stator, divide the stator chamber into several parts of varying volume.

3.1.9
liquid ring vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which an eccentric rotor with fixed blades throws a liquid against the stator wall

Note 1 to entry: The liquid takes the form of a ring concentric to the stator and combines with the rotor blades to define a varying volume.

3.1.10
external vane vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which a rotor is turning eccentrically, in contact with the internal wall of the stator

Note 1 to entry: A device moving relative to the stator is pressed against the rotor and divides the stator chamber into parts of varying volume (external vane pump).

3.1.11
rotary piston vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which a rotor is turning eccentrically to the internal wall of the stator

Note 1 to entry: The stator chamber is divided into two parts of varying volume by a bulkhead (piston or plunger) sealed in the stator (piston bearing) and rigidly fixed to the rotor.

Note 2 to entry: Rotary piston vacuum pump also called rotary plunger vacuum pump.

3.1.12
trochoid vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which an elliptical piston moves around a shaft eccentrically

Note 1 to entry: The case is in continuous non-contact sealing with the piston. Oil is fed for sealing.

3.1.13
peristaltic vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which a turning rotor compresses with a number of rollers or lobes a flexible tube and forcing the gas move through the tube

3.1.14
roots vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which two or three lobed rotors, interlocked and synchronized, rotate in opposite directions moving past each other and the housing wall with a small clearance and without touching

Note 1 to entry: Roots vacuum pumps are used as primary — also referred to as mechanical booster vacuum pump — as well as secondary or main vacuum pump.

Note 2 to entry: Roots pumps have per stage no inner compression ratio.

3.1.15
screw vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) comprises opposing synchronously rotating screws with various profile design like tapered or variable pitch for an inner compression ratio

Note 1 to entry: The screw vacuum pump could have profile design without inner compression ratio too.

3.1.16
claw vacuum pump
rotary *positive displacement vacuum pump* (3.1.3) in which two claw-shaped rotors, interlocked and synchronized, rotate in opposite directions moving past each other and the housing wall with a small clearance and without touching

Note 1 to entry: Claw vacuum pumps are designed with one or more compression stages.

3.1.17
kinetic vacuum pump
vacuum pump (3.1.1) in which a gas or gas molecules can be displaced from the pump inlet to the *outlet* (3.2.3) either mechanically (rotating it at high speed or by providing an impulse in the direction of flow) or by the use of another fluid (providing also an impulse in the direction of flow) or using an electrical potential to displace gas ions

Note 1 to entry: Three categories can be considered: mechanical kinetic pumps (3.1.18–3.1.22), fluid entrainment pumps (3.1.23–3.1.30) and *ion transfer pumps* (3.1.31).

3.1.18
turbine vacuum pump
rotary *kinetic vacuum pump* (3.1.17) in which the transfer of a large amount of gas is obtained by a rapidly rotating device

Note 1 to entry: The dynamic sealing is obtained without rubbing. The gas flow either may be directed parallel to the axis of rotation (axial flow vacuum turbine pump) or at right angles to the axis of rotation (radial flow vacuum turbine pump or centrifugal vacuum pump).

3.1.19
regenerative vacuum pump
rotary *kinetic vacuum pump* (3.1.17) in which the transfer of gas is obtained by a centrifugal rotor stage, utilizing the vortex behaviour of the gas in combination with a side channel parallel to the rotor

Note 1 to entry: Regenerative vacuum pumps are designed with one or more gas ring compression stages. Regenerative vacuum pumps are available with an axially located gas channel and/or radially located gas channel.

3.1.20
molecular drag vacuum pump
kinetic vacuum pump (3.1.17) in which a momentum is imparted to the gas molecules by contact between them and the surface of a high-speed rotor, causing them to move towards a channel to the *outlet* (3.2.3) of the vacuum pump.

Note 1 to entry: The technical design based on invention from Gaede, Holweck or Siegbahn.

3.1.21
turbo-molecular vacuum pump
molecular drag vacuum pump (3.1.20) in which the rotor is fitted with discs provided with slots or blades rotating between corresponding discs in the stator

Note 1 to entry: The linear velocity of a peripheral point of the rotor is of the same order of magnitude as the velocity of the gas molecules. A turbo-molecular vacuum pump operates normally when molecular flow conditions obtain.

Note 2 to entry: Compound turbo-molecular vacuum pump.

3.1.22
compound turbo-molecular vacuum pump
one shaft *high vacuum pump* (3.4.6) with compression-stages based on turbo-molecular vacuum pump design combined with drag stages based on molecular drag vacuum pump design and/or regenerative pump stages on the fore vacuum side of the vacuum pump

3.1.23
diffusion vacuum pump
kinetic vacuum pump (3.1.17) in which a low-pressure, high-speed vapour stream provides the entrainment fluid

Note 1 to entry: The gas molecules diffuse into this stream and are driven to the outlet. The number density of gas molecules is always low in the stream. A diffusion vacuum pump operates, when molecular flow conditions of pumped gas obtained, since vapour jets will not be formed unless the mean free path inside the pump is large enough.

3.1.24
self-purifying diffusion vacuum pump
oil vapour *diffusion vacuum pump* (3.1.23) in which the volatile impurities of the operating fluid are prevented from returning to the boiler but are transported towards the *outlet* (3.2.3) by a special design

3.1.25
fractionating diffusion vacuum pump
multi-stage oil vapour *diffusion vacuum pump* (3.1.23) in which the lowest pressure stage is supplied with the more dense, low vapour pressure constituents of the operating fluid, and where the higher-pressure stages are supplied with the less dense constituents of higher vapour pressure

3.1.26
diffusion-ejector vacuum pump
multi-stage *kinetic vacuum pump* (3.1.17) in which a stage or stages having the characteristics of a *diffusion vacuum pump* (3.1.23) are succeeded by a stage or stages having the characteristics of an *ejector vacuum pump* (3.1.27)

3.1.27
ejector vacuum pump
kinetic vacuum pump (3.1.17) based on the pressure decrease due to a Venturi-effect and in which the gas is entrained in a high-speed stream towards the *outlet* (3.2.3)

Note 1 to entry: An ejector vacuum pump operates when viscous and intermediate flow conditions of pumped gas are obtained.

3.1.28
liquid jet vacuum pump
ejector vacuum pump (3.1.27) in which the entrainment fluid is a liquid (usually water)

3.1.29
gas jet vacuum pump
ejector vacuum pump (3.1.27) in which the entrainment fluid is a non-condensable gas

3.1.30
vapour jet vacuum pump
ejector vacuum pump (3.1.27) based on an entrainment vapour (water, mercury or oil vapour)

Note 1 to entry: The entrainment vapour is subsequently condensed at the outlet of the pump.

3.1.31
ion transfer pump
kinetic vacuum pump (3.1.17) in which the gas molecules are ionized and then transferred towards an *outlet* (3.2.3) by means of electric fields combined or not with a magnetic field

3.1.32
gas gathering vacuum pump
vacuum pump (3.1.1) that captures gas in a solid or adsorbed state

3.1.33
gas entrapment vacuum pump
capture vacuum pump
vacuum pump (3.1.1) in which the gas or vapour molecules are retained by physical or chemical adsorption, condensation or deposition on internal surfaces

3.1.34
adsorption vacuum pump
entrapment vacuum pump (3.1.33) in which the gas is retained mainly by physical adsorption of a material of large real area (for example a porous substance) enhanced by low temperatures

3.1.35
getter vacuum pump
entrapment vacuum pump (3.1.33) based on gas binding mainly by chemical adsorption on a material usually a metal alloy either bulk material or a freshly deposited thin layer

3.1.36
non-evaporable getter vacuum pump
NEG-vacuum pump
entrapment vacuum pump (3.1.33) with a reactive porous alloy or powder mixtures getter material

Note 1 to entry: After the system is evacuated and sealed, the reactive getter material has to be heated (by radio frequency induction heating usually) before the material is binding the gas by a chemical reaction.

3.1.37
sublimation vacuum pump
evaporation vacuum pump
entrapment vacuum pump (3.1.33) in which a getter material is sublimed (evaporated) from a target and deposited on the inner surface of the vacuum chamber as the active pump getter

Note 1 to entry: In that context evaporation and sublimation are similar concepts.

3.1.38
sputter ion vacuum pump
getter ion *vacuum pump* (3.1.1) in which the ionized gas is transferred towards a getter which is dispersed in a continuous way by cathodic sputtering additional combined by implantation of ions in the cathode

Note 1 to entry: The getter effect is the dominated pump principle, but for noble gases the implantation effect is important.

3.1.39
standard diode ion vacuum pump
sputter ion vacuum pump (3.1.38) with only chemical active cathodes

3.1.40
differential ion vacuum pump
sputter ion pump (3.1.38) with a chemical reactive cathode and an additional active cathode based on Tantalum for better pumping effect of noble gases

3.1.41
triode Ion vacuum pump
sputter ion vacuum pump (3.1.38) with a cathode designed as a lattice, an anode in the middle and a surrounding collector for the highest pumping speed of noble gases

