Content

1 Scope of application and purpose

This Ardenne standard describes the basic instructions and expectations that VON ARDENNE has for the manufacture of vacuum components.

All content of this Ardenne standard is considered part of the order specification, must be adhered to by the supplier on a binding basis and must be evaluated already within the scope of the feasibility study. Notify VA immediately if you become aware of any deviations or if any deviations are unavoidable before or during commissioning.

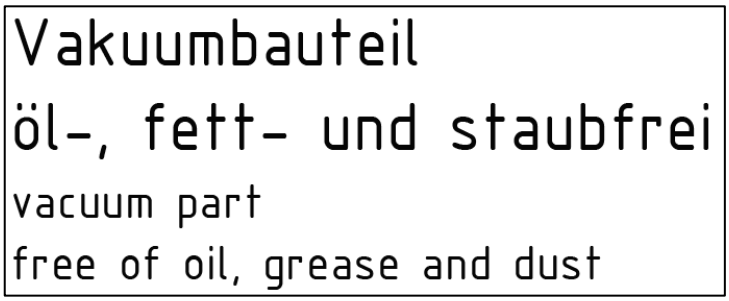
You must request approval of deviations using the appropriate form (special approval).

2 Terms and abbreviations

Term/abbreviation	Definition/description
VA	VON ARDENNE
Vacuum part	The term vacuum part serves as a general term for vacuum parts, vacuum assemblies, vacuum parts and vacuum systems. In vacuum systems, vacuum parts are parts whose surfaces are subjected to vacuum in full or in part. Leak tightness (leak rate), saturation pressure of the materials used, outgassing, gas release from surfaces (desorption) and permeation through these parts in the vacuum are quality indicators of all vacuum parts.
Saturated vapour pressure	The saturation vapour pressure is the pressure that is exerted by a vapour that is in thermodynamic equilibrium with one of its condensed phases at the prevalent temperature. It is a measure of the evaporation rate of the materials in a vacuum. The saturation vapour pressure depends on the material and temperature.
Desorption	Desorption is the emission of gases that are accumulated on the surface of the parts in a vacuum. The desorption rate depends, among other things, on the material and temperature, the type of gas accumulated at the surface of the part and on the surface structure (roughness) of the part surface.
Leak rate	The leak rate is the amount of gas per unit time that penetrates into the system through leaks. It is measured in the units mbar l s^{-1}.

3 Scope and provisions

(1) The components concerned shall be described and identified as follows in accordance with the drawing stamp:



4 Material usage

(1) Standard parts and special parts are selected according to the drawing, bill of materials and specification of the material.

(2) VA is to expressly approve any deviation from the material, even if it is believed that the material has been improved.

(3) Due to compatibility, purchased parts from different manufacturers may only be used after consultation with VA and after a deviation approval has been issued.

5 Vacuum hygiene – freedom from oil, grease and dust

The requirements for the surface cleanliness of vacuum parts result from contaminations that can occur before, during or after the manufacturing process and in some cases remain on the surface of the workpiece. The surfaces of vacuum parts must be free of such contamination. **This applies in particular to surfaces that cannot be seen (e.g., the inner walls of pipes/tubes) which are connected to the environment via openings, holes or gaps. In this case, volatile components can escape if they are heated.**

Such contaminations include dust, chips, abrasion, chlorine, fluorine and sulphur compounds, coolants and lubricants, other greases, oils, waxes, coatings from corrosion products, ferritic contaminations in CrNi steels, residues of blasting abrasives, “rolling skin”, scale, slag, welding beads, annealing colours due to welding processes and oxide colours on copper.

For VON ARDENNE, freedom from oil, grease and dust means the fabrication of an initial part condition at the manufacturer which is free from contamination based on the production process and its procedures.

In order to ensure that all presumed soiling during production is provided with an appropriate removal step as part of production planning, an analysis in the following form is recommended:

Table 1 - Example Contamination Analysis

Production step	Possible soiling	Contamination medium	Method of removal	Working Step	Inspection
Intermediate storage		Flight grease, dust	Ultrasonic bath	Ultrasonic cleaning	Wipe test before packaging
Turning/milling	Lubricant/coolant runs on component in crevice Chips, dust from machining	Cutting/drilling oil type 0815 Aluminium dust, spiral chips	Blowing off the component with compressed air and cleaning with cleaning petrol (Note crevices!)	Working step Parts cleaning: dry cleaning and blasting High-grade corundum - ensure complete machining!	Final inspection / outgoing goods inspection

5.1 Vacuum-compliant cleaning of parts

The following overview shows appropriate cleaning procedures for the respective area of application and the respective vacuum class in order to ensure compliance with this VA standard. They can be used to adapt a cleaning procedure to the respective part properties. It is always helpful for Von Ardenne to evaluate the process and the supplier can request this.

Table 2 - Cleaning procedures for vacuum parts

Operational range	**Material**	**Glass bead blasting**	**Without glass bead blasting**
Rough vacuum 1 bar – 1mbar Fine vacuum 1mbar – 10^{-3}mbar	All	Degreasing Rinsing Drying Blasting Blowing off	Degreasing Rinsing Drying
High vacuum 1 10^{-3}mbar – 10^{-7}mbar	All	Degreasing Rinsing Drying Blasting Blowing off Rinsing Drying Dry heating* Cleaning heating*	Degreasing Rinsing Drying Dry heating* Cleaning heating*
High vacuum 2 10^{-7}mbar – 10^{-11}mbar Ultra-high vacuum <10^{-11}mbar	No ferritic steels	Degreasing Rinsing Drying Cleaning heating (optional) Blasting Ultrasonic bath Rinsing (DI water) Drying Preheating (optional)	Degreasing Rinsing Rinsing (DI water) Drying Cleaning heating (optional) Preheating (optional)

*Examine requirements on a case-by-case basis

For the complete cleaning process, the following work steps and auxiliary materials must be planned, trained by the supplier and checked for effectiveness:

5.1.1 Degreasing

(1) The cleaning agent (degreasing agent) and its dosing must be chosen specifically for the material and contamination.

(2) In order to keep the auxiliary production materials from drying on, cleaning should be carried out as soon as possible after machining.

(3) Preserving the integrity of sealing faces requires special consideration. For this reason, sealing faces may need to be protected and cleaned separately.

(4) The following principles are to be complied with when selecting the cleaning agent:

a. Aluminium → degrease with acidic, neutral or alkaline cleaners
b. Steel → degrease with neutral or alkaline cleaners (risk of corrosion!)
c. Stainless steel → degrease with acidic, neutral or alkaline cleaners
d. Solvent-based cleaners can be used as an alternative

5.1.2 Rinsing

(1) After chemical cleaning, the cleaning agents must be removed by single-stage or multi-stage rinsing.

(2) The following are to be used for rinsing:

a. Process water of the local supplier with limited Cl^- content (< 50ppm → especially in the case of stainless steel)
b. Treated deionised water

5.1.3 Supporting cleaning measures

In addition to degreasing, washing and rinsing processes, the cleaning result is improved by doing the following:

- Mechanical cleaning using brushes
- Mechanical high-pressure cleaning with water
- Ultrasonic bath (especially for small parts)
- Cleaning blasting (glass bead blasting)
- Dry ice cleaning
- Immersion cleaning

5.1.4 Drying

Cleaning residues must be removed using suitable measures. Assemblies which are tested for leaks with a helium leak test should not show any deposits or moisture residues even in internal areas.

- Blowing off or out with oil-free air (e.g., sheets)
- Drying out by heating (e.g., cooling circuits and hard-to-reach areas in particular)
- Baking out in a vacuum furnace (e.g., parts with special requirements for high vacuum)

5.2 Handling of vacuum parts

(1) To avoid renewed soiling or corrosion of the cleaned parts due to grease and sweat caused by fingerprints, gloves must be worn during transport and handling (see figure).
(2) Nitrile gloves should generally be used in the high vacuum range (guaranteed to be free of potassium and sodium).
(3) When parts are put down or temporarily stored, metal parts must generally not lie on other metal parts. Use lint-free, soft underlays and change them when they are dirty.
(4) All tools (clamping devices, shims, screw clamps, pliers, etc.) which come into contact with cleaned vacuum parts must be kept free of grease, oil and dust.

Figure 1 For example, clean white cotton gloves (e.g., Camapur Cut 618 from Honeywell)

5.3 Packaging of vacuum parts

(1) After completion of production and final cleaning, all parts must be packaged in such a way that the surface quality achieved by cleaning is permanently maintained.
(2) The packaging must keep contamination and damage away from the part during storage and transport.
(3) Packaging should preferably be in PE film or PE stretch film (not approved for clean room applications). Paper, cardboard and wood leads to deposits of dust, chafe marks and packaging residues on the part surface.
(4) For high-vacuum applications, the materials must be wrapped twice in a special film so that they are airtight.
(5) Material labels must be attached to the part in such a way that it is not necessary to damage the packaging in order to identify what is on the labels. The label should not be applied directly to the cleaned material (adhesive residue on the surface).

5.4 Checking the surface quality – “visual assessment”

(1) In addition to the analytical methods for determining the purity of a surface, the following rapid tests are named for the inspection and are to be applied as minimum standards. These methods allow you to visually assess the surface condition.

(2) The manufacturer must provide proof of successful cleaning by selecting and applying a test procedure.

5.4.1 Visual inspection

The visual inspection serves to assess the surface of the entire part for oil and grease stains as well as chips and loose welding splatter.

Method:

The part is fully inspected from all sides at a location suitable for visual inspection (in terms of lighting, sufficient space).
In the area of the holes and on sheet edges, look for oil that appears to be creeping out of recesses and inaccessible places. This effect can be found over extended periods of time after washing.
Drill holes must be free of chips. Depending on the geometry of the holes, increased cleaning is necessary in this case (e.g., purging with compressed air).
Weld seams must be checked for residues and loose weld spatter. Inclusions and contamination that exists under welding seams can emerge.

Verification:

Surfaces are not stained or cloudy due to contamination. Locations where machining is carried out are individually inspected for visible contamination.

5.4.2 Wipe test

The wipe test is carried out with a clean white cotton cloth and isopropanol and is used for verification especially in cavities and on smooth surfaces. The test serves as a qualitative evaluation of the degree of contamination. During the test, blackening of the cloth is assessed.

Method:

The surface of the part is wiped in a random selection of locations using a clean cotton cloth or clean room cloth moistened with isopropanol. Cavities and concealed locations are to be included in the test (use of “Q-tips”).

Verification:

No contamination is permitted.

5.4.3 UV light for oil fluorescence test

Method:

The surface of the part is illuminated with a UV light source (λ = 365nm). Oil and dust are excited to fluoresce, causing them to glow. The UV lamp and surroundings must be selected so that the ambient light does not overshadow the fluorescence. Dust residues can be removed by blowing off with oil-free compressed air.

Verification:

No fluorescence of the illuminated surface

6 Mechanical processing

(1) All machined surfaces must have visually perfect surfaces with the surface roughness specified in the drawing.
(2) All outer edges must be deburred.
(3) All surfaces must be deburred and all auxiliary materials used during machining must be completely removed.
(4) All blind holes must be deburred and all auxiliary materials used during machining must be completely removed.
(5) In order to prevent local overheating, which leads to undesirable tarnishing colours and warping in case of small sheet thicknesses, the contact pressure during grinding and polishing must be kept correspondingly low.
(6) Due to the danger of pitting corrosion, coarse grinding marks are not permitted.
(7) In particular, only new or newly reground tools must be used for the last cut of finished surfaces (avoidance of material ingress due to built-up edges). This is not necessary if the last object machined with the tool was the same material.
(8) Threads and taps must have a full, smooth profile. Cracks or usage marks are not permitted.

7 Special machining rules for sealing faces

(1) In the drawings, sealing faces are identified by the symbols **c or ⊥** for the groove direction on the surface symbols.
(2) Unless otherwise specified, the required roughness depth is Ra = 0.8 µm, regardless of the vacuum section.
(3) Machining grooves, scratches and grooves transverse to the seal direction are not permitted on sealing faces. Grooves related to production may need to be reworked.
(4) In the case of circular seals, machining must be carried out in the area of the bearing surfaces in a circular manner relative to the centre of the sealing face. Traces of radial machining are not permitted.
(5) All sealing faces must be protected against damage using adequate measures immediately after production (protective caps, tape etc.).
(6) For standard flanges, protective caps for sealing faces must be provided together with the semi-finished product.
(7) Accessories, such as protective caps to protect the sealing faces must have an adequate level of cleanness.
(8) It is not permitted to place parts face down onto their unprotected sealing faces.

8 Abrasive blasting of vacuum parts

(1) Specific knowledge of the abrasive blasting system operator is assumed so that parameters such as blasting pressure, blasting angle, blasting speed, and so on are the responsibility of the supplier and are not specified by VA.
(2) It must be ensured that no contaminated blasting abrasive gets onto vacuum parts (e.g., iron particles on stainless steel surfaces). The operator of the blasting abrasive system should therefore ensure that they work with two qualities of blasting abrasive cleanliness for aluminium oxide abrasive blasting and that they use the blasting abrasives in a pure and separate manner in regard to the blasted parts.
(3) The compressed air must be filtered and free of water and oil.
(4) The parts must be cleaned and degreased before abrasive blasting.
(5) Sealing faces, screw-on surfaces, holes with tolerance specifications and threaded holes are not blasted unless this is expressly required in terms of function. They are to be covered or sealed in a suitable manner.

(6) For corrosion-resistant steels, glass bead blasting is permitted as the only blasting cleaning method after welding
(7) Any “smeared” scale or extraneous rust residues on the surface caused by blasting with too flat of ablasting angle must be removed by pickling.
(8) The blasting residues must be completely removed (use lint-free cloths), vacuumed off or blown off.
(9) After blasting, blasted surfaces can only be handled with lint-free and clean gloves.
(10) Adhesive foils and adhesive residues must be removed with grease-free solvents.
(11) Optical surfaces outside the vacuum must be preserved by suitable means (e.g., polystyrene protection PTX 100).
(12) Blasted workpieces must be stored and transported in sealed packaging which completely protects the parts.

9 Assembly regulations

(1) Due to the high demands placed on the process in terms of cleanliness, assembly must only be performed in suitable rooms.
(2) During assembly, it is necessary to wear cotton gloves to avoid leaving fingerprints.
(3) All assemblies and auxiliary parts such as screws, nuts and washers must be cleaned according to the vacuum requirements in section 5.
(4) O-rings must generally be fitted without grease.
(5) The lubricants used on the atmospheric side must be strictly separated from those used on the vacuum side.
(6) Screws inserted into blind hole must generally be of a ventilated type.
(7) In order to support sealing effects on mechanically moved parts and to reduce abrasion on sealing materials, vacuum grease LITHELEN or ULTRATHERM 2000 is used. – Starting from the pressure range of high vacuum 1 (see **Fehler! Verweisquelle konnte nicht gefunden werden.**), the use of vacuum grease must be expressly requested and approved in advance by Von Ardenne.
(8) To prevent cold welding of screw connections, all screws and threads are treated with the thread lubricant MoS_2 (molybdenum disulphide). Other lubricants are not permitted.
(9) Sealing of pipe joints up to 1" is performed with Loctite 55 sealing cord, components larger than 1" with hemp. Small parts on gas pipes should also be sealed with PTFE tape.
(10) Seals made of PTFE, silicone rubber and Viton and with a diameter of d=400mm and up are to be outgassed approx. 2h at 60°C – 80°C before assembly (drying cabinet or the like).

10 Other applicable documents

11 Change index

Short description of the change	Version	Valid from	Prepared by
Initial approval	1	2019-09-04	C. Heilmann