

Pfeiffer Vacuum Components & Solutions GmbH General quality requirements

1 Objective

The objective is to meet quality requirements, which are stipulated in respect of Pfeiffer Vacuum Components & Solutions GmbH products in regards to welding work, surface finish, cleaning, packaging and documentation.

The work must meet the requirements stipulated in the order and, where applicable, any legal restraints and engineer standards.

Conflicting information in orders, specific product specifications, customer requirement specifications or drawings take priority over the “general quality requirements”.

2 Scope

Work steps done in-house at Pfeiffer Vacuum Components & Solutions GmbH.

Work steps assigned to suppliers and their subcontractors on behalf of Pfeiffer Vacuum Components & Solutions GmbH.

3 Requirements

3.1 Welding quality requirements

3.1.1 Quality requirements in respect of the company

- Fulfilment of quality requirements in accordance with EN ISO 3834-2 or comparable.
- Requirements in respect of welding supervision in accordance with DIN EN 14731 or comparable.
- Implementation of welded seams in accordance with DIN EN ISO 5817, assessment group B or comparable.
- Qualifications of welders / operators in accordance with DIN EN ISO 9606-1 / 14732 - or comparable.
- If explicitly requested: Procedure qualifications in accordance with DIN EN ISO 15614 -1 /15614-11 or comparable.
- If explicitly requested: Traceability of all technical welding activities in an appropriate form.

3.1.2 Quality requirements in respect of welding

Approved welding processes, on the vacuum side

- WIG (141/ 142)
- Laser (52)
- Orbital (141)
- Electron beam welding (51)
- Applicable for pipes only: Plasma arc welding (153 / 154 / 155)

Additional approved welding techniques, not on the vacuum side

- MIG/MAG (135)
- Submerged arc welding (12)
- Plasma arc welding (153 / 154 / 155)

General requirements in respect of welded seams

- Avoidance of corner joints in the case of mechanical reinforcements.
- Arc strikes and weld spatters are not permitted.
- Ensure adequate forming, in particular also for penetration welding, residual oxygen content < 20 ppm.
- Homogenous transition of weld seams.
- Uniform appearance with refined flow marks.
- Annealing colours are to be removed using appropriate procedures, consideration the required surface finish and avoiding contamination with extraneous materials.
- Filler materials must be appropriate and approved for the base material and may only affect their mechanical and physical characteristics within permitted limits.
- The temporary welding on of auxiliaries made of other material groups is prohibited (for example, ferritic stainless steel on to austenitic stainless steel).
- Deep stress marks, scratches and cracks are not permitted.

Additional requirements in respect of vacuum welded seams

- Inside seams circumferentially welded, without interruption.
- If inside welds are not possible: full penetration welds from the outside. In this case, no volume must be entrapped in the welds.
- Continuous outside welds are not permitted unless these are full penetration welds. When combining an inside weld seam with outside weld seams (e.g. tack welds or support welds), no volume must be entrapped (possibility of leak testing and avoidance of virtual leaks).

3.2 Surface quality requirements

3.2.1 General requirements in respect of surfaces

Surfaces are the main source of gas loads in high and ultra-high vacuum. The aim of processing surfaces on the vacuum side is to keep the actual surface area as small as possible or to minimise it.

- Processes, which make the actual surface area larger, are to be avoided. (for example, roughening cold-rolled surfaces by means of grinding).
- Open-pored or fissured surfaces are not permitted (for example, mill scale - even when it is free from scale as a result of pickling).
- Component surfaces are to be finished in accordance with drawings.
- Average roughness value of surfaces - unless specified otherwise (excluding welded seams).
 - Vacuum area up to $1 \cdot 10^{-7}$ mbar
On average over the entire surface area $R_a (\mu\text{m}) \leq 6.3$
on the vacuum and air side
 - Vacuum range less than $1 \cdot 10^{-7}$ mbar
On average over the entire surface area $R_a (\mu\text{m}) \leq 3.2$ on the vacuum side
On average over the entire surface area $R_a (\mu\text{m}) \leq 6.3$ on the air side

Special requirements of sealing surfaces

- Scratches are not permitted.
- Unless requested otherwise, roughness $R_a < 0.8 \mu\text{m}$.
- Grinding / polishing only in sealing direction.
- Exception in the case of rectangular flange areas.
 - Sides may be ground down to the edge, on conditions that any offset to the sealing surface is not noticeable and the tightness of the flange connection is guaranteed.

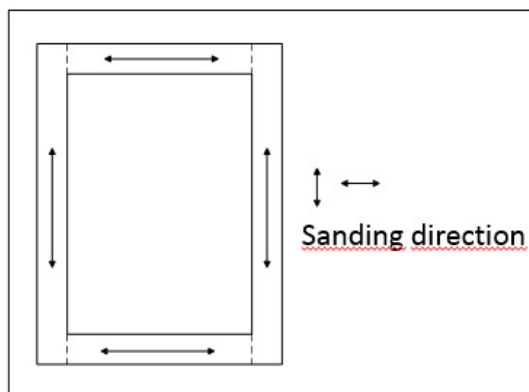


Figure 1: Example for grinding directions on rectangular flange

3.2.2 Special requirements in respect of specific surfaces

Fine glass bead blasting

- Blasted surfaces must be finished uniformly, flaws, shadows and stripes are not permitted.
- Different classes of material may not be blasted with the same blast material (for example, ferritic stainless steel and austenitic stainless steel).
- Grain size 70 to 110 μm .
- Only use clean, dry blasting material.
- Used blast material is to be replaced.

Pickling

- The pickling parameters are to be chosen according to the material, in particular overpickling is not permitted.
- Passivation should follow pickling.
- Residues from pickling or passivation are not permitted (rinse properly!).

Grinding

- Care should be taken to achieve a uniform grinded finish.
- Where applicable, grinding should be cross-ground to ensure that the roughness does not vary too much in and against the direction of grinding.
- SiC is permitted as a grinding material.
- Different classes of materials may not be ground with the grinding materials (for example, ferritic stainless steel and austenitic stainless steel).
- Abrasive residues and ground material must be removed from the surface in full (for example using a follow-on process such as pickling).

Mechanical polishing

- Care should be taken to achieve a uniform finish.
- Only use polishes, which are fully removed in subsequent cleaning. If components of the polish used are left on or in the surface these will result in unpermitted outgassing in vacuum.
- Different classes of materials may not be polished with the polishing materials (for example, ferritic stainless steel and austenitic stainless steel).
- Residues of polish and abrasive material must be removed in full from the surface.

Anodic cleaning and electrolytic polishing

- The electrolyte and the process parameters are to be chosen according to the material.
- Unless specified otherwise, the following material thicknesses are to be removed uniformly.
 - Anodic cleaning: 3 to 5 μm
 - Electrolytic polishing: 15 to 20 μm

- Where to contact the anode with the component is either stated on the drawing or has to be agreed with the customer.
- Knife edges from CF flanges are to be covered so that the edges are not removed inadmissibly. After electrolytic polishing, the transitions to the covered surface areas are to be polished (no “frayed” transition zone).
- Passivation should follow on from electrolytic polishing.
- Residues from the electrolyte or from the passivation bath are not permitted (rinse properly! Pay attention in case of non-continuous weld seams - rinse and dry gaps).

3.3 Cleaning quality requirements

Contaminants on surfaces make it more difficult to create a vacuum and/or disrupt processes.

- They can evaporate and as a result generate large quantities of gas.
- They bind gases and liquids, which they release in vacuum.
- Particles or gases can be released and attach to functional surfaces.
- In addition, many applications are disrupted by hydrocarbons or other residual gases.

Consequently, the following requirements are stipulated in respect of the cleaning.

- The cleaning process is to be chosen according to the materials and components.
- The cleaning agents are to be chosen according to the material and types of dirt.
- Residues of cleaning agents or contaminants must be fully removed (multiple rinses in deionised water).
- The surfaces must be free of oil and grease.
- The surfaces must be free of particles.
- Particles and impurities incorporated into the surface must also be completely removed. The same applies for bore holes and threads.
- All surfaces must be dry. Moisture in vacuum technology represents an impurity.
- Dry spots or water marks are not permitted.

A simple method for checking the result of a cleaning operation is a wipe test. For this purpose, a white / lint-free cloth impregnated with isopropanol is wiped repeatedly over the surface. No impurities may subsequently be visible on the cloth.

3.4 Packaging quality requirements

- Sealing surfaces are to be covered using appropriate, clean coverings.
- Components are to be sealed or wrapped in airtight PE foil. Thereby no impurities may be applied to the component, potentially due to an electrostatic charge of the foil.
- Components are to be transported in appropriate packaging to prevent damage or contamination.

3.5 Documentation quality requirements

- Inspections and documents may only be completed by qualified personnel.
- The extent of testing and the required values are to be taken from the order, drawings, component specification or the customer requirement specifications.
- The nature and scope of documentation are to be taken from the order, drawings, component specification or the customer requirement specifications.