Pretreatment

Mechanical grinding of stainless steel surfaces before electropolishing.

Why Pretreatment?

Electrochemical polishing describes a controlled galvanic surface removal process using selective anodic metal dissolution and the resulting measurable improvement in the technical parameters that characterise the surfaces, such as (micro)topography, morphology and energy level. Besides the application of the electopolishing parameters, the surface finish produced by the controlled electrochemical treatment also invariably depends, of course, on the initial surface condition. For this reason, the initial surface condition also determines in every instance the surface quality following the applied electropolishing process. Stainless steel surfaces prior to electrochemical polishing are often bright-rolled, cold-drawn, mechanically ground, blasted, etc., although the original mechanically ground condition is found in the majority of practical applications.

Mechanical Grinding.

The mechanical grinding process is a relatively complex technical removal process which is defined by a wide range of parameters and which must also be specified in detail in terms of guaranteed reproducibility and calculability. At HENKEL, the grinding process is described and defined in detail in a surface specification accompanying each order as a surface pretreatment step, including testing and documentation.

The technical purpose of mechanical grinding is

- to achieve as bare metallic surface as possible, although metallically pure stainless steel surfaces cannot be achieved by mechanical grinding.
- to remove mill scale and cast skin, although scale layers and traces of corrosion cannot for the most part be removed permanently by mechanical grinding.
- to equalise macroroughness, dents, grooves, weld seams or similar geometric defects. to carry out controlled contour smoothing.
- to ensure as consistent an output quality as possible over the entire surface area with a controlled processing depth and defined output roughness Ra/Rz in order to guarantee, through subsequent electropolishing with controlled material removal, the roughness desired by the customer in the final surface condition.

Technical Basic Rules.

In order to ensure the desired result, professional mechanical grinding must be carried out in accordance with specific technical rules, some of which are detailed below:

The grinding process can be dry or wet. Hand-guided or semiautomatic grinding in particular is carried out in dry grinding procedures, whereby the use of grinding oils or pastes is not recommended, especially since they carry the risk that these (mostly organic) additives will burn as a result of the grinding heat and that the combustion residues will enter the metal surface, leading to surface structure defects which may be detected in the subsequent electropolishing process, in some instances as serious surface defects (e.g. chromium carbide formation). Moreover, abrasives must be guaranteed to be free from Cl and Fe.

Grinding wheels which are bonded with glue should not be used under any circumstances.

New, technically approved abrasives (belts, wheels) should in principle always be used. Used, dull grinding belts carry the danger that the component‘s surface can no longer be removed safely, and that it will overheat mainly as a result of friction, causing localised smearing effects. Abrasives must therefore be regularly checked and changed in good time.

The component‘s surface must be cleaned carefully before the mechanical grinding process in order to remove grease residues and other organic residues such as adhesive residues, plastic film residues, etc.

Our Service Range

- On-site and factory service
- Electrochemical polishing
- Anodic cleaning
- Chemical polishing / deburring
- Chemical pickling and passivation
- Precision cleaning (chemical, anodic, ultrasound)
- Cleaning and packaging in clean room
- Derouging and re-passivation
- Process and cleaning chemicals
- Documentation

HENKEL Beiz- und Elektropoliertechnik
Waidhofen-Thaya (AT) | Györ (HU) | Neustadt-Glewe (DE)
info@henkel-epol.com | www.henkel-epol.com

The initial grain size for coarse pre-grinding is always determined by the initial roughness of the surface and the grinding layer which is to be removed by this process. The initial grain size is generally selected on the basis that the grinding surface can reach the base of the groove and therefore that the defects (macro-defects) can be safely removed deep into the grooves.

The mechanical grinding process is usually carried out in several grinding stages as a structured grinding procedure, whereby the grain gets finer and finer until the desired roughness Ra/Rz is achieved. When selecting the grain sizes, it is important that the subsequent grinding procedure safely reaches the groove structures of the previous grinding procedure deep into the grooves and removes them fully. Experience shows that the grain size increment selected for each grinding stage should not be greater than two grades. The complete removal of the grinding grooves from the previous grinding procedure is therefore easy to check when you vary the grinding direction for each subsequent grinding procedure as far as possible, as this allows you to easily identify any grinding grooves from the previous grinding procedure.

The roughness Ra/Rz achieved by mechanical grinding is reproducibly reduced with professional electropolishing. For the roughness range Ra = 0.5 … 1.5 µm following electropolishing, mechanical pre-grinding should be carried out at approximately double the Ra value: target value following electropolishing Ra = 0.8 µm ….. mechanical pre-grinding at Ra = 1.6 µm (corresponds to approx. grain size 80 or A 300 according to Trizact™ definition).

When using „3M™ Trizact™“ abrasives, please note that there are three abrasive types here in the first instance; in particular, types 307EA and 237EA with the grain media aluminium oxide (Al2O3 or white corundum) and silicon carbide (SiC) are designed for dry grinding and the relevant grain sizes from A 006…A 160 are defined by the manufacturer. There are corresponding assignments between the A values of 3M™ and the P values of conventional abrasives according to the DIN (German Institute for Standardisation) and FEPA (Federation of European Producers of Abrasives), for example

P 60 = A 400 | P 80 = A 300 | P 120 = A 160
P 150 = A 130 | P 180 = A 110 | P 220 = A 90
P 240 = A 80 | P 280 = A 65 | P 320 = A 60 etc.

If Ra values of between 0.2…0.5 µm are expected following electropolishing, mechanical pre-grinding should be carried out at approximately 1.3 times this value – so for 0.4 µm following electropolishing, the value is approximately 0.55 µm following pre-grinding (corresponds to approximate grain size 180 – 220 or A 110 – A 90).

If you still want to be able to see the mechanical grinding structure clearly following electropolishing, the mechanical pre-grinding procedure must be selected with a grain size coarser than 120 or A 160 (better grain size 80 or A 300). If, however, no grinding grooves from the mechanical grinding process can be seen following electropolishing (complete polishing out of the grinding structure), this requires professional structured grinding up to a grain size of 280 or 320 (A65 or A60 for Trizact™ abrasives).

Should you have any queries, please do not hesitate to contact us.

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