Technical Bulletin

provided by

CRITERIA FOR THE ASSESSMENT OF FUNCTIONAL STAINLESS STEEL SURFACE

Essay No 7 / Rev. 00

Georg Henkel, MSE, PhD

Benedikt Henkel, MSE

The component's value is assured by its surface

info@henkel-epol.com www.henkel-epol.com

CRITERIA FOR THE ASSESSMENT OF FUNCTIONAL STAINLESS STEEL SURFACE

Surfaces of stainless steel equipment components and tube systems must fulfil the important functions of being resistant to corrosion, neutral to the medium, easy to clean etc. specially when they are in contact with the medium. These aspects are especially taken into account when the material is specified and selected by the planner in order to meet the demands of the producing companies as exactly as possible.

Even if we assume that the demands of the user have been correctly transformed into the material specification, a technologically empty space often remains as regards the surface assessment of the components. Due to the given control techniques this is less than satisfying. Besides the visual assessment with the naked eye and the comparison with standards which are often subjective, roughness measurements generally remain as a fast and cheap method with one of the commercially available test or stepwise processes such as Hommel or Perthen. These simple methods generally give a two-dimensional geometric index whose interpretation, however in comparison to the fairly complicated condition of the surface as regards its operative behaviour is problematic, and requires further observation and classification.

For a serious assessment of the facts it is without doubt meaningful to define three areas for consideration which are interrelated:

a) Topography
b) Morphology
c) Level of Energy

At the same time the surface treatment process (non-cutting and/or chemical or electro chemical) must be conclusively considered and classified.

The Topography describes the three-dimensional geometric structure of the surface i.e. the accessible micro-cavities near the surface whereby the formation of a flowing boundary layer and diffusion behaviour may also be considered in the interpretation depending on the state of the process (static, dynamic).

Statements on the topography of a surface if all these factors are taken into consideration are hardly or only in a very limited manner possible through the roughness measurements mentioned above. Isolated information on roughness is therefore a criteria which is of little help.

Important supplementary information on the geometric structure is given, for example, by the localised elution of a suitably prepared surface, whereby the diffusion mechanisms both in fluid and gas ranges can be examined and assessed.

The Morphology of the surface, i.e. the layer near the surface mainly shows, that the surface treatment process has left traces which have altered the austenitic structure, which was originally pure and clean usually to its detriment.

The disturbances can be detected without trouble with a probe analysis up to a depth of 30 μm, so that it is beyond doubt that a surface in contact with the media is represented by a material structure which to say the least, is not exactly defined.

Foreign matter pressed into the surface (e.g. Abrasive grit) may equally be found as alterations in the structure (ferrite parts) or grain deformation. Besides the problems of particle generation above all a weakening of the corrosion resistance must be expected.

This energy level of a surface is a thermo-dynamics statement and can be divided into the fundamental alloy rate and into stored external energy. This storage is caused by the introduction of foreign matter (see morphology) and, above all, the plastic deformation of the grain respectively of the crystals (entropy-mainly energy-elasticity) by the cutting and non-cutting formation of the surface, as well as by diffusion in thermal processes (welding etc.).

The alteration of the energy level to higher values alters all the other factors of behaviour such as corrosion resistance, adhesion behaviour, catalytic behaviour etc., whereby mainly conditions which are less favourable are achieved.

It should be pointed out that the above division of criteria lead to the conclusion whereby it can additionally be argued that the morphology influences both the topography and the energy level and vice-versa.

These perceptions allow the conclusion that roughness values are only meaningful of informative value in combination with further information (e.g. the traceability of the history of the surface via specification and certification) and that within the framework of further quality control a number of supplementary testing processes should be standardised and implemented if the needs of the user are to be exactly and safely fulfilled.

Please contact us for further information

Technical Bulletin

Procedures for the treatment of metal surfaces

- Electrochemical polishing
- Electrochemical and chemical deburring
- Chemical polishing
- Chemical pickling
- Passivation
- Derouging and professional repassivation

All services can be carried out on the premises of the customer

Development and supply of

- chemicals for pickling, electropolishing and passivation of metal surfaces
- chemicals for derouging and repassivation of stainless steel surfaces
- turnkey constructions/equipments for the chemical and electrochemical surface treatment of metals

Technical consultation

- for the surface treatment of
  - Stainless steel (i.e. 1.4435 / 1.4404 / 316l, 1.4539 / 904l, etc.)
  - Nickel and Nickel Alloys (i.e. Alloy 59, Hastelloy, Inconel)
  - Aluminium
  - Copper
  - Niobium
  - Titanium
  - Zirkonium
  - C-steel
- for apparatus, tubes and fittings in the food, beverage, chemical, cosmetic and pharmaceutical industries, bio and medical technology, plant, refrigeration and heat technology
- for surface treatment specifications for apparatus and tube systems
- concerning corrosion of stainless steel

Further services

- Colouring of stainless steel
- Clean room treatment
- Waste water technology
- Research & Development

We are member of VDMA, EHEDG und ISPE

For further information please contact us

info@henkel-epol.com
www.henkel-epol.com

Certified according to EN ISO 9001:2000
Certificate no : A06/0007

HENKEL
Pickling and Electropolishing

HENKEL Beiz- und Elektropoliertechnik
GmbH & Co. KG
Stoissmühle 2
A – 3830 Waidhofen / Thaya
Tel : + 43 (0) 28 42 / 543 31 - 0*
Fax : + 43 (0) 28 42 / 543 31 - 30
info@henkel-epol.at
www.henkel-epol.com

HENKEL Beiz- und Elektropoliertechnik
GmbH & Co. KG
An der Autobahn 12
D – 19306 Neustadt-Glewe
Tel : + 49 (0) 387 57 / 66 - 0*
Fax : + 49 (0) 387 57 / 66 - 122
info@henkel-epol.com
www.henkel-epol.com

HENKEL Kémial és Elektrokémial
Felületkezelö Kft
H – 9172 Györzámoly, Központi Major
Tel : + 36 (0) 96 / 352 - 035
Fax : + 36 (0) 96 / 585 - 035
info@henkel-epol.hu
www.henkel-epol.com

The component's value is assured by its surface