

# PICKLING OF STAINLESS STEEL



Co-funded by the  
Erasmus+ Programme  
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# Pickling

What?

- Surface treatment;
- Controlled Corrosion;

Why?

- Removing unstable, active oxide layer  
→ retrieving original corrosion properties;
- Removing iron pollution;
- Chemically cleaning the surface;

How?

- Nitric acid and hydrofluoric acid;
- Sometimes sulphuric acid;

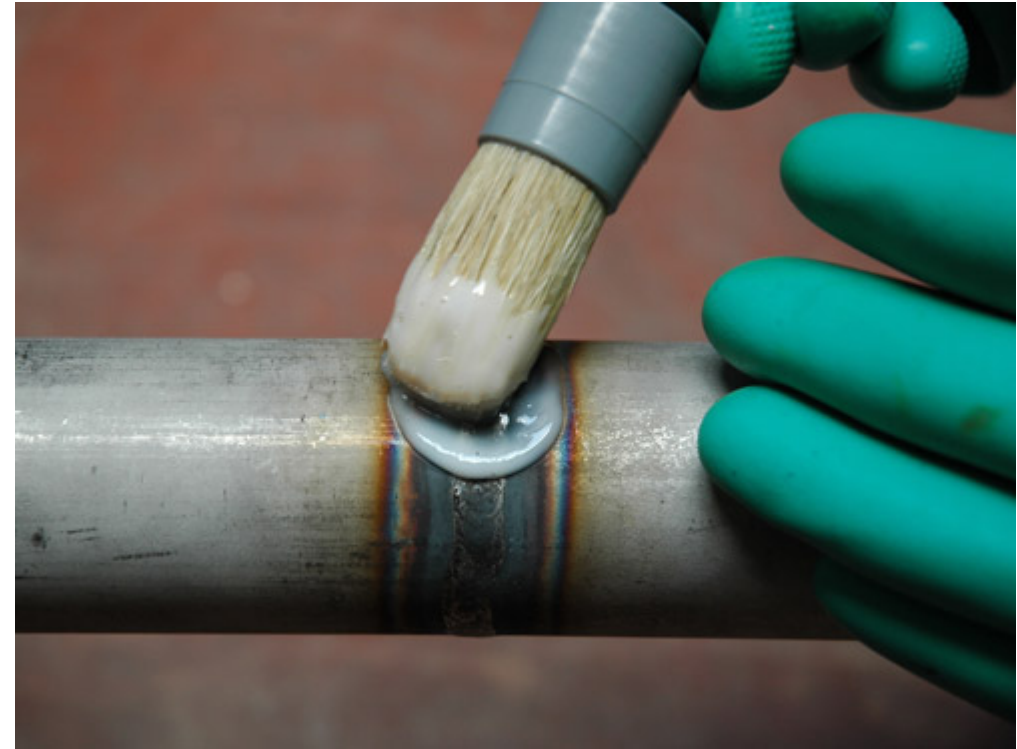


Figure 1- Pickling with paste. Source:  
<https://multinal.com/en/treatments/metal-surface-treatments/pickling-and-passivation/self-pickling-of-stainless-steel/>



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# Pickling

Steel grade 1.4404/316L with MMA welds exposed to a marine environment for two weeks

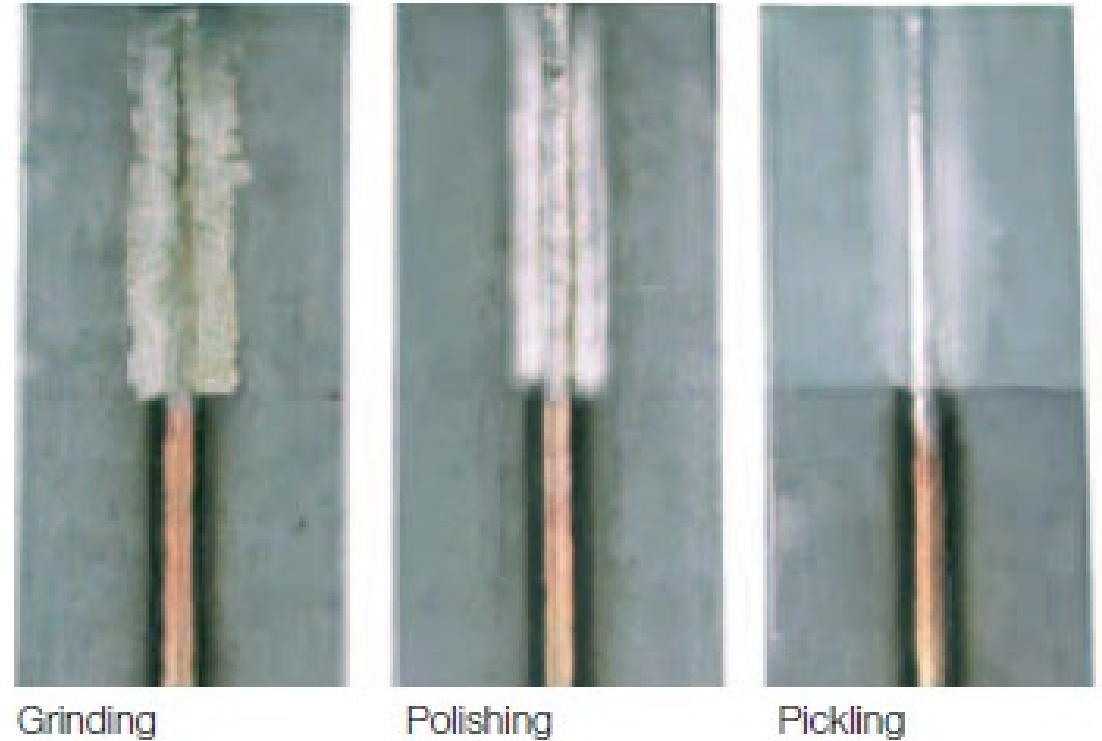


Figure 2 - Comparing pickling. Source: Outokumpu. (2013). Handbook of Stainless Steel. Handbook of Stainless Steel, 92

# Methods

- Immersion Pickling
- Paste or Gel Pickling
- Spray Pickling
- Electrochemical Cleaning/Polishing



Figure 3 - Spray pickling. Source: [http://www.sofel-sts.be/PDF/NL/PF/INOX\\_&\\_METAL\\_PICKLE\\_GEL.pdf](http://www.sofel-sts.be/PDF/NL/PF/INOX_&_METAL_PICKLE_GEL.pdf)

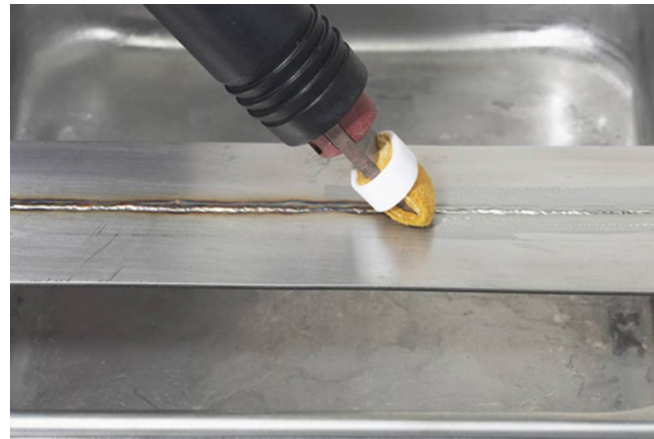


Figure 4 –Electromchemica.  
Source: <http://www.sspicklingandpassivation.com/companyprofile.php>



Figure 5-  
Picklingpast.  
Source: <http://www.euroshl.com/project/avesta-pickling-gel-122/>



Figure 6- Pickling bath.  
Source: <https://polyshop.nl/kunststof-beitsbad-4500-liter>

# Choosing method

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Depends on:

- Type of contaminants;
- Degree of cleanness required;
- The cost;

# Choosing method

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## ➤ Electrochemical pickling

- Less aggressive chemicals ➔ less risks

## ➤ Chemical pickling

- More aggressive chemicals ➔ more risks

# Risks

Health	Environmental
<ul style="list-style-type: none"> <li>• Skin contact</li> <li>• Toxic fumes</li> <li>• Contact with eyes</li> </ul>	<ul style="list-style-type: none"> <li>• Waste</li> <li>• Endangering local fauna and flora</li> <li>• Water pollution</li> </ul>

Table 1 – Risks during pickling. Source: VCL



Figure 7- Hazard symbols. Source: [www.gevaarsymbolen.be/nl](http://www.gevaarsymbolen.be/nl)

# Risks

Immersion Pickling	Spray Pickling
Droplets will leak from submerged workpiece	Contact with skin
Chance of falling in pickling bath	Mist of acid
Fumes	• Fumes
Leakage	• Environment
	• Eyes

Tabel 2 – Risks during pickling. Source: VCL



Figure 8 – Risk of falling. Source:<https://veiligheidspictogrammen.be/blog/13-algemeen/15-en-iso-7010-2012>



Figure 9 – Caustic Substance.  
 Source:<https://veiligheidspictogrammen.be/blog/13-algemeen/15-en-iso-7010-2012>



# General requirements

- Instructions and information
- Training for personnel
- PPE
- Pickling indoors is recommended
  - Use a separate room → health/environmental hazards + stable temperature
- Ventilation
- Acid-resistant materials → floors, walls, ... (splashes)
- Washing facility → preferably high-pressure water jet
- First aid kit
- Water recycling



Figure 10 -Hose down and ventilate. Source:<https://veiligheidspictogrammen.be/blog/13-algemeen/15-en-iso-7010-2012>

# Safety rules

- Training personnel
- Data sheets of the products
- No eating, drinking and smoking in pickling area
- Wash hands and face before eating and after finishing work
- All skin must be covered with acid-resistant material
- First aid kit for acid splashes
- Ventilation
- Keep containers/jars closed ➔ evaporation
- Neutralize pickling residues



Figure 11 – Eye shower. Source: <http://www.cgk-online.be/nl/oogdouche-nooddouche-144.htm>

# Ventilation

- Extraction of fumes directly above pickling surface
- Do not work directly above the pickling bath
  - If you do ➔ wear respiratory protection



Figure 12 – Respiratory protection.  
Source: <https://www.officeworks.com.au/shop/officeworks/p/prochoice-respirator-chemical-maxi-mask-pcmabek1>

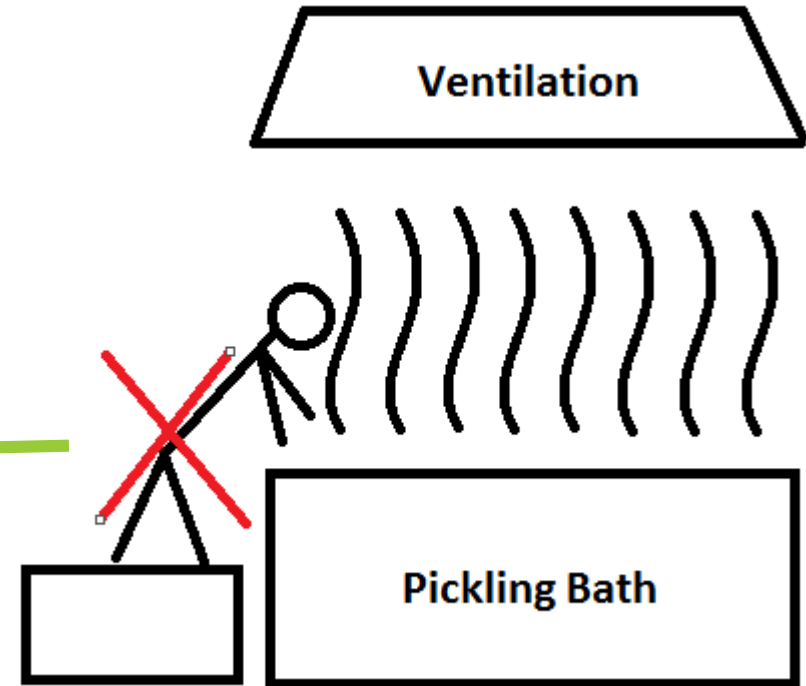


Figure 13 –Fumes extraction. Source: VLC



# Waste treatment

- After rinsing workpiece
  - ➔ water is acidic and contaminated with heavy metals
- Water must be neutralised
- Heavy metals will form sludge ➔ dispose as prescribed by local waste regulations
- Plastic containers, bottles,... can be recycled



Figure 14- Symbol for recycling.  
Source: <http://www.cgk-online.be/nl/oogdouchenooddouches-144.htm> .

# Safe storage

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- Store products:
  - Cool;
  - Dry;
- Read instructions for storage on the container;

# PPE

## Important

Use the proper PPE's

➔ Get information from manufacturers

Never re-use PPE's

➔ Exception: safety goggles

Dispose of PPE's in the correct manner

➔ Environmental reasons



Table 3 – Use of PPE's. Source: VCL

Figure 15 – Read Instructions, & Figure 16 – Disposal  
Source: <http://www.cgk-online.be/nl/oogdouche-nooddouche-144.htm> .

# PPE

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Figure 17- Grinding cap. Source:  
<https://www.amazon.co.uk/TOOGOO-Safety-Grinding-Shield-Protection/dp/B078H4HSNM>



Figure 18- Safety glasses. Source: Anonymous



Figure 19- Safety glasses. Source:  
<http://ashleytchemblog.blogspot.com/2015/>

# PPE

## Disposable gloves

- EN 374-X



Function	Symbol
Waterproof and low chemical protection	
Waterproof and chemically resistant	

Table 4 -Explanation symbols. Source: EN 374

Table 1 – Permeation performance levels	
Measured breakthrough time (min)	Permeation performance level
> 10	1
> 30	2
> 60	3
> 120	4
> 240	5
> 480	6

Table 5 - Permeation performance levels. Source: EN 374





A D F

List of test chemical			
Code letter	Chemical	CAS number	Class
A	Methanol	67-56-1	Primary alcohol
B	Acetone	67-64-1	Ketone
C	Acetonitrile	75-05-8	Nitrile compound
D	Dichloromethane	75-09-2	Chlorinated paraffin
E	Carbon disulphide	75-15-0	Sulphur containing organic compound
F	Toluene	108-88-3	Aromatic hydrocarbon
G	Diethylamine	109-89-7	Amine
H	Tetrahydrofuran	109-99-9	Heterocyclic and ether compound
I	Ethyl acetate	141-78-6	Ester
J	n-Heptane	142-85-5	Saturated hydrocarbon
K	Sodium hydroxide 40%	1310-73-2	Inorganic base
L	Sulphuric acid 96%	7664-93-9	Inorganic mineral acid

Table 6 - List of test chemicals. Source: EN 374

# PPE

## Disposable masks



Figure 20 - Respiratory device. Source:  
<https://www.moody.af.mil/News/Photos/igphoto/2000344071/>

## Ventilation



Figure 21 – Ventilation (Sentryair). Source:  
[https://en.wikipedia.org/wiki/File:Ducted\\_Fume\\_Hood.jpg](https://en.wikipedia.org/wiki/File:Ducted_Fume_Hood.jpg)

# European, National Regulations and Recommendations

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## ➤ EN 374