UIP guideline

Cleaning levels

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Foreword

When the cleaning level key is applied, deviations frequently occur when persons assess the same tank condition differently because of their dissimilar points of view and experience.

With the present guideline, the UIP working group “Cleaning levels” intends to give users assistance with the aim of progressing towards a standardisation of appraisals.

The present issue of this guideline focuses initially on particularly controversial assessments. The UIP invites users to discuss any points and will gladly consider suggestions. The guideline can be expanded by the UIP if necessary.

This manual was developed by a working group of the UIP after their best knowledge. UIP takes however no responsibility and/or adhesion for any kind of damage, which results from the use of the key or this manual.

We recommend you use a colour printer to print out this guideline, as the quality of the photos contributes considerably to the effectiveness of the presentation.

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Introduction

The UIP cleaning key supports a standard assessment of tank interiors and all items of equipment coming into contact with the product carried. It provides a basis for describing a cleaning condition of a tank. Detailed information on e.g. pores, adhesions or minor shading effects is to be agreed on additionally.

In case of doubt, further information, e.g. detailed report, comprehensive photo documentation, is necessary.

Structure of cleaning key

1. Tank material
2. Tank surface
3. Product residues
4. Tank atmosphere (necessary because this information is crucial for the cleaning process or for further use)
   e.g., nitrogen: tank must not be accessed

Figure 1. Material	Figure 2. Surface Appearance									Figure 3. Product residue reference	Figure 4. Condition	Figure 5.
	1	2	3	4	5	6	7	8	9			
	Clean, No rust	Clean, slight rust dust	Slight oxydation, powdered rust	Powdered rust,and slight discoloration	Powdered and compacted rust, strong discoloration	Layered rust, rust pitting	Loose rust flakes		Special stipulations			not yet in use
1. Mild steel										**0** No residue, no odour, dry **1** No residue, slight odour, dry	**1** Air **2** Nitrogen	
2. CrNi-Steel **3. CrNiMo-Steel** **8. Aluminium**	metal clean	metal clean, slight shading	Dull metal, discoloration from product carried	Uneven due to corrosion	Uneven due to corrosion with discoloration	Localised corrosion			Special stipulations	**2** No residue, product related odour, dry **3** firm deposits, product dust	**3** Other Specification	
4. Soft or hard natural rubber lining or comparable polymer quality	Clean, surface intact	surface intact	Surface not intact, Blisters, peeling, lifting due to corrosion						Special stipulations	**4** Barrel plates slightly oily, greasy, no firm deposits **5** Barrel plates slightly oily, greasy, firm deposits		
5. Enamel lining **6. Lead lining** **7. Coatings**						Date				**6** Empty, no visible residue, steamed out **7** Up to 2 ‰ residue **8** Residue over 2 ‰ **9** Special stipulations		

Date: January 2001

Ill. 1 - Cleaning level key

General notes

- The 1st digit refers to the materials of the surfaces of the tank that come into contact with the product. These also include linings or coatings.
- Determination of a cleaning level does not represent any safety assessment, e.g. concerning minimum wall thickness or weld seam evaluation. Details of the tank atmosphere do not replace requirements relevant to industrial safety, e.g. measurements before accessing the tank.
- It is vital to assess the condition of equipment such as fittings, distributor pipes, rising pipes etc., as this can result in a downgrading of the cleaning level.

- Score marks on the tank surface influence the cleaning level in 2. only if no suitable scouring agents were employed. This is the case particularly when ferritic scouring materials were used in stainless steel tanks that later lead to corrosion.
- The assessments should usually be carried out by specialists of the cleaning or repair firm and apply **only for the time** of the inspection.
- **Determination of a cleaning level is no substitute for a cleaning certificate or an entering permit!**

Corrosion in black steel tank

Almost every tank made of black steel shows the effects of corrosion over time. Thus, the “rust film” (similar to discoloration, cannot be wiped off) mentioned in the cleaning level 1.2.x.x is already caused by the oxidation of the iron. This rust film does not, of course, lead to an impairment of the products usually carried in steel wagons. This also applies to “beginning of rust formation and loose rust (powder)” (1.3.x.x) or “fixed rust” (1.5.x.x).

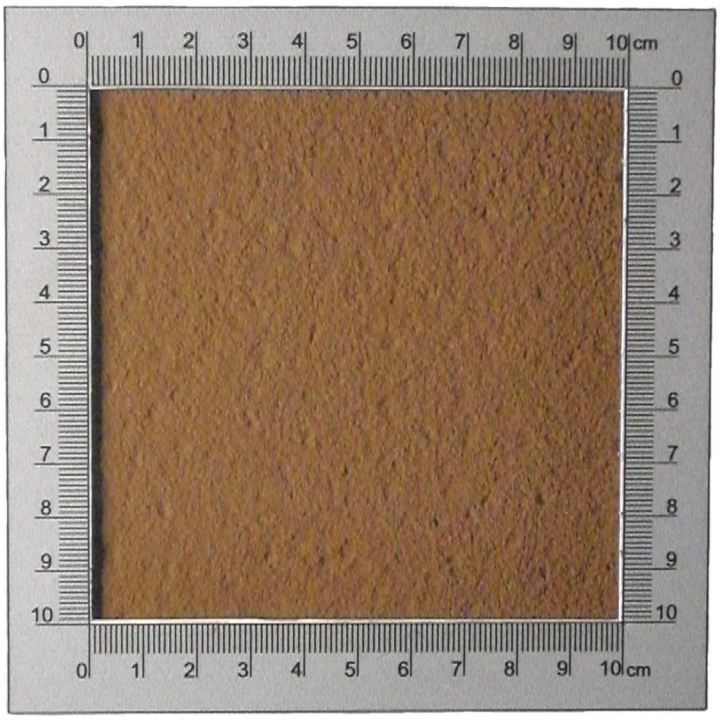
These effects of corrosion result in only low and normal wear of the steel surface of the tank.

On the other hand, local corrosion that is not extensive but penetrates deep into the wall is problematic. The thickness of the wall may be below the minimum level in this case and under some circumstances there may be leakage.

Whether a critical level (1.6.x.x, corrosion pits) or only a slight, possibly optical impairment is involved in the particular case is explained with the photos.

Note: The illustrations below are of surface structures without considering necessary minimum wall thickness.

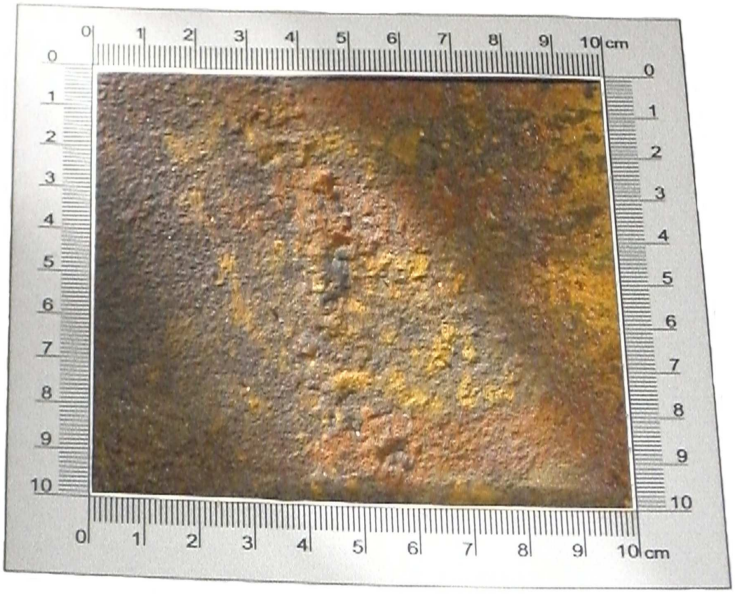
Onset of rust formation also involves minor cavities/erosion or rust grit. They have no further influence on the deployability of the tank.



Ill. 2

Extensive corrosion, unproblematic wear of tank surface

Cleaning level: 1.3.x.x



Ill. 3

Significant corrosion in tank bottom, beginning of borderline with corrosion pits, but still not detrimental for mineral oil transport

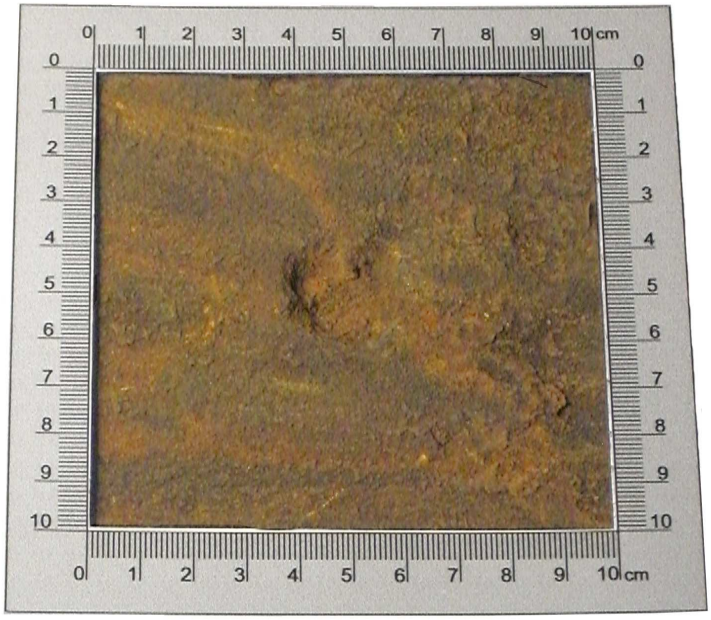
Cleaning level: 1.3.x.x
Abb. 3

Ill. 4

Fixed rust in tank bottom

Cleaning level: 1.5.x.x

If no other restrictions are present and/or appear afterwards, the degree of purity 1.3.x.x can be reinstalled by removing the fixed rust.



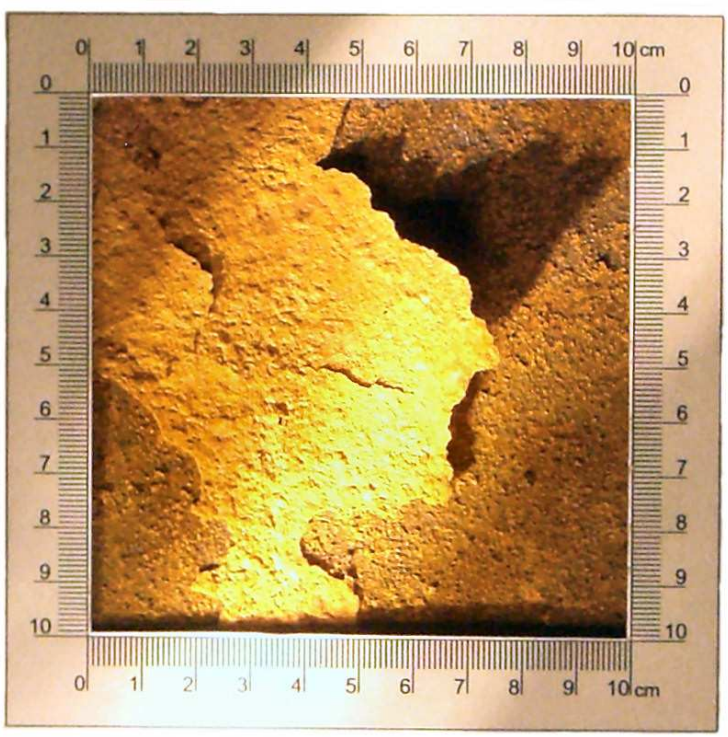
Ill. 5

Considerable corrosion pits, several millimetres to centimetres in diameter and several millimetres deep

Cleaning level: 1.6.x.x

Remedial action required; assessment of wall thickness and if necessary refurbishment of tank

The rating in the cleaning level 1.6.x.x is necessary for corrosion pits in the event of critical cavities/erosion, requiring further treatment (e.g., wall thickness below minimum). If no corrective measures are necessary, onset of rust formation is involved instead of corrosion pits.

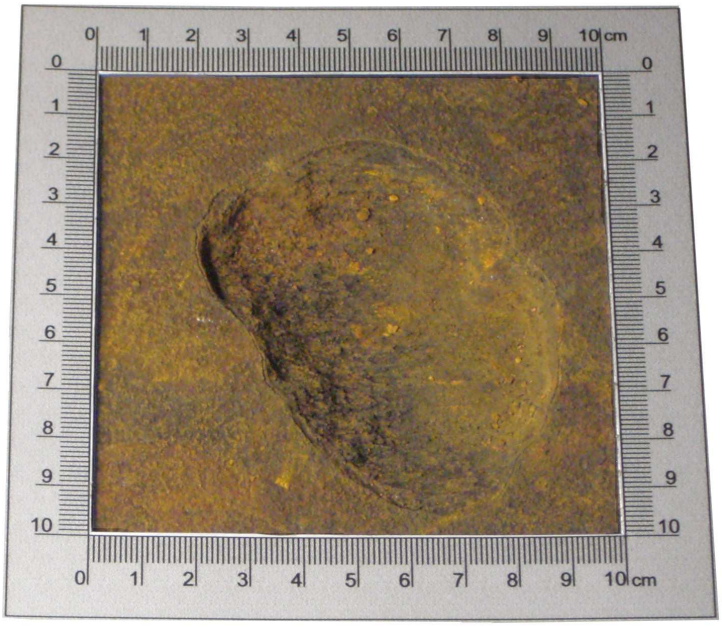


Ill. 6

Detaching rust scale

Cleaning level 1.6.x.x

If no other restrictions are present and/or appear afterwards, the degree of purity 1.3.x.x can be reinstalled by removing the layered rust.



Ill. 7

Serious corrosive damage – almost breakthrough of wall, no longer to be considered as corrosion pit

Cleaning level: 1.9.x.x

Discoloration/shading effects

Stainless steel can as a result of temperature (e.g., during welding) and products display as a rule brownish and bluish discoloration on the surface. This discoloration is due to damage to the tank material or its passive layer.

To eliminate discoloration and restore the passive layer, it is usually necessary to remove the metal surface at the µm level by pickling or glass bead blasting followed up by passivating

Ill. 8

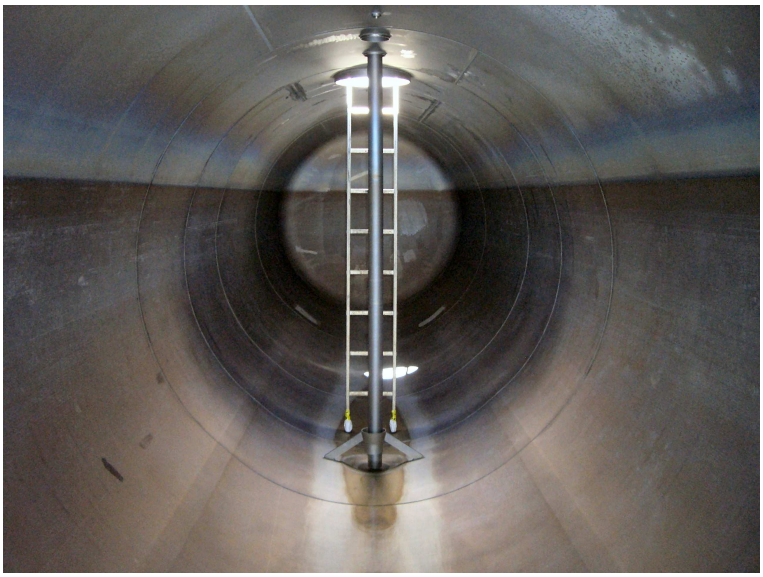
Ring of discoloration "Product stripes"

Cleaning level: 3.3.x.x

Ill. 9

Veil-like or extensive discoloration

Cleaning level: 3.3.x.x



Ill. 10

Completely discoloured stainless steel tank due to product (sodium hydroxide solution)

Cleaning level: 3.3.x.x

Ill. 11

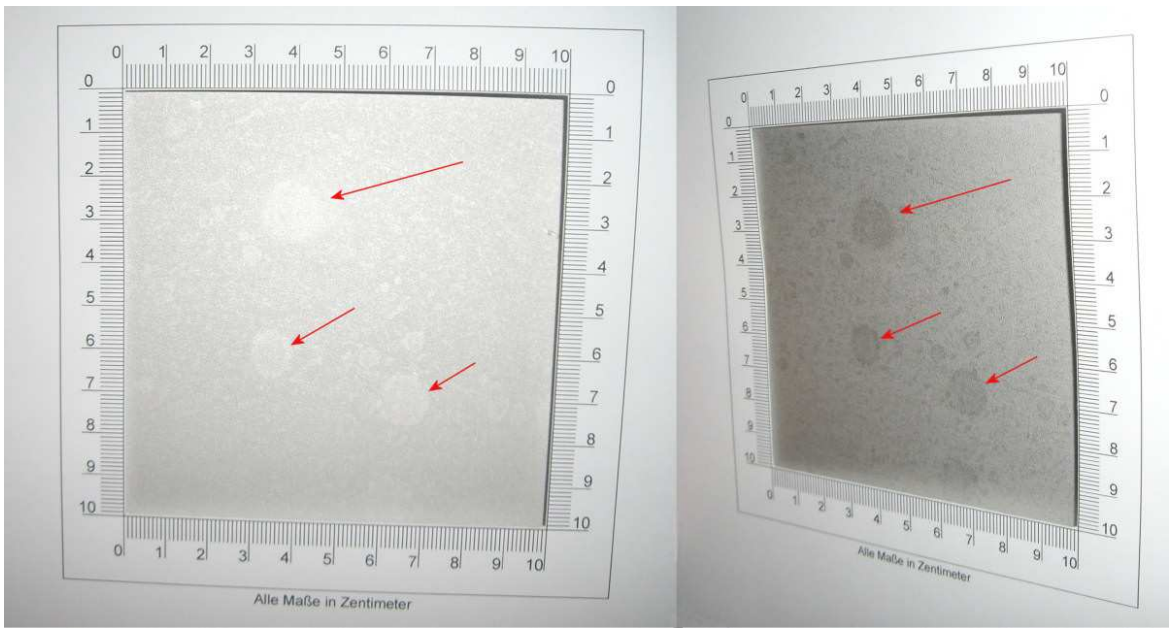
Tank without discoloration

Cleaning level: 3.2.x.x

Apart from discoloration, there can be a further impairment of the surface that is only of an optical nature and has no influence on the product or the corrosion resistance of the metal surface. This shading on the metal surface or the passive layer is caused not by coloured particles but by physical effects (interference).

In contrast to discoloration, shading effects depend on the angle of view or illumination. For example, it may be possible to identify from one side a dark or grey spot that cannot be seen or is visible only as a white spot from the other side.

The following illustrations each show the same wall section from two viewing angles. On the right, we tend to see dark spots. On the left, the same areas look lighter than the surrounding metal.



Ill. 12 – Shading effects, Cleaning level: 3.2.x.x

Ill. 13 – Shading effects, cleaning level 3.2.x.x

The example in Ill. 13 also involves shading effects, which appear lighter or darker depending on the viewing angle.

Comment:

Shading effects can arise if walls were not adequately cleaned before pickling or the pickle for other reasons could not take effect evenly. This also explains footprints on dished ends or in the top area. In this case, the plates lying on the floor were stepped on and not cleaned before production of the tank or before pickling after tank production.

The more or less cloudy picture after a glass bead blasting is also interpreted as shading effect.

Scuff markings

Scuff markings have no influence on the cleaning level. Even tanks with scuff markings over a very extensive area can be given a cleaning level of e.g. 3.2.1.1.

Ill. 14
Scuff markings

Cleaning level: 3.2.x.x

If scouring of the walls is carried out as inexpertly as in Ill. 14 and also with unsuitable/impure scouring materials, this can result in inclusion of ferritic particles, leading initially to a brown discoloration of the scuff markings and possibly later causing considerable corrosion of the stainless steel surface.

Ill. 15
Scuff markings with ferritic inclusions

Cleaning level: 3.5.x.x

Corrosion in stainless steel or aluminium tank

Corrosion in tanks of stainless steel or aluminium is given twice in the cleaning key; under 3.4.x.x or 3.5.x.x there is “roughening due to corrosion” and under 3.6.x.x “local corrosion”.

Note: The following comments refer to stainless steel tanks and are in important respects also applicable to aluminium tanks.

Roughening due to corrosion

Ill. 16

Extensive roughening, without discoloration

Cleaning level: 3.4.x.x

Roughening and discoloration due to corrosion

Ill. 17

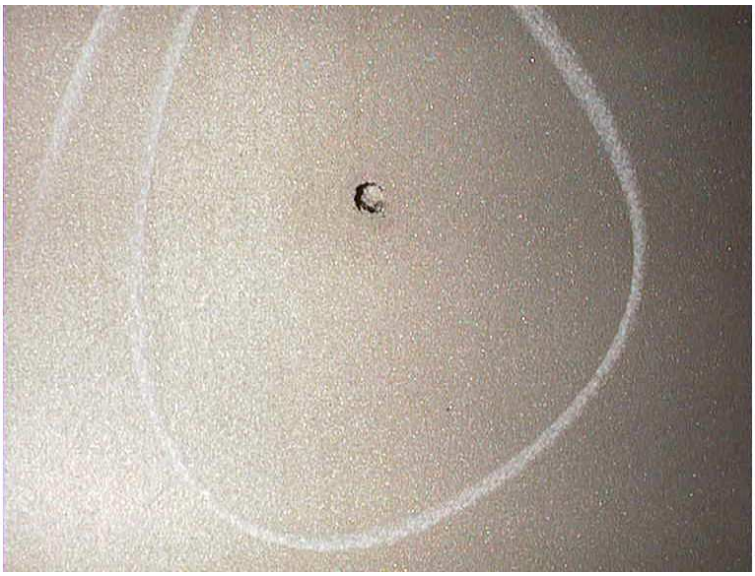
Extensive roughening with badly discoloured surface

Cleaning level: 3.5.x.x

Local corrosion

The following forms of local corrosion are in practice important:

- Pitting corrosion
- Intergranular corrosion
- Stress corrosion
- Corrosion fatigue



Ill. 18
Pitting corrosion in wall

Cleaning level: 3.6.x.x

These forms of corrosion always occur when because of various parameters the protecting passive layer can no longer perform its function. The main factors involved here include:

- Impermissibly high concentrations of chloride ions
- Uncontrolled effect of fluorides
- Impermissible concentrations of product (acids and lyes)
- Mechanical damage of surface immediately before loading
- Temperature levels

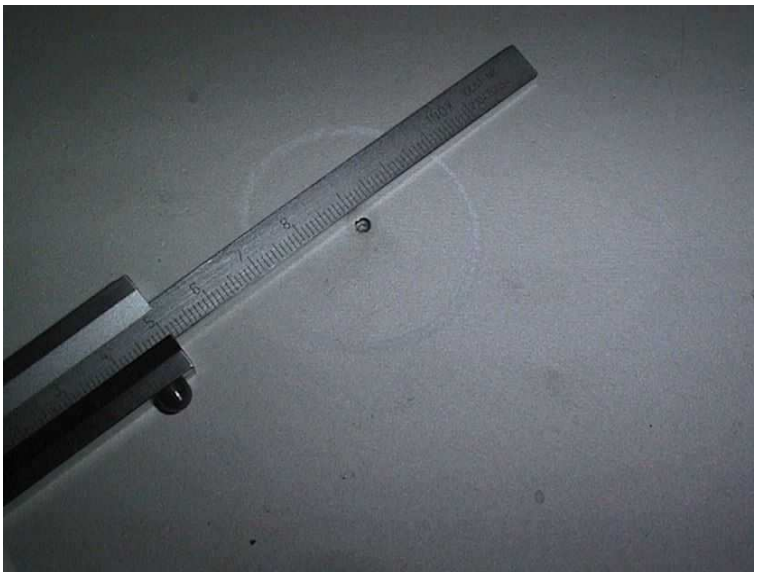
Pitting corrosion initially involves a perforation of the passive layer. Then it is possible to identify decomposition of the pure metal surface coming into contact with the product, resulting in a nucleus of pitting corrosion.

This nucleus can then spontaneously (i.e., unforeseeably) lead to pitting. Initially with the further decomposition of the metal a cavity forms, in which an electrolyte collection and further concentration of chloride ions then result in an accelerated corrosion process.

The pitting corrosion is apparent initially often in the form of needle-like cavities, which subsequently enlarge. The metal surface next to the blemish exercises the cathode function and thus remains completely undamaged.

Very often cavern-like corrosion nuclei can then be found which with their form prevent a rinsing out of the electrolytes.
On the bottom of the corrosion pits salt deposits form, preventing a repassivation of the metal surface even when the corrosion element disintegrates (e.g., when the tank dries). When the tank surface is moistened again (also with condensed humidity under some circumstances), corrosion recurs after the salt film has dissolved.

In conclusion, it is obvious that it is essential to treat pitting corrosion that is identified in the tank. Sharp-edged pits and cavern-like pitting have to be removed mechanically. Then after pickling and passivating the surface will be fully restored for further use.

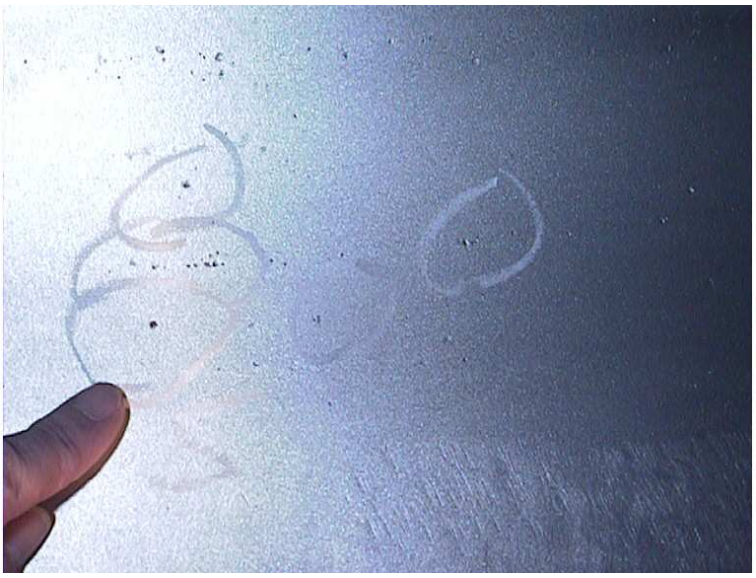


Ill. 19
Pitting corrosion in wall

Cleaning level: 3.6.x.x

Ill. 20
Pitting corrosion in wall

Cleaning level: 3.6.x.x



Ill. 21
Pitting corrosion in wall

Cleaning level: 3.6.x.x

With relevant documentation on the treatment of the corrosive damage, the tank can then be assessed again e.g. with cleaning level 3.2.1.1.

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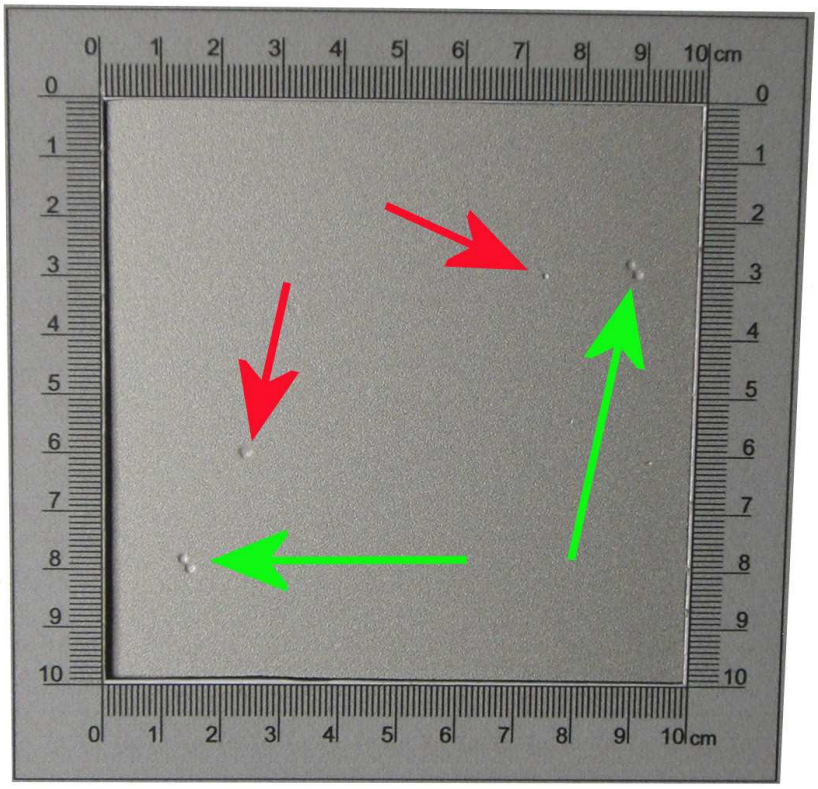
Comment (rolling flaws)

Rolling flaws can be easily mistaken for trough-shaped shaped corrosion on stainless steel. It is frequently possible to avoid this error by carefully checking the entire section, as rolling flaws usually recur within a section.



Ill. 22
Rolling flaws

The red arrows show pitting corrosion, the green arrows (in this case very close to one another) rolling flaw errors. The recurring cavities with an identical form are often located over a metre apart.

Rolling flaws do not have an effect on the degree of purity of a tank.

Photo credits

Ill. 1	UIP
Ill. 2	Jungenthal-Waggon GmbH
Ill. 3	Jungenthal-Waggon GmbH
Ill. 4	Jungenthal-Waggon GmbH
Ill. 5	Jungenthal-Waggon GmbH
Ill. 6	Jungenthal-Waggon GmbH
Ill. 7	Jungenthal-Waggon GmbH
Ill. 8	Jungenthal-Waggon GmbH
Ill. 9	Jungenthal-Waggon GmbH
Ill. 10	Jungenthal-Waggon GmbH
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Ill. 13	Jungenthal-Waggon GmbH
Ill. 14	Jungenthal-Waggon GmbH
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Ill. 21	GATX Rail Germany GmbH
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