INTERNATIONAL UNION
OF WAGON KEEPERS

Guide
to the Cleaning Level Key

Edition 02 – ENGLISH

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Version information

This guide was initially published in August 2009.

The following elements were revised in the second edition from March 2023:

- Use of simple and clear language to ensure better understanding and to aid translation into additional languages
- Removal of content that goes beyond determining the cleaning level (e.g. chemistry / oxidation process)
- Creation of a glossary, which defines terms that relate to the cleaning level

Contents

Foreword

When using the cleaning level key, the judgement and experiences may lead to evaluate the same tank interior differently from another user.

The UIP Guide to the Cleaning Level Key makes no claims to completeness. It is intended as a generally applicable representation of the market and does not therefore take special technical methods into consideration.

The guide is intended to help ensure that evaluations of the tank interior are consistent.

UIP accepts no responsibility or liability for damages resulting from the use of the key or this guide, except in cases attributable to intent or gross negligence.

Use of this guide does not relieve anyone of responsibility for their own actions. Generally applicable and legally mandated regulations concerning work safety must be complied with (e.g. VPI-EMG module 11).

Introduction

This cleaning level key is designed to help users make consistent evaluations of tank interiors as well as all tank car equipment, which is used in the transportation of liquids and liquified gases and which come into contact with the product. It provides a basis for describing the cleanliness of a tank. Details such as information on pores, deposits or discoloration must also be provided. Additional information may also be required, such as a detailed report or comprehensive photographic documentation.

Structure of the cleaning level key

The cleaning level key consists of five numbers:

1st number Material
2nd number Tank surface
3rd number Product residue
4th number Atmosphere (air or nitrogen)
5th number Not yet in use

1st number material	2nd number description of surface									3rd number characterisation of product residue	4th number atmosphere	5th number (not yet in use)
1 - steel (unalloyed)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**0** - no residue, no odour, dry **1** - no residue, slight odour, dry **2** - no residue, product-related odour, dry **3** - firm deposits, product dust **4** - tank walls slightly oily, greasy, no deposits **5** - tank walls slightly oily, greasy, deposits **6** - empty, no visible residue, vapour phase **7** - up to 2‰ residue **8** - residue over 2‰ **9** - special specifications	**1** - air **2** - nitrogen **3** - other specifications	
	clean, no rust	clean, rust film	initial rust and loose rust (powder)	powdered rust and slight discoloration	powdered and compacted rust, strong discoloration	layered rust, rust pitting	loose rust flakes		special specifications			
2 - CrNi - steel **3** - CrNiMo - steel **8** - aluminium	metallic clean	metallic clean, slight discoloration	dull metal, product-related discoloration	roughness due to corrosion	roughness due to corrosion with discoloration	localised corrosion			special specifications			
4 - soft or hard natural rubber lining or lining of comparable polymer quality **5** - enamel lining **6** - lead lining **7** - coatings	clean, surface intact	surface intact	surface not intact, blisters, detaching, corrosion under lining						special specifications			

Figure 1: Cleaning level key (version from: 1/2/2023)

General information

- The 1st number of the cleaning level refers to the material on the part of the tank surface that comes into contact with the product. This also includes linings or coatings. Equipment made of other materials is not relevant when determining the 1st number.
- The tank material is indicated on the tank plate.
- The determination of a cleaning level is not a safety evaluation. It does not provide information about the minimum wall thickness or make a weld seam assessment, for example.
- Information concerning the tank atmosphere does not relieve the user from following work safety requirements, such as taking measurements of the atmosphere before entering the tank.
- The condition of equipment such as valves, distributor pipes, standpipes, etc. must be taken into account when determining the cleaning level.
- When determining the second number of the cleaning level, grinding marks on the tank surface are only relevant if an inappropriate grinding tool was used – in particular, if a ferrite grinding tool was used on a stainless steel tank, which later lead to corrosion.
- Cleaning level determinations should generally be made by experts at cleaning facilities or repair workshops. They are only valid **for the point of time at which the determination was made.**
- A cleaning level determination is no substitute for a cleaning certificate or a tank entry permit!

Corrosion in an unalloyed steel tank

Practically every tank made of unalloyed steel shows the consequences of corrosion over time. For example, the “rust bloom” mentioned in cleaning level 1.2.x.x is caused by oxidation of the steel. This rust bloom does not cause any more damage to the products carried in steel tank cars than do the “initial rust and loose rust” of cleaning level 1.3.x.x or the “compacted rust” of 1.5.x.x.

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

Local signs of corrosion that are not limited to the surface but extend deep into the walls are more problematic for the use of the tanks. Minimum wall thicknesses may not be met and leaks could occur in some circumstances.

Whether the extent of the flaw is critical or only minor and due to a visual effect is explained below with the aid of photographs.

Note: The figures below depict surface structures without taking the required minimum wall thickness into consideration.

Initial rust also includes minor cavities / erosion or rust grit.

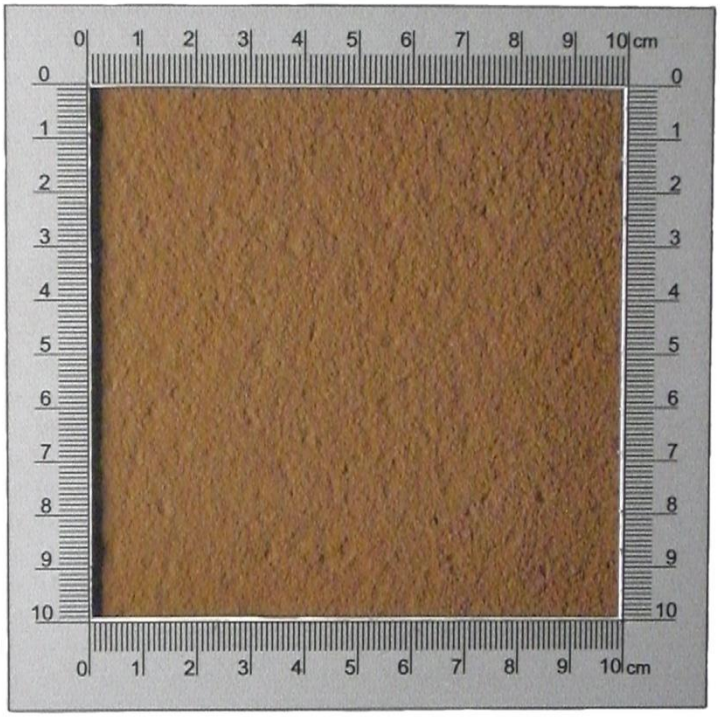

Figure 2:
Cleaning level 1.3.x.x

Extensive corrosion, unproblematic wear on the tank surface

Figure 3:
Cleaning level 1.3.x.x

Rust grit

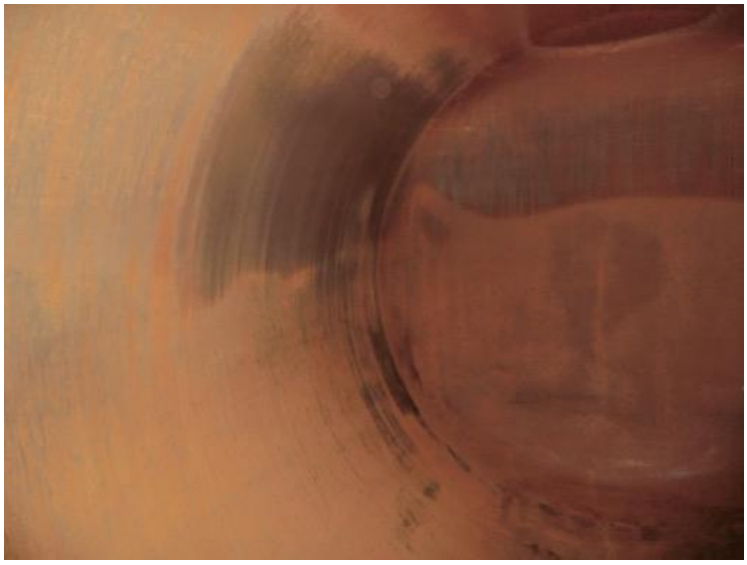

Figure 4:

Cleaning level 1.4.x.x

Powdered rust and slight discoloration

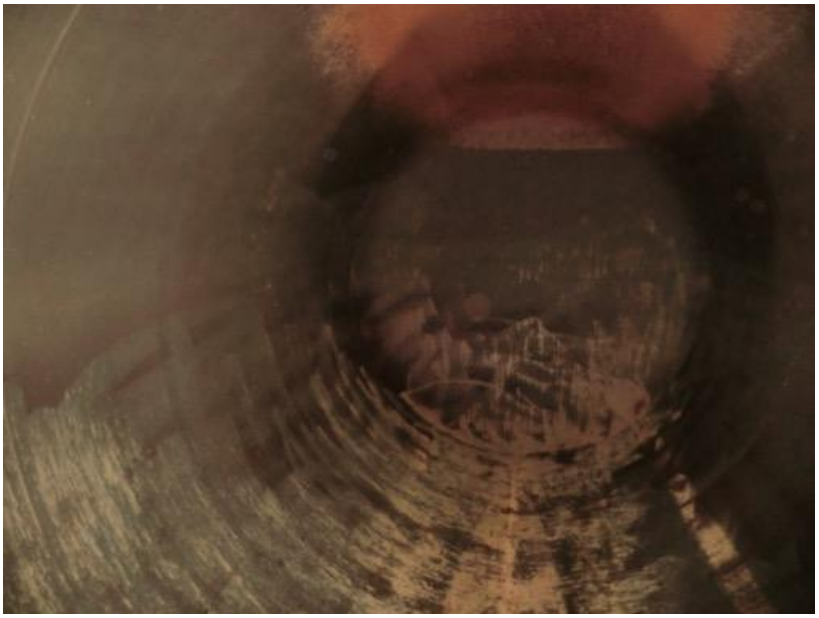

Figure 5:

Cleaning level 1.5.x.x

Pronounced, possibly black discoloration

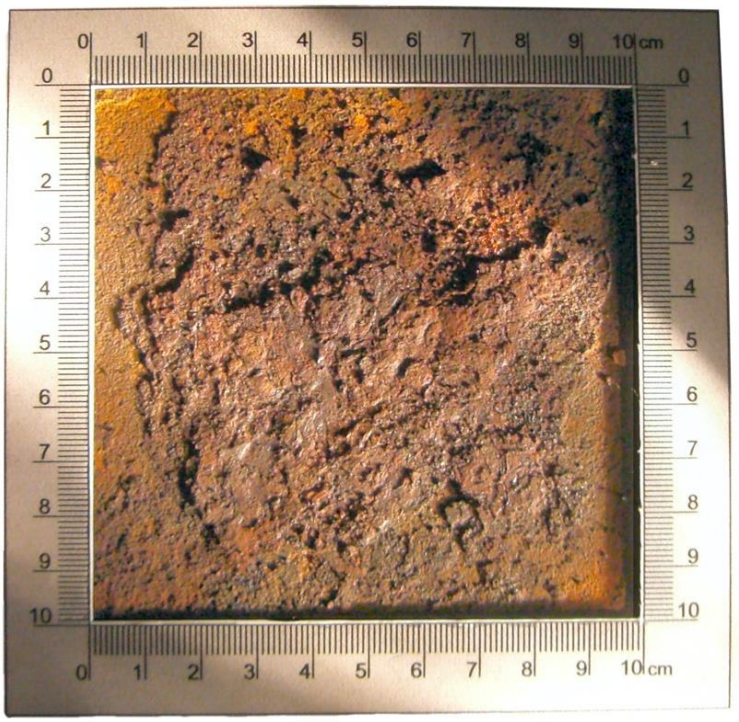

Figure 6:

Cleaning level 1.5.x.x

Compacted rust on the bottom of the tank

If no other limitations exist, the tank can be restored to cleaning level 1.3.x.x by removing the compacted rust.

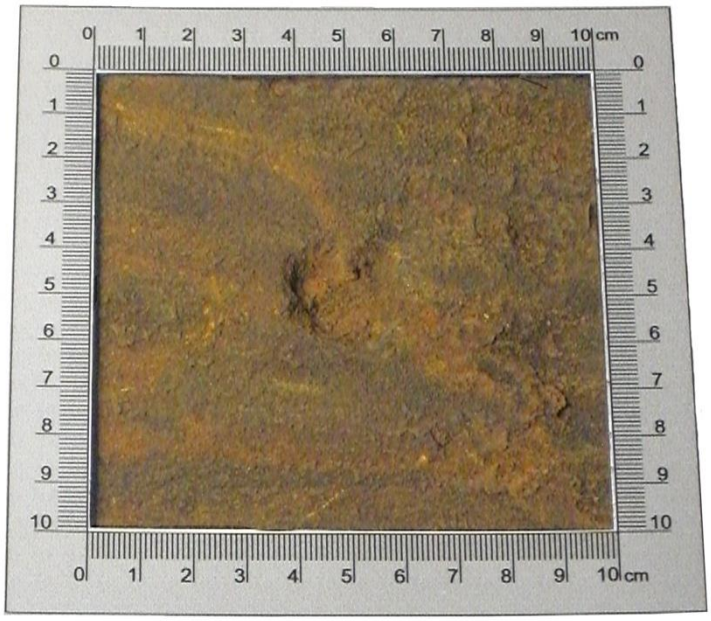

Figure 7:

Cleaning level 1.6.x.x

Significant pitting, several millimetres to centimetres in diameter and several millimetres deep

Depending on what the wagon is used for, action may be required; determination of wall thickness and possible rehabilitation of the tank

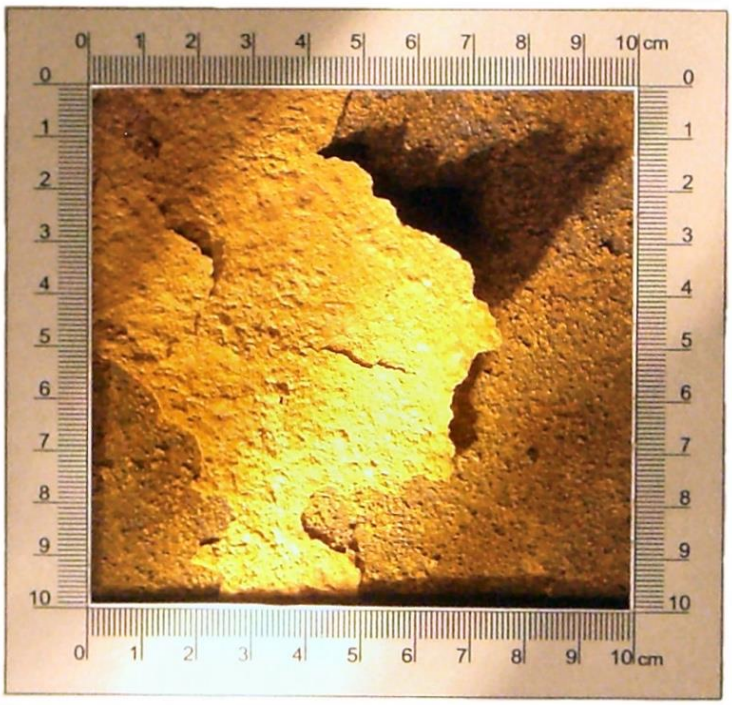

Figure 8:

Cleaning level 1.6.x.x

Rust flakes – separating from the surface

If no other limitations exist or subsequently arise, the tank can be restored to cleaning level 1.3.x.x by removing the rust flakes.

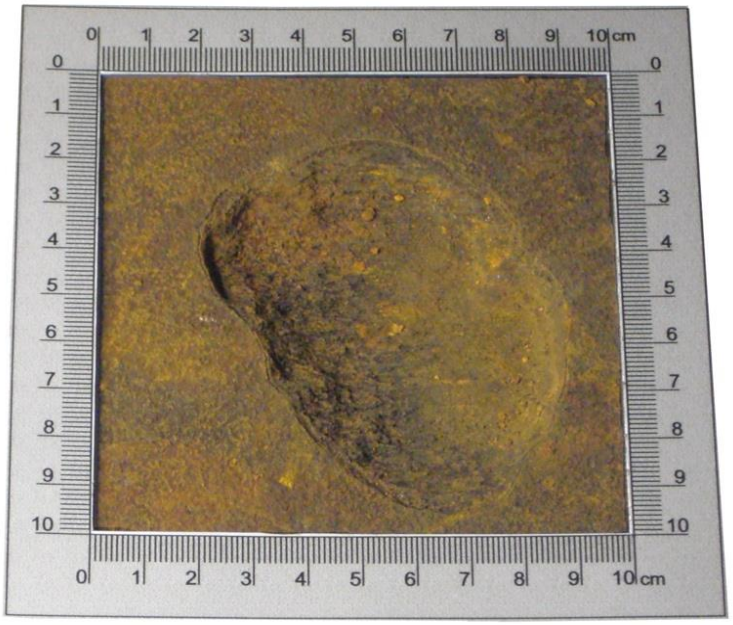

Figure 9:

Cleaning level 1.9.x.x

Extreme damage due to corrosion. Wall nearly broken through, already beyond pitting.

Discoloration / Shading

As a result of temperatures (e.g. during welding) and the product carried in the tank, the surface of stainless steel can often take on a brownish or blueish discoloration.

To remove this discoloration and restore a passive layer, it is generally necessary to remove material from the tank surface in the micrometre range by pickling or glass-bead blasting followed by passivation.

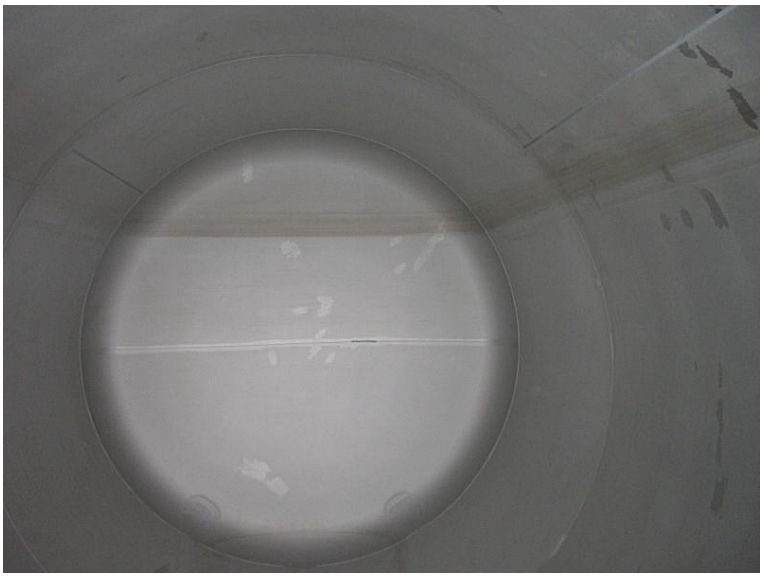

Figure 10:

Cleaning level 3.3.x.x

Continuous “product line” discolouration on a CrNiMo steel wagon

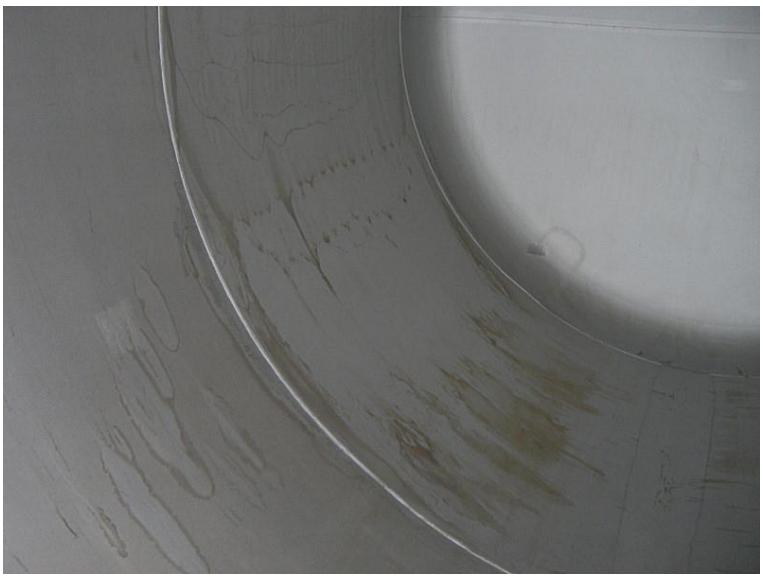

Figure 11:

Cleaning level 2.3.x.x

Streak-like or patchy discoloration on a CrNi steel wagon

Figure 12:

Cleaning level 2.3.x.x

CrNi stainless steel tank completely discoloured by product (sodium hydroxide solution)

Figure 13:

Cleaning level 3.2.x.x

CrNiMo steel tank without discoloration

In addition to discoloration, there is another superficial flaw that is purely visual in nature and does not have any impact on the product or the corrosion resistance of the metal surface, namely a light “shading” on the metal surface or the passive layer. Such shading is not caused by coloured particles but by physical effects.

In contrast to discoloration, shading depends on the angle of the light shining on the metal or the angle from which the metal is seen. From one side, a dark or grey spot can be seen, and from the other, either nothing or only a white spot.

The following figures show the same wall section from two different angles. On the right, one sees darkish spots, while on the left, these same areas are lighter than the surrounding metal.

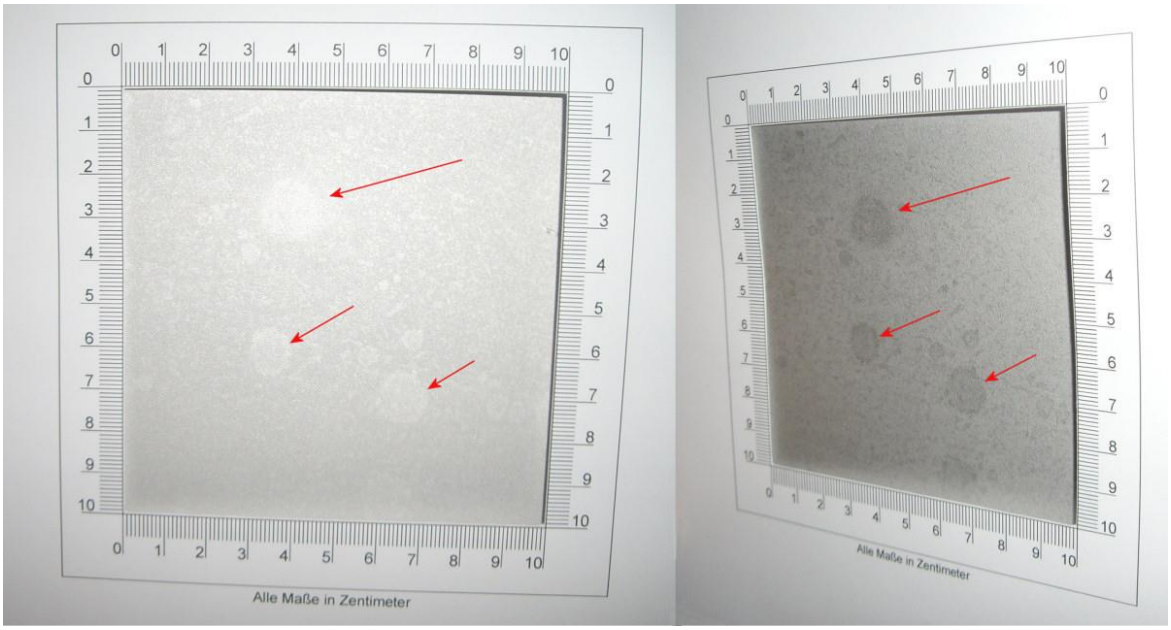

Figure 14: Cleaning level 3.2.x.x, shading

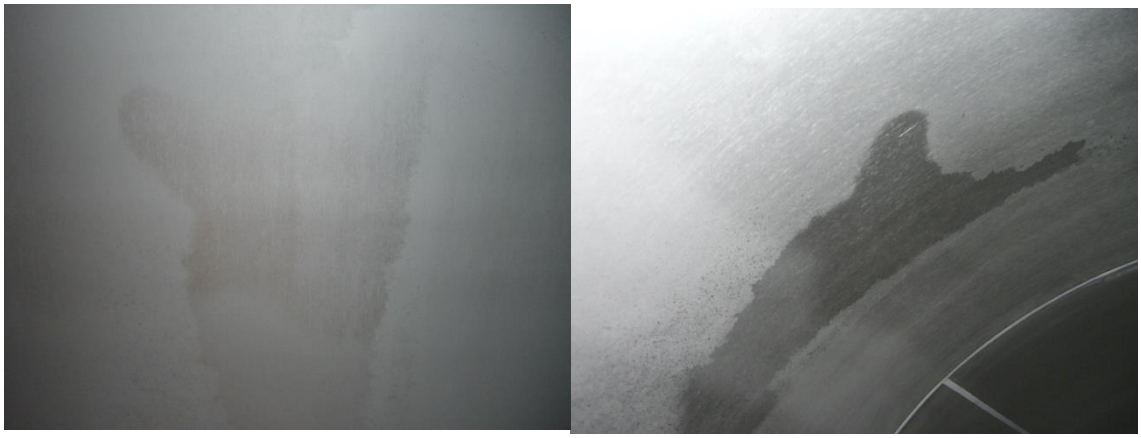

Figure 15: Cleaning level 3.2.x.x, shading

Shading can also result from shot blasting.

Grinding marks

Grinding marks have no impact on the cleaning level. Even tanks that have extensive grinding marks can be assigned a cleaning level of 3.2.1.1, for example.

Figure 16:
Cleaning level 3.2.x.x
Grinding marks

If grinding is done as inexpertly as in Figure 16 and also with an inappropriate / dirty abrasive material, inclusion of ferrous particles may occur. This initially leads to a brownish discoloration of the grinding marks and may later cause significant corrosion on the stainless steel surface.

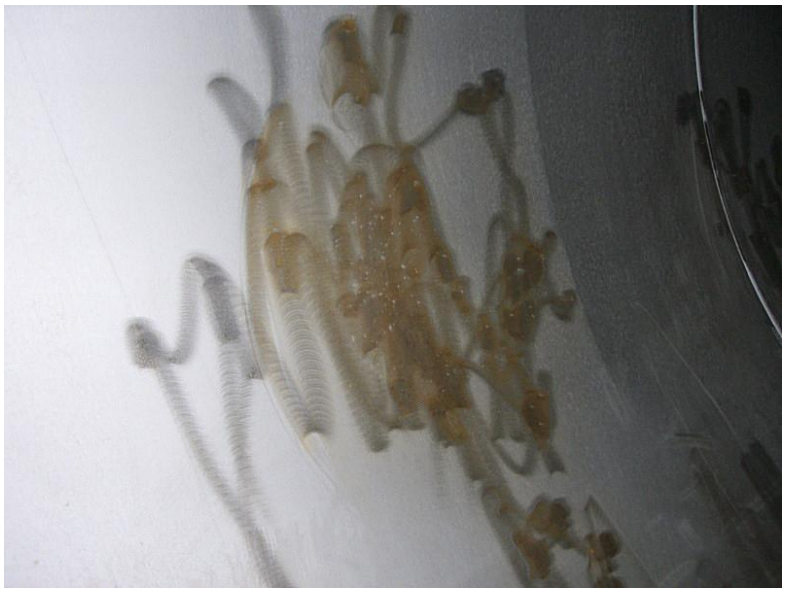

Figure 17:
Cleaning level 3.5.x.x
Grinding marks with ferrous inclusions

Corrosion in a stainless steel or aluminium tank

The cleaning level key lists two types of corrosion on stainless steel or aluminium tanks: Both 3.4.x.x and 3.5.x.x mention “roughness due to corrosion” and 3.6.x.x mentions “localised corrosion”.

Note: The explanations below refer to stainless steel tanks, and many aspects also apply to aluminium tanks.

Roughness due to corrosion

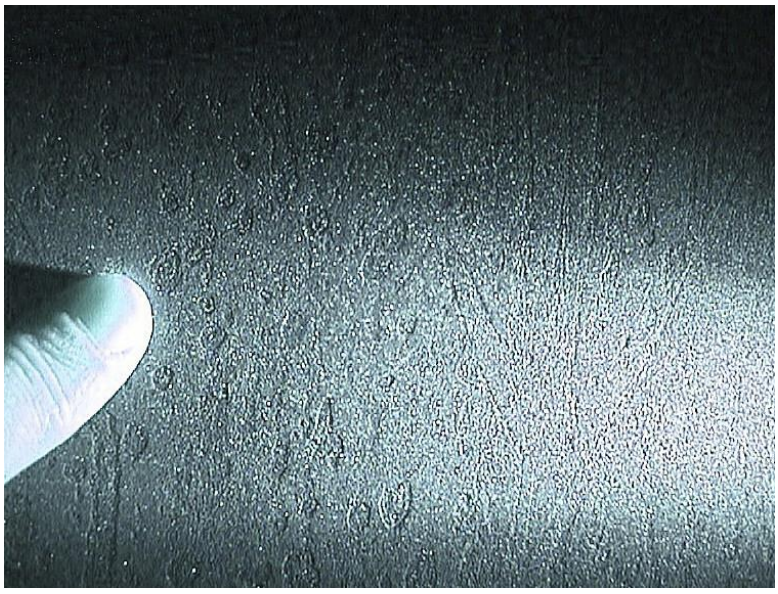

Figure 18:

Cleaning level 3.4.x.x

Roughness due to corrosion, no discoloration

Roughness due to corrosion, with discoloration

Figure 19:

Cleaning level 3.5.x.x

Extensive roughness with a highly discoloured surface

Local corrosion

Pitting is a form of local corrosion. Initially, pitting often appears as tiny depressions, similar to needle pricks, which then subsequently expand in size. One very often finds “cavern-like” corrosion, which, due to its shape, makes rinsing out the product residue difficult or impossible. This product residue is generally the cause of the corrosion.

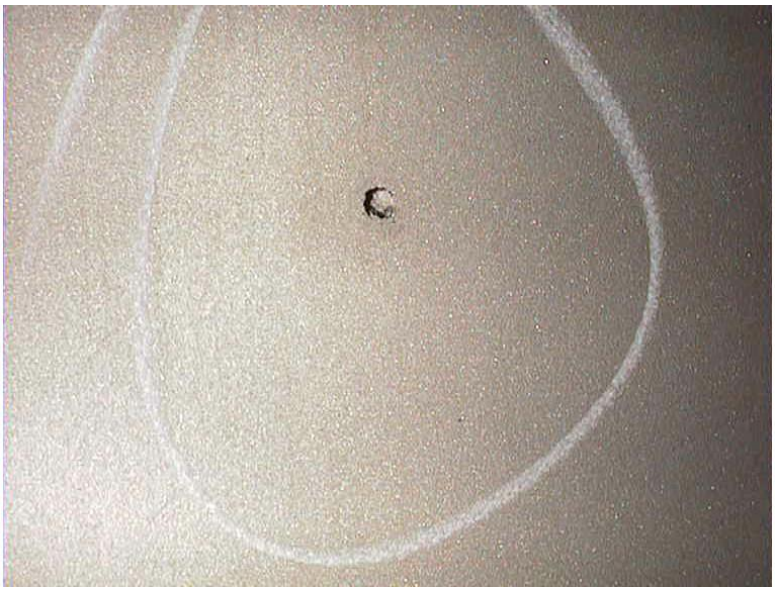

Figure 20:
Cleaning level 3.6.x.x
Pitting in the wall

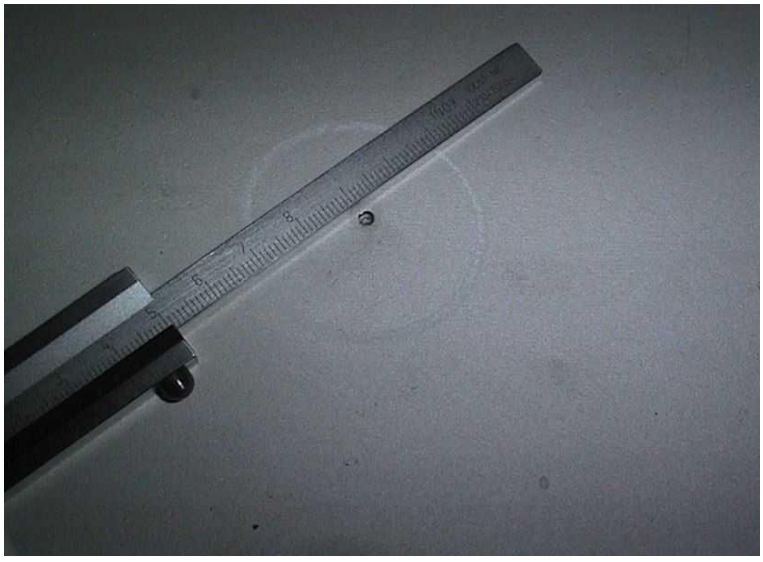

Figure 21:
Cleaning level 3.6.x.x
Pitting in the wall

Figure 22:
Cleaning level 3.6.x.x
Pitting in the wall

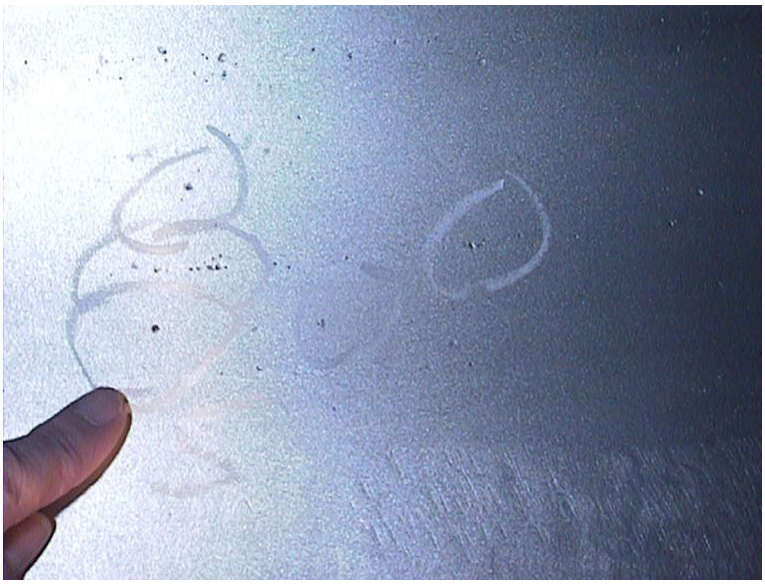

Figure 23:
Cleaning level 3.6.x.x
Pitting in the wall

If the local corrosion is treated appropriately, the tank can be assigned cleaning level 3.2.1.1. Such treatment must be documented.

Rolling defects

Rolling defects have no impact on the cleaning level. Rolling defects on stainless steel or aluminium tanks may be mistakenly identified as cavity-shaped corrosion. It is often possible to distinguish between rolling defects and corrosion by carefully examining the entire tank section since rolling defects may repeat within a section.

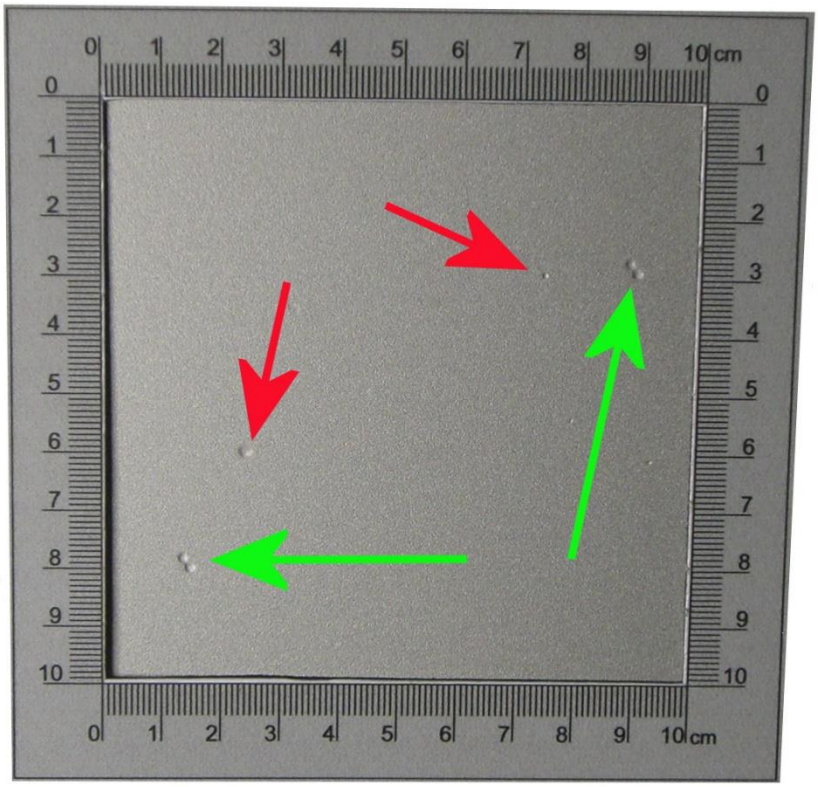

Figure 24:

Rolling defects

The red arrows point to pitting, while the green arrows point to rolling defects. These defects – repeated depressions, identical in form – often lie over a metre apart.

Lined tanks

The evaluation underlying the classification of a tank's cleaning level is purely visual. With lined surfaces, only damage such as dents, blisters and the like must be taken into account. No further measures must be taken.

Figure 25:

Cleaning level 4.3.x.x

Blisters in the rubber lining

Figure 26:

Cleaning level 4.3.x.x

Blisters in the rubber lining

Glossary

Terms	Definition
Tank entry permit	Permission to enter a tank, which is only granted according to previously established processes and criteria.
Pickling	Removal of surface material to a depth of a few micrometres through the use of hydrofluoric acid.
Flaking	A type of corrosion in steel tanks in which the topmost layer of rust separates from the surface in a leaf-like fashion.
Stainless steel	Steel alloyed with chromium and nickel, often also with molybdenum, to make it more resistant to corrosion.
Ferrous	Containing iron
Rust bloom	Start of rust formation on a steel surface. Very fine, does not wash off.
Cavern-like corrosion	Refers to an invisible, spheroidal cavity within the tank wall
Product line	Discoloration or film which runs continuously around the inside of the tank at the boundary line between the product and the tank atmosphere.
Powdered rust	Rust particles on a steel surface – can be wiped off.
Passivation	Step following treatment of a surface by pickling or blasting.
Passive layer	Thin protective layer on a stainless steel surface
Rust grit	Gritty rust, which firmly adheres to the steel surface
Pitting	Clearly identifiable corrosion in steel tanks, the depth and diameter of which can measure several millimetres.
Rust flakes	Layers of rust that have completely separated from the surface in flakes
Shading	A difference in colour in the passive layer, which can be clearly distinguished from its surroundings.
Tank section	A tank consists of multiple sheets (tank sections), which are rolled into a ring shape and then welded together.
Black discoloration	Describes the presence of black iron oxide beneath a layer of brown iron oxide on a steel tank. Because of the way it forms, the black oxide is very fine and can contaminate the product.
Unalloyed steel	Also called “steel” or “structural steel”. In contrast to “stainless steel”, it is not alloyed with other metals.
Shot blasting	Treatment of a tank surface by using compressed air to propel an abrasive blasting material, such as steel shot, slag or glass beads. Removes product film, corrosion and discoloration. Shot blasting with dry ice can remove film and rust but will not remove discoloration on stainless steel surfaces.
Subsurface rust	Corrosion that forms beneath coatings / linings.
Rolling defects	If rollers with damaged or impure surfaces are used in production, depressions in the sheet metal may result.