# Specifications

## For Obtaining the Quality Label for Industrial Coating

## by Cathodic Dip Coating, Chemically Depositing Dip Coating with Powder Coating

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# Foreword

The QIB quality specifications apply to industrial coating by cathodic dip coating and/or powder coating and liquid coating. To simplify the readability of the quality regulations, the QIB has decided to divide the quality regulations into three areas. So now the parts

- Powder coating
- Cathodic Dip Coating and powder coating, Chemically Depositing Dip Coating and powder coating
- Liquid Coating and Liquid Coating in the Rail Vehicle Industry

were created. Each of these special quality specifications contains only the technical requirements for the respective coating process.

However, to ensure comparability with the document as a whole, the numbering has been retained. The paragraphs and chapters dealing with the other coating technologies have only been "hidden".

**This part of the quality regulations deals exclusively with Cathodic Dip Coating and Chemically Depositing Dip Coating (with Powder Coating).**

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# A General Quality Specifications for Obtaining the Quality Label for Industrial Coating by Cathodic Dip Coating, Chemically Depositing Dip Coating, Powder Coating and Liquid Coating

## A.1 General Information

### A.1.1 Scope

These quality specifications shall apply to industrial coating on metal by cathodic dip coating, chemically depositing dip coating, powder coating and liquid coating. In particular, a quality mark for liquid coating for the rail vehicle industry has been created. It shall be possible to obtain the corresponding quality label individually or in combination with others.

The following specifications shall describe the minimum requirements for member companies (coaters) as well as their organically coated end products.

They shall serve as basis for granting the quality label. All requirements shall be fulfilled. The specifications mentioned shall only apply to batch coating and not to coil coating.

### A.1.2 Further applicable specifications and standards

These General and Special Quality Specifications shall apply in connection with the corresponding laws, regulations, and standards.

### A.1.3 Terms and definitions

**Base material:** Base materials are steel, continuously hot-dipped steel (strip galvanizing), discontinuously galvanized steel (batch galvanizing) and aluminum.

**Coating material:** Organic coating materials which are applied by cathodic dip coating, chemically depositing dip coating, powder coating or liquid coating.

**Coating system:** The complete layer structure of organic layers on the base material including the mechanical and/or chemical pre-treatment is defined as coating system.

**Corrosivity category:** Classification of the principal environments to which steel constructions are exposed as described in detail in DIN ISO 12944-2, DIN 55633-1 and DIN 55634-1. Those environments are classified from C1 (very low corrosivity) to CX (extreme corrosivity). For more information, please refer to chapter A.1.4 of these specifications.

**Expected lifetime (term of protection):** The period specified in ISO 12944 part 1 until the first maintenance by re-applicating the coating. The term of protection “high” (15 years up to 25 years) is generally taken as basis when defining QIB stress groups.

**QIB stress groups:** QIB stress groups I – V apply to all base materials. They are determined for the base materials steel and galvanized steel by means of laboratory tests for the corresponding corrosivity categories and term of protection according to DIN 55634-1:2017, and analogous to DIN ISO 12944-6 while the test requirements of QIB are partially stricter. Therefore, the corrosivity categories (C1 - C5) are defined in connection with the expected lifetime high (H) for stress groups I - V.
Stress group VI is an exception defining the term of protection very high (VH) of corrosivity category C5 according to DIN EN ISO 12944-6.

The base materials aluminum and stainless steel is another exception: for this material separate requirements have been defined for stress groups I - VI. For more information, please refer to chapter A.1.4.

**Hot-dip galvanized steel:** The requirements specified in ISO 1461 as well as further regulatory requirements, if applicable, e.g. DAST guideline 022 must be observed.

**Licensee:** A coater who is authorized to use the QIB quality label based on this quality standard.

**License:** The QIB quality label or labels granted to a coater fulfilling the requirements of the present specifications.

**Surface preparation:** Surface preparation is the pre-treatment of the substrate prior to the application of coating materials, e.g. removing rust and deficiencies at welding seams, edges, and other areas of the substrates prior to coating.

**Pre-treatment process**: The pre-treatment process is the preparation of the base material prior to the coating, either with a chemical or a mechanical process or with a combination of both.

**Testing body and laboratory:** An independent testing body and laboratory approved by QIB carrying out all necessary testing for the coater. The laboratory must be accredited according to DIN EN ISO/IEC 17025 “General requirements for the competence of testing and calibration laboratories”, and the inspection body must be accredited in accordance with DIN EN ISO/IEC 17065 “Conformity assessment — Requirements for bodies certifying products, processes and services” and acknowledged by QIB.

### A.1.4 QIB stress groups

In contrast to other quality labels it is possible to agree on different minimum requirements on the pre-treatment of the coated parts. For this reason, the six following stress groups have been defined:

Stress group I: The parts are only used indoors without humid or corrosive stress, e. g. heated buildings.

Stress group II: The parts are occasionally resp. for a short term exposed to temperature or humidity stress. However, parts which have been pre-treated in such a way are mostly used indoors.

Stress group III: The parts have a conversion layer allowing to expose them to slightly corrosive and humid stress for longer time.

Stress group IV: Due to the high requirements on the applied conversion layers it is possible to expose these parts to usual corrosion as well as to humidity all over their service life. Special corrosion stress such as filiform corrosion resistance and the like is the only exception. This requires additional pre-treatment and protection measures for steel as well as for aluminum.

Stress group V: Steel and aluminum parts are treated with mostly multi-layered coating systems due to the very high requirements for industrial, coastal, and offshore regions with a term of protection of more than 15 years. In the case of aluminum this is only possible by pre-anodizing or 2-layer structure.

Stress group VI: Steel and aluminum parts are treated with mostly multi-layered coating systems due to the very high requirements for industrial, coastal, and offshore regions with a term of protection of more than 25 years. In the case of aluminum this is only possible by pre-anodizing.

A comparison of QIB stress groups with the corrosivity categories of DIN 55633-1 “Paints and varnishes - Corrosion protection of steel structures by powder coating systems - Part 1: Assessment of powder coating systems and execution of coating” and DIN EN ISO 12944-6

“Corrosion protection of steel structures by protective coating systems” and the test periods of the neutral salt spray test required herein are shown in the following table:

| Stress group according to QIB | Test period acc. to QIB stress group (h) | Test period acc. to DIN 55633-1; analogous DIN EN ISO 12944-6 (h) | Short term corrosivity category and term of protection acc. to DIN 55633-1; analogous DIN EN ISO 12944-6 |
|---|---|---|---|
| I | - | - | C2 (high) |
| II | 264 | 240 | C3 (medium)<br>C4 (low) |
| III | 504 | 480 | C2 (very high)<br>C3 (high)<br>C4 (medium)<br>C5 (low) |
| IV | 1.008 | 720 | C3 (very high)<br>C4 (high)<br>C5 (medium) |
| V | 1.512 | 1.440 | C4 (very high)<br>C5 (high) |
| VI * | 2.208 | - | C5 (very high) |
| * only for coatings on galvanized base material with a cathodic dip coating primer or in the case of aluminum with pre-anodization | | | |

These quality specifications are used to define a process-reliable and consistently high coating quality which is specified for the application. Deviations from the specifications may affect the result of the coating quality and are not subject to the requirements mentioned herein. Changes in the specifications are carried out according to the articles of association.

The metals intended for coating as well as their alloys must be appropriate for the coating processes mentioned in these specifications. Neither signs of corrosion nor other coverings or coatings which might affect the coating must be visible. This includes lubricants containing silicone, such as bearing protection oils or applied chemical conversion layers (e. g. chromate, zinc phosphate or no-rinse products) which are used for storage. Please refer to Annex L.1 for further information on quality and properties of the base material.

Application-specific tests, such as resistance against acids, bases, oils, solving agents, benzine etc. require additional agreement between member company and ordering party.

Depending on the defined minimum requirements the member company is bound to operate a process-reliable production and use only processes and coating materials which have been approved by the Quality Association Industrial Coating according to chapter J. Other processes or products may only be used if the customer specifies them expressly in his/her order.

However, for products treated with these processes or products the quality label cannot be granted.

### A.1.5 QIB CDC-, chemically depositing dip coating and powder coating systems

The specifications and recommendations provided by DIN EN ISO 12944-5 do not apply to CDC, chemically depositing dip coating or powder coating systems, but only for air-drying liquid coating systems. Regulations for CDC and powder coating systems can be found in DIN 55633 and DIN 55634. In order to bring these regulations together, the QIB has developed the following table as basis for licensing the coating companies with CDC, chemically depositing dip coating and/or powder coating processes. This table contains information on the possibly achievable stress group (also depending on the corresponding pre-treatment used) by the licensee for which the system can be approved. The coaters can also be approved for lower QIB stress groups, but not for higher ones than those listed in the table – even if this would be theoretically possible according to the results of the laboratory tests.

The following table provides an overview about the achievable stress groups on the corresponding base material by the coater.

| Base material | Layer structure powder coating | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|---|
| Aluminum | 1 | | | | | | |
| | 2 | | | | | | |
| Aluminum with pre-anodizing | 1 | | | | | | |
| Steel | 1 | | | | | | |
| | 2 | | | | | | |
| Stainless steel | 1 | | | | | | |
| | 2 | | | | | | |
| Continuously hot dipped steel (strip galvanized) | 1 | | | | | | |
| | 2 | | | | | | |
| Hot-dip galvanized steel (batch galvanized) | 1 | | | | | | |
| | 2 | | | | | | |
| Steel coated by thermal spraying | 1 | | | | | | |
| | 2 | | | | | | |
| Aluminum, steel and hot-dip galvanized steel with CDC coating | 0 | | | | | | |
| Steel with chemically depositing dip coating | 0 | | | | | | |
| Aluminum with CDC coating | 1 | | | | | | |
| | 2 | | | | | | |
| Steel with CDC coating or chemically deposition dip coating | 1 | | | | | | |
| | 2 | | | | | | |
| Galvanized steel (batch or strip galvanized) with CDC coating | 1 | | | | | | |
| | 2 | | | | | | |

### A.1.6 QIB liquid coating systems (hidden)

### A.1.7 Pre-treatment

The coater either has a mechanical pre-treatment (e.g. blast cabinet) or uses a chemical pre-treatment process. A combination of both is possible.

Detailed information on surface types and the mechanical surface pre-treatment can be found in DIN EN ISO 12944-4. However, some substrates require additional treatment.

The base material can be contaminated by oil and grease, chalk markings or paint, stickers or other, such as dirt, oxidation, or salts on the surface. These contaminations must be removed with appropriate agents prior to the pre-treatment process or application of a coating system.

The pre-treatment process is used to prepare the substrate for the application of a coating system. Every surface treatment must be carried out in the plant itself. Pre-anodizing is admissible for aluminum. External pre-anodizing is admissible, if subsequent coating of the parts within 72 hours after pre-anodizing can be guaranteed.

If steel is cut by laser, the cutting edge will oxidize unless nitrogen gas or similar is used during cutting. This oxide must then be removed either mechanically by brushing, blasting or another appropriate method, or by etching with an acid. In case of metal combinations, tests must be carried out prior to the treatment.

### A.1.7.1 Achievable stress groups by chemical pre-treatment

The stress groups which can be maximally achieved by chemical pre-treatment are as follows:

- Pre-treatment by degreasing or equivalent processes: Stress group I
- Pre-treatment by pickling degreasing: stress group III - for steel, with subsequent chemically depositing dip coating
- Pre-treatment by iron phosphating or equivalent processes: Stress group II
- Pre-treatment by film-forming or equivalent processes: Stress group III - V
  - Zinc phosphating
  - Equivalent chromate-free pre-treatment process
- Pre-treatment by pre-anodizing: Stress group V and VI, for aluminum:
  - Pre-anodizing
- Pre-treatment by film-forming processes: Stress group VI in case of galvanized base material with subsequent CDC coating:
  - Zinc phosphating
  - Equivalent chromate-free pre-treatment process

### A.1.7.2 Mechanical pre-treatment for powder coating (hidden)

### A.1.7.3 Mechanical pre-treatment for liquid coating (hidden)

### A.1.7.4 Combined pre-treatment

If the mechanical pre-treatment is followed by chemical pre-treatment, the maximally achievable stress group depends on the mechanical pre-treatment (max. stress group V for powder coating; max. stress group VI for liquid coating).

## A.1.8 QIB test panels (CDC / chemically depositing dip coating / powder coating)

Approved QIB test panels made of the following materials are to be used for the inspection of external quality control (with chemical pre-treatment):

| | | |
|---|---|---|
| Steel DC01 / 1.0330 | Thickness 0.7 – 0.8 mm | (1 hole) |
| Steel DC01 / 1.0330 [1)]<br>hot-dip galvanized acc. to DIN EN ISO 1461 | Thickness 0.7 – 0.8 mm | (5 holes) |
| Aluminum EN AW-5754<br>H 22/32 (AlMg3) | Thickness 0.7 – 0.8 mm | (2 holes) |
| Strip-galvanized steel [2)]<br>DX51D+Z275 U / 1.0226 | Thickness 0.8 – 1.0 mm | (3 holes) |
| Stainless steel WNR 1.4301 | Thickness 0.7 – 1.0 mm | (4 holes) |
| and dimensions | 70 x 140 mm | |
| [1)] Galvanized and stainless-steel test plates are to be supplied by the coating company<br>[2)] strip galvanized oiled | | |

Test panels made of the following materials are to be used (in case of mechanical pre-treatment) for the inspection of external quality control:

| | | |
|---|---|---|
| Steel DC01 / 1.0330 | Thickness 2.0 mm | (1 hole) |
| Steel DC01 / 1.0330<br>hot-dip galvanized acc. to DIN EN ISO 1461 [1)] | Thickness 2.0 mm | (5 holes) |
| Aluminum EN AW-5754<br>H 22/32 (AlMg3) | Thickness 0.7 – 0.8 mm | (2 holes) |
| Strip-galvanized steel [2)]<br>DX51D+Z275 U / 1.0226 | Thick ness 0.8 – 1.0 mm | (3 holes) |
| Stainless steel WNR 1.4301 [1)] | Thickness 2.0 mm | (4 holes) |
| and dimensions | 70 x 140 mm | |
| [1)] Galvanized and stainless-steel test plates are to be supplied by the coating company<br>[2)] strip galvanized oiled | | |

***Notes:***

- To differentiate between material types, the parts must be clearly marked by holes as indicated above in a state as produced.
- The indications are also shown on the certificates.

### A.1.9 QIB test panels (liquid coating) (hidden)

## A.2 General standard operating procedures

The coating company must have an organizational chart showing the responsibilities and authorities. The coating company must implement a quality control system including an in-house inspection plan in compliance with these quality specifications. Production methods as well as the coated products must be monitored and tested. Test instructions must be available for all tests that the coating company must carry out on the basis of its license. These quality specifications include detailed information on parameters resp. properties which must be tested, testing frequency and at which point in the process the tests must be carried out.

The coating company must implement the below standard operating procedures to achieve the license.

### A.2.1 Order verification

The contractor (coating company) must receive coating specifications (e.g. drawings indicating the surfaces to be coated) or order information from the ordering party which define the necessary preparations and coating structure. The coater must check the technical feasibility.

Indications can be:

- Contact-, functional surfaces (bonding, screwing)
- Principal and secondary visual faces
- Optical requirements (shade, gloss and texture/structure)
- Covering measures
- Layer structure (paint system, article number and name)
- Information on the substrate
- Specifications on durability (corrosion protection, UV-resistance, chemical resistance etc.)
- Intended use (ambient conditions, term of protection resp. service life)
- If necessary, project-specific specifications (drawings must be compared with the order text)

### A.2.2 Incoming goods inspection

The coater must carry out the incoming goods inspection of the parts to be coated and of coating materials as following described:

#### A.2.2.1 Components

The details on the delivery bill (article designation, material designation, number of items, quantity) must be checked. If there is a risk of condensation forming on shrink-wrapped or tightly packed materials (falling below the dew point), these must be opened. The parts intended for coating must be visually inspected for coatability (e.g. homogeneity of the base material, edge radius, degree of preparation, contamination, stickers, white rust, passivation on galvanized materials and other corrosion, etc.). The specifications of DIN 55633 and DIN 55634 regarding post-treatment of galvanized materials must be observed. Further explanations can be found in Appendix L.1.

#### A.2.2.2 Coating material

The indications on the delivery note (article designation, number of parts, quantity, colour etc.) and use-by date must be checked. Technical data sheets as well as material safety data sheets must be always available.

### A.2.3 Storage of the parts to be treated

Components delivered to the coater must be stored in a dry area, protected from condensation and other contamination.

### A.2.4 Storage of coating materials and pre-treatment chemicals

Storage of coating materials and pre-treatment chemicals must be carried out according to safety regulations and specifications of the manufacturers.

All coating materials must be stored in a dry room and protected from low or hot conditions (the temperature range can be found in the technical data sheet). In addition, they must be isolated from production facilities and protected against any contamination. Each batch must be marked. Appropriate measures must be taken to avoid mix-up.

### A.2.5 Storage of pre-treated parts

Pre-treated workpieces should be coated immediately after pre-treatment. They must not be stored in dusty or otherwise harmful atmosphere. Storage conditions must not allow for water condensation on the workpieces. All employees coming into contact with the workpieces must wear clean, appropriate gloves to avoid contamination on the surface. In case of steel the degree of surface preparation must be at least Sa 2,5. Aluminium and galvanized steel must have a flat, uniform, clean blasting pattern.

The following table indicates the maximum admissible time between pre-treatment and coating.

| | |
|---|---|
| Stress groups III - VI | ≤ 8 hours<br>(max. 16 hours) |
| Stress groups I - II | ≤ 24 hours |
| Stress groups V-VI (pre-anodizing) | ≤ 72 hours |

If the specified times cannot be kept due to production reasons, an appropriate proof of coatability must be provided (instructions for handling, e.g. visual inspection in accordance with DIN EN ISO 8501, measuring of object humidity and carbon content etc.).

In the case of external pre-anodization, an incoming goods inspection must be carried out using a dye-spot test (see chapter 0)

### A.2.6 Plants, installations, and testing equipment

Maintenance and cleaning plans must be existing. The pre-treatment and coating facilities must be maintained regularly according to the maintenance plan. It must be ensured that no extrinsic contamination, e.g. by silicones or aerosols, is entered into the painting area. The necessary testing instruments for self-monitoring procedures (pre-treatment, self-monitoring, coating process and testing of finished parts) must be available and functional. One a month a functional test of the testing instruments must be carried out and documented. Necessary calibration standards and solutions must be available and functional (date of expiry). The coating plant must have a written calibration process. The implementation of the calibration process must be documented.

### A.2.7 Control of pre-treatment (mechanical and/or chemical)

#### A.2.7.1 Mechanical pre-treatment

The parts are preferably to be pre-treated in-house.

External mechanical pre-treatment is admissible, if

- subsequent coating is carried out within the predefined time period in chapter A.2.5,
- the mechanically pre-treated material is protected against water condensation, humidity, and corrosion during transport,
- the external mechanical pre-treatment has been verified and documented according to the specifications of these quality specifications,
- the coater verifies within the scope of his incoming goods inspection the level of surface preparation, surface roughness and that the goods are free from grease and dust.

The blasting agent used must be appropriate for the process. Only non-ferrous blasting agents (stainless steel) may be used on galvanized materials.

The coater must verify the production methods and products with following methods and at following intervals:

| Required tests | Pressure blasting | | Wheel blasting process | | Stress group |
|---|---|---|---|---|---|
| | metallic abrasive | mineral abrasive | metallic abrasive | mineral abrasive | |
| Salinity of the abrasive | 1 x monthly | not applicable | 1 x weekly | Not applicable | III - VI |
| Grain size of the abrasive | 1 x monthly[3)]<br>½ annually[4)] | not applicable | 1 x weekly[)]<br>½ annually[4] | | III - VI |
| Grease-free of the abrasive | 1 x weekly | not applicable | 1 x daily | | III - VI |
| Grease-free surface[1)] | 1 x per production shift | 1 x per production shift | 1 x per production shift | | III -VI |
| Surface preparation degree | per order / at least once per shift | per order / at least once per shift | per order | | I - VI |
| Dust test[1)] | 1 x weekly | 1 x daily | 1 x weekly | | I - VI |
| Surface roughness | 1 x per production shift | 1 x per production shift | 1 x per production shift | | I - VI |
| Evaluation of zinc layer | each component / hanger | each component / hanger | each component / hanger | | III- VI |
| Dew Point Measurement[1)] | 2 x daily[2)] | 2 x daily[2)] | 2 x daily[2)] | | III - VI |
| Suitability of the abrasive | not applicable | each delivery batch | not applicable | | I - VI |

1) The in-house control measures can be waived if the production process has no influence on the coating quality, e.g. in the case of subsequent chemical pre-treatment.
2) twice a day: in the morning and in the late afternoon; each batch of parts where the temperature is suspected to be too low. The dew point does not need to be measured if the process can be used to rule out the possibility of the temperature falling below this value - process-related acclimatization time
3) by the coating company
4) by the abrasive manufacturer

If blasting is followed by chemical pre-treatment, quality control of the chemical pre-treatment process must be fulfilled as well.

### A.2.7.2 Laboratory and testing equipment for the mechanical pre-treatment process

Coaters must have the following equipment:

- Dew point meter (if required by the used process)
- Dust tape test kit according to DIN EN ISO 8502-3 (if required by the used process)
- Test device for determining that surfaces are free of grease (if required by the used process)
- Roughness meter resp. ISO surface profile comparators according to DIN EN ISO 8503-1.

Coaters of stress group III-V must additionally have the following equipment:

- Conductivity meter (if required by the used process)

### A.2.7.3 Chemical pre-treatment

The parts must internally be treated in a process-reliable way. The existing pre-treatment possibilities serve as a standard. External treatment is excluded. The baths must be carried out within the specifications of the manufacturer. The test methods which are specified of the manufacturer of the conversion coating systems must be used and continuously documented in compliance with the quality specifications. The use of laboratory scales is only stringently required, if it is demanded for characterization by the manufacturer of the conversion coating system.

The subsequent drying must also correspond to the specifications of the manufacturer of the pre-treatment agent.

The coating company must have written instructions from the chemical supplier in which the bath parameters are defined for the specific system. The instructions must also contain the minimum monitoring measures in accordance with these quality regulations.

The coater must inspect the production methods and products **according to the supplier's recommendations**, but at least in accordance with the following test plan:

<table>
<tr><th>Required test</th><th>I - II</th><th>III</th><th>IV-VI</th></tr>
<tr><td>Coatability of the parts</td><td colspan="3">each lot</td></tr>
<tr><td>Bath analysis [2)] of pre-treatment process baths acc. to the supplier's</td><td>once a day specifications</td><td colspan="2">once a day; at least concentration</td></tr>
<tr><td>Assessment of pH[2)] of the baths acc.to the supplier's specifications</td><td colspan="3">once a day</td></tr>
<tr><td>Conductivity of rinsing baths[2)]</td><td colspan="3">once a day</td></tr>
<tr><td>Degreasing effect</td><td colspan="3">once a day</td></tr>
<tr><td>Pickling removal (Aluminium)</td><td></td><td></td><td>once a week</td></tr>
<tr><td>Temperature of pre-treatment process baths</td><td colspan="3">once a day</td></tr>
<tr><td>Drying Temperature</td><td colspan="3">once a day, if the process requires a prescribed drying temperature</td></tr>
<tr><td>Assessment of conversion coating</td><td></td><td colspan="2">Visually, if possible once a day[1)]<br>In case of chromate-free conversion layers, qualitative measurement (spot test) once a week</td></tr>
<tr><td>Weight of the conversion coating</td><td></td><td></td><td>Quantitative measurement acc. to the supplier's specifications</td></tr>
<tr><td colspan="4">1) and in the case of extraordinary bath care measures or new bath<br>2) In the case of automated bath analysis of the pre-treatment baths and documentation of the measured values, a cross-check of the automated bath analysis must be carried out once a week.</td></tr>
</table>

### A.2.7.4 Laboratory and testing equipment for the chemical pre-treatment process

The coater must have the following equipment:

- pH-meter
- Conductivity meter
- Thermometer
- Chemicals for determining the bath analysis
- Temperature test strips for the drying oven

Coaters of the category stress groups III-VI must additionally have the following equipment:

- Test solutions and equipment for testing the chemical conversion coating according to supplier's instructions
- Photometer, if necessary
- Analytical scales, if necessary

### A.2.8 Drying of the pre-treated parts

Forced drying must be carried out. Oxidation processes, such as flash rust on steel parts must be avoided. If necessary, the specifications of the manufacturer of the pre-treatment agents must be followed.

### A.2.9 Curing of the coating systems

The curing conditions must be consistent with the recommended values in the manufacturer`s technical data sheets.

#### A.2.9.1 Thermally cross-linking systems (stoving process)

The coated components must be stoved directly after the coating process in accordance with the manufacturer's instructions of the respective coating material manufacturer. Care must be taken to ensure that the required curing window is observed.

The curing oven must be equipped with a monitoring system that allows the circulating air temperature to be controlled.

An oven temperature measuring device consisting of at least four measuring points (three object temperature sensors and one circulating air sensor) must be used to check the temperature at least once a month.

#### A.2.9.2 Air-drying systems (hidden)

### A.2.10 Storage of coated material

Coated products must be stored and protected in an appropriate area. Parts which have not been accepted by quality control must be clearly marked and stored separately from accepted parts.

### A.2.11 Finished parts and In-house control

Coaters must control and document their production processes and products according to the corresponding special quality specifications for the respective coating process and in compliance with chapters K.4. and K.5.

At the same time the specified in-house controls must be carried out once a week per substrate (aluminum, steel, galvanized steel) on test panels approved by QIB. In case of exclusive chemical pre-treatment, the test panels must not be prepared mechanically (grinding, blasting and so on).

### A.2.12 Test station

The coating company must have a test station which is separated from the production facilities. It must be appropriately equipped (chemicals, instruments) to ensure mechanical pre-treatment, chemical pre-treatment (solutions) as well as testing finished products.

Technical data and manuals of the test equipment as well as their identification numbers must be available. The equipment must be fully functional.

Technical data sheets (TDS) as well as safety data sheets (SDS) of all products must be available together with the valid standards respectively precise standard operating procedures describing the test procedures to the responsible persons.

## A.3 License of the coaters

### A.3.1 Granting the license (quality label)

#### A.3.1.1 Application for a QIB license

Any industrial coater with a process-reliable chemical or mechanical pre-treatment can apply for a QIB license. The application must be sent in written form (application for admission) to Qualitätsgemeinschaft Industriebeschichtung e.V.

A QIB licensee can obtain the quality label for one or more QIB coating systems. It is indicated on his license document for which systems the coater obtained the license and which stress groups can be achieved with these systems.

QIB coating systems are not valid for higher stress groups than those mentioned in the license. But they are valid for lower stress groups covered by the same coating system.

It is possible to inspect several coating lines in a company at the same time. A coating line consists of at least the chemical pre-treatment with retained water dryer and/or mechanical pre-treatment and the application. As defined by QIB a plant is considered as another plant if it can be operated independently from the first one. Therefore, one plant can consist of several pre-treatments and several applications. The coating lines which have been inspected are indicated in the license.

#### A.3.1.2 First inspection

Prior to granting the license, the first inspection must be performed. It is carried out by an independent testing institute based on the present quality specifications and the official QIB inspection report. The inspection comprises the following points:

##### A.3.1.2.1 Order verification

According to chapter A.2.1

##### A.3.1.2.2 Incoming goods inspection

According to chapter A.2.2

##### A.3.1.2.3 Storage of the parts to be treated

Corresponding to chapter A.2.3

##### A.3.1.2.4 Storage of coating materials and pre-treatment chemicals

Corresponding to chapter A.2.4

##### A.3.1.2.5 Storage of pre-treated parts

Corresponding to chapter A.2.5

##### A.3.1.2.6 Control of plants, installations and testing equipment

Corresponding to chapter A.2.6

#### A.3.1.2.7 Control of laboratory equipment

As described in chapter A.2.7.2 to ensure completeness and operational reliability.

#### A.3.1.2.8 Control of pre-treatment (mechanical and/or chemical)

The control of the mechanical and/or chemical pre-treatment must be carried out according to the specifications in chapters A.2.7 by the quality assurance of the coater in the presence of the inspector. Corresponding to the specifications of the manufacturer of the conversion coating system the specified test methods must be used and continuously documented in compliance with the quality specifications.

If the coater uses a QIB coating system which contains a CDC priming, the requirements on the pre-treatment according to chapter B.1.2 must be fulfilled.

#### A.3.1.2.9 Control of finished parts

Certain tests can be carried out on the finished product. However, the complete testing process must be carried out on test panels which have passed the treatment process together with a production lot (see chapters A.2.11 and K.4).

Only finished products which have been accepted by the in-house quality control are tested.

The appearance and coating thickness measurements on the finished product shall be carried out according to the following test plan (DIN EN ISO 2859-1).

| Number of parts per lot [1)] | Number of finished products (random selection) | Number of admissible scrap parts |
|---|---|---|
| 2 - 8 | 2 | 0 |
| 9 - 15 | 3 | 0 |
| 16 - 25 | 5 | 0 |
| 26 - 50 | 8 | 1 |
| 51 - 90 | 13 | 1 |
| 91 - 150 | 20 | 1 |
| 151 - 280 | 32 | 2 |
| 281 - 500 | 50 | 2 |
| 501 - 1200 | 80 | 3 |

[1)] Lot: One lot corresponds to the complete order of a customer or that part of it which is at the coating company.

The quality assurance has to check the appearance of at least 20 finished products in the presence of the inspector acc. to chapter I.12.1 and the coat thickness acc. to chapter I.12.3

#### A.3.1.2.10 Control of QIB test panels

Execution and documentation of in-house control on QIB test panels according to chapter A.1.8 is verified by the inspector. The specified in-house controls must be carried out at least once a week per substrate (aluminum, steel, stainless steel, galvanized steel), for which the license has been granted, on the approved QIB test panels. This applies to both, mechanical as well as chemical pre-treatment. Further in-house controls can also be performed on the company's own material. In case only chemical pre-treatment is carried out, the test panels must not be prepared mechanically (grinding, blasting and so on).

#### A.3.1.2.11 Monitoring of documentation

The documentation of the controls of the coating company is randomly tested (at least three times) for compliance with the documentation of the test panels. Therefore, all test panels must be kept at the disposal of the inspector. The tested panels must be kept for one year. The panels of the mandrel bending test may be re-bent to facilitate the storage.

#### A.3.1.2.12 Training

Personnel involved in pre-treating, coating procedure and quality control shall be qualified based on adequate education, training, or experience. An appropriate system for the records of the training shall be established and maintained. The qualification of the personnel deployed must be ensured. Furthermore, the applicant undertakes to send employees who are involved in QA (at least 2) to the next QIB training course. 2 employees each of the member company must have a corresponding training proof.

#### A.3.1.2.13 Control of the QIB coating system

The inspector must take a sufficient number of test panels (20 of each system) of **all QIB coating systems for which the coater seeks to obtain a license. In case of liquid coating systems, which are not yet ready for transport at the time of application (multi-layer structures, air-drying systems), the first coat of paint must be applied in the presence of the inspector. The other layers may be applied afterwards. After the entire layer structure has been applied and fully cured, the coater sends the test panels to the QIB.** These test panels are intended for final assessment after all required test procedures have been performed in a testing laboratory approved by QIB. The complete testing process must be carried out on test panels which have passed the treatment process together with a production lot. For this purpose, the coater is provided with QIB-approved and marked test panels. Batch and spray galvanized test panels as well as stainless steel and thick materials are the only exception, these can be provided for testing in sufficient number (20 pieces) by the coater. If the parts are only pre-treated chemically, the test panels must not be prepared mechanically (grinding, blasting and so on).

In case of CDC, chemically depositing dip coating and/or powder coating in addition to the technological tests in the coating company, test panels for the boiling test, neutral salt spray test (steel, stainless steel, galvanized material), acetic acid salt spray test (only aluminum) and constant condensation water atmosphere are tested in the test laboratory. The test result is positive, if the neutral salt spray test respectively the acetic acid salt spray test has been passed. The boiling test is only carried out as a preliminary control. Additionally, from stage V on the filiform corrosion test is carried out on aluminium. If it is not passed, the license is only granted up to stressgroup IV depending on the result of the acetic acid salt spray test.

In case of liquid coating systems, in addition to the corrosion tests, the technological tests (cross-cut test, X-cut test and/or pull-off test) are carried out in the laboratory.

The tests required for licensing are listed in the following table and apply to powder and liquid coating systems:

| Required test | In the laboratory | Remarks |
|---|---|---|
| cross-cut test | x | layer thicknesses below 250 µm |
| pull-off test | x | layer thicknesses above 250 µm |
| neutral salt spray test | x | only steel, stainless steel and galvanized material |
| acetic acid salt spray test | x | only aluminum |
| filiform corrosion resistance | x | only aluminum from stage V |
| constant condensation water atmosphere test | x | - |

The tests required for licensing “Liquid Coating in the rail vehicle industry” are listed in the following table:

| Required test | In the laboratory | Remarks |
|---|---|---|
| cross-cut test | x | layer thicknesses below 250 µm |
| pull-off test | x | layer thicknesses above 250 µm |
| resistance to cyclic corrosion conditions | x | 4 cycles for indoor use<br>6 cycles for outdoor use |
| constant condensation water atmosphere test | x | 240 h for indoor use<br>480 h for outdoor use |

### A.3.1.3 Evaluation and granting of the license

The testing institute sends the inspection reports (on-site inspection and laboratory inspection) to the association’s office of QIB.

The technical commission evaluates the inspection reports and decides on granting the quality label:

- If the results of the specified test(s) correspond to the specifications, the applicant is granted the authority to use the quality label.
- If the result of one of the two inspections does not correspond to the specifications, the coater must be informed that the license cannot be granted at the moment, indicating all details and reasons. Within 6 months the coater must carry out another inspection to obtain the license.

### A.3.1.4 Monitoring the licensee (coater)

After being granted the quality label the coating company will be inspected at least once a calendar year. The monitoring test are carried out after advance notification and comprise the same inspection elements as the first inspection.

Furthermore, the safekeeping of the test panels and written records of the in-house control according to chapter A.3.1.2.11 will be verified which applies according to statutory specifications, but they must be kept for at least one year.

The coating company must verify and document the precision of temperature control of the stoving oven monthly.

The testing institute sends the inspection reports (on-site inspection and laboratory inspection) to the association’s office of QIB.

The technical commission evaluates the inspection reports and decides on renewal or withdrawal of the authorization:

- If the results of the inspection correspond to the specifications, the authorization to use the quality label is extended.
- If the results of the inspection do not correspond to the specifications, the technical committee mandates a repeated inspection which must be executed within three months.
- If the repeated inspection again does not correspond to the specifications, the authorization to use the quality label is immediately withdrawn. The coating company can submit a new application for the quality label after 3 months only.

### A.3.1.5 Change in coating process

If the coater changes his coating process significantly, he must inform the QIB about this. A change of process exists if the change can significantly influence the product quality, e.g. if the process chemistry of its pre-treatment changes significantly or the application process changes. The technical committee then decides whether an external re-inspection must be carried out in order to maintain the licence.

### A.3.1.6 Change in legal form

The QIB quality label is not transferable. However, if a company holding the QIB quality label becomes the subject of a merger or takeover by another company, the license will be transferred to the new owner. But if the company terminates the coating work for whatever reason, the QIB quality label becomes void.

### A.3.1.7 Liability disclaimer

QIB stands for a quality label and grants this quality label based on inspection or testing reports issued by a qualified testing institute and laboratory. The results of these reports are based on the quality at the moment of testing. QIB does not assume any liability for consequences or damages whatsoever, directly, or indirectly imposed on persons or materials, companies, products or organizations, nor can it be held responsible for any material or other damages caused by a holder of the label in the execution of his coating activities, or by any product with a QIB label.

# B Special Quality Specifications for Obtaining the Quality Label for Industrial Coating by Cathodic Dip Coating

## B.1 Process control of the CDC coating company

### B.1.1 Coatability

The parts to be coated must be checked by the incoming goods inspection for their coatability.

### B.1.2 Pre-treatment

In case of the CDC-coating, the mechanical surface preparation is followed by chemical pre-treatment or there is only chemical pre-treatment without mechanical surface preparation.

The achievable stress group depends on chapters A.1.4 and A.1.7.1. In case of CDC-coating without further topcoat maximally stress group III can be achieved. Due to the fact that the CDC-coating without topcoat is not weathering-resistant, the system must only be used in areas without UV-stress.

In-house control procedures for pre-treatment according to chapter A.2.7 must be implemented.

### B.1.3 In-house control of CDC-bath

The coater must inspect his/her CDC-bath at least according to the following methods and intervals:

| Evaluated property | Equipment | Interval |
|---|---|---|
| Solids content | Laboratory scales and oven | Once a day |
| pH-value | pH-meter | Once a day |
| Conductivity value | Conductivity meter | Once a day |
| Temperature | Thermometer | Once a day |
| Fill level of basin | Visual control | Once a day |
| Conductivity value of anolyte circulation system | Conductivity meter | Once a day |
| Flow ultrafiltrate / permeate | Flow meter | Once a day |

The analyses procedures must be carried out according to the specifications of the manufacturer.

The results of the in-house control must be documented.

### B.1.4 Process validation by the supplier

The coater must have the CDC-bath tested by the supplier according to the following methods and intervals to validate the process once more comparing the own parameters found with the parameters established by the supplier. In-house controls are admissible.

| Evaluated property | Equipment | Interval |
|---|---|---|
| Solids content | Laboratory scales and oven | Every 4 weeks |
| Ash-content / PB-ratio | Laboratory scales and oven | Every 4 weeks |
| pH-value | pH-meter | Every 4 weeks |
| Conductivity value | Conductivity meter | Every 4 weeks |
| Total solvents | | Every 4 weeks |
| Bacteria test | Dip Slides / dip test | Every 4 weeks |
| pH-value of ultrafiltration bath | pH-meter | Every 4 weeks |
| Conductivity value of ultrafiltration bath | Conductivity meter | Every 4 weeks |

The results of the supplier control must be documented.

### B.1.5 Control of finished products

The finished products must be tested by measuring the coat thickness according to the following inspection plan (DIN EN ISO 2859-1):

| Number of parts per lot [1)] | Number of end products (random selection) | Number of admissible scrap parts |
|---|---|---|
| 2 - 8 | 2 | 0 |
| 9 - 15 | 3 | 0 |
| 16 - 25 | 5 | 0 |
| 26 - 50 | 8 | 1 |
| 51 - 90 | 13 | 1 |
| 91 - 150 | 20 | 1 |
| 151 - 280 | 32 | 2 |
| 281 - 500 | 50 | 2 |
| 501 - 1200 | 80 | 3 |

[1)] Lot: One lot corresponds to the complete order of a customer or to that part of it which is at the coating company

Quality assurance must perform the following tests on the coated parts:

- Visual appearance (uniformity of finished products) (chapter I.12.1)
- Coat thickness (chapter I.12.3)

### B.1.6 In-house control measures of CDC coating

Whenever possible in-house control measures should be performed on workpieces or comparable materials from the production process. For that reason, an additional number of workpieces provided by the customer may be necessary. If test panels are used, they must match the production parts.

The coater must validate the production process according to the following methods and intervals. The test panels must be coated with a current production lot with the same material thickness.

Once a week approved QIB test panels must be used according to chapter A.1.8 to validate the production process.

| Assessed properties | Stress groups I-III |
|---|---|
| Coat thickness | Each order according to sampling scheme; test panel once per shift |
| Cross cut | Once per shift on the test panel |
| Cupping test | Once per shift on the test panel (acc. to manufacturer specification) |
| Degree of cross-linking test (MIBK) | Once a day on the test panel |
| Homogeneity (L-sheet-effect test) | Once a week |
| Visual inspection | Each order |

The results of the in-house control measures must be documented.

## B.2 Labeling

Performances provided according to the General and Special Quality Specifications and for which the quality label has been granted, can be marked with the following quality label with the performance-related add-on “CDC coating“.

***Figure:***

Quality Label “KTL-Beschichtung”
(“Industrial Coating by Cathodic Dip Coating”

# C Special Quality Specifications for Obtaining the Quality Label for Industrial Coating by Chemically Depositing Dip Coating

## C.1 Process control of the chemically depositing dip coating company

### C.1.1 Coatability

The parts to be coated must be checked by the incoming goods inspection for their coatability.

### C.1.2 Pre-treatment

In the case of chemically depositing dip coating, mechanical surface preparation or chemical pre-treatment can be carried out.

The achievable stress group is based on chapters A.1.4 and A.1.7. In the case of a chemically depositing dip coating without further topcoat, the maximum achievable stress group is III. As an epoxy-based, chemically depositing dip coating without topcoat is not weather-resistant, the system may only be used in areas without UV exposure.

The self-monitoring procedures for pre-treatment in accordance with section A.2.7 must be implemented.

### C.1.3 Internal monitoring of the coating bath and rinsing

The coater must inspect his/her coating-bath at least according to the following methods and intervals:

| Evaluated property | Equipment | Interval |
|---|---|---|
| Solids content | Analytical balance and furnace | Once a day |
| pH-value | pH-Gauge | Once a day |
| Conductance | Conductivity meter | Once a day |
| Temperature | Thermometer | Once a day |
| Fill level basin | Visual control | Once a day |
| Flow Ultrafiltrate / Permeate* | Flowmeter | Once a day |
| Bacteria test | Test strip | Every 4 weeks |
| Viscosity | Spout cups (ISO 2431) | Once a week |

* if available

The analysis procedures must be carried out in accordance with the manufacturer's specifications.

The results of the self-checks must be documented.

### C.1.4 Process validation by the supplier

The coater must have his coating bath checked by his supplier in accordance with the methods and intervals listed below in order to validate the process again. The coater's own determined parameters must be compared with the parameters determined by the supplier. Self-checks are permissible.

| Evaluated property | Equipment | Interval |
|---|---|---|
| Solids content | Analytical balance and furnace | Every 4 weeks |
| pH-value | pH-gauge | Every 4 weeks |
| Conductance | Conductivity meter | Every 4 weeks |
| Bacteria test | Dip slides / dip test | Every 4 weeks |
| pH-value ultrafiltration bath * | pH-gauge | Every 4 weeks |
| Conductance ultrafiltration bath * | Conductivity meter | Every 4 weeks |
| Accelerator | HPLC | Every 4 weeks |

* if available

The results of the supplier`s checks must be documented.

### C.1.5 Control of finished products

Coat thickness measurements must be carried out on the finished product in accordance with the following test plan (DIN EN ISO 2859-1).

| Number of parts per lot [1)] | Number of finished products (random selection) | Number of permissible scrap parts |
|---|---|---|
| 2 - 8 | 2 | 0 |
| 9 - 15 | 3 | 0 |
| 16 - 25 | 5 | 0 |
| 26 - 50 | 8 | 1 |
| 51 - 90 | 13 | 1 |
| 91 - 150 | 20 | 1 |
| 151 - 280 | 32 | 2 |
| 281 - 500 | 50 | 2 |
| 501 - 1200 | 80 | 3 |

[1)] lot: A lot corresponds to the total order of a customer or the part of it that is in the coating company.

Quality assurance must perform the following tests on the coated parts:

- Visual appearance (uniformity of finished products; chapter I.12.1)
- Coat thickness (chapter I.12.3)

### C.1.6 In-house control measures of coating

Whenever possible, the in-house control measures should be carried out on workpieces or comparable materials from production. This may require an additional number of workpieces from the customer. If test panels are used, these must match the production parts.

The coater must validate his production process in accordance with the methods and intervals listed below. The test panels must be coated with a running production batch that has the same substrate thickness.

Approved QIB test panels must be used once a week to validate the production process in accordance with Chapter A.1.8 of the General Quality Regulations.

| Assessed property | Beanspruchungsgruppe I-III |
|---|---|
| Layer thickness | Each order according to sampling scheme; test panel once per shift |
| Cross cut | Once per shift on the test panel |
| Cupping test | Once per shift on the test panel (acc. to manufacturer specification) |
| Degree of cross-linking test (MIBK) | Once a day on the test panel |
| Visual inspection | Each order |
| Homogeneity (L-sheet-effect test) | Once a week |

The results of the in-house control must be documented.

## C.2 Labeling

Performances provided according to the General and Special Quality Specifications and for which the quality label has been granted, can be marked with the following quality label with the performance-related add-on “chemically deposited dip coating“.

***Figure:***

Quality Label “chemisch abscheidende Tauchlackierung”
(“Industrial Coating by Chemically Depositing Dip Coating”)

**chemisch abscheidende Tauchlackierung**

# D Special Quality Specifications for Obtaining the Quality Label for Industrial Coating by Powder Coating (hidden)

# E Special Quality Specifications for Obtaining the Quality Label for Industrial Coating by Cathodic Dip Coating and Powder Coating

## E.1 Process control of the company for the cathodic dip coating and powder coating

### E.1.1 Coatability

If the CDC coating is carried out externally, the coater must implement an appropriate control system for incoming goods and inspect the coatability of the parts. The parts to be coated must correspond to the requirements of the General Quality Specifications and the Special Quality Specifications for the Industrial Coating by CDC coating. The coater must obtain written confirmation of that. The confirmation can be waived if the CDC coater holds the corresponding QIB license.

Moreover, a sufficient number of test panels of CDC-coated parts with maximum material thickness of the order must be provided to allow the execution of the in-house control program according to chapter B.1. The coater must carry out the in-house control program according to chapter B.1 without failure prior to starting the order.

### E.1.2 Storage of CDC components with subsequent overcoating

The CDC coating is damaged by UV rays. The adhesion of a subsequent overcoating can be affected by chalking processes. CDC coated components, which have to be overcoated must therefore be stored, protected from UV rays.

### E.1.3 Pre-treatment

The CDC surface to be coated must be free of dust and grease prior to subsequent coating. Degreasing must be carried out in a process-reliable way.

### E.1.4 Imperfections

Imperfections which have been caused, for example, by transport must only be repainted with special touch-up paint approved by the CDC manufacturer while making sure that the touch-up system is appropriate for the subsequent powder coating.

### E.1.5 UV-transmission stability of top coat

In case of two-layer structures UV-sensitive substrates (epoxy primer, CDC) can be damaged by UV-radiation. UV-radiation permeates the top coat which causes photodegradation of the electrophoretic coating leading to adhesion losses between electrophoretic coating and top coat causing in turn delamination.

Problems with UV-transmission stability particularly show with the colors blue / yellow / green / white / orange / metallic at wavelengths between 290 and 480 nm.

The admissible limit value of UV-transmission of the top coat can be taken from the following table:

| Wave length (nm) | Admissible UV-transmission |
|---|---|
| 290 - 380 | < 0,1 |
| 380 - 400 | < 0,5 |
| 400 - 480 | < 1,0 |

The coater must guarantee that the used top coat corresponds to the above-mentioned UV-transmission values.

### E.1.6 Thermal hardening

Object temperatures and stoving time must comply with the recommended values in the technical specifications of the manufacturers of both systems.

The temperature of the oven must be measured with a measuring device consisting of 4 measuring points (object temperature measuring) at least once a month.

### E.1.7 Control of finished products

Coat thickness of finished products must be measured according to the following inspection plan (DIN EN ISO 2859-1).

| Number of parts per lot [1)] | Number of finished products (random selection) | Number of admissible scrap parts |
|---|---|---|
| 2 - 8 | 2 | 0 |
| 9 - 15 | 3 | 0 |
| 16 - 25 | 5 | 0 |
| 26 - 50 | 8 | 1 |
| 51 - 90 | 13 | 1 |
| 91 - 150 | 20 | 1 |
| 151 - 280 | 32 | 2 |
| 281 - 500 | 50 | 2 |
| 501 - 1200 | 80 | 3 |

[1)] Lot: One lot corresponds to the complete order in the same colour of a customer or to that part of it which is at the coating company.

Quality assurance must carry out following inspections on the coated parts:

- Visual appearance (uniformity of finished products) (chapter I.12.1)
- Coat thickness (chapter I.12.3)
- Gloss degree measurement (chapter I.12.2)

### E.1.8 In-house control

Whenever possible in-house control measures should be performed on workpieces or comparable materials from the production process. For that reason, an additional number of workpieces provided by the customer may be necessary. If test panels are used, they must match the production parts.

The coater must validate the production process according to the following methods and intervals. The test panels must be coated with a current production lot with the same material thickness.

Once a week approved QIB test panels must be used according to chapter A.1.8 of the General Quality Specifications to validate the production.

| Type of test | Procedure | Specifications | | | | | | Minimum requirement | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | | Stress group | | | | | | | |
| | | I | II | III | IV | V | VI | | |
| Gloss | Reflectometer value | X | X | X | X | X | X | 1 x per order and shift | > 100 m² |
| Coat thickness | Measuring | X | X | X | X | X | X | 1 x per order and shift | > 100 m² |
| Adhesion | Cross cut | X | X | X | X | X | X | 1 x per order and shift | > 100 m² |
| Elasticity | Cupping test | | | X | X | X | X | 1 x per order and shift | > 100 m² |
| Quality of pre-treatment | Machu test | | | X | X | X | X | 1 x per week | |
| | Boiling test exposure time (min) | | 30 | 60 | 120 | 180 | 180 | 1 x per day | |

The results of the tests in the table must be documented.

## E.2 Labeling

Performances provided according to the General and Special Quality Specifications and for which the quality label has been granted, can be marked with the following quality label with the performance-related add-on “CDC + Powder Coating “.

***Figure:***

Quality Label “KTL- und Pulverbeschichtung”
(„CDC and powder coating“)

**KTL- und Pulverbeschichtung**

# F Special Quality Specifications for Obtaining the Quality Label for Industrial Coating by Chemically Depositing Dip Coating and Powder Coating

## F.1 Process control of the company for the Industrial Coating by Chemically Depositing Dip Coating and Powder Coating

### F.1.1 Coatability

If the coating by chemically depositing dip coating is carried out externally, the coater must implement a suitable control system for incoming goods and check the coatability of the parts. The parts to be coated must meet the requirements of the General and Special Quality Specifications for industrial coating by chemically depositing dip coating. The coater must obtain written confirmation of this. Confirmation can be dispensed with if the coater has a corresponding QIB license for chemically depositing dip coating.

In addition, test panels (chemically depositing dip coated) in the maximum material thickness of the order must be supplied with the order in sufficient quantity to enable the inhouse controls according to chapter B.1. The coater must carry out the inhouse control program according to chapter B.1 without failures bevor starting the application.

### F.1.2 Storage of chemically depositing dip coated components with subsequent overcoating

Depending on the binder system, the chemically deposited dip coating layer can be damaged by UV radiation. The adhesive strength of a subsequent coating can be impaired by chalking processes. Components that are still being recoated must therefore be stored protected from UV radiation.

### F.1.3 Pre-Treatment

The primer surface to be coated must be free of dust and grease before the subsequent coating. The pre-treatment process must be process-safe. Free of oxides, e.g. from laser cutting, welding.

### F.1.4 Defects

Defects resulting from transportation, for example, may only be repainted with a special touch-up paint that has been approved by the manufacturer. It must be ensured that the touch-up system is suitable for subsequent powder coating.

### F.1.5 UV transmission stability of the topcoat

With a two-layer structure, UV-sensitive substrates (epoxy primer; epoxy-based, chemically differentiated dip coating) can be damaged by UV radiation. The UV radiation penetrates the topcoat, causing photo-oxidative degradation of the dip coating. This leads to loss of adhesion between the dip coating and the topcoat, resulting in delamination.

Problems with UV transmission stability are particularly evident with the colors blue / yellow / green / white / orange / metallics at wavelengths in the range of 290 - 480 nm.

The permissible limit value of the UV transmission of the topcoat is shown in the following table:

| wavelength (nm) | Permitted UV transmission |
|---|---|
| 290 - 380 | < 0,1 |
| 380 - 400 | < 0,5 |
| 400 - 480 | < 1,0 |

The coater must ensure that the topcoat used complies with the UV transmission values specified above.

### F.1.6 Thermal Curing

The object temperatures and the curing time must comply with the recommended values in the technical specifications of the manufacturers of both systems.

A monthly check must be carried out using an oven temperature measuring device consisting of at least four measuring points (object temperature measurement).

### F.1.7 Control of Finished Products

Coat thickness of finished products must be measured according to the following inspection plan (DIN EN ISO 2859-1).

| Number of parts per lot [1)] | Number of finished products (random selection) | Number of admissible scrap parts |
|---|---|---|
| 2 - 8 | 2 | 0 |
| 9 - 15 | 3 | 0 |
| 16 - 25 | 5 | 0 |
| 26 - 50 | 8 | 1 |
| 51 - 90 | 13 | 1 |
| 91 - 150 | 20 | 1 |
| 151 - 280 | 32 | 2 |
| 281 - 500 | 50 | 2 |
| 501 - 1200 | 80 | 3 |

[1)] Lot: One lot corresponds to the complete order in the same colour of a customer or to that part of it which is at the coating company.

Quality assurance must carry out following inspections on the coated parts:

- Visual appearance (uniformity of finished products) (chapter I.12.1)
- Coat thickness (chapter I.12.3)
- Gloss degree measurement (chapter I.12.2)

### F.1.8 In-House Control

Whenever possible, the self-inspection measures should be carried out on workpieces or comparable materials from production. This may require an additional number of workpieces from the customer. If test panels are used, these must match the production parts.

The coater must validate his production process according to the methods and intervals listed below. The test panels must be coated with a running production batch that has the same substrate thickness.

| Type of test | Procedure | Stress Group | | | | | | Minimum Requirement | remark |
|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | | |
| Gloss | Reflektometer value | X | X | X | X | X | X | 1 x per order and shift | > 100 m² |
| Coat thickness | Measuring | X | X | X | X | X | X | 1 x per order and shift | > 100 m² |
| Adhesion | Cross cut | X | X | X | X | X | X | 1 x per order and shift | > 100 m² |
| Elasticit< | Cupping test | | | X | X | X | X | 1 x per order and shift | > 100 m² |
| Quality of Pre-treatment | Machu test | | | X | X | X | X | 1 x per week | |
| | Boiling test exposure time (min) | | 30 | 60 | 120 | 180 | 180 | 1 x per day | |

The results of the tests in the table must be documented.

## F.2 Labeling

Performances provided according to the General and Special Quality Specifications and for which the quality label has been granted, can be marked with the following quality label with the performance-related add-on “Chemically Depositing Dip Coating and Powder Coating “.

***Figure:***

Quality Label “Chemically Depositing Dip Coating + Powder Coating powder coating“
(“Chemisch abscheidende Tauchlackierung + Pulverbeschichtung”

**chemisch abscheidende Tauchlackierung und Pulverbeschichtung**

# G Special Quality Specifications for Obtaining the Quality Label for Industrial Coating by Liquid Coating (hidden)

# H Special Quality Specifications for Obtaining the Quality Label for Industrial Coating of rail vehicles by Liquid Coating (hidden)

# I Requirements and Test Methods

The following test methods are used to control finished products and test panels.

## I.1 Coatability of parts

The following questions must be considered when evaluating the suitability of an object for applying a coating system:

(1) Is the pre-treatment adapted to the workpiece?

(2) Can the coating system be applied to the substrate?

(3) Is the coating system appropriate respectively approved for the corresponding stress group?

Any doubts about the suitability of an object with regard to the application of the eligible coating system must be discussed with the customer who must agree in writing. Sharp edges must be rounded or broken. The possible level of pre-treatment depends on the material thickness.

The quality of the punching and cutting edges must achieve the required edge protection.

In the case of thermally cut parts the edges must be reworked mechanically or wet-chemically.

## I.2 Determination of particle size distribution

The particle size distribution test (sieve analysis of the operating mixture) is carried out on metallic blasting agents according to ISO 11125-2. The average mass value of both tests and the nearest result to 1 % must be determined. The particle size distribution must correspond to the distribution which is required to achieve the required surface roughness.

Manual sieving is sufficient for the coating company's monthly inhouse control.

## I.3 Salt content of the blasting agent (hidden)

## I.4 Grease-free blasting agent (water penetration test) (hidden)

## I.5 Grease-free surface after blasting (hidden)

## I.6 Testing the level of surface preparation (surface purity) after blasting

The surface (steel) must be cleaned very thoroughly according to ISO 8501-1 by blasting (Sa 2 ½). The purity level must be visually compared by using reference specimens. The surface must be cleaned from dust prior to a possible chemical pre-treatment.

For other substrates (aluminium, stainless steel, galvanized material), a uniform blasting pattern must be achieved.

### I.6.1 Determination of surface roughness

After blasting the roughness of the substrate must be evaluated by visual and/or tactile procedures which can be performed by ISO surface profile comparators of edged or spherical blasting agents of known average roughnesses. The tactile procedure is used to show the parameters of the surface profile of a standardized assessment length/area. The coater can choose the method for determining the surface roughness. The assessment of the roughness

is carried out according to ISO 8503-2 for ISO surface profile comparators (comparator procedure), or ISO 8503-4 for the use of a stylus instrument (stylus instrument procedure), or ISO 8503-5 for replica tapes (replica tapes method).

Surface roughness must be equal to or higher than the value which has been agreed with the manufacturer of the coating. The roughness depth specification of the paint supplier must always be observed. An Rz value of 40 µm has proven itself for powder coatings (DIN 55633 1). The Rz value must always be less than the layer thickness of the subsequent first coating.

Overview of roughness degrees for grit and shot blasting according to ISO 8503:

| Segment | Nominal value $R_{y5}$-Grit | Nominal value $R_{y5}$-Shot | Roughness grade |
|---|---|---|---|
| 1 | 25 µm | 25 µm | fine |
| 2 | 60 µm | 40 µm | medium |
| 3 | 100 µm | 70 µm | course |
| 4 | 150 µm | 100 µm | very coarse |
| $R_{y5}$ = averaged maximum depth of roughness | | | |

### I.6.2 Testing of the surface purity after blasting (hidden)

## I.7 Determination of conductivity of dripping water

The final rinse which precedes the conversion bath and the CDC-bath must be carried out with deionized water. The conductivity must correspond to the instructions of the supplier. The conductivity of the dripping water must not exceed 50 µS at 20°C.

## I.8 Assessment of the conversion coating

The quality of the conversion layer of conventional conversion layers (chromating, phosphating) can be visually assessed. In case of chromate-free conversion layers, however, the visual assessment turned out difficult or impossible. Therefore, the recommendations of the chemicals` supplier regarding the methods of tests, inspections and evaluation must be observed.

In the case of chromating and zinc phosphating, a visual assessment must be carried out once a day from stress group III on and the result must be documented. From stress group IV on, quantitative verification is required once a week. This can be done by determining the coating weight.

In the case of chromate-free conversion layers, a qualitative test must be carried out once a week on an aluminum sheet (aluminum EN AW 5754 H 22/32) from stress group III on (e.g. drop test). From stress group IV on, quantitative verification is required.

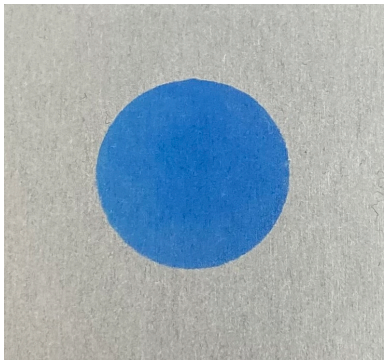
The chemical supplier must specify the layer deposition (min-max.) of the conversion layer on all substrates (aluminum, steel, zinc) in writing for each system.

The interval and the method for the quantitative determination of the conversion layer must be specified by the supplier. The quantitative determination can be carried out by the chemical supplier at the specified interval.

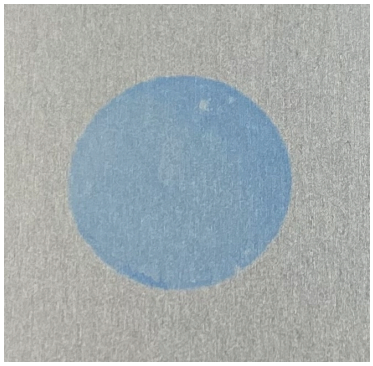
## I.9 Testing the pre-anodization (dye-spot test)

The open porosity of the pre-anodized surfaces is determined using a dye-spot test based on DIN EN ISO 2143. If the layer is open-pored as required, it can also absorb an anodizing dye well and the surface is suitable for coating in this respect. For this purpose, the surface is wetted with a small area of a suitable dye solution for 1 minute.

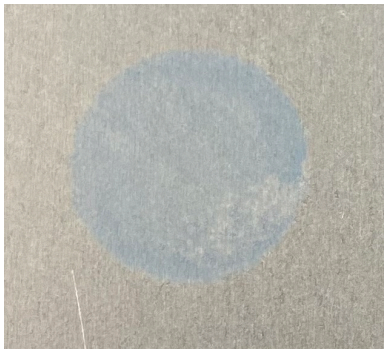
The surface is then rinsed with water and dried. The evaluation is carried out in the dry state using the following color scale:



OK



not OK



not OK

not OK

## I.10 Determination of pickling removal (aluminum)

The pickling removal (aluminum) is determined by differential weighing. The aluminum panel must be cleaned with solvent before weighing. After the pickling process, the dry, cooled aluminum panel must be weighed again. The difference between the two weighing processes gives the pickling removal. This is to be extrapolated to 1 m².

For a QIB aluminum panel, the result of the differential weighing must be multiplied by a factor of 51.

The pickling removal must correspond to 1 g/m².

## I.11 Determination of the degreasing effect

The degreased panel/component is wetted with water and the run-off behavior is observed. This can be done directly in the pre-treatment system after the final rinse or alternatively after the complete pre-treatment process. If the surface is completely wetted, it is free of grease. If, on the other hand, there is droplet formation or a retraction or tearing of the water film and therefore no full-surface wetting, the surface is contaminated with grease and oil.

# I.12 Visual evaluation of the coated surface

## I.12.1 Visual evaluation

The procedure for the visual assessment of organically, decorative surfaces is defined in QIB data sheet 3-1. It must be used in its current version. In the rail vehicle industry the VDB guide “Prüfkriterien für lackierte Oberflächen von Schienenfahrzeugen“ („Testing criteria for wet painted surfaces of rail vehicles“) must be used, unless otherwise agreed.

## I.12.2 Gloss

**Standards for evaluation of gloss**

Metrological assessments are carried out according to DIN EN ISO 2813 (60° measurement geometry). Dull matt and matt coatings should be measured with 85° measuring geometry, high-gloss coatings with 20° measuring geometry. For coatings, the following tolerance limits usually apply for coatings:

| | | | | |
|---|---|---|---|---|
| • dull matt surfaces | 0 GU | - | 9 GU | +/- 3 GU |
| • matt surfaces | 10 GU | - | 29 GU | +/- 5 GU |
| • silk glossy surfaces | 30 GU | - | 64 GU | +/- 7 GU |
| • glossy surfaces | 65 GU | - | 84 GU | +/- 8 GU |
| • high gloss surfaces | 85 GU | - | 100 GU | +/- 10 GU |

The measurement must be carried out at at least 5 representative positions. The mean value must then be calculated from the individual measurement results.

***Notes:***

- The gloss measurement of spherical parts or narrow visible surfaces must be evaluated on reference specimens.
- Structured coatings and effect varnishes (e.g. hammer finish/metallic) are excluded. It is recommended to make agreements by using reference specimens.

## I.12.3 Coat thickness measuring according to DIN EN ISO 2808; ISO 19840

The dry layer thickness of the individual layers in the system and the total dry layer thickness must be measured according to ISO 19840 using a method specified in ISO 2808. The following procedures can be used:

- Magnetic substrates (magnetic methods) DIN EN ISO 2178
- Nonferrous metals (eddy current method) DIN EN ISO 2360

The measurements must be representative for the tested area. According to ISO 19840 the whole coated surface can be used to determine the number of necessary measurements keeping a distance from edges, bore holes and other holes as this could lead to faulty measurements.

The sampling plan consists of several measurements made in the testing area and is therefore as follows:

| Area/length of the tested area ($m^2$ or running meter) | Minimum number of measurements | Maximum number of measurements which may be repeated |
|---|---|---|
| up to 1 | 5 | 1 |
| over 1 to 3 | 10 | 2 |
| over 3 to 10 | 15 | 3 |
| over 10 to 30 | 20 | 4 |
| over 30 to 100 | 30 | 6 |
| over 100 | Add 10 to every additional 100 $m^2$ or running meter | 20 % of the minimum number of measurements |

In case of rough substrates (e.g. sand blasted steel or hot-dip galvanized steel) all values are corrected according to ISO 19840.

| Surface profile in compliance with ISO 8503-1 | Corrected value |
|---|---|
| fine | Measured value – 10 µm |
| medium | Measured value – 25 µm |
| coarse | Measured value – 40 µm |

***Requirements:***

The arithmetic mean of all individual dry layer thickness measurements is equal to or greater than the required thickness.

All individual measurements are equal to or 80 % over the required thickness. The arithmetic mean must not exceed the maximum which has been specified by the manufacturer of the coating. For lack of such a value the maximum dry layer thickness (individual value) must not be greater than the triple of the nominal dry layer thickness.

***Minimum coat thicknesses of powder coatings:***

- Single-layer system: 50 µm (resp. manufacturer or customer specifications)
- Two-layer system: 110 µm (resp. manufacturer or customer specifications)
- Thin-layer powder coat: According to manufacturer or customer specifications

Due to the part geometry (Faraday cage) deviations from coat thickness may occur, if need be agreements must be made with the ordering party.

## I.12.4 Determination of hue

The following methods can be used to determine the color tone:

- by spectrophotometer (the measurement geometry and parameters (e.g. d/8°, 45/0°, normal observer, light type [d65, F11]) and permissible hue deviation $\Delta E$, $\Delta L$, $\Delta a$, $\Delta b$, color distancing formula ($\Delta E_{ab}$ $\Delta E_{00}$) must be agreed between the contractors.
- by means of visual comparison with hue patterns (defined among the contractors). Metamerism effect must be observed (use of appropriate types of light).

## I.13 Cross-cut test DIN EN ISO 2409

The procedure describes the adhesive strength of the paint film on the substrate respectively the previous layer (in case of two-layer systems).

The appropriate cutting tools (single edge cutting device, multi-cross cutter template) can be selected by the coater.

The cutting distance for coat thicknesses up to 60 µm is 1 mm, for coat thicknesses up to 120 µm 2 mm and 3 mm for greater coat thicknesses up to 250 µm.

Brush slightly back and forth on the sample along each diagonal of the grid a few times.

Alternatively, an adhesive tape can be stuck on the total surface of the cuts (pay attention to good contact). Then peel off at an angle of 120° within 0.5 – 1 sec.

***Requirements:***

Cross cut must not exceed the characteristic value of 1.

## I.14 X-cut test DIN EN ISO 16276-2

The procedure describes the adhesive strength of the paint film on the substrate respectively the previous layer. The cross-cut testing is used for layer thicknesses above 250 µm.

The appropriate cutting tools (single edge cutting device, multi-cross cutter template) can be selected by the coater.

Make a continuous cross cut down to the substrate with a single-edge device. Each of the two cuts must be 40 mm long. The angle at the point of intersection must be between 30° an 45°.

***Requirements:***

Cross cut must not exceed the characteristic value of 1.

## I.15 Pull-off test DIN EN ISO 4624 (hidden)

## I.16 Cupping test DIN EN ISO 1520

This procedure is used to determine the elasticity of the coating system. It can only be carried out with CDC coatings and chemically depositing dip coatings respectively multi-layer structures with CDC priming or chemically depositing dip coatings.

***Requirements:***

- CDC coating / chemically depositing dip coating: > 5 mm
- CDC coating / chemically depositing dip coating + top coat:> 3 mm

When viewed with the naked eye, the coating may have slight cracks. Cracks down to the base material are not permitted. Delamination from the substrate is not permitted.

## I.17 Bend test DIN EN ISO 1519 (hidden)

## I.18 Impact test ASTM D 2794, EN ISO 6272-1; EN ISO 6272-2 (hidden)

## I.19 Machu test

**(Short-term corrosion test for aluminum and steel)**

Prior to dipping the profiled part into the test solution, it must be cut with a cross cut of 1 mm width down up to the metal.

Test solution:

| Base material: | Aluminum | Steel |
|---|---|---|
| Chemicals: | acid | neutral |
| NaCl | 50 ± 1 g/l | 50 ± 1 g/l |
| $CH_3COOH$ (glacial acetic acid) 95 % | Addition up to pH 3 ± 0.2 | - |
| NaOH | - | Addition up to pH 7.0 ± 0.2 |
| $H_2O_2$ (30%) | 5 ± 1 ml/l | 5 ± 1 ml/l |
| Test temperature | 37° ± 1° C | 37° ± 1° C |
| Test duration | 48 ± 0.5 hours | 48 ± 0.5 hours |

For systems (e.g. special structured coatings) verified agreements must be made.

The solution for the acid Machu test has a pH-value of 3.0 (+/- 0.2). After 24 hours further 5 ml/l hydrogen peroxide are added. The pH-value is then corrected with acetic acid.

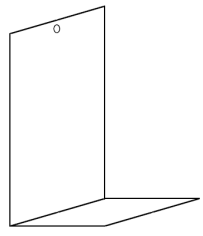
The solution for the neutral Machu test has a pH-value of 7.0. This pH-value is achieved by adding NaOH. After 24 hours further 5 ml/l hydrogen peroxide ($H_2O_2$ 30 mass-%) are added.

***Requirements:***

Disbonding must be determined at the present cross cut.

- Stress group I: No requirements
- Stress group II: No requirements
- Stress group III: Corrosion creep 1.0 mm
- Stress group IV: Corrosion creep 1.0 mm
- Stress group V: Corrosion creep 1.0 mm
- Stress group VI: Corrosion creep 1.0 mm

## I.20 L-sheet metal test



Dip paints tend to sediment. To avoid this, the sedimentation process in the paint tank is optimized by means of various mechanical procedures. The L-sheet metal test is used to determine this deposition behavior.

For this purpose, the test panel in the shape of an L (always the same standard) is always coated in the same position/at the same point and with the same coating parameters (in particular dry coat thickness) in the electrophoretic coating process.

The sheet metal standard must be defined based on the available plant dimensions. Always the same base material must be used.

The assessment of the L-sheet metal must be carried out after stoving. When evaluating the L-sheet metal the gloss degree must be measured at the horizontal bottom and top side. The assessment is performed according to chapter I.12.2.

The assessment takes place by means of data sheet 3-1 “Visual assessment of organically coated decorative surfaces“ and must be based on the requirements of optics stage IV. Maximally two flaws ≤ 0.5mm² per 100 cm² are admissible.

If the admissible deviation from the gloss degree or the defined visual assessment of the L-sheet metal is exceeded, appropriate measures must be taken.

The test must be performed at least once a week.

## I.21 Degree of cross-linking test with MIBK

Test for determining the degree of cross-linking of CDC coatings / chemically depositing dip coating

Specified solvent: MIBK (methyl isobutyl ketone)

***Execution:***

Solvent resistance of the CDC coating / chemically depositing dip coating is tested by rubbing a cloth with as high a pressure as possible performing 20 double strokes. It is important that the cloth is soaked enough to leave clear traces on the test panel. The double strokes must be carried out with uniform speed. The cloth must be soaked once again with solvent for each further test panel.

The assessment of cross-linking quality is carried out visually after drying (i.e. after 30 minutes) and according to the following scale:

1. no change in the surface.
2. slight attack on the paint film.
3. clear welling of the paint film, no stripping.
4. stripping of the film from the substrate.

***Requirements:***

- Stages 1 and 2 on the scale are sufficient.
- Stages 3 and 4 on the scale are insufficient.

## I.22 Boiling test for inspecting the pre-treatment

Inspection in simmering (small to medium-sized bubbles are breaking through the surface in the complete container), deionized water (max. 10 µS at 20° C).

The specimen is taken out of the water and cooled down to room temperature. After that it is stored for 1 hour at room temperature, then the cross-cut test is carried out according to chapter 0.

***Exposure times:***

- Stress group II: 30 minutes
- Stress group III: 1 hour
- Stress group IV: 2 hours
- Stress groups V und VI: 3 hours

***Requirements:***

Neither blistering nor stripping must be visible; a certain change in color, however, is admissible.

## I.23 Neutral salt spray test EN ISO 9227

Corrosion test for determining corrosion creep.

The coating on steel and galvanized substrates is provided with a longitudinal scratch 1 mm wide down to the base material. A Sikkens scribe must be used. An exception is hot-dip galvanized and spray-galvanized material. Here, the scratch must be carried out by a milling cutter down to the base material. The procedure is carried out on three test panels. The stress group must be determiend in advance.

- Stress group II: exposure time 264 hours
- Stress group III: exposure time 504 hours
- Stress group IV: exposure time 1,008 hours
- Stress group V: exposure time 1,512 hours
- Stress group VI: exposure time 2,208 hours

The test is carried out on test specimens according to chapters A.1.8 and A.1.9.

An intermediate evaluation shall be performed for each stress group. In case of steel and galvanized steel an intermediate assessment is carried out after 768 hours of exposure.

For the final evaluation, the test panels are assessed immediately after exposure. For this purpose, the test panels are rinsed with tap water, dried and then visually evaluated. Loose coating is carefully removed at the scribe with a knife held at an angle of between 40° and 60° at the interface between coating and substrate.

***Requirements:***

*Steel / galvanized steel:*

- Assessment of corrosion and delamination at the scribe is carried out according to DIN EN ISO 4628-8.
- Corrosion of steel at the scribe: c < 1 mm
- Delamination of the coating at the scribe (steel): d < 2 mm
- Delamination of the coating at the scribe (galvanized steel): d < 8 mm

*Stainless steel*

- Assessment of corrosion and delamination at the scribe is carried out according to DIN EN ISO 4628-8.
- Delamination of the coating at the scribe: d < 2 mm

No cracking and blistering as well as stripping must be visible with the naked eye.

Subsequently, after a sample conditioning of 24 h at standard climate (23 ± 2° C und 50 ± 5 % rel. humidity) a cross-cut test or, at layer thicknesses above 250 µm, a cupping test according to chapters 0 and I.15 must be carried out.

***Assessment:***

A 3-fold sampling takes place. The test is positive if at least 2 test specimens have fulfilled the requirements.

If two or more test penals do not meet the requirements, either the entire test must be repeated, or the specimen is classified in the stress group that was last met.

## I.24 Acetic acid salt spray test EN ISO 9227

Corrosion test for determining corrosion creep on aluminium.

The coating on aluminum must be cut cross-wise, with a width of 1 mm reaching down to the base material using a Sikkens scratch stylus. This procedure must be carried out on three test

panels. The stress group must be determiend in advance. The test must be carried out on test panels according chapters 0 and I.15.

- Stress group II: exposure time 264 hours
- Stress group III: exposure time 504 hours
- Stress group IV: exposure time 1,008 hours
- Stress group V: exposure time 1,512 hours
- Stress group VI: exposure time 2,208 hours

An intermediate evaluation shall be performed for each stress group.

For the final evaluation, the test panels are assessed immediately after exposure. For this purpose, the test panels are rinsed with tap water, dried and then visually evaluated. Loose coating is carefully removed at the scribe with a knife held at an angle of between 40° and 60° at the interface between coating and substrate.

***Requirements:***

Delamination of up to max. 15 mm² per 10 cm cutting length is admissible while no delamination must be longer than 3 mm. No cracking and blistering as well as stripping must be visible with the naked eye.

Subsequently, after a sample conditioning of 24 h at standard climate (23 ± 2° C und 50 ± 5 % rel. humidity) a cross-cut test or, at layer thicknesses above 250 µm, a cupping test according chapters 0 and I.15 must be carried out.

***Assessment:***

A 3-fold sampling takes place. The test is positive if at least 2 test specimens have fulfilled the requirements.

If two or more test penals do not meet the requirements, either the entire test must be repeated, or the specimen is classified in the stress group that was last met.

## I.25 Cyclic corrosion test DIN EN ISO 11997-1 (hidden)

## I.26 Constant condensation water atmosphere DIN EN ISO 6270-2

### I.26.1 applicable for CDC, powder coating and liquid coating

Test for determining the pre-treatment quality.

The test must be carried out on test panels according to chapters A.1.8 and A.1.9.

The coating on aluminium must be scratched cross-wise with a width of 1 mm reaching down to the base material using a Sikkens scratch stylus. Coatings on steel and galvanized steel do not require a cut.

Test duration:

- Stress group I: exposure time 48 hours
- Stress group II: exposure time 264 hours
- Stress group III: exposure time 504 hours
- Stress group IV: exposure time 1,008 hours
- Stress group V: exposure time 1,512 hours
- Stress group VI: exposure time 2,208 hours

Subsequently, after a sample conditioning of 24 h at standard climate (23 ± 2° C und 50 ± 5 % rel. humidity) a cross-cut test or, at layer thicknesses above 250 µm, a cupping test according to chapters 0 and I.15 must be carried out.

***Requirements:***

*Aluminum*

No cracking and blistering as well as stripping must be visible with the naked eye.

Delamination at the scribe is evaluated according to ISO 4628-8. Loose coating is carefully removed at the scribe with a knife held at an angle of between 40° and 60° at the interface between coating and substrate. Then the corrosion and delamination on the scribe is evaluated.

Delamination of the coating on the scribe: d ≤ 1 mm.

Adhesion or pull-off test: Compliance with the requirements of chapters 0 and I.15.

*Steel / Stainless Steel / Galvanized Steel*

No cracking and blistering as well as stripping must be visible with the naked eye.

Adhesion or pull-off test: Compliance with the requirements of chapters 0 and I.15.

***Assessment:***

A 3-fold sampling takes place. The test is positive if at least 2 test specimens have fulfilled the requirements.

If two or more test panels do not meet the requirements, either the entire test must be repeated or the specimen is classified in the stress group that was last met.

### I.26.2 applicable for liquid coating in rail vehicle industry (hidden)

## I.27 Filiform corrosion test ISO 4623-2

The test is only carried out on aluminum for stress groups V and VI.

The test is carried out acc. to DIN EN ISO 4623-2 with a running time of 1,000 h.

The cuts must be performed as follows:

Horizontal cuts must be made with a length of 30 mm and the vertical cuts with a length of 80 mm. The distance of the scribe from the edge of the specimen and the scribe to each other must be at least 20 mm. A Sikkens scratch stylus (1 mm) must be used.

***Requirements:***

- L ≤ 4 mm
- M ≤ 2 mm

***Assessment:***

A 3-fold sampling takes place. The test is positive if at least 2 test penals have fulfilled the requirements.

If two or more test penals do not meet the requirements, either the entire test must be repeated or the specimen is classified in the stress group that was last met.

# J Approval of Coating Systems

## J.1 Approval of powder coating systems on base material steel

As approval criteria of QUALISTEELCOAT are identical with the specifications of QIB, approval tests of QUALISTEELCOAT are accepted to the full extent as far as inspections are submitted via QIB. Approval criteria depend on the QUALISTEELCOAT specifications in its current version.

The manufacturer of the material receives an additional QIB approval certificate.

In external quality control coating systems which have been approved by QUALISTEELCOAT or QIB must be used for steel applications.

## J.2 Approval of powder coating systems on base material aluminum

QIB accepts the material approvals for aluminum substrates that are common on the market. Approved coating systems are to be used in the aluminum area for external monitoring tests.

## J.3 Approval of liquid coating systems according to DBS 918300

QIB accepts material approvals of liquid coating systems based on DBS 918300 for the quality mark “Flüssigbeschichtung in der Schienenfahrzeugindustrie” (“Liquid coating in the rail vehicle industry”.

# K Summary of the Specifications for In-house Measures in the Coating Company

## K.1 Incoming goods inspection

| to be tested | type of test | minimum scope | records |
|---|---|---|---|
| Powder- / Liquid- / dip coatings | Verification of compliance of article numbers on product and delivery note | each delivery | on delivery note |
| Chemicals for pre-treatment | Verification of compliance of article numbers on product and delivery note | each delivery | on delivery note |

## K.2 Mechanical pre-treatment and coating process

| Test | Pressure blasting method | | Wheel blast method | | Intervall | records [1)] |
|---|---|---|---|---|---|---|
| | abrasive | | | | | |
| | metallic | mineral | | | | |
| Salt content of blasting agent | 1 x weekly | not applicable | 1 x weekly | not applicable | 1 x monthly* (operating time) | informal |
| Particle size of blasting agent | 1 x monthly | not applicable | 1 x weekly | | ½ yearly** | informal |
| Grease-free blasting agent | 1 x weekly | not applicable | 1 x daily | | weekly | informal |
| Grease-free surface after blasting | 1 x per production shift | 1 x per production shift | 1 x per production shift | | 1 x daily | informal |
| Level of surface preparation | Per order / min. 1 x per shift | Per order / min. 1 x per shift | Per order | | Each component / hanging*** | informal |
| Dust test | 1 x weekly | 1 x daily | 1 x weekly | | 1 x daily | informal |
| Surface roughness | 1 x per production shift | 1 x per production shift | 1 x per production shift | | 1 x daily | informal |
| Assesment of zinc layer | Each component / hanging | Each component / hanging | Each component / hanging | | 1 x per shift | informal |
| Testing of dew point | Only from stress group III / if risk of dew point | Only from stress group III / if risk of dew point | Only from stress group III / if risk of dew point | | 2 x daily (in the morning and late afternoon) | informal |
| Suitability of abrasive (iron content) | not applicable | not applicable | not applicable | | 1 x monthly | informal |

1) in writing or on an electronic data carrier
* max. one-shift operation
** by the abrasive manufacturer
*** order-related documentation

## K.3 Chemical pre-treatment and coating process

| to be tested | type of test | Specifications | | | | Minimum scope | Records |
|---|---|---|---|---|---|---|---|
| | | Stress group | | | | | |
| | | I | II | III | IV-VI | | |
| Bath analysis<br>Pre-treatment baths (degreasing, etching etc.) | Temperature<br>pH value<br>conductivity<br>degreasing effect<br>concentration | X<br>X<br>X<br>X<br>--- | X<br>X<br>X<br>X<br>--- | X<br>X<br>X<br>X<br>X | X<br>X<br>X<br>X<br>X | I-II: 1 x daily according to supplier specifications<br>III-VI: 1 x daily according to supplier specifications at least concentration | informal |
| Film-forming baths (chromating, phosphatizing etc.) | Analysis, temperature, concentration | --- | --- | X | X | 1 x per day | informal |
| Layer weight of film-forming procedures | Stripping procedure resp. acc. to specifications of supplier | --- | --- | --- | X | Acc. to supplier`s specifications quantitative measurement | informal |
| Assessment of conversion layer | acc. to supplier`s specifications, dot test | X | X | X | --- | visually, if possible 1x per shift qualitative measurement for chromate-free conversion layers (spot test 1 x per week) | informal |
| Conductivity of final rinse | With measuring instrument | | X | | | 1 x per day | informal |
| Retained water dryer | With measuring instrument or tapes | X | X | | | 1 x per day, if required | Graphics or measuring tape |
| Thermal curing (stoving oven) | With measuring instrument | X | X | | | 1 x per month | Graphics |
| Pickling removal (Aluminium) | Analysis | --- | --- | --- | X | 1 x per week | informal |
| Drying temperature | Analysis | X | X | X | X | 1 x per day<br>if process requires a prescribed drying temperature | |

## K.4 Control of finished products (CDC- / chemically depositing dip coating / powder- and liquid coating)

| to be tested | type of test | Specifications | | | | Minimum scope | Records |
|---|---|---|---|---|---|---|---|
| | | Stress group | | | | | |
| | | I | II | III | IV + V | | |
| appearance | visual | X | X | X | X | on customer specification | informal |
| Gloss[1)] | reflectometer value | X | X | X | X | on customer specification | Minimum and maximum values |
| layer thickness[2)] | measurement | X | X | X | X | Acc. to sampling scheme | Minimum and maximum values |

[1)] not for CDC
[2)] acc. to in-house control chapter I.12 (coating surface)

## K.5 Control of finished products (rail vehicle industry) (hidden)

## K.6 Tests on test panels CDC coating

| to be tested | type of test | Specifications<br>Stress group<br>I - III | Minimum scope | Records |
|---|---|---|---|---|
| Coat thickness | Measurement | X | 1 x per order [1] and shift | Minimum and maximum values |
| Adhesive strength | Cross cut | X | 1 x per order [1] and shift | Property values |
| Elasticity | Cupping test | X | 1 x per order [1] and shift | Minimum and maximum values |
| Cross-linking degree | MIBK Test | X | 1 x per day | informal |
| Homogeneity | L-sheet metal test | X | 1 x per week | informal |
| Visually | Visual inspection | X | 1 x per order [1] and shift | informal |
| [1] > 100 m² | | | | |

## K.7 Tests on test panels powder coating (hidden)

## K.8 Tests on test panels CDC-coating / chemically depositing dip coating + powder coating

| to be tested | Type of test | Specifications<br>Stress group<br>I | II | III | IV | V | Minimum scope | Records |
|---|---|---|---|---|---|---|---|---|
| Gloss | Reflectometer value | X | X | X | X | X | 1 x per order [1] and shift | Minimum and maximum values |
| Coat thickness | Measurement | X | X | X | X | X | 1 x per order [1] and shift | Minimum and maximum values |
| Adhesive strength | Cross cut | X | X | X | X | X | 1 x per order [1] and shift | Property values |
| Elasticity | Cupping test | | | X | X | X | 1 x per order [1] and shift | Minimum and maximum values |
| Quality of pre-treatment | Machu test | | | X | X | X | 1 x per week | 1 x per week |
| | Boiling test<br>Exposure time (min) | | 30 | 60 | 120 | 180 | 1 x per day | 1 x per day |
| [1] > 100 m² | | | | | | | | |

## K.9 Tests on test panels liquid coating (hidden)

# L Annex

## L.1 Requirements on the base material

### L.1.1 Notes to the ordering party

To be able to choose and carry out the optimal pre-retreatment detailed information on the base material is required. This information must be provided by the ordering party.

If the parts to be coated must meet a high level of performance as described in chapter I.12.1 (●●●●), they must be sent in transport packaging which is to be agreed with the coater. Otherwise the parts can be scratched during transport which may have a negative impact on the visual appearance.

In the following description the requirements on individual materials are specified. The requirements on the visual appearance must be considered according to chapter I.10.

### L.1.2 Aluminum

In case of aluminum profiles so-called “extruding fleas” or other manufacture-related deposits, such as graphite residues can affect visual appearance and adhesive strength of the coating. From a surface roughness of $R_{max}$ > 9 µm also residual stripes as well as differences in roughness can become visible depending on paint system and gloss degree.

### L.1.3 Cast parts

Depending on type and quality of casting, in particular during stoving of powder coatings and partially also during forced drying of liquid coatings, gas release can occur and cause blisters and pores (craters) on the coated surface. Furthermore, separating agents used during casting can cause adhesion problems. The coating company must be informed about the used separating agents to avoid such defects or to verify if the surface is coatable.

### L.1.4 Hot-dip galvanized parts

Depending on steel quality, zinc layer thickness and cavities in the zinc layer, hot-dip galvanized steel parts tend to gas release during stoving or forced drying of powder and liquid coatings causing blisters and pores (craters) on the coated surface.

Hot-dip galvanized and strip-galvanized components are often sealed with temporary corrosion protection (S) or chemically passivated (C) to avoid the formation of corrosion products. The applied temporary corrosion protection can hardly be identified by the batch-coater. Temporary corrosion protection layers cannot be removed reliably by the pre-treatment what may lead to important adhesion problems during subsequent batch coating. **For batch coating, the components must therefore be delivered without passivation, or otherwise the coater must be informed in advance about the type of the applied passivation (see DIN 55634-1 and DIN 55633-1; QIB information sheet 2-1)**.

Many problems with the coating of hot-dip galvanized material can be traced back to a lack of communication between the client, the galvanizing company and the coating company. In this respect, the galvanizer must be informed when the order is placed that a subsequent coating is to be carried out (see also DIN EN ISO 1461).

In these cases, the abbreviation t Zn k ("no subsequent treatment") must also be used when placing the order for hot-dip galvanizing. (see also QIB information sheet 3-2 "Order correctly").

Condensation on batch-galvanized components can cause white rust. Removal of white rust on batch-galvanized surfaces can only be achieved by mild mechanical treatment, such as grinding or sweeping. If required, the parts must be submitted to this kind of pre-treatment after

prior agreement of the ordering party (additional costs). Substrates with heavy white rust formation are not appropriate for coating.

### L.1.5 Anodized parts

In case of anodized surfaces, the type of anodizing and also the performed finishing treatment (compacting scale inhibitors) can cause insufficient paint film adhesion. Therefore, the corresponding information must be obtained from the supplier and, if necessary, a test specimen must be coated beforehand (pre-treatment included). Sporadically, additional mechanical procedures (roughening with plastic fabric) have proved to be of value. Due to the type of treatment, however, they represent manual pre-treatment and can therefore not guarantee for assured quality.

If required, agreed pre-treatment procedures must be used. If liquid coatings are used, priming may be applied prior to finishing coat.

### L.1.6 Stainless steel rust-free (chromium-plated parts)

The known pre-treatment procedures do not produce appropriate adhesion promoting layers. As a result, paint film adhesion can only be achieved by correspondingly rough surface. Without this mechanical surface roughening the parts can only be provided with appropriate base coating and subsequent top coat. Without adapted treatment the use is only possible indoors.

### L.1.7 Steel

Steel parts which have been blasted and/or treated with usual iron phosphating, are highly sensitive to rust formation. Therefore, appropriate measures for prevention must be taken, such as prompt, immediate coating of pre-treated parts with the specified coating material.

### L.1.8 Coated, repaired or zinc-sprayed parts

Unknown coatings can cause incompatibility with the substrate during subsequent surface treatment. It is therefore recommended to perform beforehand the coating of a test specimen.

### L.1.9 Scale layers and laser-induced distortions of edges

All scale layers affect the adhesion properties of subsequent coatings negatively. They must therefore be removed by appropriate mechanical pre-treatment (blasting, grinding, brushing).

This also applies to burrs which are caused by laser cutting or other punching tools. The very sharp-edged edges lead to pronounced edge thinning and can crucially impair corrosion resistance in this area.

### L.1.10 Corrosion

Generally, corrosion implicates so-called corrosion products which have similar properties as the aforementioned scale layers. The complete removal is necessary.

### L.1.11 Adhesive residues, silicones and applied inscriptions

Adhesive residues and silicones affect the visual appearance negatively creating, mostly after coating, clearly visible weld puddles and flow marks and reducing the adhesive properties of the coating material of the surface. Therefore, the use of silicone-containing separating agents should be avoided when pre-treating raw parts. If corresponding materials have been used, the coater must be informed unasked.

Prior to pre-treatment adhesive residues must be removed by appropriate solvents.

### L.1.12 Greases and oils

Greases and oils as temporary corrosion protection materials can also lead to adhesion problems of the subsequently applied coatings. Particularly in case of so-called gumming or polymerization special caution is advisable. If such coatings exist, the parts must be submitted to appropriate cleaning prior to the coating. If the parts shall be blasted, greases and oils must be removed before.

### L.1.13 Chalk or ink

The surface may also be contaminated by markings of chalk or ink (edding). They must be removed before coating.

### L.1.14 Coating of different material combinations

If different base materials have already been processed on a part, a preliminary test is mandatory. During processing it is important to avoid split or blind holes or similar as non-removable pre-treatment residues may lead to paint damages or corrosion. Varying paint film adhesion can also result from pre-treatment which is not always optimal. It is therefore absolutely necessary to discuss these issues with the coater previously to using the different materials.

### L.1.15 Welding seams

In the area around welding seams diminished paint film adhesion must be expected due to existing oxide layers (e.g. oxide scale or welding beads resp. mill skin). The oxide layers can be removed with appropriate procedures.