Specifications

For Obtaining the Quality Label for Industrial Coating

by Cathodic Dip Coating, Chemically Depositing Dip Coating, Powder Coating and Liquid 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) C4 (low)
III	504	480	C2 (very high) C3 (high) C4 (medium) C5 (low)
IV	1.008	720	C3 (very high) C4 (high) C5 (medium)
V	1.512	1.440	C4 (very high) 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

For liquid coating systems, the layer structures of DIN EN ISO 12944-5, DIN 55634 and DBS 918300 are used. In principle, stress group VI is possible on all basic materials. An exception is the quality mark for liquid coating for the rail vehicle industry. Special requirements for corrosion tests apply here and a classification into indoor and outdoor use takes place.

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

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

- Pre-treatment by blasting or sweeping: Stress group IV for steel and V for galvanized base material and stainless steel
- Pre-treatment by sweeping: Stress group IV for aluminum

A.1.7.3 Mechanical pre-treatment for liquid coating

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

- Pre-treatment by blasting or sweeping: Stress group IV for steel and V for galvanized base material and stainless steel
- Pre-treatment by grinding, blasting or sweeping: Stress group IV for aluminium
- Pre-treatment by grinding: Stress group IV for GFRP

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)] hot-dip galvanized acc. to DIN EN ISO 1461	Thickness 0.7 – 0.8 mm	(5 holes)
Aluminum EN AW-5754 H 22/32 (AlMg3)	Thickness 0.7 – 0.8 mm	(2 holes)
Strip-galvanized steel [2)] 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 [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 hot-dip galvanized acc. to DIN EN ISO 1461 [1)]	Thickness 2.0 mm	(5 holes)
Aluminum EN AW-5754 H 22/32 (AlMg3)	Thickness 0.7 – 0.8 mm	(2 holes)
Strip-galvanized steel [2)] 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 [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)

Test panels made of the following materials are to be used for the inspection of external quality control:

Steel DC01 / 1.0330	Thickness 2 - 3 mm	(1 hole)
Steel DC01 / 1.0330 hot-dip galvanized acc. to DIN EN ISO 1461	Thickness 2 - 3 mm	(5 holes)
Aluminum EN AW-5754 H 22/32 (AlMg3)	Thickness 3 - 4 mm	(2 holes)
Strip-galvanized steel[1)] DX51D+Z140 O / 1.0306	Thickness 0.8 – 1.0 mm	(3 holes)
Stainless steel WNR 1.4301	Thickness 2 - 3 mm	(4 holes)
GFRP[2)] (original material)	Thickness min. 2 mm	(without holes)
and dimensions	DIN A5	

1) strip-galvanized oiled
2) Test specimens must be manufactured on an order-related basis. Influence of moisture must be avoided by appropriate protective applications on edges.

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.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 (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 I.9)

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)] ½ annually[4)]	not applicable	1 x weekly[)] 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)]
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
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

The components can be dried at room temperature or forced. The parameters in the technical data sheets must be observed.

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 0.

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 to 0).

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 and A.1.9 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 6 cycles for outdoor use
constant condensation water atmosphere test	x	240 h for indoor use 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 0 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

D.1 Process control of the powder coating company

D.1.1 Coatability

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

D.1.2 Pre-treatment

Powder coating requires mechanical and/or chemical pre-treatment.

The achievable stress group is based on chapters A.1.4 and A.1.7.1.

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

D.1.3 Control of the finished products

Coat thickness of finished products must be measured according to the following inspection plan.

Number of parts per lot [1)]	Number of finished parts (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)

D.1.4 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 0 of the General Quality Specifications to validate the production.

Test methods	procedure	stress groups						minimum scope	remarks
		I	III	III	IV	V	VI		
gloss	Reflectometer value	X	X	X	X	X	X	1 x per order and shift	> 100 m²
layer thickness	measuring	X	X	X	X	X	X	1 x per order and shift	> 100 m²
adhesion	cross cut test	X	X	X	X	X	X	1 x per order and shift	> 100 m²
deformability	bend test		X	X	X	X	X	1 x pro Auftrag und Arbeitsschicht	> 100 m²
deformability under dynamic stress	impact test		X	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 holding time (min)		30	60	120	180	180	1 x per day	

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

Notes:

The tests are only carried out from order sizes of 100 m² coated surface resp. other agreements with the ordering party, but at least 1 x per work shift.

D.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 “Powder Coating “.

Figure:

Quality Label “Pulverbeschichtung”
(“powder coating“)

Pulverbeschichtung

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 0 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

G.1 Process control of the company for the liquid coating

G.1.1 Coatability

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

G.1.2 Plants, facilities and equipment

Before coating a functional control of the supply and exhaust air must be carried out in wet painting facilities. The spraying equipment and test equipment (scales, agitators, viscosity cups) etc. must also be checked for function.

G.1.3 Coating material

Only coating material used for the application must be in the wet paint booth.

The temperature of the stock must be determined and documented once a day.

Opened containers must be sealed airtight and marked with the date of opening.

The durability of open containers must be individually agreed with the wet paint manufacturer in writing. The requirements of the wet paint manufacturer must be adhered to accordingly.

The batch number must be documented order-relatedly.

G.1.4 Instructions

Work instructions or work plans must be available at all stages of work and must be known (e.g. mixing ratio, pot times, etc.)

G.1.5 Repair process

The coater must have installed a process for repair of wet paint.

G.1.6 Pre-treatment

The liquid coating is pre-treated mechanically and/or chemically.

The achievable stress group is governed by Chapters A.1.4 and A.1.7.

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

G.1.7 Environmental conditions and process times

Important technological environmental conditions and process times, such as temperature, humidity characteristics, overcoating times, must be monitored, complied with and documented in the context of production according to the manufacturer's specification.

G.1.8 Control of finished products

Layer thickness measurements shall be carried out on the final 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 allowed 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 of the same colour or part of it that is in the coating plant.

The quality assurance has to carry out the following tests on the coated parts:

- Appearance (uniformity of finished products) (Chapter I.12.1)
- Layer thickness (single layers and total layer thickness) (Chapter I.12.3)
- Measurement of gloss degree, as far as specified by the customer (Chapter I.12.2)
- Determination of hue, as far as specified by the customer (Chapter I.12.4)

G.1.9 In-house control

Whenever possible, self-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 plates are used, they must match the production parts.

The coater must validate his production process according to the methods and intervals listed below. The workpieces or test plates must be coated with a running production lot. The test plates are created in the format DIN A5. The formats can be deviated from if the customer specifies. Each individual layer and the pre-treated base material must be visible (bonding approx. 20 mm).

kind of test	procedure	stress group						miniumum scope	remarks
		I	II	III	IV	V	VI		
gloss	Reflektometer value	X	X	X	X	X	X	1 x per order and work shift	> 100 m²
layer thickness	Measuring	X	X	X	X	X	X	1 x per order and work shift	> 100 m²
adhesion	grid cut, cross cut pull-off test	X	X	X	X	X	X	1 x per order and work shift	> 100 m²

The test results named in the table have to be documented.

Notes:

The tests are only carried out from order sizes of 100 m² coated surface resp. other agreements with the ordering party, but at least 1 x per work shift.

G.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 “Liquid Coating “.

Figure:

Quality Label “Flüssigbeschichtung”
(“Liquid coating“)

H Special Quality Specifications for Obtaining the Quality Label for Industrial Coating of rail vehicles by Liquid Coating

H.1 Additional requirements for liquid coating in the rail vehicle industry

To obtain the QIB quality mark “Flüssigbeschichtung in der Schienenfahrzeugindustrie” (“Liquid coating in the rail vehicle industry”) the general quality specifications, the special quality specifications for liquid coating and these additional special quality regulations must be complied with.

H.1.1 Coating material

The temperature of the stock must be determined and documented once a day.

The temperature specifications for the delivery of the coating material must be ensured (e.g. temperature monitors). Appropriate documentation must be made on this.

The approved and prescribed wet paint systems for the rail vehicle sector must be used, e.g. in accordance with DBS 918300.

H.1.2 Storage of pre-treated parts

The following table indicates the maximum allowable time between pre-treatment and coating for the car body:

	Car body aluminium / steel
Stress group I - VI	≤ 6 days

If the specified times cannot be met due to production, an appropriate proof of coatability provided (instruction for handling; e.g. visual inspection according to DIN EN ISO 8501, measurement of the object moisture and grease-freeness).

H.1.3 Pre-treatment of GFRP parts

GFRP is usually a thermoset of unsaturated polyester (UP), les often epoxy resins (EP) or Polyurethane (PUR). Newly manufactured UP-GFRP has proportions of monomeric styrene, which is recognizable by its typical smell. Since they have not yet reacted completely, they are subject to a subsequent shrinkage and lose their original form. Therefore, only tempered (min. 80° C with sufficient drying time) should be wet painted. The surface defects “pores/bubbles”, “dry points”, “open fibre” and “marking of shrinkage” can be detected easily on the shell part. Depending on the shape and size the defects can be processed with additional effort or lead to the failure of the part. The smooth side (Gelcoat side) may have a mold release agent that impairs the adhesive properties of the surface. The rough side facing the air during production usually contains paraffin as an air-drying additive. A thorough grinding of the surface is necessary here.

In general, a test of the parts should be carried out for the coating of GFRP.

Since GFRP is a special substrate due to its composition, the following must be observed when coating:

- In general, the GFRP manufacturer (contractor) is responsible for ensuring that the components are delivered in a wet-paint-proof manner and that the resistance requirements are met according to the specifications (e.g. DB 918300).
- This must be ensured in advance in cooperation with the rail vehicle manufacturer and the wet paint manufacturer.
- For this purpose, the manufacturing history of the component is necessary:
- When was the component manufactured?
- Information on the resin used
- Which gelcoat was used?
- When was the gelcoat applied?
- Was force dried (how long and at what temperature?
  Attention: It should be dried at at least 80° C, as it is dried up to 4 times at 60° C during the coating process. Drying at the coater has to be carried out according to the GFRP manufacturer`s specifications.
- Which release agent was used?
- How is the release agent to be removed? Removal should be carried out according to the requirements of the GFRP manufacturer.
- The components should be transported and stored according to the requirements of the GFRP manufacturer (temperature, moisutre of gelcoat). In case of doubt, a moisture test must be carried out.

The wet painter must verify in advance as follows:

- The manufacturing of the component according to previous paragraph.
- Visual checks on
- pores
- blistering
- open fibers
- irregularities
- Test for coatability
- delivery free of release agents
- Test for contaminations
- Removal of residues of release agents/impurities
- cleaning with suitable cleanig agents/grinders

If re-work is due to surface defects, the coater must inform the customer and obtain consent in order to avoid the warranty in the event of consequential damage. Consent must be documented.

The troubleshooting (e.g. filling of pores, shrinkage or burst blisterings) must also be agreed on with the customer in writing.

The substrate must be flawless, sanded, dry, clean and grease-free immediately before wet painting.

H.1.4 Control of finished products

In addition to the layer thickness measurements, the following in-house controls must be carried out on the finished products:

- Visual appearance (uniformity of finished products) (chapter I.12.1)
- The visual appearance of the running of wet paint (Orange-Peel) or of texture/structure must be checked by means of comparision patterns or Wave-Scan-measurement. The VDB guide “Prüfkriterien für lackierte Oberflächen von Schienenfahrzeugen“ („Testing criteria for wet painted surfaces of rail vehicles“) must be used, unless otherwise agreed.
- Gloss degree measurement (chapter I.12.2)
- Determination of hue for decorative components (Chapter I.12.4). The VDB guide “Prüfkriterien für lackierte Oberflächen von Schienenfahrzeugen“ („Testing criteria for wet painted surfaces of rail vehicles“) must be used, unless otherwise agreed.

H.1.5 In-house control

Whenever possible, self-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 plates are used, they must match the production parts.

The coater must validate his production process according to the methods and intervals listed below. The workpieces or test plates must be coated with a running production lot. The test plates are created in the format DIN A5. The formats can be deviated from if the customer specifies. Each individual layer and the pre-treated base material must be visible (bonding approx. 20 mm).

kind of test	procedure	scope inside and outside	miniumum scope	remarks
gloss	Reflektometer value	X	1 x per order and work shift	> 100 m²
layer thickness	Measuring	X	1 x per order and work shift	> 100 m²
adhesion	grid cut, cross cut pull-off test	X	1 x per order and work shift	> 100 m²

The test results named in the table have to be documented.

Notes:

The tests are only carried out from order sizes of 100 m² coated surface resp. other agreements with the ordering party, but at least 1 x per work shift.

When testing the adhesion, the curing conditions must be observed.

H.1.6 Controls in laboratory

In deviation from the quality mark for liquid coating, the following corrosion tests must be carried out in the accredited test laboratory:

required test	in the laboratory	remarks	
		interior	exterior
climate change test	x	4 cycles	6 cycles
condensate constant climate test	x	240 h	480 h

H.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 „Flüssigbeschichtung in der Schienenfahrzeugindustrie“ (“Liquid Coating in the rail vehicle industry“).

Figure:

“Flüssigbeschichtung in der Schienenfahrzeugindustrie”
(“Liquid Coating in the rail vehicles industry”)

Flüssigbeschichtung in der Schienenfahrzeugindustrie

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

50 g blasting agent (operating mix) must be brought into 100 g deionized water at room temperature. The conductivity value of the deionized water is measured prior to the addition of the blasting agent and one hour after the addition. If the difference of both measurements exceeds 100 µS the salt content on the surface of the blasting agent is too high and another dose must be added.

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

The water penetration test is used to determine the state of the blasting agent with regard to contamination by oils and greases. For that purpose, a test specimen of the blasting agent is taken at the sifter of the blasting plant. Then, tap water is dripped onto a pile of the blasting agent. If the blasting agent is free of oil and grease, the water immediately penetrates the pile. If the blasting agent contains oil, the water remains as pearls on the pile due to the low surface tension. The longer the pearls remain on top of the pile, the heavier the contamination by oil or grease. In case of shot blasting agents, the water must seep away into the pile within 10 - 60 seconds; in case of grit (nominal grain size < 0.3 mm) within 3 - 5 minutes, otherwise grease and/or oil content of the blasting agent is too high. Depending on the grain size, seepage may take longer. The water bead test must be verified in accordance with I.5 "Grease-free surface". The surface tension test on the surface must be $\geq$ 38 mN/m.

I.5 Grease-free surface after blasting

The procedure to determine if a surface is free of grease can be freely selected. Following procedures can be used:

- Test of surface tension:

  Surface tension is measured by means of the ink test method testing the blasted material with test ink ≥ 38 mN/m. Test inks can be used, which are applied with a cotton swab (single use).

  The test ink is applied onto the surface which is being tested. The result is ok, if the test ink does not converge immediately after application and keeps its brushing shape for at least 3 seconds.

- Wetting test:

  The blasted surface is wetted with water while observing the drain-off properties. If the complete surface is wetted, it means that the surface is free of grease. But if drops form and therefore not the complete surface is wetted, grease and oil contaminate the surface.

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

According to ISO 8501-1 the surface must be very thoroughly cleaned by blasting (Sa 2 ½). Prior to a possible chemical pre-treatment and application of a primer the surface must be cleaned from dust.

The residual dust quantity and size must be assessed according to ISO 8502-3. Therefore, the dust is removed by using a special tape and then visually assessed. It is recommended to use the professional ISO 8502-3 dust tape test kit.

Classes	Description of dust particles
0	Particles are not visible under 10-times magnification
1	Particles are visible under 10-times magnification, but not with the naked eye or corrected sight (usually particles with less than a diameter of 50 µm)
2	Particles are only visible with the naked eye or corrected sight (usually particles with a diameter between 50 µm and 100 µm)
3	Particles are clearly visible with the naked eye or corrected sight (particles with a diameter of up to 0.5 mm)
4	Diameter of particles is between 0.5 mm and 2.5 mm
5	Diameter of particles is bigger than 2.5 mm

Requirements:

Dust quantity and size of particles must not exceed class 2.

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.

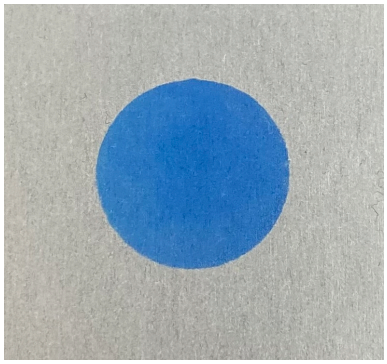
The chemical supplier must specify the layer deposition (min-max.) of the conversion layer on all substrates (aluminum, steel, zinc) in writing for each system.

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:



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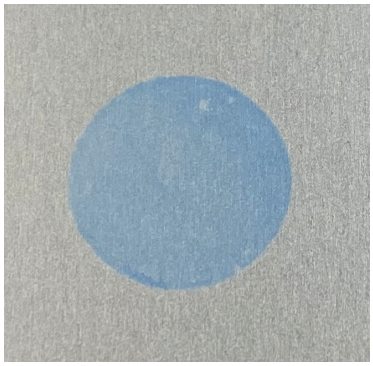

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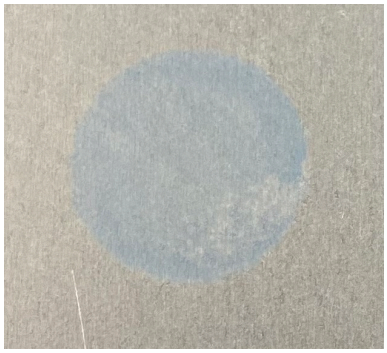


not OK

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 ΔE, ΔL, Δa, Δb, color distancing formula (ΔE_{ab} ΔE_{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

The procedure describes the adhesive strength of the paint film on the substrate respectively the previous layer. The pull-off test is used for liquid coatings.

The coating material(s) for the coating to be tested or the coating system is (are) applied in an even layer on a flat test panel with a uniform surface structure.

After drying/hardening test stamps are glued directly on the coated test panel.

After hardening of the glue the test stamps are removed with a tensile tester and the force required to tear off the test stamp is measured.

To avoid possible bending of the substrates during the pull-off test, test stamps with smaller diameter of 2 cm as used for steel substrates may be used to reduce the applied force.

The test result is the minimum tensile stress that must be applied to break the weakest interface (adhesion break) or the weakest point (cohesive break) of the test assembly. Adhesion breaks and cohesive breaks may occur next to each other (mixed breaks).

Method A or B must be used.

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

This procedure is used to assess flexibility. It must be carried out in the same way for all substrates (aluminum, steel, stainless steel and strip-galvanized steel).

Requirements:

- Single-layer system: bending around an 8-mm mandrel.
- Two-layer system: bending around a 12-mm mandrel.

The assessments must be carried out from a distance of 10 mm to the corresponding edge. Viewed with the naked eye the coating may show slight crack formation. Cracks down to the base material are not permitted. Delamination of the substrate is not admissible. The bending mandrel test cannot be carried out on batch-galvanized base material and blasted material with a sheet thickness of 2 mm.

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

The procedure is used to determine impact resistance of powder coats.

The impact must be carried out on the uncoated side. The evaluation, however, is made on the coated side. The test may be performed directly or indirectly. The impact is to be carried out with a weigth piece of 1,000 +/- 10 g.

The impact is carried out on aluminum (single-layer systems) with the energy of 22-inch pounds (2.5 Nm = 25 cm/kg).

The impact is carried out on steel, stainless steel and galvanized steel (single-layer systems) with the energy of 16-inch pounds (1.8 Nm = 18 cm/kg).

In case of two-layer systems the impact is carried out on all substrates with the energy of 22-inch pounds (2.5 Nm = 25 cm/kg).

In case of two-layer systems the impact must be carried out on the coated side. The assessment is also made on the coated side.

Requirements:

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.

The impact test must not be carried out on blasted base material with a sheet thickness of 2 mm.

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.

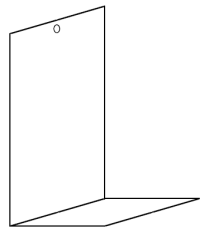
The solution for the neutral Machu test has a pH-value of 7.0. This pH-value is achieved by adding NaOH. After 24 hours further 5 ml/l hydrogen peroxide (H_2O_2 30 mass-%) are added.

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 0 and 0.

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

Applicable for the quality mark “Flüssigbeschichtung in der Schienenfahrzeugindustrie“ („Liquid coating in the rail vehicle industry“).

Corrosion test under cyclically changing stress.

The test must be carried out on test panels according to chapter 0.

The coating on aluminium and steel is scratched with a longitudinal cut of 1 mm width down to the base material using a Sikkens scratch stylus. The test must be carried out on test panels.

Stress according to DIN EN ISO 11997-1 cycle B.

Duration of testing:

- indoor application 4 cycles
- outdor application 6 cycles

After the last exposure to condensation water stress, the test panels are rinsed with tap water, dried and then tested for the degree of blistering according to DIN EN ISO 4628-2.

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.

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.

Requirements:

- Corrosion and delamination at the scratch is assessed according to DIN EN ISO 4628-8.
- Corrosion on the scribe: c < 2 mm
- Delamination of the coating on the scribe: d < 2 mm
- 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 penals have fulfilled the requirements.

If two or more test penals do not meet the requirements, either the entire test must be repeated or a classification in the lower passed application (indoor application) takes place.

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

Test for determining the pre-treatment quality.

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

The test must be carried out on test panels according to chapters 0 and 0.

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

The test must be carried out on test panels of aluminium, steel and FGRP acc. to chapter 0.

Duration of testing:

- indoor application: holding time 240 h
- outdor application holding time 480 h

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 a classification into the lower passed application (indoor application) takes place.

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 Pre-treatment baths (degreasing, etching etc.)	Temperature pH value conductivity degreasing effect concentration	X X X X ---	X X X X ---	X X X X X	X X X X X	I-II: 1 x daily according to supplier specifications 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 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)

to be tested	type of test	specifications		minimum scope	records
		application			
		interior	exterior		
appearance	visual	X	X	on customer specification	informal
gloss	reflektometer value	X	X	on customer specification	Minimum and maximum values
layer thicknes[1)]	measurement	X	X	Acc. to sampling scheme	Minimum and maximum values
determination of hue	measurement hue pattern	X	X	for decorative components	informal
[1)] acc. to in-house control chapter I.12.3 (coating surface)					

K.6 Tests on test panels CDC coating

to be tested	type of test	Specifications	Minimum scope	Records
		Stress group		
		I - III		
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

to be tested	Type of test	Specifications					Minimum scope	Records
		Stress group						
		I	II	III	IV	V		
Gloss	Reflectometer value	X	X	X	X	X	1 x per order [1)] and shift	Minimum and maximum values
Layer 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
Deformability	Bend test[2)]		X	X	X	X	1 x per order [1)] and shift	Minimum and maximum values
Deformability under dynamic stress (cross-linking test for powder coats)	Impact test[3)]		X	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 Exposure time (min)		30	60	120	180	1 x per day	1 x per day

[1)] > 100 m²
[2)] Not on blasted material with 2 mm sheet thickness and hot-dip galvanized material
[3)] Not on blasted material with 2 mm sheet thickness

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

to be tested	Type of test	Specifications					Minimum scope	Records
		Stress group						
		I	II	III	IV	V		
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 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

to be tested	type of test	specifications					minimum scope	records
		stress groups						
		I	II	III	IV	V+VI		
gloss	reflektometer value	X	X	X	X	X	on customer specification	Minimum and maximum values
layer thickness	measurement	X	X	X	X	X	1 x per order [1] and shift	Minimum and maximum values
adhesive strength	cross-cut / X-cut	X	X	X	X	X	1 x per order [1] and shift	characteristics
[1] > 100 m²								

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.