TECHNICAL SPECIFICATION

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1. General Information

1.1. Scope

QUALISTEELCOAT is an international quality label for the coating of steel with organic coatings.

Being the most frequently used construction material in the architectural and industrial field, steel must be protected against corrosion. If corrosion protection is achieved by organic coatings, then this falls in the field of application of QUALISTEELCOAT.

The requirements of QUALISTEELCOAT go beyond corrosion protection and include requirements for mechanical characteristics, weathering resistance and decorative appearance.

In this specification QUALISTEELCOAT defines the quality level and the requirements a coating company must achieve internally to be able to offer their products on the market as a company licensed by QUALISTEELCOAT.

It includes the definition of quality requirements on coating companies, coating systems and the approval of coating material, as well as the regular external quality control of coating companies holding a QUALISTEELCOAT quality label.

Only coating systems which are in line with this specification shall be used. The coating company shall only use coating material for which the material's supplier has acquired an approval by QUALISTEELCOAT.

The corresponding license document indicates for which coating systems and corrosivity categories a coating company holding a QUALISTEELCOAT license is qualified.

1.2. QUALISTEELCOAT corrosivity class

The ISO Standard 12944 is international acknowledged as technical standard for the protection of steel with liquid coatings. Therefore, QUALISTEELCOAT is using the **atmospheric corrosivity classes** C1 to C5 as described in ISO 12944 part 2.

The ISO 12944 standard however, is limited to coating substances which dry or harden under ambient conditions – thus liquid coating without forced drying. ISO 12944 explicitly excludes powder coatings, stoving enamels, thermosetting coating material as well as other coating systems from the scope of application. But as the corrosivity categories of ISO 12944 part 2 are widely recognized and referred to in many other specifications, QUALISTEELCOAT uses them as basis for all types of organic coating systems.

ISO 12944-2 defines 5 general atmospheric corrosivity categories ranging from C1 to C5. These categories combined with the expected lifetime High (H) are the basis for the classification of the QUALISTEELCOAT coating system and the licences for QUALISTEELCOAT coaters. The following table shows the corrosivity categories per ISO 12944-2 (1998)

Corrosivity category	Examples for typical ambient conditions in a moderate climate	
	interior	exterior
C1 very low	heated buildings with clean atmospheres, e.g. offices, shops, schools, hotels.	-
C2 low	atmosphere with low level of pollution; mostly rural areas	unheated buildings where condensation may occur, e.g. depots, sports halls.
C3 medium	urban and industrial atmospheres, moderate sulphur dioxide pollution; coastal areas with low salinity	production rooms with high humidity and some air pollution, e.g. food processing plants, laundries, breweries, dairies
C4 high	industrial areas and coastal areas with moderate salinity	chemical plants, swimming pools, coastal ship- and boatyards
C5-I very high (industrial)	industrial areas with high humidity and aggressive atmosphere	buildings and areas with almost permanent condensation and with high pollution
C5-M very high (marine)	coastal and offshore areas with high salinity	buildings and areas with almost permanent condensation and with high pollution

Beside the atmospheric corrosivity category ISO 12944 part 1 defines a lifetime that fixes the time until the steel parts must undergo a first major maintenance painting. This standard durability is expressed in 3 ranges:

low (L) 2 to 5 years
medium (M) 5 to 15 years
high (H) more than 15 years

The technical requirements on corrosivity categories of QUALISTEELCOAT in this specification always refer to the expected lifetime “high” (more than 15 years). Only the requirements of this category in the corrosivity categories C1 - C5 are taken as a basis for the approval of the coating material and the awarding of licenses to coating companies.

The QUALISTEELCOAT corrosivity class is defined by the corrosivity Category in combination with the expected lifetime high (H).

However, this term of protection is no warranty period. The warranty period is fixed per statutory provisions as well as agreements between the parties.

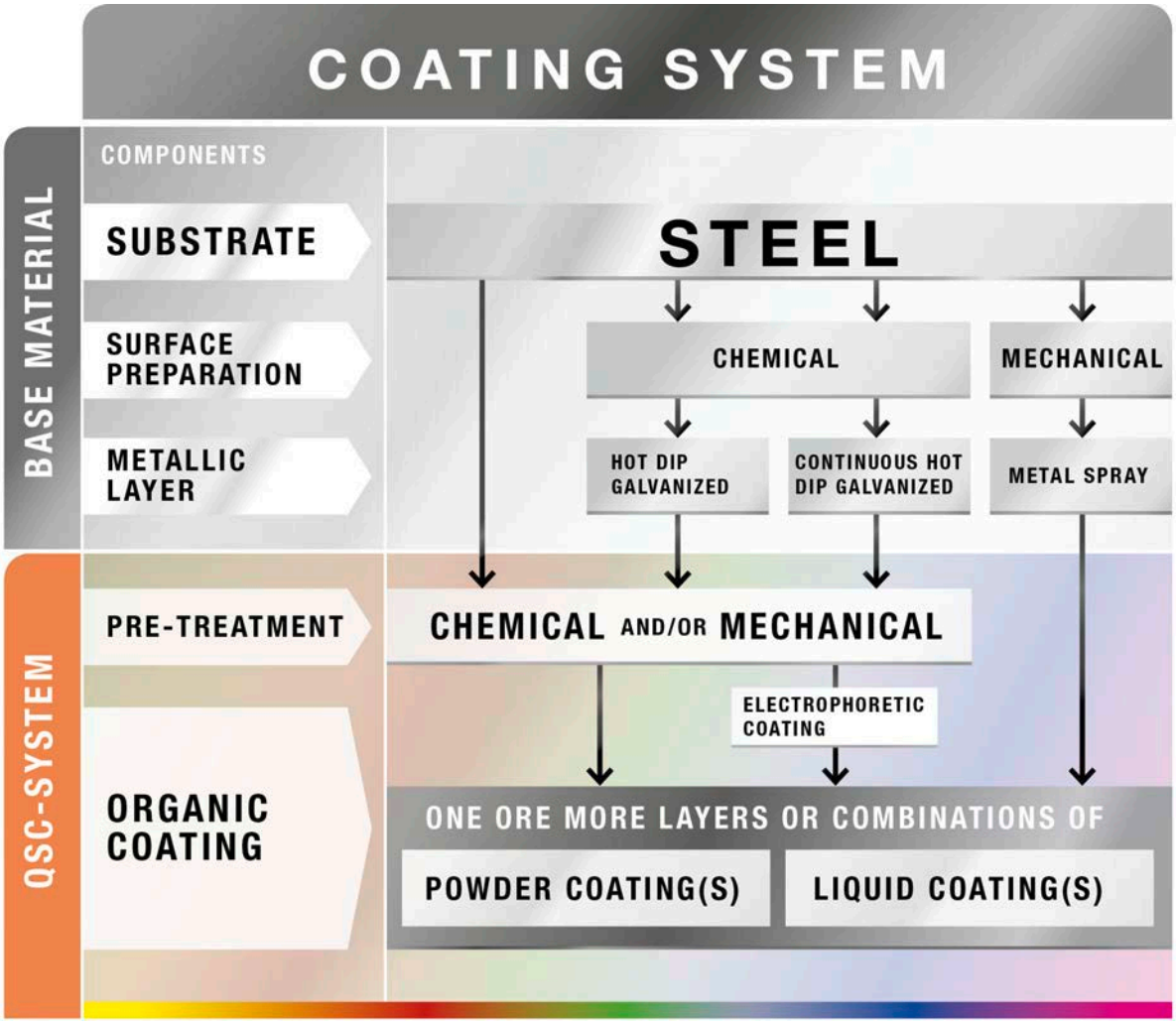
1.3. QUALISTEELCOAT coating system

A QUALISTEELCOAT coating system (QCS) is defined by the base material, the pre-treatment method and the type of the organic coating.

The license attributed to a coater or an approval for a coating system is always related to a QUALISTEELCOAT coating system.

All coating materials used for the QUALISTEELCOAT coating systems must be QUALISTEELCOAT approved by their suppliers and licenced QUALISTEELCOAT coaters can use them to produce the QUALISTEELCOAT coating systems that are indicated on their licence.

QUALISTEELCOAT coating systems are grouped by the type of base material, the type ofpre-treatment and the type of organic coatings. Powder coatings and liquid coatings have special requirements as defined in this specification.



All QUALISTEELCOAT coating systems are based on this specification. For each group of coating systems (liquid or Powder coating) the special requirements describing the type of coating systems including the maximal QUALISTEELCOAT corrosivity category that can be archived with the system. For Example: A Powder Coating System with only one layer Coating on Steel can theoretically pass in the laboratory the test requirements for the neutral salt spray test for C3 high. But in the scope of QUALISTEELCOAT it is restricted to a maximum QUALISTEELCOAT corrosivity class of C2.

For each type of coating system, the quality assurance of the coater and the requirements for the approvals of coating systems are clearly defined.

In case of a combination of different types of coating systems (i.e. a combination of liquid coating, electrophoretic coating and powder coating) the type of the QUALISTEELCOAT coating system is defined by the top-layer.

Requests for the approval of coating systems not yet defined by QUALISTEELCOAT are possible by written request to the QUALISTEELCOAT secretariat. It will be decided by the technical committee if an approval for such a system is possible.

1.3.1. Liquid coating systems

ISO 12944-5 defines examples for coating systems which are based on liquid coatings. QUALISTEELCOAT assumes the example systems which are established on the market, as specification for the approval of liquid coating systems. QUALISTEELCOAT approvals are based on the requirements of ISO 12944-5.

1.3.2. Powder coating systems

The specifications and recommendations of ISO 12944-5 do not apply to powder and electrophoretic coating systems. Therefore, QUALISTEELCOAT developed the following table as basis for the approval of powder coating systems[1] containing specifications for the approval of QUALISTEELCOAT coating systems based on these organic coating systems. The table contains indications about the potential corrosivity category for which the system can be approved. Systems can also be approved for lower corrosivity categories, but not for higher ones than mentioned in the table, even if this would be theoretically possible per the results of the laboratory tests.

The following table indicates the Powder coating systems that are possible for approvals as QUALISTEELCOAT coating systems including the QUALISTEELCOAT corrosivity classes they are allowed for.

Base material	Number of powder coating layers		C1	C2	C3	C4	C5-M	C5-I
Steel	1	ST1						
	2	ST2						
	3	ST3						
Continuously galvanized steel	1	SZ1						
	2	SZ2						
	3	SZ3						
Hot-dip galvanized steel (batch-galvanized)	1	HD1						
	2	HD2						
	3	HD3						
Steel coated by thermal spraying (MS)	1	MS1						
	2	MS2						
	3	MS3						
Steel with 1 layer electrophoretic coating (STEC)	1	STEC2						
	2	STEC3						
Hot-dip galvanized Steel with 1 layer electrophoretic coating (HDEC)	1	HDEC2						

The QUALISTEELCOAT coating systems for Powder coating systems including the pre-treatment methods and the required layer thickness are detailed in Annex 4.

Note to pre-treatment: The supplier of a QUALISTEELCOAT coating system shall specify which pre-treatment is allowed for his system. However, C3 is the maximum corrosivity category for chemical pre-treatment based on iron phosphate or without forming a conversion layer. (See chapter 2.2.2)

[1] These specifications are only valid for thermosetting powder coating systems not for thermoplastic. QUALISTEELCOAT has the intention to cover these in a later edition.

1.4. Terminology and Definitions

Approval: Coating material tested in a testing laboratory and fulfilling the requirements of the present specification gets an QUALISTEELCOAT approval.

Base material: The defined base materials in QUALISTEELCOAT coating systems are steel (ST), continuously galvanized steel (SZ), hot-dip galvanized steel (HD), thermally sprayed parts with layers of aluminium alloys or zinc on steel (MS), but also electrophoretic coated steel (STEC) and hot dip galvanized steel with one layer of electrophoretic coat (HDEC)

Coating material: Organic coating material approved by QUALISTEELCOAT as part of a QUALISTEELCOAT coating system.

QUALISTEELCOAT coating system: The complete layer composition of organic layers on the base material including the mechanical and/or chemical pre-treatment is defined as QUALISTEELCOAT coating system. See chapter 1.3

Corrosivity category: Classifications of the principal environments to which steel constructions are exposed as they are detailed in ISO 12944 part 2. Those environments are classified from C1 (very low) to C5-I (Very high, Industrial) or C5-M (Very high, marine). For more details See chapter 1.2 of this specification.

Expected lifetime: The period specified in ISO 12944 part 1 until the first maintenance task by repainting the coating. The term of protection “high” (more than 15 years) is always taken as a basis when defining QUALISTEELCOAT coating systems.

QUALISTEELCOAT corrosivity class: The QUALISTEELCOAT corrosivity class C1 high - C5 M high or C5-I high is defined by the Corrosivity Category (C1-C5-M or C5-I) in combination with the expected lifetime high (H)

General licensee: An organization which is authorized by QUALISTEELCOAT to manage the QUALISTEELCOAT quality label in a country or region. Per the statutes this organization has a voice in the legal bodies of QUALISTEELCOAT. To avoid possible conflicts of interest, it is excluded that a testing institute which is commissioned with QUALISTEELCOAT inspections or approvals acts as general licensee.

Hot-dip galvanized steel (HDG): The requirements specified in ISO 1461 as well as further regulatory requirements, if applicable, e.g. DAST guideline 022.

Licensee: A coater who is authorized to use the QUALISTEELCOAT quality label based on this specification.

License: The quality label QUALISTEELCOAT granted to a coater fulfilling the requirements of the present specification.

Metal spray: Thermal spraying of zinc, aluminium and their alloys per ISO 2063.

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.

Substrate: In line with the QUALISTEELCOAT specification the base material steel is always defined as substrate, which principally can be all types of steel. However, specific requirements may apply: in the case of stainless steel as base material, for example, the requirements on corrosion protection are only applicable to a limited extent.

Surface preparation: The surface preparation is the pre-treatment of the steel substrate prior to the metallization (i.e. galvanizing, metal spray), as well as the removal of imperfections at welds, edges and other areas of the steel substrates prior to the painting. Only the latter is covered by the QUALISTEELCOAT specification.

Testing laboratory: An independent laboratory, appointed by the national general licensee and approved by QUALISTEELCOAT, to carry out all the assessments necessary for the QUALISTEELCOAT quality label, both for coating systems and for coaters. The laboratory must be accredited according ISO/IEC 17025 general requirements for the Competence of Testing and Calibration laboratories and must be acknowledged by QUALISTEELCOAT.

QUALICOAT: Quality label for liquid and powder organic coatings on aluminium for architectural applications. See www.qualicoat.net

1.5. Liability Disclaimer

QUALISTEELCOAT stands for a quality label and attributes its label based on inspection or testing reports issued by a qualified laboratory. The results of those reports are based on the quality at the moment of testing. QUALISTEELCOAT cannot be liable for any consequences or damages whatsoever, directly or indirectly imposed to 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 having a QUALISTEELCOAT label.

2. Requirements to get a licence

2.1. Application for a QUALISTEELCOAT license

Any coater of steel constructions or steel equipment can apply for a QUALISTEELCOAT license. A letter of intent expressing the company's engagement to obtain a QUALISTEELCOAT license must be addressed to the general licensee that is responsible in the country where the company is situated. If there is no general licensee the letter can be sent to QUALISTEELCOAT - c/o AC-Fiduciaire SA, P.O. Box 1507, CH-8027 Zürich, Switzerland.

The letter of intent must define the coating system in detail and the corrosion category the coater wishes to apply for.

Every QUALISTEELCOAT licensee must use QUALISTEELCOAT approved coating systems.

A QUALISTEELCOAT licensee can obtain a label for **one or more** QUALISTEELCOAT coating systems. It is indicated on his licence document for which systems he obtained his QUALISTEELCOAT licence and which corrosivity classes can be achieved with these systems.

QUALISTEELCOAT coating systems are not valid for a higher QUALISTEELCOAT corrosivity class as mentioned on the licence. But they are valid for lower corrosivity classes covered with the same coating system.[2]

2.2. First inspection

After receipt of the letter of intent, the general licensee will start up the procedure and contact the testing laboratory, which will contact the coater for an appointment.
During the first inspection, the coater must use coating objects corresponding to the corrosion category the coater requests the license for.

The inspection will be performed per the official QUALISTEELCOAT checklist in its latest version. The inspector from the testing laboratory will check especially the following points:

2.2.1. QUALISTEELCOAT coating system

The coater shall define his coating system or systems by transmitting for each approval his unique system name, which includes the coating-system-number per QUALISTEELCOAT. This includes the kind of pre-treatment process (chemical, mechanical or both) the manufacturer and the related coating materials.

The inspector will check that the coater uses coating materials that are part of an approved coating system on the parts or test panels that will be tested.

[2] The COATER may use coating material that is approved for QUALISTEELCOAT corrosivity category C4. But the coaters may with his set-up and pre-treatment only can archive the lab results for C3. In that case the system will be restricted on the coaters licence on C3.

2.2.2. Pre-treatment methods and restrictions for corrosivity classes

The supplier of a QUALISTEELCOAT coating system (QCS) must specify generally the pre-treatment method that is allowed for the coating system. Beside that any chemical pre-treatment without conversion layer (i.e. degreasing or etching) based only on iron-phosphate is restricted to corrosivity class 3! This also applies for the pre-treatment of electrophoretic coated material.

2.2.3. Electrophoretic coating

If the coater is applying a QUALISTEELCOAT coating system that includes electrophoretic coating (STEC or HDEC) the requirements for pre-treatment accordingly to chapter 3.5 must be fulfilled.

If the Electrophoretic coating is applied externally, the coater must install a suitable control for the incoming goods and verify the Coatability of the parts. In this case a cleaning process is required before further coating. This process must be defined by the supplier of the QUALISTEELCOAT coating system.

2.2.4. Laboratory equipment

The required testing equipment must be available and functional, together with the relevant documents. The inspector must verify that the laboratory equipment is functioning as described. This includes the verification of measuring results.

2.2.5. The production process

Both the pre-treatment process and the actual coating process will be monitored.
All the equipment used at the production lines should be properly working. This will be checked.

2.2.6. Assessment of QUALISTEELCOAT coating systems for the coater

The inspector must take enough test panels[3] **from all QUALISTEELCOAT SYSTEMS that the coater wants to apply for**. These test panels are for the final assessment to perform all necessary tests in the QUALISTEELCOAT approved laboratory as shown in the following table:

required test	**by the inspector in the plant (*)**	**in the laboratory**	**number of panels to be tested**
dry film thickness	x	x	all panels per sampling plan
adhesion	x	x	1
direct impact resistance test	x	x	1
gloss	x	x	1 (mean of 10 measurements)
wet adhesion		x	3 (not applicable for coating systems on zinc and thermal spray metallic layers)
neutral salt spray test		x	6 for C5, 5 for C4, 4 for C3
resistance to humidity		x	3
chemical resistance		x	9 (3 for each solution) only for C5I
resistance to humid atmospheres containing sulphur dioxide		x	3 (only for C5I)

(*) The test panels can be produced during the inspection and used for the in-house control. In case not all the test panels can be produced during the inspection the company can send the panels to the approved laboratory for the assessment. The samples must be sent no later than 2 weeks after the date of the inspection. Alternatively, a general licensee of QUALISTEELCOAT can decide, that the test panels from all licensees will be send at a certain Date directly to the testing laboratory for Assessment.

It is the responsibility of the general licensee to decide about the procedure and to organize and monitor the Assessment of test panels.

In case a coater is not sure about the performance of his coating system he can optionally request the inspector and the laboratory to test the system additionally for a lower corrosivity category. In such case the request must be made during the inspection at the latest and the inspector must prepare enough additional test panels for the laboratory tests.

2.2.7. In-house control and registers

The inspector will check that in-house control has been carried out and that the coating plant maintains the required registers. The results recorded in the registers must be coherent with the results obtained on the test panels. Test panels must be kept and provided for the inspector for one year, and the registers must be stored for five years.

[3] For type and dimensions of test panels see chapter 4.4 Types of test panels

2.2.8. Training

Personnel involved in the pre-treatment process, the coating operation and quality inspection shall be qualified based on proper education, training or experience. Appropriate records of training shall be established and maintained. Furthermore, training needs shall be identified and provided, as well as documented.

2.3. Final assessment for granting the license

The inspection report must be submitted to the general licensee. If a coater is in a country or region without general licensee the report will be sent to QUALISTEELCOAT in Zürich. If the result of the inspection meets the requirements, a license to use the QUALISTEELCOAT label will be granted.

The coater can apply for any corrosivity category in correspondence with the allowed corrosivity class for the applied QUALISTEELCOAT coating system for which enough panels with positive test result were tested at the testing laboratory.

2.4. Inspections of licensees, routine inspection

After a plant, has been granted a license to use the QUALISTEELCOAT label, it will be inspected once every year. This is called routine inspection. This routine inspection can be announced by the inspector as long the general licensee does not instruct otherwise.

The routine follows all requirements of the first inspection according chapter 2.2.
The assessment of all QUALISTEELCOAT coating system on the coaters licence accordingly to chapter 2.2.6 must be repeated every 2 years. If there have been major changes in the Pre-treatment process or in the line repetition must be made after 1 year.

The inspection report must be submitted to the general licensee. If no general licensee is available, the report will be sent to QUALISTEELCOAT in Zürich. If the result of the routine inspection meets the requirements, authorization to use the quality label will continue and a new licence document will be issued by QUALISTEELCOAT.

If the coater is not satisfied with the corrosivity category he achieved as result of the inspection (e.g. the result is lower than in his existing licence), he can ask for an additional voluntary inspection. This request must be made during 30 calendar days after receiving the test results. If the second inspection does not lift the unsatisfactory requirement, the coater will be informed in a letter explaining the reasons for the momentary refusal, and the license for the lower corrosivity category is granted. The coater must wait at least three months before making a new license application for a higher corrosivity category.

2.5. Change of chemistry

When the coater modifies his pre-treatment process chemistry in an important way or introduces a new type of pre-treatment process chemistry, he must notify the general licensee, and apply for a new QUALISTEELCOAT license.

2.6. Use of the QUALISTEELCOAT Logo by the coater

The use of the logo must comply with the Regulations for the use of the QUALISTEELCOAT quality label (see www.QUALISTEELCOAT.net).

2.7. Company status change

The QUALISTEELCOAT label is not transferable. However, if a company holding a QUALISTEELCOAT license is subject of a fusion or taken over by another company, then the license is transferred to the new owner. If for whatever reason the company stops its activities as a coater, the QUALISTEELCOAT label granted to the company will lose its validity.

3. Quality assurance by the coater

The inspector from the testing laboratory will evaluate the quality assurance system set up by the coater by assessing the following points:

3.1. In-house control procedures

The coater shall have set up a quality control system including an internal test plan in accordance with the present specification. Both the production methods and the coated products must be monitored and tested.
This specification contains detailed information about the parameters or properties that must be tested, the test frequency, and where in the process will be tested.

The internal test plan also needs an estimation of the duration of the tests, and a statement on any required resources. If a supplier specifies further parameters or tests, they also must be followed.

3.2. Technical control room

The coater must set up a technical control room or a laboratory facility that is separated from the production facilities. This room must be equipped to assess the quality of the process, the pre-treated and the coated parts.
technical information and the instruction manuals of every testing device, showing the identification number must be available. All instruments must be in good working condition and functioning.
The technical data sheets (TDS) and the material safety data sheets (MSDS) of all the products must be available to the responsible persons, as well as the applicable Standards or precise working instructions describing the test procedures.

3.3. Control register and quality documentation

The results of the in-house control must be recorded and be easily accessible to the inspector. This control register with numbered pages or a computer record must be maintained by the laboratory supervisor and must include all the measurement results and laboratory tests. The control register must show the nominal values, maximum values not to be exceeded and the measured values. Any corrective measures, when required or implemented, must be noted in the register. The register must be kept for a period of five years.

The register must contain the following information:

- the name of the customer and the order or lot identification
- corrosivity category of the environment in which the product will be used
- gloss, colour or RAL number and visual reference of the colour (colour card or model piece)
- references on the blasting media with dates of their removal or renewal
- references of the used coating: product name and manufacturer; batch numbers; for liquid coatings, both base and the curing agent and eventually the thinner
- the application date of the different coating layers
- thickness of the different layers of the coating system
- list of responsible persons with their name, their function/responsibility and department
- test results of all specified quality control tests and parameters per this specification including the date and time, the set nominal values and corrective measures

3.4. Requirements for storage

3.4.1. Storage of coating material

The storage of coating materials must comply with the applicable safety requirements. Only the coating used during the application, and in case of liquid coating the additional thinner, may be present in the coating application area.
All coating materials must be stored in a dry room, protected against freezing or too high temperature (see technical data sheet for temperature range), isolated from the production facilities and protected from any contamination.

3.4.2. Storage of parts for coating process

Every lot of parts in the company must be labelled or must be clearly identifiable.

The coated products must be stored in a suitable area. The parts must be packed for transport as soon as possible.

Parts not accepted by quality control must be clearly identified and kept separated from the accepted parts.

Pre-treated parts should preferably be coated immediately after pre-treatment process. They must not be stored for more time than mentioned in the table below, and never in a dusty or harmful atmosphere. At all times zinc corrosion products, must be avoided.
The storage conditions must not allow condensation onto the parts. All workers handling pre-treated parts must wear clean textile gloves to avoid contamination of the surface.

Material	**dry and dust-free atmosphere**	**atmosphere with humidity more than 70%**
parts for C1 - C3	≤ 24 hours	≤ 3 hours
parts for C4 - C5	≤ 8 hours	
hot-dip galvanized material and thermal sprayed parts after blasting or sweeping	≤ 3 hours	

3.5. Quality control for pre-treatment process

For the pre-treatment process, a coater is equipped with either a mechanical pre-treatment (e.g. blasting booth) or a chemical pre-treatment process. A combination of these is possible.

Detailed information on types of surfaces and surface preparation can be found in ISO 12944-4. Some substrates will however require a supplementary treatment.

The base material can be contaminated with oil and grease, marks with chalk or paint, stickers or other, as dirt or oxidation. Prior to the pre-treatment process and the application of a coating system or with any such surface contamination must be removed by suitable means.

The purpose of the pre-treatment process is to prepare the substrate for the application of the protective coating system, and consists in sandblasting or in a chemical treatment, or both.
Every surface treatment must be done in the plant. Only hot-dip galvanizing, continuous hot-dip galvanizing and the application of an electrophoretic coating can be subcontracted.

If steel is cut by laser, the cutting edge will be oxidized, unless nitrogen gas or alike is used during the cutting. This oxide must be removed, either mechanically by brushing or sanding or any other suitable method, or by pickling with an acid. In case of various metal combinations, a preliminary testing of such combinations is mandatory.

3.5.1. Quality control for surface preparation and pre-treatment by blasting

The coater must check his production methods and products per the following methods and frequency.

required test	C1 – C2	C3 – C5
Coatability of parts	every lot	
Blast cleanliness and dust removal	random testing twice per day	
Surface roughness (blasting only steel)	not applicable	once per shift
Assessment of the zinc layer thickness after blasting or sweeping (only for hot-dip galvanized steel)		once per shift
Difference between dew point and surface temperature	twice per day - morning & late afternoon every lot of parts suspected of too low temperature	

If the blasting is followed by a conversion treatment, the quality control for chemical pre-treatment process must be fulfilled too.

3.5.2. Laboratory and inspection equipment for Mechanical pre-treatment process

All coaters must have a

- dew-point-meter
- thermometer
- Dust-Tape-Kit ISO 8502-3

coaters with category C3-C5 must have in addition a

- roughness measurement device (if applicable)
- thickness measurement gauge for zinc layer thickness (if applicable)

3.5.3. Quality control for chemical pre-treatment process

The coater must check his production methods and products **per the chemical supplier's recommendations** but at least per the following frequency.

required test	C1 – C2	C3 – C5
Coatability of parts	every lot	
concentration of pre-treatment process baths per the supplier's instructions		once per day
assessment of pH value of baths per the supplier's instructions	once per day	once per shift
conductivity of rinsing water (last rinse)		once per shift
temperature of pre-treatment process baths	once per day	
content of Zn and Al with a method according to the supplier´s recommendations		once per day

required test	C1 – C2	C3 – C5
drying temperature		once per day
assessment of the zinc layer thickness after pickling (only for hot-dip galvanized steel)		once per shift
assessment of conversion coating		visual once per shift, and chrome free once per month
weight of the conversion layer		once per month
surface preparation		visual

3.5.4. Laboratory and inspection equipment for chemical pre-treatment process

All coaters must have a

- pH-meter
- thermometer

coaters with corrosivity category C3-C5 (if applicable) must have in addition a

- thickness measurement gauge for zinc layer thickness
- chemicals to determine the bath concentrations
- conductivity meter
- temperature test strip for drying oven
- test solutions and equipment to test the chemical conversion coating per the chemicals supplier's instructions
- test solutions for Zn and Al content (only if combined zinc aluminium pickling bath and/or conversion coating bath is used)

3.6. Quality control for finished products

Whenever possible, tests should be carried out on parts from the production. This may require a supplementary number of parts from the customer. When test panels are used, these shall match with the production parts and the coating system.

The coater must check his production methods and coated products per the following methods and frequency, based on the type of coating system.

3.6.1. Quality control for Powder coating systems

required test	C1 – C2	C3 – C5
dry film thickness	every order per the sampling plan	
adhesion	once per shift on 1 test panel	
direct impact resistance test	not applicable	Once per shift on 1 test panel[4].
gloss	twice per shift on production parts or test panels	
determination of dew point	not applicable	every lot of parts suspected of too low temperature (base material)
assessment of stoving conditions (measurement on products representative for the coated parts in thickness, geometry and position in the oven)	actual oven temperature once per day. once per month a 4-point measurement	actual oven temperature twice per day. once per week a 4-point measurement
visual appearance	every order	
wet adhesion	not applicable	every order on 1 test panel[5]

3.6.2. Quality control for liquid coating systems

required test	C1 – C5
dry film thickness	every order per the sampling plan
adhesion	once per shift on 1 part or test panel
gloss	not applicable (only on customer's request)
determination of dew point	twice per day
assessment of forced drying conditions (if applicable)	twice per day: morning & late afternoon and every lot of parts suspected of too low temperature
visual appearance	every order

3.7. Laboratory and inspection equipment for finished products

All coaters must have a

- dry film thickness gauge
- gloss meter 60º
- cross cut tester or pull-off tester for adhesion
- thermometer

The following equipment is necessary if applicable according the tables in chapter 3.6

- recording instrument for object temperature and curing time with 4 measuring points
- equipment for dew-point measurement
- wet adhesion test equipment

[4] For type and dimensions of test panels see chapter 4.4 Types of test panels

[5] The wet adhesion test is not applicable for coating systems on zinc and thermal spray metallic layers)

4. Approval of coating systems

To maintain an optimal performance of the paint systems that are applied by the QUALISTEELCOAT licensed coater, the quality of the coating that is supplied by coating manufacturers is tested. In this part of the specification, the test methods and acceptable test result limits are given.

A coater can only use an approved coating system for those applications where the QUALISTEELCOAT label is involved. All approved and valid coating systems are listed on the QUALISTEELCOAT website.

A QUALISTEELCOAT coating system is defined by:

- the substrate steel
- the optional presence and the type of a metallic layer (e.g. HDG, Thermal spray)
- type of surface pre-treatment (chemical/mechanical)
- number and type of organic layers
- gloss category of the topcoat, (matt, satin, glossy)
- finish of the topcoat (smooth or textured)

For multiple organic layers, the QUALISTEELCOAT approval can be valid for different QUALICOAT approved topcoats of the same supplier and in the same QUALICOAT class (UV resistance) Those QUALICOAT approvals (P-Numbers) need to be communicated to the laboratory before granting an approval or renewal.

Only QUALICOAT class 1 or 2 are valid for QUALISTEELCOAT systems.

The definition of gloss categories corresponds to QUALICOAT specified in the table below:

gloss category	**gloss range**	**acceptable variation***
1 (matt)	0 - 30	+/- 5 units
2 (satin)	31 -70	+/- 7 units
3 (glossy)	71-100	+/- 10 units

4.1. Application for the approval of a coating system

Any company may apply for the approval of a coating system. A QUALISTEELCOAT approval for a coating system will be attributed to a coating manufacturer, or to any company that defines, partially or completely, the formulation of the coating, but relies for the manufacturing on a third party. The applicant is called Supplier.

In case a QUALISTEELCOAT coating system consists of different layers of primer, intermediate coats and topcoats from different manufacturers, the approval must be made by one supplier who takes responsibility for the whole QUALISTEELCOAT coating system. This applies also in case of Combinations with Electrophoretic coatings (STEC or HDEC). In all such cases the supplier and type of the different materials must be indicated.

The company addresses a letter of intent expressing its engagement to obtain a QUALISTEELCOAT approval to the general licensee responsible for the country the company is located in. If there is no general licensee in the country, the letter can be sent to QUALISTEELCOAT - c/o AC-Fiduciaire SA, P.O. Box 1507, CH-8027 Zürich, Switzerland.

4.2. First approval of a coating system

The testing laboratory will contact the supplier. The necessary quantities of coating products and/or test panels will be handed over to the testing laboratory. If possible, the testing laboratory will prepare the test panels, but for a possible zinc layer or chemical pre-treatment process, it might be necessary to rely on a subcontractor, which is therefore allowed.

For the initial approval of topcoats, the colours RAL 9010, RAL 7016 and RAL 6005 will be tested.[6]

The supplier provides all the necessary information on his coating system to the testing laboratory, including details on the successive coating layers to apply and the minimal film thickness of every layer. All the corresponding product data sheets must also be transmitted.

All the tests will be executed on a complete system as defined above, unless otherwise specified. The testing laboratory will allow the coating system to cure properly per the supplier's instructions before starting the tests. All samples must be produced at lowest specified curing temperatures and shortest corresponding curing times per the technical data sheet of the supplier.

The testing laboratory submits the test results to the general licensee. In case there is no general licencee in the region the test results are submitted directly to QUALISTEELCOAT in Zürich.

If the test results meet the requirements a QUALISTEELCOAT approval for the coating system will be granted to the supplier.

If the test results do not meet the requirements, the supplier will be informed with a letter by the general licencee explaining the reasons for the momentary refusal. The supplier must wait at least three months before making a new application for an approval.

The QUALISTEELCOAT approval for a coating system is valid for the licensed company and for all its production sites where the approved coating is manufactured. However, the coating manufacturer must assure by using the QUALISTEELCOAT approval, that the composition of the produced coating is identical to the approved coating.

4.3. Renewal of an approval for a coating system

The QUALISTEELCOAT approval for a coating system remains valid for two full calendar years. The supplier provides the testing laboratory with the necessary coating products and test panels for the renewal application. The tests required for the renewal application are the same as for the initial application. The validity of the first approval for a coating system spans from the date of approval until the end of the second year following on the year of the approval. The renewal is for two years.

[6] If the topcoat has already a Qualicoat approval the accelerated weathering test and the natural weathering test by QUALICOAT is accepted and has not to be repeated (See chapter 4.5)

Every two years, the technical committee of QUALISTEELCOAT defines the colour that shall be submitted to the testing for the next two years. A rotation between RAL 9005 – RAL 7016 – RAL 6005 will be effective.

If the topcoat of the QUALISTEELCOAT coating system already has a valid QUALICOAT approval, some of the properties do not have to be re-tested. These tests are marked with (*) in the tables of required tests. The supplier must clearly identify which QUALICOAT P-Numbers belong to the tested QUALISTEELCOAT system. This will be mentioned on the approval. He shall make a rotation of the different P-numbers for the renewal tests.

The test report from the QUALISTEELCOAT laboratory must be submitted through the general licensee to QUALISTEELCOAT secretariat. The secretariat decides on renewal or withdrawal of the approval. In case of noncompliance, the tests that failed are repeated on samples taken from another batch. If the second series of tests do not lead to satisfactory results, but corresponds to a lower corrosivity category, the approval is decreased to this lower category if the sufficient number of test panels for the category is examined and has passed. The supplier of the tested product can submit a new application for an approval for the higher level at any time, in such case the full test range must be repeated.

Any change in the base formula (binder, hardener, additives) of the coating product implies, however that it must be considered as a new product, which consequently requires a new QUALISTEELCOAT approval.

Also, test results for artificial weathering and outdoor exposure tests from approved laboratories, collected to obtain other quality labels, may be used as test results for the QUALISTEELCOAT approval, if the conducted tests comply with these specifications and the test report is approved by the testing laboratory.

4.4. Types of test panels

type	purpose	composition of panel	application	dimension
A	mechanical tests	test panels bare steel + zinc phosphate + organic layer	applied by the testing laboratory	105 x 190 mm 0,75 mm thick
B	corrosion tests	substrate + complete coating system (eventual surface preparation + eventual metallic layer + eventual pre-treatment + organic layer)	applied by the supplier of the coating system or by the testing laboratory	140 x 70 mm DC01 1-2 mm thick
C	Florida	test panels EN AW5005 +organic layer	applied by the testing laboratory	300 x 100 mm 1 mm thick

4.5. Laboratory tests for the approval of Powder coating system

This chapter lists the tests, the type and number of panels that must be performed for the approval. test procedures, assessments and requirements are listed in chapter 5 testing procedures and requirements.

required test	panel	number of panels to be tested
dry film thickness	A, B, C	all panels
adhesion	B	1
direct impact resistance test	A, B	1
gloss	A	1 (mean of 10 measurements)
wet adhesion (resistance to boiling water)	B	3 (not applicable for coating systems on zinc and thermal spray metallic layers)
resistance to mortar (*)	B	3 (not necessary for QUALICOAT approved systems)
neutral salt spray test	B	6 (3 for final evaluation and 3 for a pre-evaluation 1 category earlier)
resistance to humidity	B	3
chemical resistance	B	9 (3 for each solution) only C5I
resistance to humid atmospheres containing sulphur dioxide	B	3 only C5I
accelerated weathering (*)	A or C	2 (1 for testing, 1 for reference)
natural weathering (*)	C	4 (3 for testing, 1 for reference)

(*) These tests are not necessary for topcoats with QUALICOAT approval or for interior approvals.

4.6. Laboratory tests for the approval of liquid coating systems

This chapter lists the tests, the type and number of panels that must be performed for the approval. Test procedures, assessments and requirements are listed in chapter 5 testing procedures and requirements.

The testing laboratory will prepare test panels with the dimensions the testing laboratory is used to work with, or alternatively use panels of approximately 150x70 mm, with a thickness between 0.5 and 2 mm.

The preparation of the panels must be in accordance with the QUALISTEELCOAT specification.

- Steel panels of cold rolled steel are prepared to a degree of cleanliness Sa 2 ½ or Sa 3, per ISO 8501-1. The roughness Rz must be between 50 µm and 100 µm. Blasted panels are de-dusted prior to the application of the primer coating.
- Hot-dip galvanized or continuous hot-dip galvanized panels of the same dimensions may be bought or prepared by a subcontractor. The former panels are sweep blasted prior to the application of the primer coat; the latter panels may be sweep blasted prior to the application of the primer coat, per the instructions of the coating manufacturer. The panels can eventually also be chemically pre-treated.
- A subcontractor may prepare thermal sprayed panels of the same dimensions.

required test	panel	number of panels to be tested
dry film thickness	A, B, C	all panels
adhesion	B	1
neutral salt spray test	B	6 (3 for final evaluation and 3 for a pre-evaluation 1 category earlier)
resistance to humidity	B	3
chemical resistance	B	9 (3 for each solution) only for C5 Industrial
resistance to humid atmospheres containing sulphur dioxide	B	3 only for C5 Industrial
accelerated weathering (*)	A	2 (1 for testing, 1 for reference)
natural weathering (*)	C	4 (3 for testing, 1 for reference)

(*) These tests are not necessary for topcoats with QUALICOAT approval or for topcoats for interior use per ISO 12944-2 (see Annex 1).

4.7. Use of the QUALISTEELCOAT Logo by the Supplier of a QUALISTEELCOAT coating system

The use of the logo must comply with the Regulations for the use of the QUALISTEELCOAT quality label (see www.QUALISTEELCOAT.net).

coating systems or products that belong to a QUALISTEELCOAT coating system can be identified by the text on the label: "Part of QSC-system" or "Part of QUALISTEELCOAT coating system".

5. Testing procedures and requirements

5.1. Coatability of parts

The following questions should be considered to evaluate the suitability of an object for the application of a coating system:

- Is the pre-treatment process adapted to the work piece?
- Can the coating system be applied to this substrate?
- Is the paint system suitable for the corrosivity category?
- Is the preparation grade suitable per the table below?

Doubts about the suitability of the object for the application of the considered coating system must be discussed with the customer. A written agreement must then be available.

Apart from that for structures with an expected corrosivity category from C3H and higher the preparation grade in accordance with ISO 8501-3 preparation grade must fulfil the requirements shown in the table below.

P1- Light preparation
P2 - Thorough preparation
P3 - Very thorough preparation

Expected life of the corrosion protection [a]	**Corrosivity category** [b]	**Preparation grade**
> 15 years	C1	P1
	C2 to C3	P2
	Above C3	P2 or P3 as specified
5 years to 15 years	C1 to C3	P1
	Above C3	P2
< 5 years	C1 to C4	P1
	C5 – Im	P2
[a] [b] Expected life of the corrosion protection and corrosivity category are referenced in EN ISO 12944 and EN ISO 14713-1 as relevant.		

For a liquid coating system, the edges shall be protected by a stripe coat extending across approximately 25 mm on both sides of the edge and applied to a nominal thickness appropriate to the coating system.

Requirements:
The questions regarding the coatability need to be positively answered and the preparation grade must fulfil the requirements of the table above. The testing of coatability must be reported in the register.

5.2. Determination of surface roughness

The roughness of the substrate after blasting must be assessed.
The used parameter is R_z (average distance between the highest peak and lowest valley)
The coater has the choice of the method in accordance with:

- ISO 8503-2 surface profile comparators
- ISO 8503-4 stylus instrument
- ISO 8503-5 replica tape

Requirements for mechanical pre-treatment process:
For liquid coatings R_z must be in the range from 50 - 100µm or otherwise as specified by the coating manufacturer in the technical data sheet.

5.3. Assessment of Zinc coating after sweep blasting or pickling

A zinc coating must be made ready to be coated, and dross particles, droplets and sharp points, zinc ashes, zinc flakes, flux residues, and the like must be removed. Additional sweeping may be necessary. This must be done with a fine grade non-metallic abrasive at low pressure at an angle of 30-35° to the surface. Pickling of zinc coating is done in an acid or alkaline bath, or eventually both in different steps.

Requirements:
The remaining zinc layer thickness after sweep blasting and/or pickling must comply with ISO 1461 - Table 3, as shown below in the table. The required thickness is related to the dimension of the steel parts.

parts and dimensions (mm)	minimum thickness	average thickness
steel ≥ 6 mm	≥ 70 µm	≥ 85 µm
steel ≥ 3 mm and < 6 mm	≥ 55 µm	≥ 70 µm
steel ≥ 1,5 mm and < 3 mm	≥ 60 µm	≥ 70 µm
steel < 1,5 mm	≥ 35 µm	≥ 45 µm
cast iron ≥ 6 mm	≥ 70 µm	≥ 80 µm
cast iron < 6 mm	≥ 60 µm	≥ 70 µm

5.4. Inspection of surface cleanliness after blasting

The surface must be very thoroughly blast cleaned (Sa 2 ½) per
ISO 8501-1. Prior to an eventual chemical pre-treatment process and prior to the primer application, the surface must be de-dusted.
The remaining dust quantity and size must be evaluated per ISO 8502-3. Therefore, the dust will be removed with a specific tape and visually evaluated. It is recommended to use a professional ISO 8502-3 Dust-Tape-Kit.

class	description of dust particles
0	particles not visible under 10x magnification
1	particles visible under 10x magnification but not with normal or corrected vision (usually particles less than 50 μ m in diameter)
2	particles just visible with normal or corrected vision (usually particles between 50 μ m and 100 μ m in diameter)
3	particles clearly visible with normal or corrected vision (particles up to 0.5 mm in diameter)
4	particles between 0.5 mm and 2.5 mm in diameter
5	particles larger than 2.5 mm in diameter

Requirements:
Dust quantity and dust size must not exceed class 1.

5.5. Determination of the conductivity of dripping water

The final rinse preceeding the conversion bath must be done with deionized water. The conductivity must comply with the supplier's instructions.

The measurement with the conductivity meter includes one measurement in the rinsing-bath before rinsing and one measure of the dripping water after final rinse.

Requirements:
If not otherwise prescribed by the chemical supplier, the conductivity of dripping water shall not exceed 30 µS/cm at 25°C.

5.6. Assessment of the conversion coating

The assessment for quality control of conversion coatings varies a lot for each system and different suppliers. The minimum requirements are defined in chapter 3.5.3

Requirements:
The chemical supplier's recommendations about the test method, frequency and the minimum requirements of this specification.

5.7. Assessment of stoving conditions

The temperature in the curing oven (powder coatings) and the object temperature must be measured with a 4-point measuring device. Three detectors must be attached to the parts (in the top, middle and bottom of the oven) and one to measure the air temperature amidst the parts.

Requirements:
Stoving time and temperature must meet the specifications of the coating system.

5.8. Assessment of forced drying conditions

For forced drying (liquid coatings) the temperature of the substrate in the drying oven must be measured. This may be done by means of a 4-point measuring device, using temperature probes attached to the substrate.

Requirements:

Forced drying time and temperature must meet the specifications of the coating system.

5.9. Determination of dew point

The dew point is the temperature at which water condenses at the same rate at which it evaporates. The measurement must be done with a dew point meter. The measurement is only required if it is expected, that the temperature of the parts for before coating could possibly be below the requirements of 3°C above the dew point temperature. This can happen if parts are stored outside in cold climate conditions or in unheated factories before blasting or before coating and the factory is not using a drying oven after the pre-treatment.

Requirements:
The substrate temperature for any coating application must be at least 3°C above the dew point.

5.10. Adhesion

The adhesion of the coating system onto the substrate can be measured by the following methods:

- cross cut test (ISO 2409)
- pull-off test (ISO 16276-1)

For film thickness of organic layers exceeding 250 µm, only the pull-off test per ISO 16276-1 can be used.

Requirements:
The cross-cut test requires a level 0 or maximum 1. The adhesion at the pull-off test shall be higher 5 MPa.

5.11. Direct impact resistance test

The direct impact resistance is determined per ISO 6272-1 using a 20-mm diameter spherical indenter dropped under standard conditions.
For powder coatings with a thickness d≥60 µm, a mass of one kilo that falls from a height of 25 cm must be used. Test panels must have the thickness of the parts they are linked to.

Requirements:
coating systems should not show any cracking or any detachment of the coating from the substrate.

5.12. Determination of dry film thickness

The dry film thickness of the individual layers in the system and the total dry film thickness shall be measured with a thickness gauge per ISO 2808.

The measurements must be representative of the inspected area.
Per ISO 19840, the total coated surface can be used to determine the number of necessary measurements. The sampling plan consists of the number of measurements to be taken in an inspection area, and is as follows:

area/length of the inspected area (m^2 or running meter)	minimum number of measurements	maximum number of measurements allowed to be repeated
up to 1	5	1
above 1 to 3	10	2
above 3 to 10	15	3
above 10 to 30	20	4
above 30 to 100	30	6
above 100	add 10 for every additional 100 m^2 or running meter	20 % of the minimum number of measurements

In case of rough substrates (e.g. sandblasted steel or HDG) the values will be corrected per ISO 19840.

surface profile in accordance with ISO 8503-1	correction value
fine	measured value – 10 µm
medium	measured value – 25 µm
coarse	measured value – 40 µm

Requirements:
The arithmetic mean of all individual dry film thicknesses is equal to or greater than the required thickness.
All individual measurements are equal to or above 80 % of the required thickness.
The arithmetic mean shall not exceed the maximum imposed by the coating manufacturer, or in absence of such a value the maximum dry film thickness (individual value) shall be not greater than three times the nominal dry film thickness.

5.13. Visual appearance

Any visual inspection of coated parts should be done at 3 m for an interior setting and 5 m for an exterior setting in diffuse daylight and with a normal unaided vision.

Requirements:
At these distances and in diffuse daylight, the coating must not show any wrinkles, runs, sags, craters, blisters and other surface irregularities. Irregularities that are an image of the steel surface or the hot-dip galvanized zinc, visible through the coating, must be disregarded.

Colour and gloss may be measured if agreed upon between customer and coater.

5.14. Gloss

Gloss is measured per ISO 2813, using incident light at an angle of 60°.

Note: If the significant surface is too small or unsuitable for gloss to be measured with the gloss meter, the gloss should be compared visually with a reference sample, both observed under the same viewing angle.

Requirements:
Low gloss: (0 – 30) ± 5 units
Semi-gloss: (31 – 70) ± 7 units
High gloss: (71 – 100) ± 10 units

5.15. Wet adhesion

The objective of this test is to determine the resistance of the coating system to cracking and loss of adhesion after accelerated aging by hot water. The coater or testing lab can decide wich test is preferably used.

Method 1 with boiling water:
2 hours' immersion in boiling demineralised water (maximum 10 µS at 20°C). Remove the test sample and allow it to cool down to room temperature. Apply an adhesive tape to the surface, ensuring that no air is trapped. After one minute, remove the tape at an angle of 45° with a sharp even pull.

Method 2 with a pressure cooker:
Add demineralised water (maximum 10 µS at 20°C) to a pressure cooker with an internal diameter of about 200 mm or more to a depth of 25 mm and place a test panel measuring 50 mm in it. Place the lid in position and heat the pressure cooker until steam escapes from the valve. The weighted needle valve shall be adjusted to produce an internal pressure of 100 +/-10 kPA (1 bar). Continue heating for 1 hour, timing from the moment when steam first escapes from the valve. Cool the pressure cooker, remove the sample and allow it to cool down to room temperature. Apply an adhesive tape to the surface, ensuring that no air is trapped. After one minute, remove the tape at any angle of 45° with a sharp even pull.

Requirements:
No blistering more than 2 (S2) per ISO 4628-2. There shall not be any defects or detachment. Some slight colour change is acceptable.

5.16. Resistance to mortar

Per EN 12206-1 mortar is a mixture of sand, lime and water. The mortar must be prepared by mixing 15 g of hydrated lime, 41 g of cement and 244 g of sand with sufficient tap water to make a soft paste. Apply four portions of the mortar, approximately 15 mm in diameter and 6 mm thick, to the test panel. Place the test panel horizontally at 38 ± 3ºC and 95 ± 5% relative humidity for 24 hours. Then manually remove the mortar from the coated surface and remove any residue with a damp cloth. Allow the panel to dry, and examine the coating with normal or corrected vision.

Requirements:
The mortar must be easily removable without leaving any residue. Any mechanical damage to the coating caused by grains of sand must be disregarded. The panel should not show any change in appearance or in colour after the test.

5.17. Neutral Salt spray test (NSS)

The objective of this test is to determine the corrosion resistance of the coating system. For the corrosive categories, the test results will give an indication of the durability of the coating system.

Test panels without a metallic zinc layer must be scratched. In the middle of the test panel, scribe a cross to expose the substrate. The cross shall be a rectangular cross in which each of the diagonals has a length of 50 mm, the intersection is centred in the middle of the panel and the scribe lines intersect at 90 º.

Test panels with a metallic zinc layer shall not be scratched

Place the coated test piece in a spray cabinet complying with EN ISO 9227 – continuous salt spray. After testing, remove the sample carefully from the test cabinet, wash the test panels in de-ionized water at a temperature of less than 35ºC, and dry immediately. A cross cut test will be performed on each panel.

Attempt to lift the coating from the scribed line with a sharp tool. Examine the area around the scribed cross. Per following formula:

$$M = \frac{C - W}{2}$$

M = corrosion and delamination of the substrate from the scribe (mm)
C = average of nine measurements of corrosion including the worst points of corrosion (mm)
W = width of the scratch (mm)

Number of samples: 3 panels type B for each corrosivity-category

Requirements:

category	exposure time (based on ISO 12944-6)
C1 high	not applicable
C2 high	240 h (10 days)
C3 high	480 h (20 days)
C4 high	720 h (30 days)
C5 high (industrial or marine)	1440 h (60 days)

assessment	requirement
blistering (ISO 4628-2)	0
rusting (ISO 4628-3)	Ri0
cracking (ISO 4628-4)	0 (S0)
flaking (ISO 4628-5)	0 (S0)
delamination (ISO 4628-8)	M ≤ 3 mm
corrosion (ISO 4628-8)	M ≤ 1 mm (For C5 ≤ 2 mm)
adhesion (ISO 2409)	0 or 1

rating	number of samples passed / failed	consequence for inspection / application
A	3 / 0	passed
B	2 / 1	passed
C	1 / 2	failed
D	0 / 3	failed

5.18. Resistance to humidity

The determination of the resistance of organic layers to humidity is evaluated per ISO 6270-2 Category CH: condensation atmosphere with constant humidity (also knows as continuous condensation test). The test is not applicable to corrosivity category C1. The exposure time for the other corrosivity categories is based on ISO 12944-6.

Number of samples: 3 panels type B for each corrosivity category

Requirements:

category	exposure time (based on ISO 12944-6)	
	base material steel	base material zinc
C1 high	not applicable	not applicable
C2 high	120 h (5 days)	240 h (10 days)
C3 high	240 h (10 days)	240 h (10 days)
C4 high	480 h (20 days)	480 h (20 days)
C5 high (industrial or marine)	720 h (30 days)	720 h (30 days)

assessment	requirement
blistering (ISO 4628-2)	0
rusting (ISO 4628-3)	Ri0
cracking (ISO 4628-4)	(0) S0
flaking (ISO 4628-5)	(0) S0

rating	number of samples passed / failed	consequence for inspection / application
A	3 / 0	passed
B	2 / 1	passed
C	1 / 2	failed
D	0 / 3	failed

5.19. Chemical resistance

The chemical resistance of the coating system, corresponding to highly industrial environments is determined per ISO 2812-1, Method 1 - procedure A for 168 hours and **only for the corrosivity category C5 I (Industrial).** The following three different solutions must be used:

- NaOH 10 % (m/m) aqueous solution
- H_2SO_4 10 % (m/m) aqueous solution
- mineral spirits, containing 18% of aromatic compounds

The samples are placed in a container holding the described test liquid.
Assessment is done immediately after the test and with the unaided eye.

Requirements:

category	exposure time (based on ISO 12944-6)
C5 high (industrial)	168 h (7 days)

assessment	requirement
blistering (ISO 4628-2)	0
rusting (ISO 4628-3)	Ri0
cracking (ISO 4628-4)	(0) S0
flaking (ISO 4628-5)	(0) S0

rating	number of samples passed / failed	consequence for inspection / application
A	3 / 0	passed
B	2 / 1	passed
C	1 / 2	failed
D	0 / 3	failed

5.20. Resistance to humid atmospheres containing sulphur dioxide

The objective of this test - called Kesternich test - is to determine the resistance of coating systems to heavily polluted atmospheres, and therefore only applicable to the corrosion category C5I (Industrial). The coated surface is exposed to 0.2 litre of SO_2 in a test cabinet for 720 hours per ISO 3231. Assessment is done immediately after the test and with the unaided eye

Requirements:

category	exposure time (based on ISO 12944-6)
C5 high (industrial)	720 h (30 days)

No surface defects or discoloration shall be observed.

assessment	requirement
blistering (ISO 4628-2)	0
rusting (ISO 4628-3)	Ri0
cracking (ISO 4628-4)	(0) S0
flaking (ISO 4628-5)	(0) S0

rating	number of samples passed / failed	consequence for inspection / application
A	3 / 0	passed
B	2 / 1	passed
C	1 / 2	failed
D	0 / 3	failed

5.21. Accelerated weathering

This test simulates the resistance to discoloration and loss of gloss for an exterior use of coated products, and is executed per ISO 16474-2. This test is only required for coating systems in corrosivity categories C3-C5.
After 1000 h exposure, the test specimen is rinsed in demineralized water.

To assess gloss and colour, mean of 10 measurements will be made on the cleaned, weathered sample and on the unexposed reference panel.

Requirements:

parameter	measurement method	acceptance criteria
loss of gloss	gloss measurement at 60° in accordance with ISO 2813	gloss must be above 50 % of the initial value
colour change	ΔE in accordance with ISO 11664-4	in accordance with acceptable ΔE values determined by QUALICOAT

5.22. Natural weathering

The resistance of a coating system to weathering because of exposure in Florida is evaluated. This test only applies to coating systems intended for outdoor exposure. The test is executed by exposing the coating materials in Florida per EN 13438, A.4.8.2 and following the procedures per ISO 2810.

The test must start in april and the samples must be exposed to the elements facing 5° south for one year.
After exposure, the exposed samples must be cleaned using the following method:
Wash the test panels prior to inspection with water containing 1% neutral detergent, using a sponge and avoiding polishing. Afterwards rinse the panels with water with a maximum electrical conductivity of 10 µS/cm. This process must not scratch the surface.
To assess gloss and colour, three measurements will be made on each of the cleaned, weathered samples and on the unexposed reference panels. These measurements must be made at different points at least 50 mm apart.

Requirements:

parameter	measurement method	acceptance criteria
loss of gloss	gloss measurement at 60° in accordance with ISO 2813	gloss must be above 50 % of the initial value
colour change	ΔE in accordance with ISO 11664-4	in accordance with acceptable ΔE values determined by QUALICOAT

ANNEX 1 – LIST of applicable Standards

Standard		Title
EN	13438	Paints and varnishes - Powder organic coatings for hot dip galvanised or sherardised steel products for construction purposes (EN 13438:2013-12)
ISO	1461	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods (ISO 1461:2009)
ISO	2409	Paints and varnishes - Cross-cut test (ISO 2409:2013-02)
ISO	2808	Paints and varnishes - Determination of film thickness (ISO 2808:2007-02)
ISO	2810	Paints and varnishes - Natural weathering of coatings - Exposure and assessment (ISO 2810:2004-07)
ISO	2813	Paints and varnishes - Determination of gloss value at 20°, 60° and 85° (ISO 2813:2014-10)
ISO	3231	Paints and varnishes - Determination of resistance to humid atmospheres containing sulfur dioxide (ISO 3231:1993-01)
ISO	9227	Corrosion tests in artificial atmospheres - Salt spray tests (ISO 9227:2015-09)
ISO/IEC	17025	General requirements for the competence of testing and calibration laboratories; Technical Corrigendum 1 (ISO/IEC 17025 Technical Corrigendum 1:2006-08)
ISO	11664 1-6	Colorimetry – Part 1: CIE standard colorimetric observers (ISO 11664-1:2011-07)
ISO	11664 4	Colorimetry - Part 4: CIE 1976 L*a*b* Colour space
ISO	12944-1	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 1: General introduction (ISO 12944-1:1998-05)
ISO	12944-2	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 2: Classification of environments (ISO 12944-2:1998-05)
ISO	12944-3	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 3: Design considerations (ISO 12944-3:1998-05)
ISO	12944-4	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 4: Types of surface and surface preparation (ISO 12944-4:1998-05)
ISO	12944-5	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 5: Protective paint systems (ISO 12944-5:2007-09)
ISO	12944-6	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 6: Laboratory performance test methods (ISO 12944-6:1998-05)
ISO	12944-7	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 7: Execution and supervision of paint work (ISO 12944-7:1998-05)
ISO	12944-8	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 8: Development of specifications for new work and maintenance (ISO 12944-8:1998-05)
ISO	16276-1	Corrosion protection of steel structures by protective paint systems - Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating - Part 1: Pull-off testing (ISO 16276-1:2007-05)
ISO	2812-1	Paints and varnishes - Determination of resistance to liquids - Part 1: Immersion in liquids other than water (ISO 2812-1:2007-01)
ISO	4628 -2	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 2: Assessment of degree of blistering (ISO 4628-2:2016-01)
ISO	4628-3	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 3: Assessment of degree of rusting (ISO 4628-3:2016-01)
ISO	4628-4	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 4: Assessment of degree of cracking (ISO 4628-4:2016-01)
ISO	4628-5	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 5: Assessment of degree of flaking (ISO 4628-5:2016-01)

ANNEX 1 – LIST of applicable Standards

Standard	Title
ISO 6270-2	Paints and varnishes - Determination of resistance to humidity - Part 2: Procedure for exposing test specimens in condensation-water atmospheres (ISO 6270-2:2005-07)
ISO 6272-1	Paints and varnishes - Rapid-deformation (impact resistance) tests - Part 1: Falling-weight test, large-area indenter (ISO 6272-1:2011-08)
ISO 8501-1	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings (ISO 8501-1:2007-05)
ISO 8501-3	Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 3: Preparation grades of welds, edges and other areas with surface imperfections (ISO 8501-3:2006-03)
ISO 8502-3	Preparation of steel substrates before application of paint and related products - tests for the assessment of surface cleanliness - Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method) (ISO 8502-3:1992-10)
ISO 8503-1	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates - Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces (ISO 8503-1:2012-02)
ISO 8503-2	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates - Part 2: Method for the grading of surface profile of abrasive blast-cleaned steel - Comparator procedure (ISO 8503-2:2012-02)
ISO 8503-4	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates - Part 4: Method for the calibration of ISO surface profile comparators and for the determination of surface profile - Stylus instrument procedure (ISO 8503-4:2012-02)
ISO 8503-5	Preparation of steel substrates before application of paints and related products - Surface roughness characteristics of blast-cleaned steel substrates - Part 5: Replica tape method for the determination of the surface profile (ISO 8503-5:2003-07)
ISO 16474-1	Paints and varnishes -- Methods of exposure to laboratory light sources -- Part 1: General guidance (ISO 16474-1:2013-11)
ISO 16474-2	Paints and varnishes -- Methods of exposure to laboratory light sources -- Part 2: Xenon-arc lamps (ISO 16474-2:2013-11)
ISO 2063	Thermal spraying - Metallic and other inorganic coatings - Zinc, aluminium and their alloys (ISO 2063:2005-03)
ISO 14713-1	Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 1: General principles of design and corrosion resistance (ISO 14713-1:2009-12)
ISO 19840	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces (ISO 19840:2012-09)
EN 1090-1	Execution of steel structures and aluminium structures - Part 1: Requirements for conformity assessment of structural components; German version EN 1090-1:2009+A1:2011 (EN 1090-1:2012-02
EN 1090-2	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures; (EN 1090-2:2011)

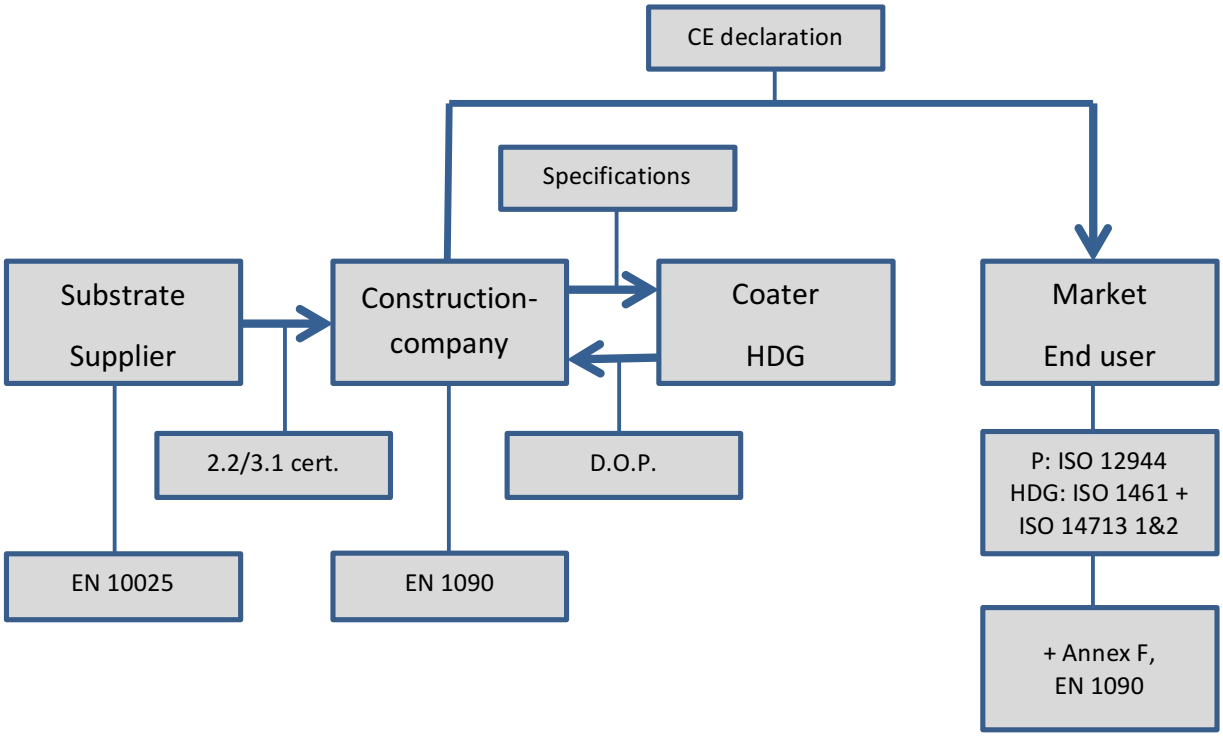
Annex 2: Voluntarily requirements to comply with EN 1090.

Voluntary part of the Qualisteelcoat specifications, to meet the EN1090 requirements.

In fact, for a coater there is not an obligation to give a Declaration of Conformity (DoC). This obligation is for the party that brings the product to the market, and a coater mostly works on order of a construction company or product company.

Due to the fact that EN 1090 adresses the party that brings the product on the market, A coater can do the declaration by himself that his in-house Control and production process fulfils the requirements of EN 1090. However, if a problem occurs, and the coater declared the performance by himself, and the procedures are not right, the customer (construction company) is in deep problems, and will have a significant penalty. If a customer wants to avoid that, either he have to do the audit by himself, or he have to do an audit by an external party. It is obvious, a declaration by a notified body is must stronger than a do it yourself audit, and that is much stronger than a self-declaration of performance by your supplier.

So, for an above mentioned company, it is rather convenient to work with a coater or HDG that do have a guaranteed working process in line with the EN 1090. So it is an advantage to audit the coater in line with the EN 1090 as an extra option on the Qualisteelcoat specifications.



ISO 9001.

The EN 1090 is covered by the Qualisteelcoat specifications with the exception of:
1. Personnel chart with educated tests.
2. The description of the order to the coater with the written coating specifications.
3. An incoming goods procedure.
4. A procedure for customers with complains.

In most cases, an ISO 9001 can cover these aspects, however, one should verify this.

Annex 2: Voluntarily requirements to comply with EN 1090.

Items of the EN1090 not (completely) covered by the Qualisteelcoat specification if this voluntary part is not executed.

EN 1090-1 Section 6.3.2 Personnel

Responsibilities, authorities and cooperation of all employees in managerial, executive or supervising functions, which have an impact on the conformity of the product, must be determined.

>>The company needs to have an organisation chart, descriptions of functions and responsibilities and a record of qualification of personnel.

As an example, one can use the following table.

Name employee	Date of birth	Education level	Test to do	Date instruction	Instruction valid to	Instructor

EN 1090-1 Section 6.3.6, EN 1090-2 attachment F, Coating specification

The coating system is defined by:

The expected lifetime (ISO 12944-1)and corrosivity class (ISO 12944-2), to be specified by the customer. The coater has to define a coating system which meets these requirements.

Or;

The coating system is specified by the customer. If applicable special working procedures regarding pre-treatment and/or special coating application are specified.
The coating system to be applied must be indicated in the order specification.
The coater must implement a written supervising and verifying schedule for the verification and recording of the components coated in compliance with the order specification.

>> The coater has to have a procedure for defining a proper coating system according ISO 12944 in case the customer specifies an expected lifetime and corrosivity class. If the customer does not specify an expected lifetime and corrosivity class, the coater needs a procedure to assure the right system for the right use and/or circumstances. The coater has to check if the preparation grade is specified and executed according EN 1090-2, 10.2 (EN-ISO 8501-3).

All necessary information to execute the corrosion protection according the EN 1090 (preparation, corrosivity class and lifetime or coating system, testing requirements, special instructions regarding masking holes or edges) has to be provided by the customer and all this information must be clearly stated on the order guidance form or fabrication form:

- P-grade
- Pre-treatment
- Paintsystem
- Layer thickness

- Special requirements

EN 1090-2 Section 10.2, 12.6 and Annex F, Incoming goods (products to be coated)

All surfaces to which paints and related products are to be applied shall be prepared to meet the criteria of EN ISO 8501. The preparation grade according to EN ISO 8501-3 shall be specified.

If the expected life of the corrosion protection and corrosivity category are specified, the preparation grade shall be in accordance with Table 22. Integratie EN1090 en Quali-labels 150626 Thermally cut surfaces, edges and welds shall be suitably smooth and able to achieve the specified roughness after subsequent surface preparation (see Annex F).

NOTE Thermally cut surfaces are sometimes too hard for the abrasive material to achieve the suitable surface roughness. The procedure test specified in 6.4.4 may be used to establish surface hardness and determine whether grinding is necessary.

If the structure is to be protected against corrosion, inspection of the structure prior to corrosion protection shall be carried out against the requirements of Clause 10.
All surfaces, welds and edges shall be visually inspected. The acceptance criteria shall meet requirements of EN ISO 8501.

>> The company has to have a procedure for visual inspection of all surfaces, welding joints and edges (preparation grade ISO8501-3, EN13438) to check the coatability of incoming goods. Also the action if the coatability is not sufficient must be described.

EN 1090-1, 6.3.8 and annex F, Checking and non-conforming products

Inspection and checking shall be undertaken in accordance with the quality plan. The execution specification shall specify any requirements for additional inspection and testing. Inspection and checking, including routine checking shall be recorded.

The manufacturer shall have written procedures that specify how to deal with non-conforming products. Such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures.

>> The coater must have procedures how to determine and treat non-conforming products. All cases of non-conformity must be recorded. Non-conforming products must be clearly and visibly marked.

Annex 3 : Interior Coating Systems with Powder Coating

Coating System codification	REFERENCE base material + number of organic layers	Surface Preparation	Base material	Pretreatment	Organic layer							C1	Corrosivity Class			
					primer		Intermediate Coat	Type	Topcoat	Total coating system			C2	C3	C4	C5I C5M
					Type	µm	µm		µm	Number of organic layers (@)	µm (@)					
IP-ST1-100	ST1		ST	Chemical degreasing				EP/P	60	1	60	✓	×	×	×	×
IP-ST2-100	ST2		ST	Chemical (*)	Z/ZF	50		EP/P	60	2	110	✓	✓	×	×	×
IP-ST2-101	ST2		ST	Chemical (*)	Z/ZF	50		EP/P	80	2	130	✓	✓	✓	×	×
IP-ST2-200	ST2		ST	Mechanical (SA 2 1/2)	Z/ZF	50		EP/P	60	2	130	✓	✓	✓	×	×
IP-ZE1-200	?		ZE 50/50	Chemical degreasing				EP/P	60	1	60	✓	✓	×	×	×
IP-ZE1-201	?		ZE 50/50	Chemical degreasing				EP/P	60	1	60	✓	✓	×	×	×
IP-ZE1-300	?		ZE 100/100	Chemical Deoxidation				EP/P	80	1	80	✓	✓	✓	×	×
IP-SZ1-100	SZ1		Z 100	Chemical degreasing				EP/P	60	1	60	✓	✓	×	×	×
IP-SZ1-300	SZ1		Z 100	Chemical Deoxidation				EP/P	60	1	60	✓	✓	×	×	×
IP-SZ1-101	SZ1		Z 225	Chemical degreasing				EP/P	80	1	80	✓	✓	✓	×	×
IP-SZ1-400	SZ1		Z 225	Mechanical (sweeping)				EP/P	60	1	60	✓	✓	✓	×	×
IP-SZ1-301	SZ1		Z 225	Chemical Deoxidation				EP/P	80	1	80	✓	✓	✓	✓	×
IP-HD1-100	HD1		HDG	Chemical (*)				EP/P	60	1	60	✓	✓	✓	×	×
IP-HD1-101	HD1		HDG	Chemical (*)				EP/P	80	1	80	✓	✓	✓	✓	×
IP-HD1-400	HD1		HDG	Mechanical (sweeping)				EP/P	80	1	80	✓	✓	✓	✓	×
IP-MS1-700	MS1	Sa 3	MS 50 µm	none				EP/P	60	1	60	✓	✓	×	×	×
IP-MS1-701	MS1	Sa 3	MS 50 µm	none				EP/P	80	1	80	✓	✓	✓	×	×
IP-STEC2-600	STEC2		EC	EC-pretreatment (#)				EP/P	60	1	60	✓	✓	×	×	×
IP-STEC2-601	STEC2		EC	EC-pretreatment (#)				EP/P	80	1	80	✓	✓	✓	×	×

Codification :

ST	Steel
Z100	Continuous hot dip galvanized steel (coil) with 100 g/m² zinc
Z225	Continuous hot dip galvanized steel (coil) with 225 g/m² zinc
HDG	Hot Dip Galvanized Steel
MS	Metal Spray
ZE	Electroplated zinc
EC	Electrophoretic primer (e-coat) 15 µm
Z	zinc flakes containing powder primer
ZF	zinc free powder primer
(*)	Conversion de surface EN 13438 (annex B). Following the procedure and supplier recommendations.
✓	Recommended
✓	This Coating System requires agreement between interested parties (ISO 2063)
×	Not possible to
EC-pretreatment (#)	Only degreasing except for integrated electrophoretic lines.
@	Number of organic layers and total layer thickness EC **EXCLUDED**

EP/P	Epoxy Polyester

Annex 4 : Exterior Coating Systems with Powder Coating

Coating System codification	REFERENCE base material + number of organic layers	Surface Preparation	Base material	Pretreatment	Organic layer						Corrosivity Class			
					primer		Intermediate Coat	Topcoat (Polyester)	Total coating system		C2	C3	C4	C5I C5M
					Type	µm	µm	µm	Number of organic layers (@)	µm (@)				
EP-ST1-21	ST1		ST	Mechanical (SA 2 1/2)				60	1	60	✓	×	×	×
EP-ST1-11	ST1		ST	Chemical (*)				60	1	60	✓	×	×	×
EP-ST2-11	ST2		ST	Chemical (*)	Z/ZF	70		80	2	150	✓	✓	✓	×
EP-ST2-12	ST2		ST	Chemical (*)	Z/ZF	100		80	2	180	✓	✓	✓	×
EP-ST2-21	ST2		ST	Mechanical (SA 2 1/2)	Z/ZF	50		60	2	110	✓	✓	✓	×
EP-ST2-22	ST2		ST	Mechanical (SA 2 1/2)	Z/ZF	70		80	2	150	✓	✓	✓	×
EP-ST2-31	ST2		ST	Mechanical (SA 2 1/2) + Chemical (*)	Z/ZF	60		80	2	140	✓	✓	✓	×
EP-ST3-11	ST3		ST	Chemical (*)	Z/ZF	50	60	80	3	190	✓	✓	✓	×
EP-ST3-21	ST3		ST	Mechanical (SA 2 1/2)	Z/ZF	50	60	80	3	190	✓	✓	✓	×
EP-SZ1-11	SZ1		Z 225	Chemical (*)				60	1	60	✓	✓	×	×
EP-SZ1-41	SZ1		Z 225	Mechanical (sweeping)				60	1	60	✓	✓	×	×
EP-SZ1-12	SZ1		Z 275	Chemical (*)				80	1	80	✓	✓	×	×
EP-SZ1-42	SZ1		Z 275	Mechanical (sweeping)				80	1	80	✓	✓	×	×
EP-SZ2-11	SZ2		Z 275	Chemical (*)	ZF	50		60	2	110	✓	✓	✓	×
EP-SZ2-41	SZ2		Z 275	Mechanical (sweeping)	ZF	60		80	2	140	✓	✓	✓	×
EP-HD1-11	HD1		HDG	Chemical (*)				60	1	60	✓	✓	✓	×
EP-HD1-41	HD1		HDG	Mechanical (sweeping)				80	1	80	✓	✓	✓	×
EP-HD1-51	HD1		HDG	Mechanical (sweeping) + Chemical (*)				60	1	60	✓	✓	✓	×
EP-HD2-11	HD2		HDG	Chemical (*)	ZF	60		80	2	140	✓	✓	✓	✓
EP-HD2-41	HD2		HDG	Mechanical (sweeping)	ZF	60		80	2	140	✓	✓	✓	✓
EP-HD2-51	HD2		HDG	Mechanical (sweeping) + Chemical (*)	ZF	60		60	2	120	✓	✓	✓	✓
EP-HD3-11	HD3		HDG	Chemical (*)	ZF	60	60	60	3	180	✓	✓	✓	✓
EP-HD3-41	HD3		HDG	Mechanical (sweeping)	ZF	60	60	60	3	180	✓	✓	✓	✓
EP-MS1-71	MS1	Sa 3	MS 50 µm	none				80	1	80	✓	✓	✓	×
EP-MS1-72	MS1	Sa 3	MS 100 µm	none				80	1	80	✓	✓	✓	×
EP-MS2-71	MS2	Sa 3	MS 50 µm	none		60		80	2	140	✓	✓	✓	✓
EP-MS2-72	MS2	Sa 3	MS 100 µm	none		60		80	2	140	✓	✓	✓	✓
EP-MS2-73	MS2	Sa 3	MS 150 µm	none		60		80	2	140	✓	✓	✓	✓
EP-STEC2-61	STEC2		EC	EC-pretreatment (#)				60	1	60	✓	✓	✓	×
EP-STEC2-62	STEC2		EC	EC-pretreatment (#)				80	1	80	✓	✓	✓	✓
EP-STEC3-61	STEC3		EC	EC-pretreatment (#)			60	60	2	120	✓	✓	✓	✓
EP-HDEC2-61	HDEC2		EC	EC-pretreatment (#)				60	1	60	✓	✓	✓	✓

Codification:

ST	Steel
Z225	Continuous hot dip galvanized steel (coil) with 225 g/m² zinc
Z275	Continuous hot dip galvanized steel (coil) with 275 g/m² zinc
HDG	Hot Dip Galvanized Steel
MS	Metal Spray
EC	Electrophoretic primer (e-coat) 15 µm
Z	zinc flakes containing powder primer
ZF	zinc free powder primer
(*)	Conversion de surface EN 13438 (annex B). Following the procedure and supplier recommendations.
✓	Recommended
✓	This Coating System requires agreement between interested parties (ISO 2063)
×	Not possible to