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How to select the right paint system

Guidelines for corrosion protection
in accordance with ISO 12944

Introduction

The purpose of this document is to help you select the best Hempel coating system to protect your structure against corrosion. All steel structures, facilities and installations exposed to the atmosphere, submerged under water or in soil, suffer because of corrosion. Consequently they require protection from the harm caused by corrosion during their lifetime. Throughout this document you will find important information regarding paint technology, criteria for the right paint selection and surface preparation requirements.

This document has been prepared in accordance with the latest edition of the International Standard ISO 12944 “Paints and varnishes – Corrosion protection of steel structures by protective paint systems”. Hempel’s own guidelines and recommendations for coating protection technology are also included.

Outlined at the end are generic coating systems recommended by Hempel for different corrosive environments.

This document contains a series of guidelines and presents an overview of the changes to the ISO 12944 standard. It is in no way binding. If you would like specific information on your project please contact a member of the our technical team.

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1. How to select the right paint system

Selecting the correct paint system for protection against corrosion requires a variety of factors to be taken into account to ensure that the most economical and best technical solution is achieved. For each project the most important factors to consider before selecting a protective coating are:

a. Environmental corrosivity

When selecting a paint system it is vitally important to define the conditions in which the structure, facility or installation is to operate. To establish the effect of environmental corrosivity, the following factors must be taken into account:

- humidity and temperature (service temperature and temperature gradients)
- the presence of UV radiation
- chemical exposure (e.g. specific exposure in industrial plants)
- mechanical damage (impact, abrasion etc)

In the case of buried structures their porosity and the ground structures they are subject to, must be considered as well as the ground conditions which they are subject to. The dampness and pH of the terrain and biological exposure to bacteria and micro-organisms are of critical importance. In the case of water, the type and chemical composition of the water present is also significant.

The nature of the environment and the corrosive contributing conditions will have an effect on:

- the type of paint used for protection
- the total thickness of a paint system
- the surface preparation required
- minimum and maximum recoating intervals

Note that the more corrosive the environment, the more thorough the surface preparation required. The recoating intervals must also be strictly observed.

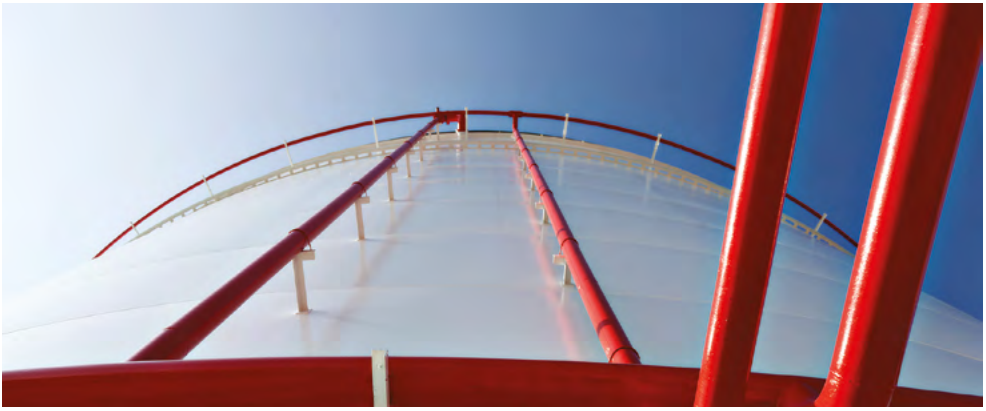
Part 2 of ISO 12944 standard gives the corrosion classifications for atmospheric conditions, soil and water. This standard is a very general evaluation based on the corrosion time for carbon steel and zinc. It does not reflect specific chemical, mechanical or temperature exposure. However the standard specification may still be accepted as a good indicator for paint system projects as a whole.

ISO 12944 distinguishes 6 basic atmospheric corrosivity categories:	
C1	very low
C2	low
C3	medium
C4	high
C5	very high
CX*	extreme

*New category that covers offshore Part 9.

Corrosivity category	Environment examples	
	Exterior	Interior
C1 very low	-	Heated buildings with a clean atmosphere such as offices, shops, schools, hotels.
C2 low	Atmospheres contaminated to a small extent, mainly rural regions.	Buildings which are not heated, where condensation may occur e.g. storage facilities, sports halls.
C3 medium	Industrial and urban atmospheres with a low sulphur oxide (IV) contamination level. Inshore areas of low salinity.	Production halls to facilities humidity and certain air contamination e.g. foodstuff plants, laundries, breweries, dairies.
C4 high	Industrial areas and inshore areas of medium salinity.	Chemical plants, swimming pools, ship repair yards.
C5 very high	Industrial areas of high humidity and aggressive atmosphere and inshore areas of high salinity.	Buildings and areas of almost constant condensation and high contamination.
CX extreme*	Offshore areas of high salinity or industrial areas of extremely high humidity and aggressive atmosphere or subtropical and tropical areas.	Buildings and areas of almost constant condensation and aggressive contamination.

*New category that covers offshore Part 9.



ISO 12944 distinguishes 4 corrosivity categories for the structures immersed in water or soil	
Im1	fresh water
Im2	sea or brackish water
Im3	soil
Im4*	sea or brackish water

Corrosivity categories	Environment	Examples of environments and structures
Im1	Fresh water	River installations, hydroelectric power plants.
Im2	Sea or brackish water	Immersed structures without cathodic protection (e.g. harbour areas with structures like sluice gates, locks, jetties, offshore structures).
Im3	Soil	Underground tanks, steel stilts, pipelines.
Im4*	Sea or brackish water	Immersed structures with cathodic protection (e.g. harbour areas with structures like sluice gates, locks, jetties, offshore structures).

*New category that covers offshore Part 9.

b. Type of protected surface

Designing a coating system normally involves dealing with construction materials such as steel, hot dipped galvanised steel, spray-metallised steel, aluminium or stainless steel. The surface preparation, the paint products used (particularly the primer) and the total system thickness will depend mainly on the construction material to be protected.

c. The durability required for a paint system

The lifetime of a paint system is assumed to be the period of time which passes until extraordinary maintenance is required for the first time after application. ISO 12944 specifies a range of four time frames to categorise durability:

LOW – L	up to 7 years
MEDIUM – M	7 to 15 years
HIGH – H	15 to 25 years
VERY HIGH – VH	more than 25 years

d. Planning the paint application process

The building schedule and the various stages of construction of any particular project determine how and when the paint system needs to be applied. Consideration needs to be given to materials at their prefabrication stage, when components are being prefabricated both off and on-site and when building stages are complete.

It is necessary to plan the job so that surface preparation and the drying/curing time of paint products in relation to temperature and humidity are considered. Also if one stage of construction takes place in a protected workshop environment and the next stage then takes place on site, recoating intervals must also be taken into account.

Our skilled personnel are always available to assist its customers in selecting the most adequate coating system or the customer's needs and requirements. For further information, please contact your local Hempel representative.

2. Surface preparation

2.1 Surface preparation grades

There are many ways to classify steel surface preparation grades but this study focuses on those outlined below.

A. Grades of a surface according to the ISO 8501-1 standard

Standard surface preparation grades for primary surface preparation by abrasive blasting methods	
Sa 3	**Blast-cleaning to visually clean steel** When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and shall be free from mill scale, rust, paint coatings and foreign matter[1]. It shall have a uniform metallic colour.
Sa 2 ½	**Very thorough blast-cleaning** When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from mill scale, rust, paint coatings and foreign matter[1]. Any remaining traces of contamination shall show only as slight stains in the form of spots or stripes.
Sa 2	**Thorough blast-cleaning** When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from most of the mill scale, rust, paint coatings and foreign matter[1]. Any residual contamination shall be firmly adhering. (see note[2] below).
Sa 1	**Light blast-cleaning** When viewed without magnification, the surface shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter[1].

Notes:

[1] The term 'foreign matter' may include water-soluble salts and welding residues. These contaminants cannot always be completely removed from the surface by dry blast-cleaning, hand and power tool cleaning; wet blast-cleaning may be necessary.

[2] Mill scale, rust or a paint coating is considered to be poorly adhering if it can be removed by lifting with a blunt putty knife.

Standard preparation grades for primary surface preparation by hand cleaning	
St 3	**Very thorough hand and power tool cleaning** As for St 2, but the surface shall be treated much more thoroughly to give a metallic sheen arising from the metallic substrate.
St 2	**Thorough hand and power tool cleaning** When viewed without magnification, the surfaces shall be free from visible oil, grease and dirt, and from poorly adhering mill scale, rust, paint coatings and foreign matter (see note below).

Notes:

Preparation grade St 1 is not included as it corresponds to a surface unsuitable for painting.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B. Surface preparation grades after high pressure water cleaning

Surface preparation grades by high pressure water cleaning should not only include the cleanliness grade but also the flash rust grade, since flash rusting may occur on cleaned steel during the drying period. There are several ways to classify the degree to which a steel surface is prepared after high pressure water cleaning.

This document has used the ISO 8501-4 surface preparation grade standard using high pressure water jetting: **"Initial surface conditions, preparation grades and flash rust grades in connection with high pressure water jetting"**.

The standard applies to surface preparation by high pressure water cleaning for a paint coating. It distinguishes three levels of cleanliness with reference to visible contaminants (Wa 1 — Wa 2½) such as rust, mill scale, old paint coatings and other foreign matter:

Description of the surface after cleaning:	
Wa 1	**Light high-pressure water jetting** When viewed without magnification, the surface shall be free from visible oil and grease, loose or defective paint, loose rust and other foreign matter. Any residual contamination shall be randomly dispersed and firmly adherent.
Wa 2	**Thorough high-pressure water jetting** When viewed without magnification, the surface shall be free from visible oil, grease and dirt and most of the rust, previous paint coatings and other foreign matter. Any residual contamination shall be randomly dispersed and can consist of firmly adherent coatings, firmly adherent foreign matter and stains of previously existent rust.
Wa 2½	**Very thorough high-pressure water jetting** When viewed without magnification, the surface shall be free from all visible rust, oil, grease, dirt, previous paint coatings and, except for slight traces, all other foreign matter. Discoloration of the surface can be present where the original coating was not intact. The grey or brown/black discolouration observed on pitted and corroded steel cannot be removed by further water jetting.

Description of the surface appearance relating to three grades of flash rust:	
L	**Light flash rust** A surface which, when viewed without magnification, exhibits small quantities of a yellow/brown rust layer through which the steel substrate can be seen. The rust (seen as a discolouration) can be evenly distributed or present in patches, but it will be tightly adherent and not easily removed by gentle wiping with a cloth.
M	**Medium flash rust** A surface which, when viewed without magnification, exhibits a layer of yellow/brown rust that obscures the original steel surface. The rust can be evenly distributed or present in patches, but it will be reasonably well adherent and it will lightly mark a cloth that is gently wiped over the surface.
H	**Heavy flash rust** A surface which, when viewed without magnification, exhibits a layer of red-yellow/brown rust that obscures the original steel surface and is loosely adherent. The rust layer can be evenly distributed or present in patches and it will readily mark a cloth that is gently wiped over the surface.

2.2 Types of surfaces

A. Steel surfaces

To guarantee that a coating system delivers long lasting protection, it is essential to ensure that the right surface preparation is carried out before any paint is applied. For this reason the initial surface condition of the steel needs to be evaluated.

Generally speaking, the condition of a steel surface prior to painting falls into one of the three following categories:

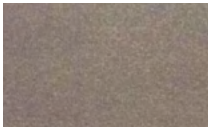
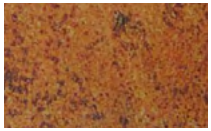
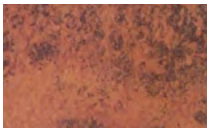
a) a bare steel structure with no previous protective paint coatings
b) a steel surface coated with a shop primer
c) a steel surface coated with a paint system which needs to be maintained

These categories are outlined in more detail below.

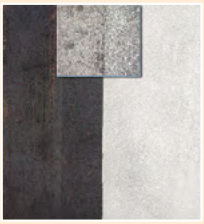
a. Bare steel structure with no previous protective coatings

Steel surfaces which have never been protected by paint coatings may be covered to a varying extent by rust, mill scale or other contaminants (dust, grease, ionic contamination/soluble salts, residues etc.). The initial condition of such surfaces is defined by ISO 8501-1 standard: **"Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness".**

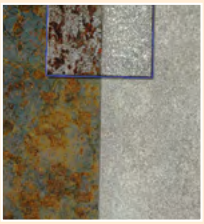
ISO 8501-1 standard identifies four initial conditions for steel – A, B, C, D:

A	Steel surface largely covered with adherent mill scale but little, if any, rust.	
B	Steel surface which has begun to rust and from which the mill scale has begun to flake.	
C	Steel surface on which the mill scale has rusted away or can be removed by scraping, but with slight pitting visible under normal vision.	
D	Steel surface on which the mill scale has rusted away and on which general pitting is visible under normal vision.	

The corresponding photographs show levels of corrosion, preparation grades of unprotected steel substrates and steel substrates after completely removing previous coatings.



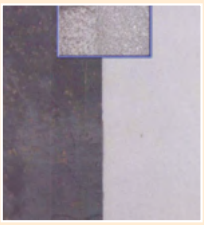
A GRADE
Sa 2½



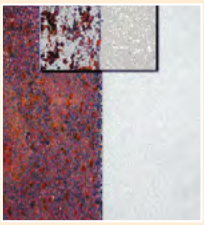
B GRADE
Sa 2½

C GRADE
Sa 2½

D GRADE
Sa 2½



A GRADE
Sa 3



B GRADE
Sa 3

C GRADE
Sa 3

D GRADE
Sa 3

b. Steel surface covered with shop primers

The main purpose of applying Shop primers is to protect steel plates and structural components used in the prefabrication stage, or in storage before a main paint system is applied. A shop primer film thickness normally equals 20–25 µm (these figures are quoted for a smooth test panel). Steel plates and structural components coated with shop primers can be welded.

Hempel offers the following shop primers:

Hempel's Shop Primer E 15280

(protection period 3 to 5 months)
is a solvent-borne epoxy shop primer pigmented with zinc polyphosphate.
It is designed for automatic spray application or manual application.

Hempel's Shop Primer ZS 15890

(protection period 6 to 9 months)
is a solvent borne zinc silicate shop primer designed for automatic spray application.

Hempel's Shop Primer ZS 15820

(protection period 4 to 6 months)
is a solvent borne zinc silicate shop primer, designed for automatic spray application.

Hempel's Shop Primer E 15275

(protection period 3 to 5 months)
is a solvent-borne epoxy shop primer pigmented with zinc polyphosphate.
It is designed for automatic spray application or manual application.

Surfaces coated with a shop primer must be prepared correctly prior to the application of a finishing paint system; this is termed 'second surface preparation'. A Shop primer may need to be partially or completely removed. The second surface preparation will be determined by the finishing paint system and two key factors need to be taken into account:

- the compatibility of an applied shop primer and a finishing paint system
- the surface profile achieved during preparation prior to a Shop primer application, i.e. whether the profile is suitable for a finishing paint system

A surface coated with a shop primer should always be thoroughly washed with water and detergent (e.g. Hempel's Light Clean 99350) at 15–20 MPa, and then rinsed carefully prior to a paint system application. Corrosion and damage due to welding spots must be cleaned to the preparation grade as specified in the ISO 8501-1 standard.

c. Steel surface coated with a paint system which needs to be maintained

The condition of an existing paint system must be assessed using the degradation grade according to the standard and this must be done each time maintenance work is carried out. It will need to be determined whether the system should be completely removed or whether parts of the coating can remain. For the different amounts of surface preparation required refer to ISO 8501-2 standard: "Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Preparation grades of previously coated steel substrates after localised removal of previous coatings".

B. Hot dipped galvanised steel, aluminium and stainless steel surfaces

In addition to standard steel, other non-iron materials can be used in construction such as hot dipped galvanised steel, aluminium or high-alloy steels. All of them require a separate approach in terms of surface preparation and the selection of a paint system.

a. Hot dipped galvanised steel

When galvanised steel is exposed to the atmosphere, zinc corrosion products form on its surface. These products vary in their composition and adhesion and therefore influence the adhesive properties of applied paint systems. It is generally considered that the best surface for painting is one of pure (within hours of the galvanisation process) or seasoned zinc. For stages in between it is recommended that the zinc corrosion products are removed by washing the surface with Hempel's Alkaline Cleaner. This can be carried out using a mixture of 20 litres of pure water to half a litre of Hempel's Light Clean 99350 detergent.

The mixture must be applied to the surface and then rinsed off after half an hour, preferably at high pressure. If necessary washing should be combined with scrubbing using a special hard nylon bristle brush, abrasive paper or the surface cleaned by an abrasive (glass balls, sand, etc.). For coating systems

in lower corrosion classes, special adhesion primers are recommended. For coating systems in higher corrosion classes, surface preparation should include mechanical preparation of the surface, preferably by abrasive sweep blasting with a mineral abrasive.

b. Aluminium and stainless steel

In the case of aluminium and stainless steel, the surface should be cleaned with fresh water and a detergent, then rinsed off thoroughly by pressure washing with fresh water. To obtain better adhesion for the paint system it is recommended that abrasive blasting is carried out with a mineral abrasive or special brushes are used.

For further information and thorough explanations on processes and procedures of surface preparation, you can contact your local Hempel representative.

3. Protective coatings

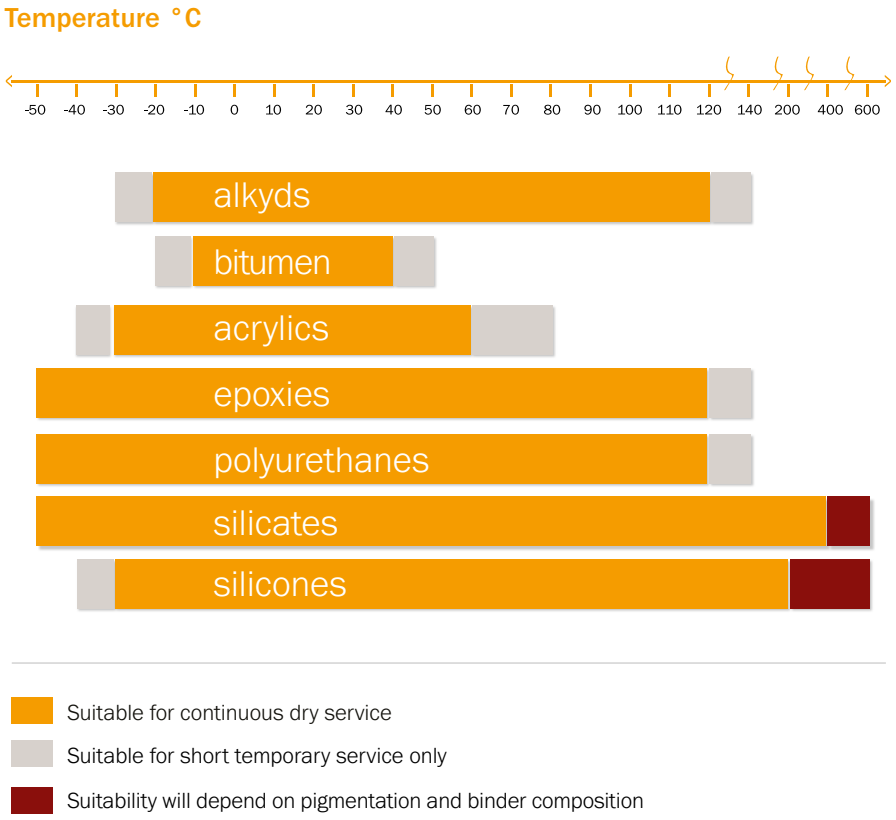
3.1 Generic types

Physically drying:
Acrylic

Chemically curing:
Alkyd
Epoxy, pure and modified
Polyurethane
Zinc silicate
Polysiloxane hybrids

3.2 Maximum service temperatures

Paint products have different resistances to temperatures depending on the binder and pigments used. The temperature resistance of individual paint types is shown below.



4. Hempel's shade identification

Paints, especially primers, are identified by a 5-digit number, as follows:

White	10000
Whitish, grey	10010–19980
Black	19990
Yellow, cream, buff	20010–29990
Blue, violet	30010–39990
Green	40010–49990
Red, orange, pink	50010–59990
Brown	60010–69990

Our standard shade numbers do not directly correlate to official colour standard numbers. However, in the case of finishing paints or other selected products, shades corresponding to specific official standard shades such as RAL, BS, NCS etc. may be established.

Shade identification example:
Hempaprime Multi 500 45950-11320

Paint Hempaprime Multi 500 in Hempel Standard shade 11320

5. Useful definitions

There are several useful definitions and terms used in coating protection technology. Below we provide you with a selection of the necessary terms that you should be acquainted with when dealing with paints:

Volume solids
The volume solids (VS) figure is expressed as a percentage the ratio of:

$$\frac{\text{Dry film thickness}}{\text{Wet film thickness}}$$

The stated figure has been determined as the ratio between dry and wet film thickness of the coating applied in the indicated thickness under laboratory conditions, where no paint loss has been encountered.

Theoretical spreading rate
The theoretical spreading rate of the paint in a given dry film thickness on a completely smooth surface is calculated as follows:

$$\frac{\text{Volume solids \% x 10}}{\text{Dry film thickness (micron)}} = m^2/\text{litre}$$

Practical consumption
The practical consumption is estimated by multiplying the theoretical consumption with a relevant Consumption Factor (CF).

The consumption factor or the practical consumption cannot be stated in the product Data Sheet because it depends on a number of external conditions such as:

a. Waviness of paint film
When paint is manually applied the film will show some waviness on the surface. It will also have an average thickness higher than the specified dry film thickness in order to fulfil the 80:20 rule for example. This means the paint consumption will be higher than the theoretically calculated amount if you want to reach the minimum specified film thickness.

b. Size and shape of the surface
Complex and small-sized surfaces will lead to higher consumption through overspray, than the square, flat area which was used to work out the theoretical calculation.

c. Surface roughness of the substrate
When a substrate has a particularly rough surface this creates a 'dead volume' which uses more paint than if the surface was smooth and this will affect any theoretical calculations. In the case of shop primers with a thin film, this has the effect of a seemingly larger surface, causing higher consumption as the paint film covers irregular surface hollows.

d. Physical losses
Factors such as residues in cans, pumps and hoses, discarded paint due to exceeded pot life, losses due to atmospheric conditions, insufficient skills of a painter etc. will all contribute to a higher consumption.

For further definitions or explanations, please contact your local Hempel representative.

6. Hempel paint systems

Recommended paint systems for various corrosivity categories and other types of environments (in accordance with ISO 12944:2018)

ISO 12944:2018 was published in 2018, a new revision of Part 5 was published in 2019. In this document when Part 5 is referenced it refers to the 2019 revision and when Part 6 is mentioned it refers to the 2018 version.

C2 Corrosivity Category

Sample systems corresponding to C2 Corrosivity Category in accordance with ISO 12944 Part 5 and Part 6

C2 High: Estimated lifetime 15-25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	SB Epoxy	Hempaprime Multi 500	120
	Total DFT		**120 µm**
2	SB Polyurethane	Hempathane Fast Dry 55750	120
	Total DFT		**120 µm**
3	SB Epoxy	Hempadur Speed-Dry ZP 500	120
	Total DFT		**120 µm**

C2 Very high: Estimated lifetime > 25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	WB Acrylic	Hemucryl 48120	2 × 100
	Total DFT		**200 µm**
2*	SB Polyurethane	Hempathane Fast Dry 55750	160
	Total DFT		**160 µm**
3	SB Epoxy	Hempaprime Multi 500	120
	SB Polyurethane	Hempathane Fast Dry 55750	60
	Total DFT		**180 µm**

Note: For the places that blasting as secondary surface preparation is not possible after production, the use of shop primed steel is an option. Zinc silicate based shop primers e.g. Hempel's Shop Primer ZS 15890 or 15820 are preferred – especially for later overcoating with zinc containing paints–Epoxy based shop primers E.g. Hempel Shop Primer 15280 can also be used in case of later overcoating with non – zinc containing paint. Ask Hempel for more specific guidelines regarding optimum choice of shop primer and need for secondary surface preparation. Please contact your local Hempel office for availability of test reports.

*Systems that pass the performance test assessments specified in ISO 12944 Part 6 but do not fulfil the paint system requirements of Part 5.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email sales.uk@hempel.com.

SB = Solvent Borne
WB = Waterborne
DFT = Dry Film Thickness

C3 Corrosivity Category

Sample systems corresponding to C3 Corrosivity Category
in accordance with ISO 12944 Part 5 and Part 6

C3 Medium: Estimated lifetime 7-15 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	SB Epoxy	Hempaprime Multi 500	120
	Total DFT		**120 µm**
2	SB Polyurethane	Hempathane Fast Dry 55750	120
	Total DFT		**120 µm**
3	SB Epoxy	Hempadur Speed-Dry ZP 500	120
	Total DFT		**120 µm**

C3 High: Estimated lifetime 15-25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	WB Acrylic	Hemucryl 48120	2 × 100
	Total DFT		**200 µm**
2*	SB Polyurethane	Hempathane Fast Dry 55750	160
	Total DFT		**160 µm**
3	SB Epoxy	Hempaprime Multi 500	120
	SB Polyurethane	Hempathane Fast Dry 55750	60
	Total DFT		**180 µm**
4	SB Epoxy	Hempadur 47300	120
	SB Polyurethane	Hempathane Speed-Dry Topcoat 250	60
	Total DFT		**180 µm**
5	SB Epoxy	Hempaprime Multi 500 Winter	120
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**180 µm**

*Systems that pass the performance test assessments specified in ISO 12944 Part 6 but do not fulfil the paint system requirements of Part 5.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email sales.uk@hempel.com.

C3 Very high: Estimated lifetime > 25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	SB Zinc Rich Epoxy	Hempadur Avantguard 750	75
	SB Polyurethane	Hempathane HS 55610	125
	Total DFT		**200 µm**
2	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	140
	Total DFT		**200 µm**
3	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	140
	Total DFT		**200 µm**
4	SB Zinc Epoxy	Hempadur Avantguard 550	40
	SB Epoxy	Hempaprime Multi 500 Winter	100
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**200 µm**
5*	SB Zinc Epoxy	Hempadur Avantguard 550	75
	SB Polyurethane	Hempathane HS 55610	125
	Total DFT		**200 µm**
6*	SB Zinc Epoxy	Hempadur Avantguard 550	60
	SB Polyurethane	Hempathane Fast Dry 55750	140
	Total DFT		**200 µm**
7	SB Epoxy	Hempaprime Multi 500	2 x 120
	Total DFT		**240 µm**
8	SB Epoxy	Hempaprime Multi 500	180
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**240 µm**
9	SB Epoxy	Hempaprime Multi 500 Winter	180
	SB Polyurethane	Hempathane Fast Dry 55750	60
	Total DFT		**240 µm**
10	SB Epoxy	Hempadur Mastic 45880/W	180
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**240 µm**
11	SB Epoxy	Hempadur Fast Dry 17410	120
	SB Polyurethane	Hempathane HS 55610	120
	Total DFT		**240 µm**
12*	SB Epoxy	Hempadur 47300	240
	Total DFT		**240 µm**
13	SB Epoxy	Hempadur 47300	190
	SB Pro-Acrylic	Hempel's Pro Acrylic 55883	50
	Total DFT		**240 µm**

C3 Very high: Estimated lifetime > 25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
14	SB Epoxy	Hempadur Speed-Dry ZP 500	180
	SB Polyurethane	Hempathane Fast Dry 55750	60
	Total DFT		**240 µm**
15	SB Epoxy	Hempadur Speed-Dry ZP 600	160
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**240 µm**
16	SB Polyurethane	Hempathane Fast Dry 55750	2 × 120
	Total DFT		**240 µm**
17*	SB Acrylic	Hempatex High-Build 46410	2 × 120
	Total DFT		**240 µm**
18*	SB Acrylic	Hempatex High-Build 46410	2 × 100
	SB Acrylic	Hempatex Enamel 56360	40
	Total DFT		**240 µm**

SB = Solvent Borne
WB = Waterborne
DFT = Dry Film Thickness

Note: For the places that blasting as secondary surface preparation is not possible after production, the use of shop primed steel is an option. Zinc silicate based shop primers e.g. Hempel's Shop Primer ZS 15890 or 15820 are preferred – especially for later overcoating with zinc containing paints – Epoxy based shop primers E.g. Hempel Shop Primer 15280 can also be used in case of later overcoating with non – zinc containing paint. Ask Hempel for more specific guidelines regarding optimum choice of shop primer and need for secondary surface preparation. Please contact your local Hempel office for availability of test reports.

*Systems that pass the performance test assessments specified in ISO 12944 Part 6 but do not fulfil the paint system requirements of Part 5.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email sales.uk@hempel.com.

C4 Corrosivity Category

Sample systems corresponding to C4 Corrosivity Category
in accordance with ISO 12944 Part 5 and Part 6

C4 Medium: Estimated lifetime 7-15 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	SB Epoxy	Hempaprime Multi 500 Winter	100
	WB Acrylic	Hemucryl 48120	80
	Total DFT		**180 µm**

*Systems that pass the performance test assessments specified in ISO 12944 Part 6 but do not fulfil the paint system requirements of Part 5.

C4 High: Estimated lifetime 15-25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	SB Zinc Rich Epoxy	Hempadur Avantguard 750	75
	SB Polyurethane	Hempathane HS 55610	125
	Total DFT		**200 µm**
2	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	140
	Total DFT		**200 µm**
3	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	140
	Total DFT		**200 µm**
4	SB Zinc Epoxy	Hempadur Avantguard 550	40
	SB Epoxy	Hempaprime Multi 500 Winter	100
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**200 µm**
5*	SB Zinc Epoxy	Hempadur Avantguard 550	75
	SB Polyurethane	Hempathane HS 55610	125
	Total DFT		**200 µm**
6*	SB Zinc Epoxy	Hempadur Avantguard 550	60
	SB Polyurethane	Hempathane Fast Dry 55750	140
	Total DFT		**200 µm**
7	SB Epoxy	Hempaprime Multi 500	2 x 120
	Total DFT		**240 µm**
8	SB Epoxy	Hempaprime Multi 500	180
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**240 µm**
9	SB Epoxy	Hempaprime Multi 500 Winter	180
	SB Polyurethane	Hempathane Fast Dry 55750	60
	Total DFT		**240 µm**
10	SB Epoxy	Hempaprime Multi 500 Winter	160
	WB Acrylic	Hemucryl 48120	80
	Total DFT		**240 µm**
11	SB Epoxy	Hempadur Mastic 45880/W	180
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**240 µm**
12	SB Epoxy	Hempadur Fast Dry 17410	120
	SB Polyurethane	Hempathane HS 55610	120
	Total DFT		**240 µm**
13*	SB Epoxy	Hempadur 47300	240
	Total DFT		**240 µm**

C4 High: Estimated lifetime 15-25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
14	SB Epoxy	Hempadur 47300	190
	SB Pro-Acrylic	Hempel's Pro Acrylic 55883	50
	Total DFT		**240 µm**
15	SB Epoxy	Hempadur Speed-Dry ZP 500	180
	SB Polyurethane	Hempathane Fast Dry 55750	60
	Total DFT		**240 µm**
16	SB Epoxy	Hempadur Speed-Dry ZP 600	160
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**240 µm**
17	SB Polyurethane	Hempathane Fast Dry 55750	2 × 120
	Total DFT		**240 µm**
18*	SB Acrylic	Hempatex High-Build 46410	2 × 120
	Total DFT		**240 µm**
19*	SB Acrylic	Hempatex High-Build 46410	2 × 100
	SB Acrylic	Hempatex Enamel 56360	40
	Total DFT		**240 µm**

C4 Very high: Estimated lifetime > 25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1**	SB Epoxy	Hempadur 15553	80
	SB Polyurethane	Hempathane HS 55610	120
	Total DFT		**200 µm**
2	SB Epoxy	Hempadur 47300	250
	SB Polyurethane	Hempathane Speed-Dry Topcoat 250	50
	Total DFT		**300 µm**
3**	SB Epoxy	Hempel's Epoxy primer HV 15410	50
	SB Epoxy	Hempadur 47300	100
	SB Polyurethane	Hempathane Topcoat 55210	50
	Total DFT		**200 µm**
4	SB Epoxy	Hempaprime Multi 500	220
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**300 µm**
5	SB Epoxy	Hempaprime Multi 500 Winter	220
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**300 µm**

*Systems that pass the performance test assessments specified in ISO 12944 Part 6 but do not fulfil the paint system requirements of Part 5.

C4 Very high: Estimated lifetime > 25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
6	SB Epoxy	Hempaprime Multi 500	240
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**300 µm**
7	SB Epoxy	Hempadur Speed-Dry ZP 600	200
	SB Polyurethane	Hempathane Fast Dry 55750	100
	Total DFT		**300 µm**
8	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	120
	SB Polyurethane	Hempathane Speed-Dry Topcoat 250	80
	Total DFT		**260 µm**
9	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	120
	SB Pro-Acrylic	Hempel's Pro Acrylic 55883	80
	Total DFT		**260 µm**
10	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur Mastic 45880/W	120
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**260 µm**
11	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	WB Acrylic	Hemucryl 48120	2 x 100
	Total DFT		**260 µm**
12	SB Zinc Rich Epoxy	Hempadur Avantguard 750	50
	SB Epoxy	Hempaprime Multi 500	150
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**260 µm**
13	SB Zinc Epoxy	Avantguard 550	60
	SB Epoxy	Hempadur 47300	120
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**260 µm**

Note: For the places that blasting as secondary surface preparation is not possible after production, the use of shop primed steel is an option. Zinc silicate based shop primers e.g. Hempel's Shop Primer ZS 15890 or 15820 are preferred – especially for later overcoating with zinc containing paints – Epoxy based shop primers E.g. Hempel Shop Primer 15280 can also be used in case of later overcoating with non – zinc containing paint. Ask Hempel for more specific guidelines regarding optimum choice of shop primer and need for secondary surface preparation. Please contact your local Hempel office for availability of test reports.

**This system is suitable only for hot dip galvanised steel.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email sales.uk@hempel.com.

C5 Corrosivity Category

Sample systems corresponding to C5 Corrosivity Category in accordance with ISO 12944 Part 5 and Part 6

C5 High: Estimated lifetime 15-25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1**	SB Epoxy	Hempadur 15553	80
	SB Polyurethane	Hempathane HS 55610	120
	Total DFT		**200 µm**
2	SB Epoxy	Hempadur 47300	250
	SB Polyurethane	Hempathane Speed-Dry Topcoat 250	50
	Total DFT		**300 µm**
3**	SB Epoxy	Hempel's Epoxy primer HV 15410	50
	SB Epoxy	Hempadur 47300	100
	SB Polyurethane	Hempathane Topcoat 55210	50
	Total DFT		**200 µm**
4	SB Epoxy	Hempaprime Multi 500	220
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**300 µm**
5	SB Epoxy	Hempaprime Multi 500 Winter	220
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**300 µm**
6	SB Epoxy	Hempaprime Multi 500	240
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**300 µm**
7	SB Epoxy	Hempadur Speed-Dry ZP 600	200
	SB Polyurethane	Hempathane Fast Dry 55750	100
	Total DFT		**300 µm**
8	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	120
	SB Polyurethane	Hempathane Speed-Dry Topcoat 250	80
	Total DFT		**260 µm**

C5 High: Estimated lifetime 15-25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
9	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	120
	SB Pro-Acrylic	Hempel's Pro Acrylic 55883	80
	Total DFT		**260 µm**
10	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur Mastic 45880/W	120
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**260 µm**
11	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	WB Acrylic	Hemucryl 48120	2 x 100
	Total DFT		**260 µm**
12	SB Zinc Rich Epoxy	Hempadur Avantguard 750	50
	SB Epoxy	Hempaprime Multi 500	150
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**260 µm**
13	SB Zinc Epoxy	Avantguard 550	60
	SB Epoxy	Hempadur 47300	120
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**260 µm**

C5 Very high: Estimated lifetime > 25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	180
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**320 µm**
2	SB Zinc Rich Epoxy	Hempadur Avantguard 750	50
	SB Epoxy	Hempaprime Multi 500	200
	SB Polyurethane	Hempathane HS 55610	70
	Total DFT		**320 µm**
3	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	200
	SB Polyurethane	Hempathane Speed-Dry Topcoat 250	60
	Total DFT		**320 µm**
4	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	200
	SB Polysiloxane	Hempaxane Light 55030	60
	Total DFT		**320 µm**
5	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500 Winter	210
	SB Polyurethane	Hempathane 55930	50
	Total DFT		**320 µm**
6	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	180
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**320 µm**
7	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	200
	SB Pro-Acrylic	Hempel's Pro Acrylic 55883	60
	Total DFT		**320 µm**
8	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	210
	SB Polyurethane	Hempathane 55930	50
	Total DFT		**320 µm**
9	SB Zinc Rich Epoxy	Hempadur Avantguard 860	60
	SB Epoxy	Hempaprime Multi 500	180
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**320 µm**
10	SB Zinc Rich Epoxy	Hempadur Avantguard 860	60
	SB Epoxy	Hempaprime Multi 500	180
	SB Polysiloxane	Hempaxane Light 55030	80
	Total DFT		**320 µm**

C5 Very high: Estimated lifetime > 25 years

System no	Paint type	Hempel paint system samples	Thickness (microns)
11	SB Zinc Rich Epoxy	Hempadur Avantguard 860	60
	SB Epoxy	Hempadur 47300	210
	SB Polyurethane	Hempathane 55930	50
	Total DFT		**320 µm**
12	SB Zinc Epoxy	Hempadur Avantguard 550	60
	SB Epoxy	Hempadur 47300	180
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**320 µm**
13	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur Speed-Dry ZP 650	200
	SB Polyurethane	Hempathane Speed-Dry Topcoat 250	60
	Total DFT		**320 µm**
14	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur Speed-Dry ZP 500	180
	SB Polyurethane	Hempathane Fast Dry	80
	Total DFT		**320 µm**
15	SB Zinc Rich Epoxy	Hempadur Avantguard 860	60
	SB Polyurea	Hemparea DTM 55970/55973	220
	Total DFT		**280 µm**
16**	SB Epoxy	Hempadur 15553	60
	SB Epoxy	Hempaprime Multi 500	100
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**240 µm**
17	SB Zinc Silicate	Hempel's Galvosil 15780	60
	SB Epoxy	Hempaprime Multi 500	200
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**320 µm**
18	SB Zinc Silicate	Hempel's Galvosil 15700	60
	SB Epoxy	Hempaprime Multi 500	180
	SB Polyurethane	Hempathane HS 55610	80
	Total DFT		**320 µm**

Note: For the places that blasting as secondary surface preparation is not possible after production, the use of shop primed steel is an option. Zinc silicate based shop primers e.g. Hempel's Shop Primer ZS 15890 or 15820 are preferred – especially for later overcoating with zinc containing paints – Epoxy based shop primers e.g. Hempel Shop Primer 15280 can also be used in case of later overcoating with non – zinc containing paint. Ask Hempel for more specific guidelines regarding optimum choice of shop primer and need for secondary surface preparation. Please contact your local Hempel office for availability of test reports.

**This system is suitable only for hot dip galvanised steel.

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CX Corrosivity Category

Sample systems corresponding to CX Corrosivity Category
in accordance with ISO 12944:2018 in accordance with Part 9

System no	Paint type	Hempel paint system samples	Thickness (microns)
1	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempadur 47300	160
	SB Pro-Acrylic	Hempel's Pro Acrylic 55883	60
	Total DFT		**280 µm**
2	SB Zinc Rich Epoxy	Hempadur Avantguard 750	60
	SB Epoxy	Hempaprime Multi 500	140
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**280 µm**
3***	SB Zinc Rich Epoxy	Hempadur Avantguard 770	60
	SB Epoxy	Hempaprime Multi 500 Winter	140
	SB Polyurethane	Hempathane Fast Dry 55750	80
	Total DFT		**280 µm**
4	SB Zinc Rich Epoxy	Hempadur Avantguard 770	60
	SB Epoxy	Hempaprime Multi 500	160
	SB Polysiloxane	Hempaxane Light 55030	60
	Total DFT		**280 µm**
5	SB Zinc Rich Epoxy	Hempadur Avantguard 860	60
	SB Epoxy	Hempadur Quatttro X0 17870	160
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**280 µm**
6***	SB Zinc Rich Epoxy	Hempadur Avantguard 860	60
	SB Epoxy	Hempaprime Multi 500	220
	Total DFT		**280 µm**
7	SB Zinc Silicate	Hempel's Galvosil 15700	60
	SB Epoxy	Hempaprime Multi 500	160
	SB Polyurethane	Hempathane HS 55610	60
	Total DFT		**280 µm**

***1.5 times CX.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email sales.uk@hempel.com.

SB = Solvent Borne
DFT = Dry Film Thickness

Immersion Category

Sample systems corresponding to Immersion Category
in accordance with ISO 12944:2018 in accordance with Part 9

System no	Paint type	Hempel paint system samples	Thickness (microns)
1*	SB Epoxy	Hempadur Multi-Strength 45703	175
	SB Epoxy	Hempadur Multi-Strength 45753	175
	Total DFT		**350 µm**
2	SB Epoxy	Hempadur Quattro XO 17720	175
	SB Epoxy	Hempadur Quattro XO 17720	175
	Total DFT		**350 µm**
3	SB Epoxy	Hempadur 15590	50
	SB Epoxy	Hempadur Multi-Strength 35840	300
	Total DFT		**350 µm**

SB = Solvent Borne
DFT = Dry Film Thickness

Note: For the places that blasting as secondary surface preparation is not possible after production, the use of shop primed steel is an option. Zinc silicate based shop primers e.g. Hempel's Shop Primer ZS 15890 or 15820 are preferred – especially for later overcoating with zinc containing paints – Epoxy based shop primers E.g. Hempel Shop Primer 15280 can also be used in case of later overcoating with non – zinc containing paint. Ask Hempel for more specific guidelines regarding optimum choice of shop primer and need for secondary surface preparation. Please contact your local Hempel office for availability of test reports.

System no 1, 2, 3: Tested in accordance to NORSOK M-501, Edition 5/6, which was ISO 20340 and is now ISO 12944 2018:part 9.

*Only prequalified in aluminium shades.

For advice on regional product availability and additional schemes, please contact your local Hempel representative or email sales.uk@hempel.com.

Notes:

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