HOW TO SELECT THE RIGHT PAINT SYSTEM

Guidelines for coating protection
in accordance with ISO 12944

HEMPEL

INTRODUCTION

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

This study 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 of this study are generic coating systems recommended by Hempel for different corrosive environments.

This study is to be considered as a guide and to be of no binding.

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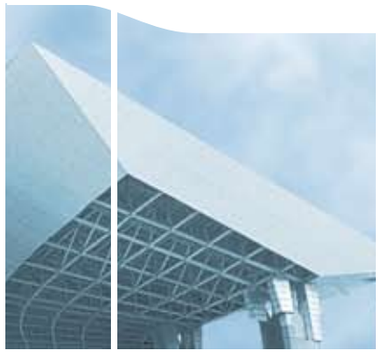




1 HOW TO SELECT THE RIGHT PAINT SYSTEM

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 work out 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 must be considered and the ground conditions which they are subject to. The dampness and pH of the terrain and biological exposure to bacteria and microorganisms are of critical importance. In the case of water, the type and chemical composition of the water present is also significant.

The corrosive aggressiveness of the environment 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 5 basic atmospheric corrosivity categories:

C1	very low	C4	high
C2	low	C5-I	very high (industrial)
C3	medium	C5-M	very high (marine)



Outlined below is how these classifications are applied: (The table numbers refer to the product listings as given in section 6 of this study, Hempel Paint Systems.)

Atmospheric corrosivity categories according to ISO 12944 standard:

Corrosivity category	Environment examples		Hempel's paint systems
	Exterior	Interior	
C1 very low	-	Heated buildings with a clean atmosphere such as offices, shops, schools, hotels.	Page 24 - 25
C2 low	Atmosphere contaminated to a small extent, mainly rural regions.	Buildings which are not heated, where condensation may occur e.g. storehouses, sports halls.	Page 24 - 25
C3 medium	Industrial and urban atmosphere with an average sulphur oxide (IV) contamination level. Inshore areas of low salinity.	Production space of high humidity and certain air contamination e.g. foodstuff plants, laundries, breweries, dairies.	Page 26 - 27
C4 high	Industrial areas and inshore areas of medium salinity.	Chemical plants, swimming pools, ship repair yards.	Page 28 - 29
C5-I very high (industrial)	Industrial areas of high humidity and aggressive atmosphere.	Buildings and areas of almost constant condensation and high contamination.	Page 30 - 31
C5-M very high (marine)	Inshore areas and offshore areas of high salinity.	Buildings and areas of almost constant condensation and high contamination.	Page 32 - 33

The categories for water and soil according to the ISO 12944 standard are shown as:

Im1	fresh water
Im2	sea or brackish water
Im3	soil






Corrosivity categories	Environment	Examples of environments and structures	Hempel's paint systems
Im1	Fresh water	River installations, hydroelectric power plants	Page 34 - 35
Im2	Sea or brackish water	Seaports with the following structures: sluice gate, locks (water steps), water stilts, piers, offshore structures	
Im3	Soil	Underground tanks, steel stilts, pipelines	

b. A type of protected surface

Designing a coating system normally involves dealing with constructional 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 constructional 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 maintenance is required for the first time after application. ISO 12944 specifies a range of three time frames to categorise durability:

LOW - L	2 to 5 years
MEDIUM - M	5 to 15 years
HIGH - H	more than 15 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.

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

2 SURFACE PREPARATION

2.1 Surface preparation grades

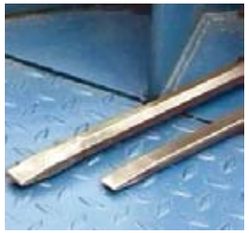
There are many ways to classify steel surface preparation grades but this study focuses on those outlined below.

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].

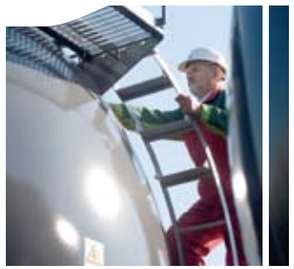
Notes:

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 or flame 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.


B. Surface preparation grades after high pressure water cleaning

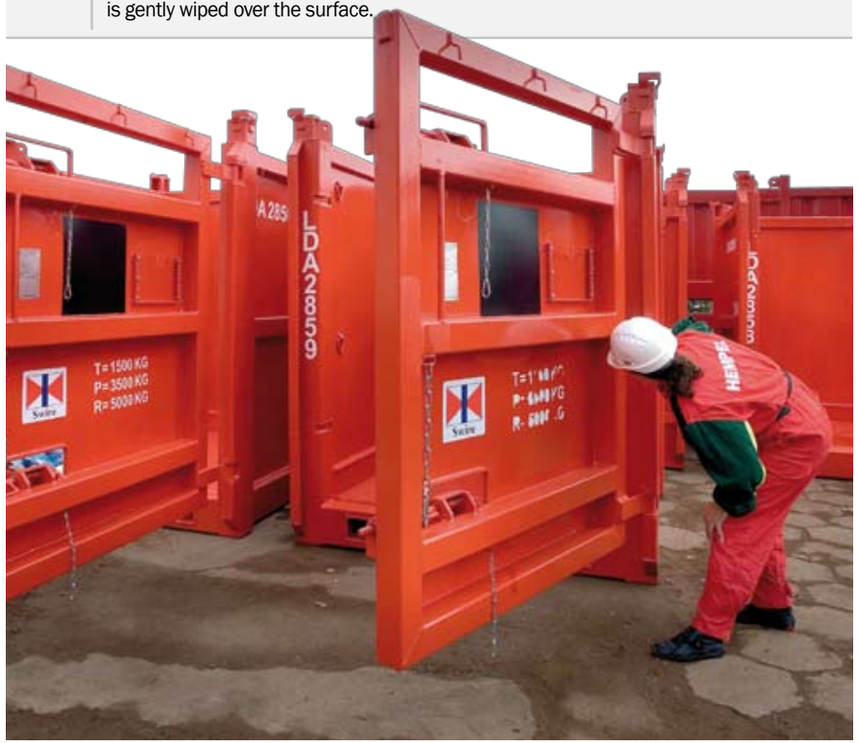
Surface preparation grades by high pressure water cleaning should not only include the cleanliness grade but also the flash rust grade, since flash rusting may occur on cleaned steel during the drying period. There are several ways to classify the degree to which a steel surface is prepared after high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

This study 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 discoloration 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 discoloration) 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 mag nification, 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 shopprimer

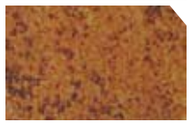
c) a steel surface coated with a paint system which needs to be maintained

These categories are outlined in more detail below.

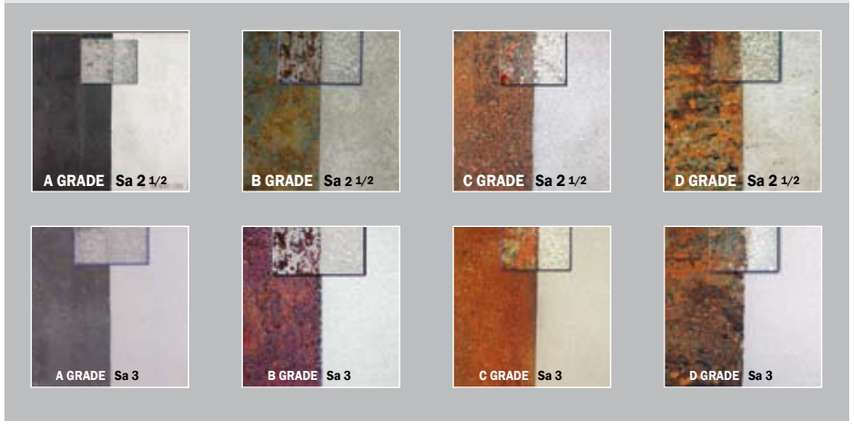
a. A bare steel structure with no previous protective coatings

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.



b. A steel surface covered with shopprimers

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

Hempel offers the following shopprimers:

HEMPEL'S SHOPPRIMER 15280 (protection period - 3 to 5 months)
is a solvent-borne epoxy shopprimer pigmented with zinc polyphosphate. It is designed for automatic spray application or manual application.

HEMPEL'S SHOPPRIMER ZS 15890 (protection period - 4 to 6 months)
is a solvent borne zinc silicate shopprimer designed for automatic spray application.

HEMPEL'S SHOPPRIMER ZS 15820 (protection period - 3 to 5 months)
is a solvent borne zinc silicate shopprimer, designed for automatic spray application.

HEMUCRYL SHOPPRIMER 18250 (protection period - 3 to 5 months)
is a waterborne acrylic shopprimer. It is designed for automatic spray application or manual application.

HEMUDUR SHOPPRIMER 18580 (protection period - 3 to 5 months)
is a waterborne epoxy shopprimer designed for automatic spray application.

Surfaces coated with a shopprimer must be prepared correctly prior to the application of a finishing paint system; this is termed 'second surface preparation'. A shopprimer 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 shopprimer and a finishing paint system
- the surface profile achieved during preparation prior to a shopprimer application, i.e. whether the profile is suitable for a finishing paint system

A surface coated with a shopprimer 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. A 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 influence therefore 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.

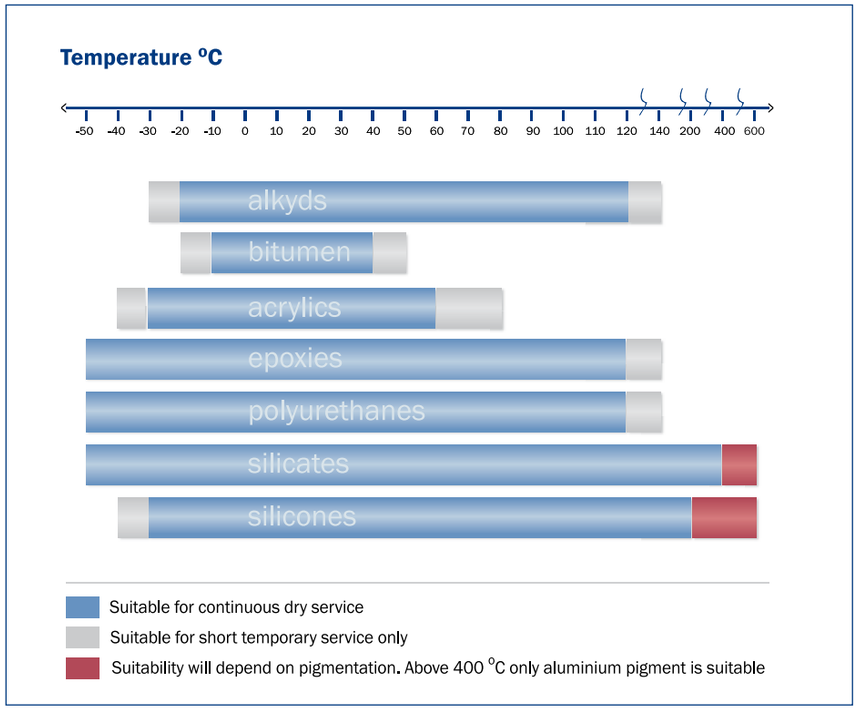
b. Aluminium and stainless steel

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 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 PAINTS






4.1. Generic Types

Hempel offers the following main types of paint:

one component:

a) Alkyd

b) Acrylic

c) Polysiloxane (for high temperature service)

two components:

a) Epoxy (pure and modified)

b) Polyurethane

c) Zinc silicate

d) Polysiloxane hybrids

4.2. Explanation of Hempel product names

Generally the name of a Hempel paint is based on a product name and a five-digit number e.g. HEMPATEX-HI BUILD 46410.

The product name denotes the group and generic type to which the paint belongs as shown in the following table:

Physically drying:	
HEMPATEX	Acrylic (solvent-borne)
HEMUCRYL	Acrylic (water-borne)

Chemically curing:	
HEMPALIN	Alkyd, modified alkyd (oxidatively drying)
HEMULIN	Alkyd (water-borne)
HEMPADUR	Epoxy, modified epoxy (solvent-borne, solvent-free)
HEMUDUR	Epoxy (water-borne)
HEMPATHANE	Polyurethane (solvent-borne)
HEMUTHANE	Polyurethane (water-borne)
GALVOSIL	Zinc silicate
HEMPAXANE	Polysiloxane hybrid (solvent-borne)



A 5-digit number identifies the remaining properties of a product. The first two digits relate to the principal function and the generic type. The third and fourth digits are serial numbers. The fifth digit identifies specific formulas with the same product, e.g. high temperature curing/low, medium temperature curing, conformity to local legislation. Therefore, the first four digits define the end-user performance, i.e. the dried, cured paint material. The fifth digit usually relates to the conditions of application, however, may also be used purely for logistic reasons.

First digit:	Function:
0– – – –	Clear varnish, thinner
1– – – –	Primer for steel and other metals
2– – – –	Primer for non-metallic substrates
3– – – –	Paste product, high-solids material
4– – – –	Intermediate coating, high-build coating used with/without primer and finishing coat
5– – – –	Finishing coat
6– – – –	Miscellaneous
7– – – –	Antifouling paint
8– – – –	Miscellaneous
9– – – –	Miscellaneous

Second digit:	Generic Type:
–0– – –	Asphalt, pitch, bitumen, tar
–1– – –	Oil, oil varnish, long-oil alkyd
–2– – –	Medium to long-oil alkyd
–3– – –	Short-oil alkyd, epoxyester, silicone alkyd, urethane alkyd
–4– – –	Miscellaneous
–5– – –	Reactive binder (non-oxidative), one or two-component
–6– – –	Physically drying binder (solvent-borne) (other than - 0 - - -)
–7– – –	Miscellaneous
–8– – –	Aqueous dispersion, thinner
–9– – –	Miscellaneous

Example: **HEMPATEX ENAMEL 56360**

5 – – – –	Topcoat
– 6 – – –	Physically drying
– – 3 6 –	Serial number
– – – – 0	Standard formula

Hempel's Product and Safety Data Sheets are available on local Hempel websites in local languages. How to find local Product Data Sheets:

www.hempel.com

4.3. 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

Hempel's 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: **HEMPADUR 45143-12170**

Paint HEMPADUR 45143
in Hempel standard shade 12170 – light grey

5 USEFUL DEFINITIONS

There are several useful definitions and terms used in coating protection technology. We provide you here with few necessary terms that you should be acquainted with when dealing with paints:

Volume solids

The volume solids (VS) figure expresses 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 shopprimers with a thin film, this has the effect of 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 ATMOSPHERIC CORROSIVITY CATEGORIES
& OTHER TYPES OF ENVIRONMENTS
(in accordance with ISO 12944-5:2007)

C1/C2 CORROSIVITY CATEGORY

C3 CORROSIVITY CATEGORY

C4 CORROSIVITY CATEGORY

C5-I CORROSIVITY CATEGORY

C5-M CORROSIVITY CATEGORY

IMMERSED STRUCTURES

HEAT RESISTANT STRUCTURES






C1/C2 CORROSIVITY CATEGORY

HEMPEL PAINT SYSTEMS

Sample Systems corresponding to C1/C2 Corrosivity Categories *

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
2 - 5 Years	1	SB Alkyd	1x HEMPAQUICK PRIMER 13624**	40
		SB Alkyd	1x HEMPAQUICK ENAMEL 53840	40
			Total DFT	**80 µm**
	2	WB Alkyd	1x HEMULIN PRIMER 18310	40
		WB Alkyd	1x HEMULIN ENAMEL 58380	40
			Total DFT	**80 µm**
	3	SB Polyurethane	1x HEMPATHANE HS 55610	80
			Total DFT	**80 µm**

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
5 - 15 Years	1	SB Alkyd	1x HEMPAQUICK PRIMER 13624**	80
		SB Alkyd	1x HEMPAQUICK ENAMEL 53840	40
			Total DFT	**120 µm**
	2	WB Alkyd	1x HEMULIN PRIMER 18310	80
		WB Alkyd	1x HEMULIN ENAMEL 58380	40
			Total DFT	**120 µm**
	3	SB Epoxy	1x HEMPADUR FAST DRY 45410	120
			Total DFT	**120 µm**
	4	SB Polyurethane	1x HEMPATHANE HS 55610	120
			Total DFT	**120 µm**

Hempel can offer many other coating systems to your specific needs. Please contact your local representative for further information.

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
>15 Years	1	SB Alkyd	2x HEMPAQUICK PRIMER 13624**	120
		SB Alkyd	1x HEMPAQUICK ENAMEL 53840	40
			Total DFT	**160 µm**
	2	WB Alkyd	2x HEMULIN PRIMER 18310	120
		WB Alkyd	1x HEMULIN ENAMEL 58380	40
			Total DFT	**160 µm**
	3	WB Acrylic	2x HEMUCRYL PRIMER HB 18032	120
		WB Acrylic	1x HEMUCRYL ENAMEL HB 58030	40
			Total DFT	**160 µm**
	4	SB Epoxy	1x HEMPADUR MASTIC 45880	160
			Total DFT	**160 µm**
	5	SB Epoxy	1x HEMPADUR FAST DRY 17410	100
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**160 µm**
	6	WB Epoxy	1x HEMUDUR 18500	100
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**160 µm**

*For places where blasting as secondary surface preparation is not possible after production, the use of shopprimed steel is an option. Ask Hempel for more specific guidelines regarding optimum choice of shopprimer and need for secondary surface preparation.

** Solvent borne alkyd paints mentioned in the brochure should be applied on installations where the Solvent Emission Directive applies (please contact your local Hempel Office for more information).

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






C3 CORROSIVITY CATEGORY

HEMPEL PAINT SYSTEMS

Sample systems corresponding to C3 Corrosivity Category *

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
2 - 5 Years	1	SB Alkyd	1x HEMPAQUICK PRIMER 13624**	80
		SB Alkyd	1x HEMPAQUICK ENAMEL 53840	40
			Total DFT	**120 µm**
	2	WB Alkyd	1x HEMULIN PRIMER 18310	80
		WB Alkyd	1x HEMULIN ENAMEL 58380	40
			Total DFT	**120 µm**
	3	SB Epoxy	1x HEMPADUR FAST DRY 45410	120
			Total DFT	**120 µm**
	4	SB Polyurethane	1x HEMPATHANE HS 55610	120
			Total DFT	**120 µm**

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
5 - 15 Years	1	WB Acrylic	1x HEMUCRYL PRIMER HB 18032	100
		WB Acrylic	1x HEMUCRYL ENAMEL HB 58030	60
			Total DFT	**160 µm**
	2	SB Epoxy	1x HEMPADUR FAST DRY 17410	100
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**160 µm**
	3	WB Epoxy	1x HEMUDUR 18500	100
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**160 µm**

Hempel can offer many other coating systems to your specific needs. Please contact your local representative for further information.

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
>15 Years	1	WB Acrylic	2x HEMUCRYL PRIMER HB 18032	125
		WB Acrylic	1x HEMUCRYL ENAMEL HB 58030	75
			Total DFT	**200 µm**
	2	SB Epoxy	1x HEMPADUR FAST DRY 17410	125
		SB Polyurethane	1x HEMPATHANE HS 55610	75
			Total DFT	**200 µm**
	3	WB Epoxy	2x HEMUDUR 18500	140
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**200 µm**
	4	SB Zinc Epoxy	1x HEMPADUR ZINC 17360	40
		SB Epoxy	1x HEMPADUR FAST DRY 17410	70
		SB Polyurethane	1x HEMPATHANE HS 55610	50
			Total DFT	**160 µm**

* For the places that blasting as secondary surface preparation is not possible after production, the use of shopprimed steel is an option. Zinc silicate based shopprimers e.g. Hempel's Shopprimer ZS 15890 or 15820 are preferred – especially for later overcoating with zinc containing paints – Epoxy based shopprimers E.g. Hempel Shopprimer 15280 or 18580 can also be used in case of later overcoating with non-zinc containing paint. Ask Hempel for more specific guidelines regarding optimum choice of shopprimer and need for secondary surface preparation.

** Solvent borne alkyd paints mentioned in the brochure should be applied on installations where the Solvent Emission Directive applies (please contact your local Hempel Office for more information).

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

C4 CORROSIVITY CATEGORY

HEMPEL PAINT SYSTEMS

Sample systems corresponding to C4 Corrosivity Category *

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
2 - 5 Years	1	WB Acrylic	2x HEMUCRYL PRIMER HB 18032	140
		WB Acrylic	1x HEMUCRYL ENAMEL HB 58030	60
			Total DFT	**200 µm**
	2	SB Epoxy	2x HEMPADUR MASTIC 45880	200
			Total DFT	**200 µm**

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
5 - 15 Years	1	SB Epoxy	2x HEMPADUR FAST DRY 17410	180
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**240 µm**
	2	WB Epoxy	2x HEMUDUR 18500	180
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**240 µm**
	3	SB Zinc Epoxy	1x HEMPADUR ZINC 17360	60
		SB Epoxy	1x HEMPADUR FAST DRY 17410	80
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**200 µm**
	4	WB Zinc Epoxy	1x HEMUDUR ZINC 18560	60
		WB Epoxy	1x HEMUDUR 18500	80
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**200 µm**

Hempel can offer many other coating systems to your specific needs. Please contact your local representative for further information.

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
> 15 Years	1	SB Epoxy	2x HEMPADUR FAST DRY 17410	220
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**280 µm**
	2	SB Zinc Epoxy	1x HEMPADUR ZINC 17360	60
		SB Epoxy	1x HEMPADUR FAST DRY 17410	120
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**240 µm**
	3	WB Zinc Epoxy	1x HEMUDUR ZINC 18560	60
		WB Epoxy	2x HEMUDUR 18500	120
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**240 µm**
	4	SB Zinc Silicate	1x HEMPEL's GALVOSIL 15700	60
		SB Epoxy	1x HEMPADUR MASTIC 45880/W	120
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**240 µm**

* For the places that blasting as secondary surface preparation is not possible after production, the use of shopprimed steel is an option. Zinc silicate based shopprimers e.g. Hempel's Shopprimer ZS 15890 or 15820 are preferred – especially for later overcoating with zinc containing paints – Epoxy based shopprimers E.g. Hempel Shopprimer 15280 or 18580 can also be used in case of later overcoating with non-zinc containing paint. Ask Hempel for more specific guidelines regarding optimum choice of shopprimer and need for secondary surface preparation.

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





C5-I CORROSIVITY CATEGORY

HEMPEL PAINT SYSTEMS

Sample systems corresponding to C5 Industrial Corrosivity Category *

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
5 - 15 Years	1	SB Epoxy	2x HEMPADUR QUATTRO 17634	300
			Total DFT	**300 µm**
	2	SB Zinc Epoxy	1x HEMPADUR ZINC 17360	60
		SB Epoxy	1x HEMPADUR FAST DRY 17410	120
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**240 µm**
	3	WB Zinc Epoxy	1x HEMUDUR ZINC 18560	60
		WB Epoxy	2x HEMUDUR 18500	120
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**240 µm**

Hempel can offer many other coating systems to your specific needs. Please contact your local representative for further information.

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
> 15 Years	1	SB Epoxy	2x HEMPADUR MASTIC 45880/W	260
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**320 µm**
	2	SB Zinc Epoxy	1x HEMPADUR ZINC 17360	60
		SB Epoxy	2x HEMPADUR FAST DRY 17410	200
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**320 µm**
	3	WB Zinc Epoxy	1x HEMUDUR ZINC 18560	60
		WB Epoxy	2x HEMUDUR 18500	200
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**320 µm**
	4	SB Zinc Silicate	1x HEMPEL's GALVOSIL 15700	60
		SB Epoxy	2x HEMPADUR MASTIC 45880/W	200
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**320 µm**

* For places where blasting as secondary surface preparation is not possible after production, the use of shopprimed steel is an option. Zinc silicate based shopprimers e.g. Hempel's Shopprimer ZS 15890 or 15820 are preferred, especially for later overcoating with paints containing zinc. Epoxy based shopprimers e.g. Hempel Shopprimer 15280 or 18580 can also be used in the case of later overcoating with paint not containing zinc. Ask Hempel for more specific guidelines regarding the optimum choice of shopprimer and the need for secondary surface preparation.

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






C5-M CORROSIVITY CATEGORY

HEMPEL PAINT SYSTEMS

Sample systems corresponding to C5 Marine Corrosivity Category *

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
5 - 15 Years	1	SB Epoxy	2x HEMPADUR MASTIC 45880	300
			Total DFT	**300 µm**
	2	WB Epoxy	3x HEMUDUR 18500	260
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	40
			Total DFT	**300 µm**
	3	SB Zinc Epoxy	1x HEMPADUR ZINC 17360	40
		SB Epoxy	1x HEMPADUR FAST DRY 17410	120
		SB Polyurethane	1x HEMPATHANE HS 55610	80
			Total DFT	**240 µm**
	4	WB Zinc Epoxy	1x HEMUDUR ZINC 18560	60
		WB Epoxy	2x HEMUDUR 18500	120
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**240 µm**

Hempel can offer many other coating systems to your specific needs. Please contact your local representative for further information.

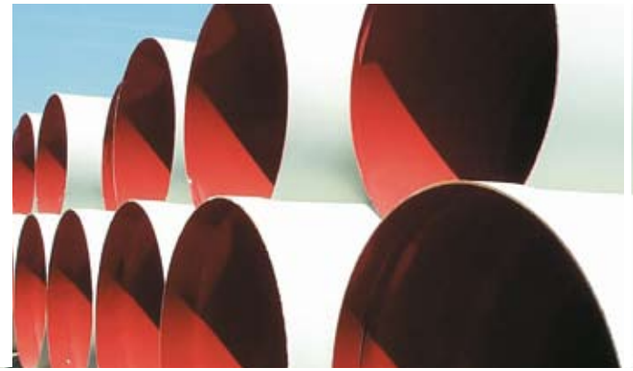
Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
> 15 Years	1	SB Epoxy	2x HEMPADUR MASTIC 45880/W	260
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**320 µm**
	2	SB Zinc Epoxy	1x HEMPADUR ZINC 17360	60
		SB Epoxy	2x HEMPADUR FAST DRY 17410	200
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**320 µm**
	3	WB Zinc Epoxy	1x HEMUDUR ZINC 18560	60
		WB Epoxy	2x HEMUDUR 18500	200
		WB Polyurethane	1x HEMUTHANE ENAMEL 58510	60
			Total DFT	**320 µm**
	4	SB Zinc Silicate	1x HEMPEL's GALVOSIL 15700	60
		SB Epoxy	2x HEMPADUR MASTIC 45880/W	200
		SB Polyurethane	1x HEMPATHANE HS 55610	60
			Total DFT	**320 µm**

* For places where blasting as secondary surface preparation is not possible after production, the use of shopprimed steel is an option. Zinc silicate based shopprimers e.g. Hempel's Shopprimer ZS 15890 or 15820 are preferred, especially for later overcoating with paints containing zinc. Epoxy based shopprimers e.g. Hempel Shopprimer 15280 or 18580 can also be used in the case of later overcoating with paint not containing zinc. Ask Hempel for more specific guidelines regarding the optimum choice of shopprimer and the need for secondary surface preparation.

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








IMMERSED STRUCTURES

HEMPEL PAINT SYSTEMS

1. For Steel Structures immersed in water (excluding potable water) or buried in soil

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
5 - 15 Years	1	Epoxy	HEMPADUR QUATTRO 17634	190
		Epoxy	HEMPADUR QUATTRO 17634	190
			Total DFT	**380 µm**
	2	Epoxy	HEMPADUR MASTIC 45880/W	190
		Epoxy	HEMPADUR MASTIC 45880	190
			Total DFT	**380 µm**
	3	Epoxy GF	HEMPADUR MULTI-STRENGTH GF 35870	400
			Total DFT	**400 µm**

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
> 15 Years	1	Epoxy	HEMPADUR QUATTRO 17634	150
		Epoxy	HEMPADUR QUATTRO 17634	175
		Epoxy	HEMPADUR QUATTRO 17634	175
			Total DFT	**500 µm**
	2	Epoxy	HEMPADUR MULTI-STRENGTH 45751/3	150
		Epoxy	HEMPADUR MULTI-STRENGTH 45751/3	175
		Epoxy	HEMPADUR MULTI-STRENGTH 45751/3	175
			Total DFT	**500 µm**
	3	Epoxy GF	HEMPADUR MULTI-STRENGTH GF 35870	300
		Epoxy GF	HEMPADUR MULTI-STRENGTH GF 35870	300
			Total DFT	**600 µm**
	4	Epoxy	HEMPADUR 87540	800
			Total DFT	**800 µm**

2. For Steel Structures immersed in potable water (drinking water)

Lifetime	System No	Paint Type	Hempel Paint System Samples	Thickness (micron)
5 - 15 Years	1	Epoxy (solventfree)	HEMPADUR 35560	200
		Epoxy (solventfree)	HEMPADUR 35560	200
			Total DFT	**400 µm**
	2	Epoxy (solventfree)	HEMPADUR 35560	400
			Total DFT	**400 µm**

3. Tank lining for fuels (Crude oil, Jet fuel, Gasoline etc.)

Paint Type	Hempel Paint System Sample	Thickness (micron)
Epoxy (Phenolic)	HEMPADUR 85671	100
Epoxy (Phenolic)	HEMPADUR 85671	100
Epoxy (Phenolic)	HEMPADUR 85671	100
	Total DFT	**300 µm**

For recommendations for tank linings for other chemicals contact your local Hempel office. Hempel can offer many other coating systems to your specific needs. Please contact your local representative for further information.

SB= Solvent Borne **WB=** Waterborne **DFT=** Dry Film Thickness **GF=** Glass Flake

HEAT RESISTANT STRUCTURES

HEMPEL PAINT SYSTEMS

For Steel Structures that need to be heat resistant

Paint Type	Hempel Paint System Sample	Thickness (micron)
Zinc Silicate	HEMPEL'S GALVOSIL 15700	75
Silicon	HEMPEL'S SILICONE ALUMINIUM 56914	25
Silicon	HEMPEL'S SILICONE ALUMINIUM 56914	25
	Total DFT	**125 µm**

Maximum heat resistance: 500°C

Hempel can offer many other coating systems to your specific needs. Please contact your local representative for further information.

Paint Type	Hempel Paint System Sample	Thickness (micron)
Silicon	HEMPEL'S SILICONE ALUMINIUM 56914	25
Silicon	HEMPEL'S SILICONE ALUMINIUM 56914	25
Silicon	HEMPEL'S SILICONE ALUMINIUM 56914	25
	Total DFT	**75 µm**

Maximum heat resistance: 600°C

Paint Type	Hempel Paint System Sample	Thickness (micron)
Zinc Silicate	HEMPEL'S GALVOSIL 15700	80
	Total DFT	**80 µm**

Maximum heat resistance: 500°C

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