KANSAI PROTECTIVE COATING SYSTEM

KANSAI PAINT CO.,LTD.

Contents

1. INTRODUCTION

Public attention today is focused on the conservation of limited natural resources. Corrosion prevention technology contributes to society by protecting all steel structures such as large plants for natural resource development, process plants, ships, sea-going containers, bridges, and port facilities. Such structures must withstand severe environmental conditions for years. Highly specialized treatment is thus required to ensure long-lasting service. Among various material technology developments to cope with the corrosion, coating is raising its position as the easiest, effective and economical measure to minimize corrosion loss and consumption of natural resources and energy.

Anticipating such corrosion problems, Kansai Paint Co., Ltd., Japan's largest paint manufacturer, has long been engaged in research and development activities and has successfully been marketing at home and abroad alike varieties of heavy-duty coatings to meet versatile requirements.

Kansai paint is always ready to listen to its customers and welcomes all inquiries in the field of protective coatings. We hope this guidebook will be of service to you.

2. HOW CORROSION OCCURS

To select the method of corrosion control, it is very important to understand how corrosion occurs.
The corrosion of steel proceeds in the presence of oxygen and water, and is restrained by removing one of them.The corrosion of steel in water, as illustrated in Figs. 1 and 2, can generally be attributed to corrosion in the air, because on a steel surface in a humid atmosphere, there is a thin water layer formed by the adsorption of water molecules in the air. Each point on a steel surface has its own tendency to dissolve in water. This is called electrolytic solution pressure.
This tendency depends on the condition of the surface and the water contacting each point. At the point of high dissolution, metallic iron dissolves in the form of ferrous ions. Since the water must remain electrically neutral, hydrogen ions are deposited as a thin layer of hydrogen along the low dissolution surface of the steel. As a result, an electric circuit is formed between the high and low points of dissolution. These points and the circuits are called anodes, cathodes and corrosion cells, respectively.
The existence of a layer of hydrogen on the cathodes obstructs the further progress of the reaction, but free oxygen in the water removes the obstruction as it combines with hydrogen. The ferrous ions dissolved in the water combine with the hydroxy ions and finally precipitate on the suface of the steel as rust after being oxidized to form ferric ions. The mill scale on steel has a comparatively low dissolution so it acts as a cathode and forms a strong corrosion cell with anodic parts in the vicinty. This big difference in the electrolytic solution pressure between the electrodes prompts the corrosion reation.
The general methods of controlling corrosion are as follows:

1)Minimize the difference in electrolytic solution pressure between anodes and cathodes by making the steel surface uniform.
2)Use a coating to restrain the supply of water and oxygen to the steel surface.
3)Restrain the corrosion reaction by the adsorption of inhibitors in the anodes of cathodes. The inhibitors are intentionally added to the water or supplied by the dissolution of anticorrosive pigments in the coating material.

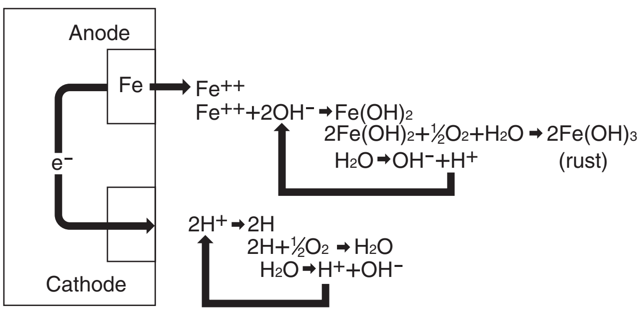


Fig. 1 Corrosive Action

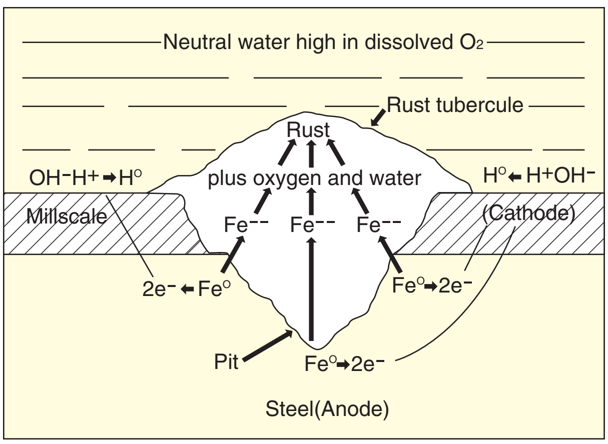


Fig. 2 Corrosion at Break in Mill Scale
(Steel Structures Painting Manual, Steel Structures Painting Council)

3. PROTECTIVE COATINGS FOR INDUSTRIAL PLANTS

VOC reduction

Although organic solvent is one of the major components of paints, which is originally utilized during paint film formation by evaporating, large amount of organic solvents has been emitted into atmosphere until now.
High solid paint, solvent free paint and water borne paint have been developed as VOC reduction plan by the government was unveiled and regulation that restricts VOC emission is expected to be more serious.

Transformation of solvents type to low tendency of oxidant generation.

Organic solvents are assumed to be causative agent generating ozone in troposphere that is known as oxidant in photochemical smog. For the generation of this oxidant, contribution to the photochemical reaction is different depending on the kind of an individual organic solvent. Mineral spirit, however, is reported to be relatively low tendency in generating oxidant. Therefore, development and marketing of mineral spirit soluble high durable paint such as epoxy, polyurethane and fluoro-carbon have been progressing.

Exclusion of carcinogen

Coal tar is useful and low cost material having high water-repellency. Tar epoxy paint that consists of combination of coal tar and epoxy resin has been applied on area that high level of water resistance is required. However, carcinogen in coal tar is considered to threaten worker's health or water pollution and has been restricted or banned for city water pipe interior coating. Kansai Paint has been developing and marketing modified epoxy paint without containing coal tar by positive trial to abolish paints with coal tar.

Measures for lead and chromium

Lead and chromium have been used as anti-corrosive pigment for primers, color pigments for top coat and dryers for alkyd paints. Those heavy metals, however, have been restricted of use world widely due to their possibility to damage work environment and water quality. The anti corrosive pigments in primers have been replaced with phosphate anti corrosive pigments. And dryers and color pigments have been also replaced with lead and chromium free materials.

4. PLANNING FOR PAINTING WORKS

Painting projects are usually planned in the following way.

1)Paints are selected after studying the factors which affect the durability of paint film.

2)The surface preparation method and the painting procedure are decided by considering the characteristics of the paint, the design of the structures and so on.

3)All painting specifications are decided by considering cost factors.

Fig. 3 shows the important factors in planning coating works.

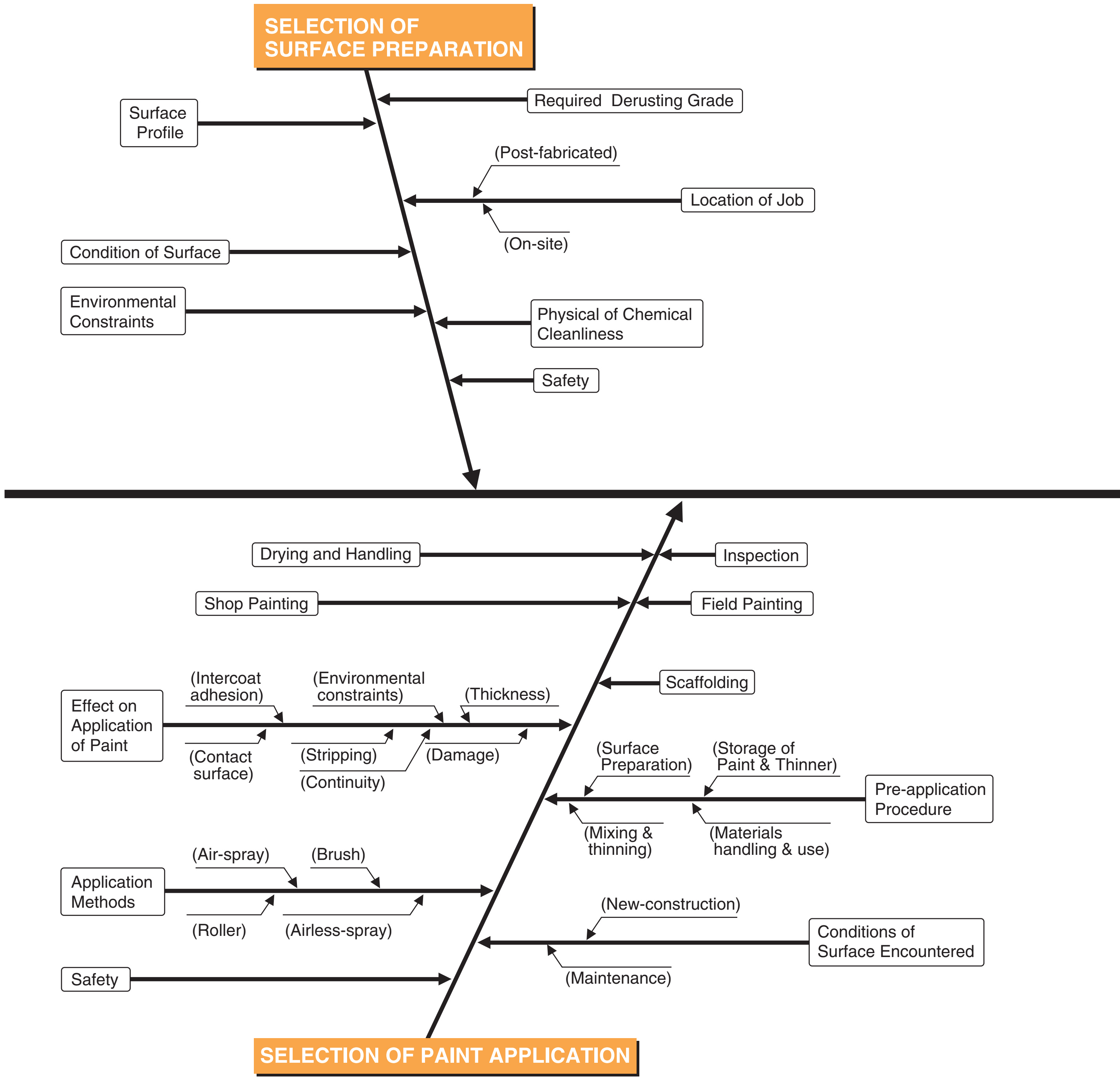
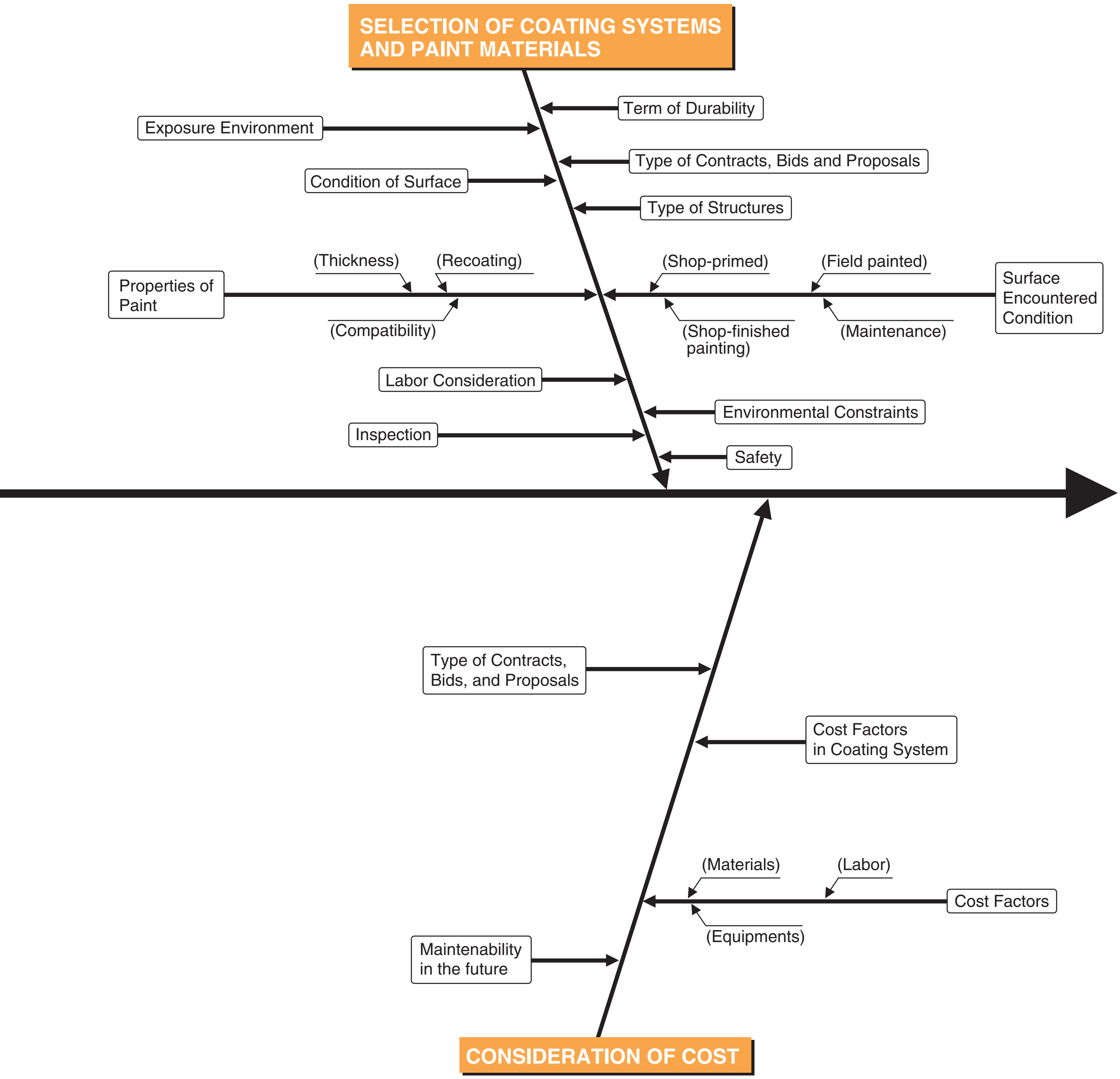


Fig. 3 Important Factors in Planning Coating Works


SELECTION OF COATING SYSTEMS AND PAINT MATERIALS
Term of Durability
Exposure Environment
Type of Contracts, Bids and Proposals
Condition of Surface
Type of Structures
(Thickness)
(Recoating)
(Shop-primed)
(Field painted)
Properties of Paint
Surface Encountered Condition
(Compatibility)
(Shop-finished painting)
(Maintenance)
Labor Consideration
Environmental Constraints
Inspection
Safety
Type of Contracts, Bids, and Proposals
Cost Factors in Coating System
(Materials)
(Labor)
Cost Factors
(Equipments)
Maintenability in the future
CONSIDERATION OF COST

5. PAINTS AND THEIR USES

It is necessary to consider the exposure condition of each plant before selecting paints to us.
Table 1 shows typical conditions of plants and types of paint recommended for those conditions.
Fig. 4 shows the durability of paint film effected by weathering conditions.

Items	Paint film performance						Exposed conditions and applications						
Generic name of paints	Weather resistance	Water resistance	Acid resistance	Alkali resistance	High temp. resistance	Impact resistance	Non-polluted & inland	Polluted & inland	Non-polluted & coastal	Polluted & coastal	(Sea) Water immersion	Chemicals immersion	Coresponding brand name of Kansai
Alkyd paints	VG	F	F	F	80℃	G	∗						Sabinite, Rusgon Safety, SD Marine Safety
Phenolic paints	G	G	VG	F	80℃	G	∗	∗					New Acnon NC, Ferrodor F
Chlorinated rubber paints	VG	VG	G	G	80℃	G	∗	∗	∗	∗			Rabatect
Vinyl paints	VG	VG	VG	E	60℃	F	∗	∗	∗	∗			Vinibon 100
Epoxy paints	VG	VG	VG	VG	100℃	E	∗	∗	∗	∗			Epomarine, Esco, Ferrodor EPX
Epoxy paints for water immersion	-	E	E	E	100℃	E	∗	∗			∗		Epomarine JW
Epoxy paints for chemical immersion	-	E	E	E	100℃	E	∗	∗				∗	Million, Epomarine PC
Modified epoxy paints	F	E	E	E	100℃	VG	∗	∗	∗	∗	∗	∗	Esco NB Safety
Non tar epoxy paints	F	E	E	E	100℃	VG	∗	∗	∗	∗			Epotect Tar Free
Polyurethane paints	E	VG	VG	VG	100℃	E	∗	∗	∗	∗			Retan 6000, Celatect U
Fluoro polymer paints	E	VG	VG	VG	100℃	E	∗	∗	∗	∗			Kanpeflon HD, Celatect F
Silicone paints	VG	VG	G	G	200 -600℃	G	∗	∗	∗	∗			Thermo
Inorganic zinc rich paints	VG	VG	G	G	400℃	VG	∗	∗	∗	∗			SD Zinc 1500

Key- E : Excellent, VG : Very Good, G : Good, F : Fair, P : Poor, ∗: Well-suited recommendable

Table 1 Typical characteristics of finish coats and recommendations

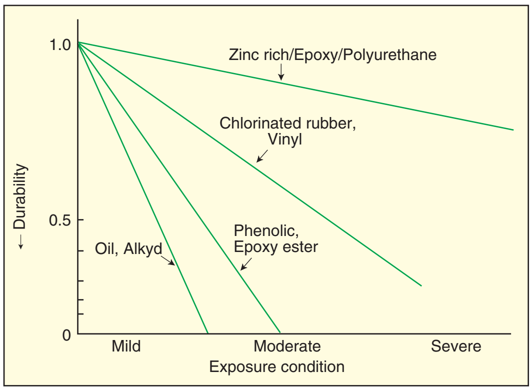
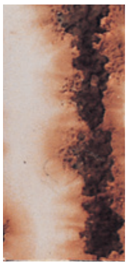
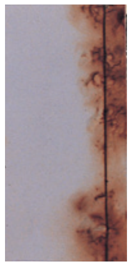


Fig. 4 Durability of Paint Films

6. SELECTING THE PROPER SURFACE PREPARATION GRADE

Surface preparation is a very important factor affecting the durability of paint film.
Fig. 5 shows the results of a coastal weathering test which was done with different dry film thicknesses of catalized epoxy paint on surfaces treated by power-tool cleaning (SSPC SP 3) and blast cleaning (SSPC SP 10).
We see that the high-grade surface preparation results in long-term durability. Poor surface preparation does not provide long-term durability.
Judging from the test results, we may conclude that coating should be planned so that the surface preparation should be of the highest grade possible.

Grade of surface preparation	Power Tool Cleaning (SSPC SP3)			Blast Cleaning (SSPC SP 10)		
Dry film thickness of epoxy paint	100 μ	200 μ	300 μ	100 μ	200 μ	300 μ
Result						
Rusting at non-scratched area	Bad	Fair	Fair	Fair	Excellent	Excellent

Remarks *1. The surface was scratched along the right side prior to weathering.*
2. The weathering test was continued for 5 years along Chiba seacoast in Japan.

Fig. 5 Coastal Weathering Test Results with Catalized Epoxy Paint

7. EFFECT OF COATING TIMES AND FILM THICKNESS

A coat of paint inevitably bears some defects and a partial deficiency in film thickness even when the paint is applied thickly. To reduce these defects, it is recommended to apply two or more coats of rust preventive primer before the topcoating.
The thicker primer film, if it bears no defects, is more rust preventive.
Table 2 shows the durability of paint film in various weathering conditions.
These paint films consist of oil-based rust preventive primers and alkyd top coats having a total film thickness of about 125 microns.
In the painting and coating manual of the Royal Dutch/Shell group, the coating intervals for the maintenance of their paint are as shown on Table 3. These intervals have been decided for the standard painting system which consists of 2 coats of red lead/red oxide oil alkyd primer and 2 coats of aluminium paint.
The total thickness of the film is at least 125 microns.

Condition	Average Repainting Interval
Seaside	3.9 years
Industrial	6.0 years
Rural	6.9 years
Mountain region	7.8 years

[Report of Japan National Railway Technical Research Institute No.892 (1974) Feb.]
[Surface Preparation: SSPC SP 10 Near White Metal Blast Cleaning]

Table 2 Weather Conditions and Durability of Paint Film

Condition / Structure	Temperate Climate	Tropical or Semitropical Climate	Exposure to Salt-Bearing Winds	Exposure Frequent Sandstorms and Marine Ameosphere
Storage tanks				
Walls	10 - 12 years	8 - 10 years	4 - 6 years	2 - 4 years
Roofs	7 - 10 years	4 - 6 years	3 - 5 years	2 - 4 years
Pipes & other structures	8 - 10 years	6 - 8 years	3 - 5 years	2 - 4 years

[Manual, Painting and Coating DEP30.48.00 10-Gem. Jan. 1973 (Royal Dutch/Shell Group)]
[Surface Preparation: SSPC SP 6 Commercial Blast Cleaning]

Table 3 Repainting intervel for Plants

8. SURFACE PREPARATION METHODS

Quality of the surface preparation seriously affects performance of paint film. It is necessary to clearly determine the method and the grade of surface preparation in the painting specification before contracting the painting work. The inspector and the painters should preferably work in concert to ensure the quality of the surface preparation before commencement of the work.
The methods of surface preparation are detailed in the Steel Structures Painting Manual, Vol. 2. The pictorial standards were prepared by the Swedish Corrosion Institute and have been jointly approved by the American Society for Testing and Materials, the Steel Structure Painting Council as the Swedish Standard Association.
The terms used in the surface preparations specified by the Steel Structures Painting Council are shown on Table 4.
The related specifications are compared on Table 5.

SSPC Specification	SSPC-Vis 1* Photograph	Description
SP 1, Solvent Cleaning		Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent, vapor, alkali, emulsion, or stream.
SP 2, Hand Tool Cleaning	B, C, D St2	Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing.
SP 3, Power Tool Cleaning	B, C, D St3	Removal of loose rust, loose mill scale, and loose paint to degree specified, by power tool chipping, descaling, sanding, wire brushing, and grinding.
SP 5, White Metal Blast Cleaning	A, B, C, D Sa3	Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by wheel or nozzle (dry or wet) using stand, grit, or shot, (For very corrosive atmospheres where high cost of cleaning is warranted.)
SP 6, Commercal Blast Cleaning	C, D Sa2	Blast cleaning until at least two-thirds of the surface area is free of all visible residues. (For rather severe conditions of exposure.)
SP 7, Brush-Off Blast Cleaning	B, C, D Sa1	Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, exposing numerous evenly distributed flecks of underlying metal.
SP 8, Pickling		Complete removal of rust and mill scale by acid pickling, duplex pickling or electrolytic pickling.
SP 10, Near-White Blast Cleaning	B, C, D Sa2 ½	Blast cleaning nearly to White Metal cleanliness, until at least 95% of the surface area is free of all visible residues. (For high humidity, chemical atmosphere, marine, or other corrosive environments.)

** Vis 1, pictorial surface preparation standards for painting of steel surfaces.*
Photographic standards used as specification; optional supplement to SSPC Surface Preparations 2, 3, 5, 6, 7 and 10.

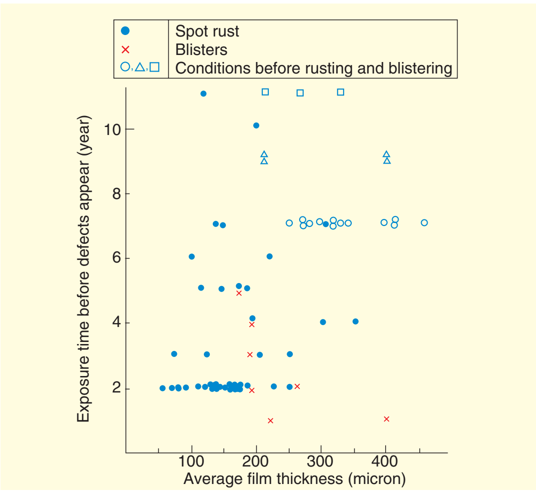
Table 4 Definitions of Surface Preparations (Steel Structures Painting Manual Vol. 2, SSPC)

SSPC *1		ISO and SIS *2	BS 4232*3	NACE*4	JSRA*5 SPSS
White metal blast cleaning	SP 5	Sa 3	First (100%)	No. 1	Sh 3, Sd 3
Near-White Metal Blast Cleaning	SP 10 (95% Min.)	Sa 2 ½	Second (95% Min.)	No. 2	Sh 2, Sd 2
Commercial Blast Cleaning	SP 6	Sa 2	Third (80% Min.)	No. 3	Sh 1, Sd 1
Brush-Off Blast Cleaning	SP 7	Sa 1		No. 4	
Power Tool Cleaning	SP 3	St 3			Pt 3
Hand Tool Cleaning	SP 2	St 2			
With Detailed Work Conditions and Procedures		With Pictorial Standards	Percentage of Removed Rust		With Pictorial Standards

Remarks
*1 *Steel Structures Painting Council*
*2 *International Standard ISO 8501-1:2007, and Svensk Standard SIS 05 5900-1967*
*3 *British Standard*
*4 *National Association of Corrosion Engineers*
*5 *The Shipbuilding Research Association of Japan*
Standard for The Preparation of Steel Surface Prior to Painting

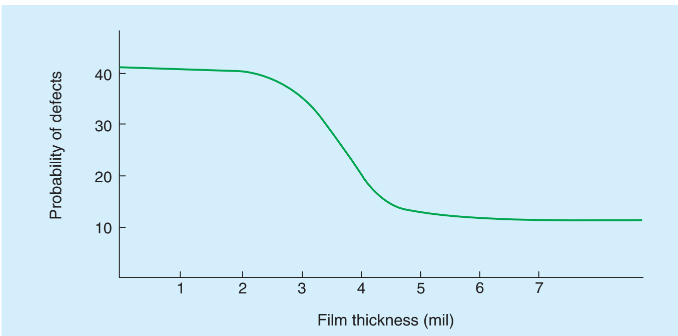
Table 5 Comparison of the Specifications of Surface Treatment

In a series of weathering tests conducted by the Railway Technical Research Institute of Japan, 86 different paint systems were exposed to the sea and compared in terms of durability and film thickness. (Fig. 6) The Test results revealed that films of 250 microns or more in thickness performed adequately for a much longer time than films that were less thick. We may, therefore, conclude that paint applications in highly corrosive environments require a film thickness of more than 250 microns.
According to the study of R. P. Pierce, the probability of finding some defects in paint film depends on the film thickness (Fig. 7).
The paint film shows good durability when applied over 5 mils (125 microns) thick.



[Report of Japan National Railway Technical Research Institute No. 1070 (1978) Mar.]

Fig. 6 Relationship between Film Thickness and Durability of Film when Weathered on Sea



[R. P. Pierce, Corrosion 8 [5] 178 (1952)]

Fig. 7 Relationship between Film Thickness and Probability of Defects on Freshly Painted Film

9. SHOP PRIMER FABRICATION SYSTEM

1) Advantages of the system

Since Japanese shipbuilders introduced the block building production system about fifty years ago, shop primers have played a very important role.
In all cases, shop primer is coated onto the steel surface which is first cleaned by abrasive blasting at the steel mill or shipbuilding plant.
After coating the steel plates with shop primer, the plates are cut and welded to make blocks. The blocks are then assembled to form a ship in a dry dock. During this period of shipbuilding, the shop primer film protects the steel surface from unnecessary corrosion and minimizes the surface preparation costs required before successive painting.
Moreover, the shop primer fabrication system has enabled shipbuilders to shorten their building schedules and reduce building costs.
The advantages of shop primers also apply to the fabrication of plants, bridges and other steel structures.

2) Film thickness of the shop primer

As shown on Table 6, phenolic resin modified wash primer and organic and inorganic zinc rich primers are used as shop primer.
The recommended film thickness is from 15 to 20 microns for wash primer and from 15 to 30 microns for zinc rich primer.
The roughness of the blasted steel surface is so great that a thin film of shop primer does not evenly cover the surface. To ensure the proper film thickness of the shop primer, cold-rolled steel plates with a smooth surface are put on the blasted surface as reference panels. After coating, the avarage thickness of these panels is determined using an electromagnetic thickness gauge.
Because the weldability of the steel plate is affected by the existence of the shop primer film, the film should be kept as thin as possible to the extent that sufficient anticorrosiveness is ensured.
Sometimes shop primer is coated very thick on steel plates for long-term corrosion prevention. In this case, the shop primer film around the parts to be welded must be removed by a power tool before welding.

3) Transportation and storage of shop-primed steels

The shop-primed steels or plant equipments are often transported over the sea and stacked portside or at a work site. During transportation and storage, shop primer films are exposed to very severe conditions.
Much salt deposits on them and rainwater or condensed water penetrates the stack of the steel.
The shop primer film rapidly deteriorates in the presence of water, oxygen and salt. For example, the zinc powder in zinc rich primer quickly loses its galvanic anticorrosiveness. Within a few weeks, heavy rust appears on the steel.
To keep the shop primed surface in good condition, all the steel must be kept dry and free from contamination by salt from the sea or salty soil.
Steel coated with phenolic resin modified wash primer will remain protected for 3 to 6 months. Steel coated with zinc rich primer remains corrosion-free nearly a year in normal weathering conditions.

4) Compatibility of paints with shop primers

Inorganic zinc rich paint can be applied only on inorganic zinc rich primer or blasted steel surfaces because of its poor compatibility with organic primers.
Oil primers, alkyd modified oil primers and phenolic primers are not recommended to apply on to organic and inorganic zinc primers as the oil component in these primers will react with the zinc and produce metallic soap which will deteriorate the adhesion between the zinc rich primer surface and overcoated film.
Table 6 shows the compatibility of paints with shop primers.

Coating Being Applied \ Shop Primers		Wash Primer	Zinc Rich Primers	
			Inorganic	Organic
Oil Primers		A	N	N
Oil & Alkyd Primers		A	N	N
Phenolic Primers		A	N	N
Epoxy Ester Primers		A	A	A
Chlorinated Rubber Primers		A	A	A
Catalized Epoxy Primers		A	A	A
Coal Tar Epoxy Paints		A	A	A
Polyurethane Primers		A	A	A
Silicone Primers		—	A	—
Zinc Rich Primers	Inorganic	N	A	N
	Organic	N	A	A

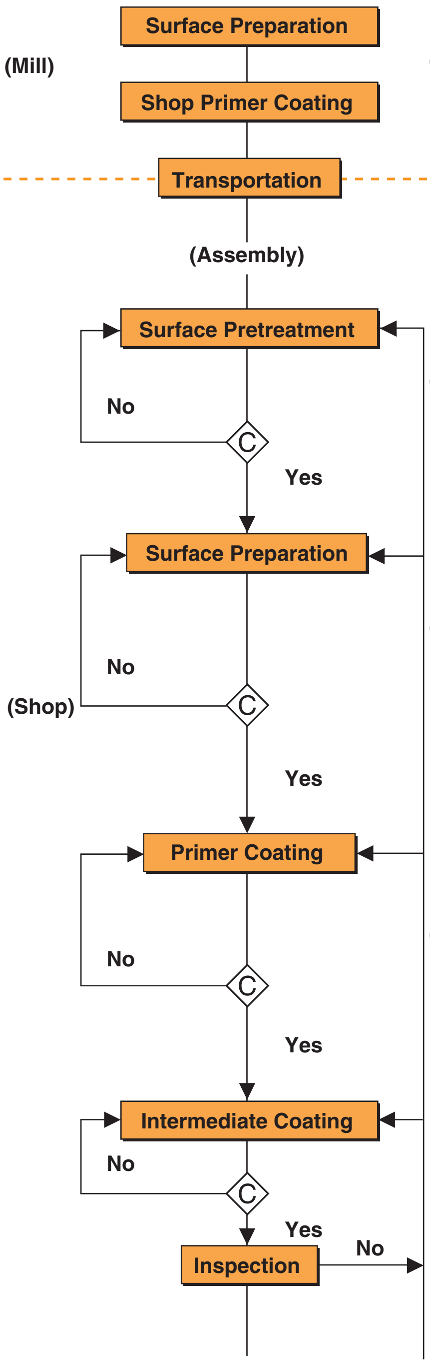
Remarks
The marks and abbreviations are as follows:
A: Acceptable
N: Not acceptable
–: The combinations are not practical because silicone primers are only employed as a heat-resistance primer.

Table 6 Overcoating Compatibility of Paints on Shop Primers

10. PAINTING WORKS AND CHECK POINTS FOR INSPECTION

The painting work must be well controlled to ensure the rust-preventive performance of the paint.
Many factors must be considered as shown below.
Below is one of the most typical application procedures.

[Flow Chart] **[Application Procedure]** **[Check Point for Inspection]**



"Shop primer fabrication system" as described on Page 14.

(Some steels are not shop-primed)

If the steel surface is wet, is should be dried using an air-blower or ventilator. Grease, oil and similar matters shall be removed by solvent cleaning.

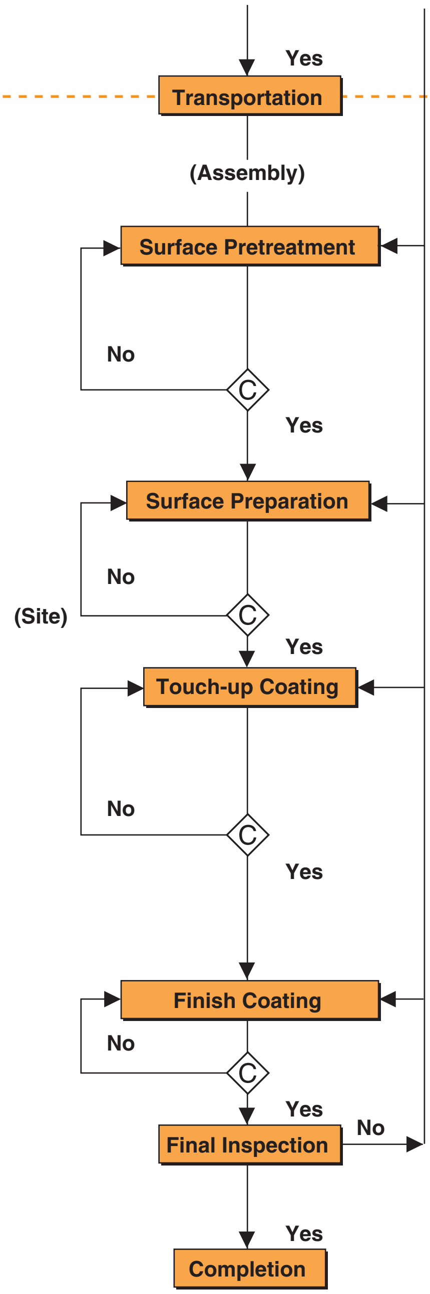
1. Moisture on steel surface
2. Existence of grease, oil and similar matters

Remove mill scale, rust and old paint film on the steel surface to the specified surface preparation degree by blast cleaning or by power tool cleaning.

1. Environmental conditions (Climate, relative humidity, condition of substrate)
2. Degree of cleaning (Removal of rust, surface roughness)

The painting shall be done in such manners as to avoid any grazing, sagging or over spraying and to secure the specified paint film thickness. The edges and holes where the specified film thickness is hard to obtain shall be brushed in stripes prior to overcoating.

1. Environmental conditions
2. Check of paint & thinner
3. Mixing & thinning ratio
4. Pot life
5. Drying time & overcoating interval
6. Appearance of wet & dry film
7. Wet & dry film thickness. SSPC PA 2 is commonly recommended to measure the dry film thickness.



If the equipment is transported by sea or stored near the sea, the salt adhering to the surface shall be washed away with fresh water to the extent that the salt content is less than 100 mg/m². The surface shall then be well dried.

1. Salt deposits on surface
2. Existence of grease, oil and similar matters
3. Moisture on surface

Damaged and welded areas shall be cleaned to the specified grade by the proper method.

1. Environmental conditions
2. Degree of cleaning

Damaged and welded areas prepared to the specified grade shall be touched up with paints of the same kind precoated at the shop.
Be sure to observe the proper overcoating interval and the specified film thickness.
The edges and holes where the specified film thickness is hard to obtain shall be thoroughly touched up.

1. Wet & dry film thickness. SSPC PA 2 is commonly recommended to measure the dry film thickness
2. Overcoating interval

Same as the primer and intermediate coatings.

Remarks: *1. ◇C = Check*
2. For details regarding the flow chart, the application procedure and the check points for inspection, please contact your local Kansai Paint Representatives.

11. MAINTENANCE PAINTING

When to repaint:
Even if a steel structure has been painted with the greatest care, the paint film will gradually deteriorate over time.
Rust will eventually appear where its thickness is insufficient or where there are discontinuities such as pin holes.
On structures which were poorly treated, blisters, peelings and other defects in the paint film will occur earlier than expected.
Once heavy rust delevops, repainting becomes costly because the entire surface must be retreated.
Chemical surface treatment, such as picking, can not be applied on fabricated steel structures. And blasting work will often be inadequate, too, in view of dust pollution.
Due to the reasons above, cleaning using a power tool or hand tool is the only means of surface preparation in some cases even though an unsatisfactory result can be anticipated. On the other hand, if maintenance painting is done at the proper time, repair will be simpler and costs will be greatly reduced.
Paint film deterioration differs depending on the kind of paint.
Conventional paints such as oil-based paint, alkyd paint or chlorinated rubber paint loses its gloss as the surface layer decomposes. When decomposed substances accumulate on the surface, it is called "chalking."
Water, oxygen and other corrosion-accelerating substances penetrate the film and react with the steel substrate.
The paint film loses its flexibility due to the oxidation, decomposition and evaporation of some components.
As a result, blisters, cracks and other defects besides chalking also appear on the paint film.
To prevent the film defects mentioned above, periodic repainting is recommended for steel structures that have been coated with conventional paint. It is most economical to repaint over old paint film which has a rust ratio between 0.2% and 0.5%. The European Scale of Rusting for Anticorrosive Paints, SSPC Vis 2 and ASTM, are shown. They are widely used to rate rust conditions.
The deterioration of protective coatings begins only where the paint has been inadequately applied. From this point of view, steel structures protected with protective coatings must be inspected regularly and all defects must be immediately repaired. It can be said that thorough inspection for protective coatings at the time of the construction completion of the structure is essential.
The timing and mode of repainting depends on the condition of the corroded parts. Paint manufacturers should also be consulted before repainting because many types of synthetic resin are used as binders in the formulas of protective coatings. The compatibility of old and new paint must be considered.
Table 7 and Fig. 8 show how repairs should be made in accordance with the condition of the old paint film. Table 8 shows the compatibility of the new paint used for repair or overcoating.

Environmental Condition	Film Conditions (area of rust)	Recommended Surface Preparations	Modes of Repainting
Outdoor General Surface	SSPC-Vis 2, Rating 9 (0.03%)	Partial Hand Tool Cleaning	Partial Touching up
	SSPC-Vis 2, Rating 7 (0.3%)	Power or Hand Tool Cleaning	Partial Repainting (less than 30%)
	SSPC-Vis 2, Rating 5 (3%)	Blast or Power Tool Cleaning	All Over Coating
	Contamination or Fading of the Film	Fresh Water or Solvent Cleaning	All Over Coating
In Water or Chemical Solution	SSPC-Vis 2, Rating 9 (0.03%)	Partial Power Tool Cleaning	Partial Touching up
	SSPC-Vis 2, Rating 7 (0.3%)	Partial Power Tool Cleaning	Partial Repainting (less than 30%)
	SSPC-Vis 2, Rating 5 (3%)	Blast Cleaning	All Over Coating

Note 1: *Please refer to SSPC-Vis 2 for the film condition.*
Note 2: *Details of the surface preparation are shown in Table 4.*

Table 7 Conditions of Paint Film and Surface Preparations Recommended for Repainting

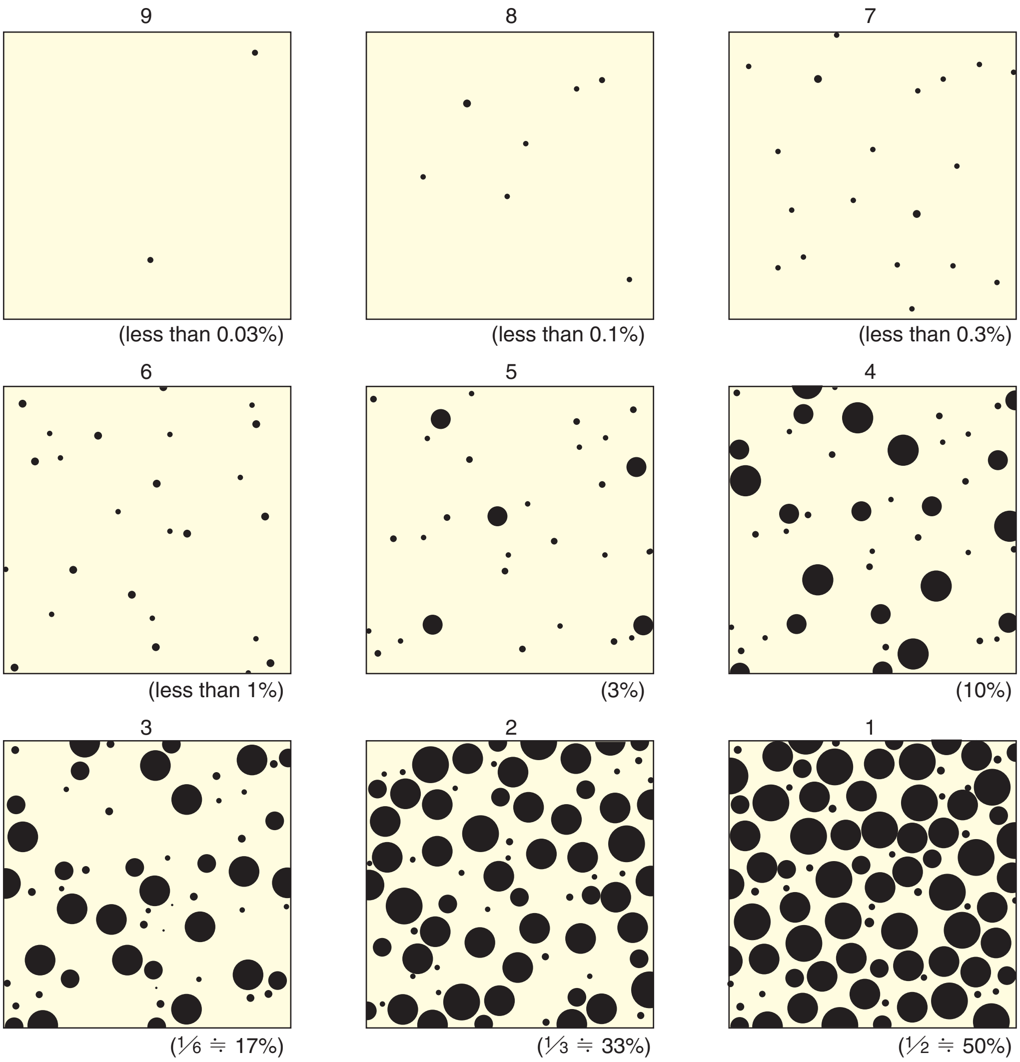


Fig. 8 Rating of Painted Steel Surfaces as a Function of Area Percent Rusted [ASTM-D610/SSPC Vis 2]

Undercoat \ Topcoat	Long exposure etching primer	Organic zinc rich primer	Inorganic zinc rich primer	Oil paint	Alkyd	Phenolic type MIO	Chlorinated rubber	Vinyl	Catalized epoxy	Modified epoxy	Coal tar epoxy	Polyurethane	Fluoro-carbon
Long exposure etching primer	A	NA	NA	A	A	A	A	A	C	C	C	A	A
Organic zinc rich primer	A	A	NA	NA	NA	NA	A	A	A	A	A	A	A
Inorganic zinc rich primer	A	A	A	NA	NA	NA	C	A	A	A	A	C	C
Oil paint	NA	NA	NA	A	A	A	C	NA	NA	NA	NA	NA	NA
Alkyd	NA	NA	NA	A	A	A	C	NA	C	C	C	C	C
Phenolic type MIO	NA	NA	NA	A	A	A	A	NA	NA	NA	NA	NA	NA
Chlorinated rubber	NA	NA	NA	NA	C	C	A	C	C	C	NA	C	C
Vinyl	NA	NA	NA	NA	NA	NA	C	A	NA	NA	NA	NA	NA
Catalized epoxy	NA	NA	NA	C	C	C	A	NA	A	A	A	A	A
Modified epoxy	NA	NA	NA	C	C	C	A	NA	A	A	A	A	A
Coal tar epoxy	NA	NA	NA	C	C	C	C	NA	C	C	A	C	C
Polyurethane	NA	NA	NA	C	C	C	C	NA	C	C	C	A	A
Fluoro-carbon	NA	NA	NA	C	C	C	C	NA	C	C	C	C	A

A: Acceptable, C: Conditional, NA: Not Acceptable

Note 1: *A change in the colour or other physical properties of the overcoated film is anticipated if the undercoat is a tar epoxy paint.*
Note 2: *Mist coating is usually required for coating over inorganic zinc rich paints.*

Table 8 The Suitability of Various Paint Combinations for Overcoating

12. RECOMMENDATIONS FOR PROTECTIVE COATINGS IN THE SPECIFIC ENVIRONMENTS AND KANSAI'S RECOMMENDED PAINTING SYSTEMS FOR NEW-CONSTRUCTION

Recommendations for protective coatings in specific environment

Environment			Surface	Recom-mended Painting System	Summary of Painting System: Paint Materials (Generic Name)	No. of Coat	Dry Film Thickness (microns)
1. Exposure Environment							
Mild	Low Pollution Low Relative Humidity Absence of Chemical Fumes and Low Contamination with Salts Operating Temp. below 80℃		Steel	A	Oil Alkyd Primer / Oil Alkyd Finish	4	125
			Galvanized Steel	B	Wash Primer / Oil Alkyd Finish	4	95
Moderate	High Humidity (Frequently Damp or Wet) Moderate Pollution (Frequently Exposed to Chemical Fumes) Operating Temp. below 80℃		Steel	C	Inorganic Zinc / Epoxy / Polyurethane	5	190
			Galvanized Steel	D	Epoxy / Polyurethane	3	95
Severe	Industrial	High Pollution Moderate or High Humidity Operating Temp. below 80℃	Steel	E	Inorganic Zinc High Build / Epoxy / Polyurethane	5	235
				F	Inorganic Zinc High Build / Epoxy / Fluoro	5	235
	Marine	High Salt Environment from Sea Coast High Humidity & Moisture Operating Temp. below 80℃		G	Inorganic Zinc High Build / Epoxy High Build	4	235
			Galvanized Steel	H	Epoxy / Fluoro	4	135
Elevated Temperature	Operating Temp. below 200℃		Steel	I	Inorganic Zinc High Build / Modified Silicone Aluminum	3	80
	Operating Temp. below 201～400℃			J	Inorganic Zinc High Build / Silicone Aluminum	3	80
	Operating Temp. below 401～550℃			K	Silicone Primer / Silicone Aluminum	4	90

Environment			Surface	Recom-mended Painting System	Summary of Painting System: Paint Materials (Generic Name)	No. of Coat	Dry Film Thickness (micron)
2. Splash Zone or Immersion							
Splash Zone	Frequent Immersion or Sea Spray		Steel	L	Epoxy Zinc / Modified Epoxy High Build	3	315
				M	Epoxy Zinc High Build / Non-Solvent Epoxy Mastic	3	3020
Immersion	Water	Sea Water Industrial Water		L	Epoxy Zinc / Modified Epoxy High Build	3	315
		Industrial Water Drinking Water		N	Epoxy Zinc / Epoxy High Build for Drinking Water	4	315
	Crude Oil Heavy Oil			O	Epoxy High Build for Chemicals	4	340
				P	Glass Flake Vinyl Ester	3	690
	Naphtha Gasoline Kerosene			O	Epoxy High Build for Chemicals	4	340
				P	Glass Flake Vinyl Ester	3	690
				Q	Inorganic Zinc High Build	1	75

Kansai's recommended painting systems for New-Construction

For exposure environment

System	Process	Generic Name	Recommended Brand Name of Kansai	No. of Coat	Dry Film Thickness (microns/coat)	Remarks
A	Surface Preparation	Commercial Blast Cleaning (SSPC SP6)				1,3
	Primer	Oil Alkyd	Rusgon Safety	2	35	
	Undercoat	Oil Alkyd	SD Marine Safety Undercoat	1	30	
	Finish	Oil Alkyd	SD Marine Safety Topcoat	1	25	
B	Surface Preparation	Solvent Cleaning (SSPC SP1) and Power Tool Cleaning (SSPC SP3)				3
	Primer 1st.	Wash Primer	Metalact H5	1	5	
	Primer 2nd.	Oil Alkyd	SD Marine CP Primer	1	35	
	Undercoat	Oil Alkyd	SD Marine Safety Undercoat	1	30	
	Finish	Oil Alkyd	SD Marine Safety Topcoat	1	25	
C	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				4,5
	Primer 1st.	Inorganic Zinc	SD Zinc 1000	1	15	
	Primer 2nd.	Catalyzed Epoxy	Epomarine Primer	2	60	
	Undercoat	Catalyzed Epoxy	Retan Undercoat E	1	30	
	Finish	Polyurethane	Retan 6000	1	25	
D	Surface Preparation	Sweep Blast Cleaning (SSPC SP7)				
	Primer	Catalyzed Epoxy	Epomarine GX	1	40	
	Undercoat	Catalyzed Epoxy	Retan Undercoat E	1	30	
	Finish	Polyurethane	Retan 6000	1	25	
E	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2,6
	Primer	Inorganic Zinc High Build	SD Zinc 1500A	1	75	
	Mistcoat	Catalyzed Epoxy	Epomarine HB	1	—	
	Undercoat 1st.	Catalyzed Epoxy	Epomarine HB	1	100	
	Undercoat 2nd.	Catalyzed Epoxy	Retan Undercoat E	1	30	
	Finish	Polyurethane	Retan 6000	1	25	

System	Process	Generic Name	Recommended Brand Name of Kansai	No. of Coat	Dry Film Thickness (microns/coat)	Remarks
F	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2,6
	Primer	Inorganic Zinc High Build	SD Zinc 1500A	1	75	
	Mistcoat	Catalyzed Epoxy	Epomarine HB	1	–	
	Undercoat 1st.	Catalyzed Epoxy	Epomarine HB	1	100	
	Undercoat 2nd.	Catalyzed Epoxy	Kanpe Flon HD Undercoat	1	30	
	Finish	Fluoro carbon	Kanpe Flon HD Topcoat	1	25	
G	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2,6,8,9
	Primer	Inorganic Zinc High Build	SD Zinc 1500A	1	75	
	Mistcoat	Catalyzed Epoxy	Epomarine HB	1	–	
	Finish	Catalyzed Epoxy	Epomarine HB	2	80	
H	Surface Preparation	Sweep Blast Cleaning (SSPC SP7)				
	Primer	Catalyzed Epoxy	Epomarine GX	2	40	
	Undercoat	Catalyzed Epoxy	Kanpe Flon HD Undercoat	1	30	
	Finish	Fluoro carbon	Kanpe Flon HD Topcoat	1	25	
I	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2
	Primer	Inorganic Zinc High Build	SD Zinc 1500A	1	50	
	Finish	Modified Silicone	Thermo 200 Silver	2	15	
J	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2
	Primer	Inorganic Zinc High Build	SD Zinc 1500A	1	50	
	Finish	Silicone	Thermo 400 Silver	2	15	
K	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2
	Primer	Silicone	Thermo 600 Undercoat	2	30	
	Finish	Silicone	Thermo 600 Silver	2	15	

For splash zone or immersion

System	Process	Generic Name	Recommended Brand Name of Kansai	No. of Coat	Dry Film Thickness (microns/coat)	Remarks
L	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2
	Primer	Epoxy Zinc	SD Zinc 100	1	15	
	Finish	Catalyzed Modified Epoxy	Epotect Tar Free	2	150	
M	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				3,9
	Primer	Epoxy Zinc High Build	SD Zinc 500	1	20	
	Finish	Epoxy Mastic	Tect Barrier SP	2	1500	
N	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				2
	Primer	Epoxy Zinc	SD Zinc 100	1	15	
	Finish	Catalyzed Epoxy	Epomarine JW	3	100	
O	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				
	Holding Primer	Catalyzed Epoxy	Epomarine Primer PC	1	40	
	Primer	Catalyzed Epoxy	Epomarine PC 100 Primer	1	100	
	Undercoat	Catalyzed Epoxy	Epomarine PC 100 Undercoat	1	100	
	Finish	Catalyzed Epoxy	Epomarine PC 100 Topcoat	1	100	
P	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				
	Primer	Vinyl Ester	Kanpe Glass SE Primer	1	40	
	Finish	Glass Flake Vinyl Ester	Kanpe Glass SE (N)	2	325	
Q	Surface Preparation	Near-White Metal Blast Cleaning (SSPC SP10)				
	Finish	Inorganic Zinc High Build	SD Zinc 1500A	1	75	

Remarks

1. In case shop primer (prefabrication primer) is to be used, "Metalact H15" (wash primer) is recommended.
2. In case shop primer (prefabrication primer) is to be used, "SD Zinc 1000" (inorganic zinc primer) is recommended. And in some cases, "SD Zinc 1000HA" can also be recommended.
3. In case silver finish is required with oil and alkyd paints, the undercoat and finish shall be replaced by "Platinite R".
4. "SD ZINC 1000", inorganic zinc primer can be replaced by "SD Zinc 100", epoxy zinc primer.
5. "Epomarine Primer can be replaced by "Epomarine HB" or "Esco"
6. "SD Zinc 1500A"can be replaced by "SD Zinc 500", epoxy zinc paint.
7. "Epomarine HB" can be replaced by "Epomarine EX 600"
8. In case weathering resistance is required, "Retan 6000" (polyurethane finish) can be applied over the system additionally.
9. "Napko Barrier 5M" can also be recommended for some cases.

ALESCO

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