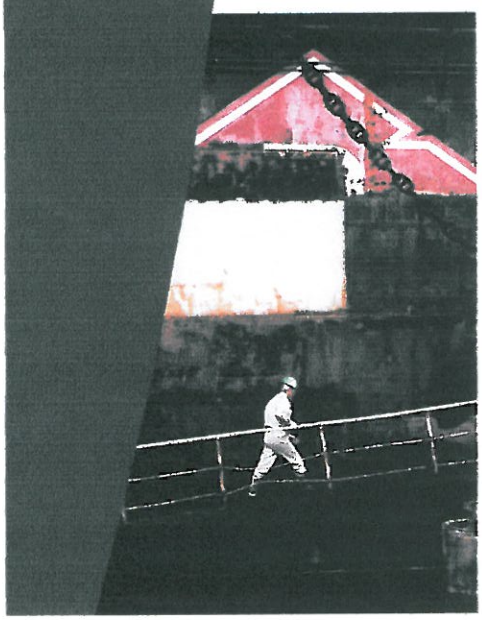
Technical Part



Test Methods for Checking Corrosion Resistance

The salt spray test is a standardized test method used to check corrosion resistance of coated samples. Coatings provide corrosion resistance to metallic parts made of steel, zamak or brass. Since coatings can provide a high corrosion resistance through the intended life of the part in use, it is necessary to check corrosion resistance by other means.

The apparatus for testing consists of a closed testing chamber, where a salted solution is atomized by means of a nozzle. This produces a corrosive environment of dense saline fog in the chamber so that parts exposed in it are subjected to severely corrosive conditions.

Salt spray test is an accelerated corrosion test that produces a corrosive attack to the coated samples in order to predict its suitability in use as a protective finish. The appearance of corrosion products (oxides) is evaluated after a period of time.
Test duration depends on the corrosion resistance of the coating; the more corrosion resistant the coating is, the longer the period in testing without showing signs of corrosion.

Salt spray testing is popular because it is cheap, quick, well standardized and reasonably repeatable. Salt spray test is widely used in the industrial sector for the evaluation of corrosion resistance of finished surfaces or parts.

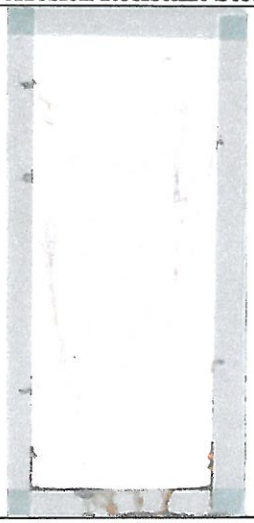
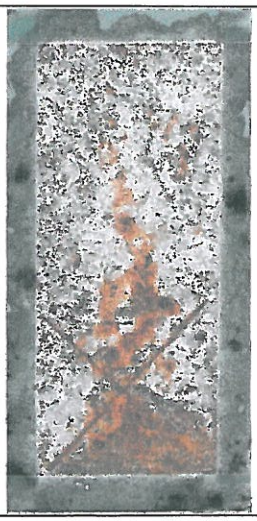
Salt Spray Testing Chamber

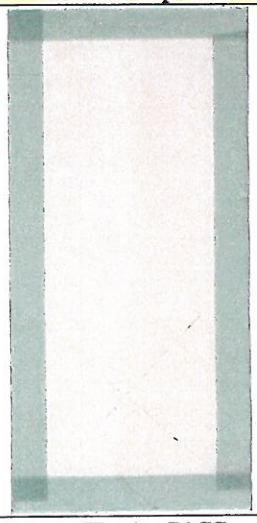
Natural Salt Spray Test (NSS Test)	* NSS testing essentially follows the procedures of ASTM B117 Salt Spray Test. * Results are represented generally as testing hours in NSS without appearance of corrosion products (e.g. 720 h in NSS according to ISO 9227). *The duration of NSS test is determined by the customer, and can range from 8 to 720 hours or beyond. (Continuous Spraying) (Performance criteria is also up to the customer.) *When performing NSS testing, a **5% sodium chloride solution** is used and the temperature of the salt spray chamber is controlled at **35 degrees Centigrade**.
Acetic Acid Salt Spray Test (ASS Test)	* ASS testing essentially follows the procedures of ASTM B117 Salt Spray Test. *The duration of ASS test is determined by the customer, and can range from 8 to 720 hours or beyond. (Continuous Spraying) (Performance criteria is also up to the customer.) *When performing ASS testing, a **5% sodium chloride solution** is used. The solution is then adjusted to a **pH range of 3.1 to 3.3 by adding acetic acid**, and the temperature of the salt spray chamber is controlled at **35 degrees Centigrade**.
Copper Accelerated Acetic Acid Salt Spray Test (CASS Test)	*CASS test is used to simulate and evaluate the corrosive performance of decorative copper / nickel / chromium or nickel / chromium coatings on steel, zinc or aluminum alloys and plastics designed for severe service. *CASS is also useful in the testing of anodized, chromated or phosphated aluminum, but is primarily used for the rapid testing of chromium plating on steel and zinc die-castings. *CASS testing essentially follows the procedures of ASTM B117 Salt Spray Test, in that it is carried out in the same type of salt spray chamber. *When performing CASS testing, a **5% sodium chloride solution** is used, with **one gram of copper chloride dehydrate added to each 3.8 liters of salt solution**. The solution is then adjusted to a **pH range of 3.1 to 3.3 by adding acetic acid**, and the temperature of the salt spray chamber is controlled at **50 degrees Centigrade**. *The duration of CASS test is determined by the customer, and can range from 6 to 720 hours or beyond. (Continuous Spraying) (Performance criteria is also up to the customer.) *CASS testing is called up in many Automotive and Military Specifications/Standards.

*CASS test is said that 10 times more effective at promoting corrosion artificially than Acetic Acid Salt Spray test (ASS).

*JIS(Japanese Industrial Standards) defines as follows;
In the case of "No particular corrosion is found out after 24-hour test of CASS", that Nickel-Chrome plating is available to use in Corrosive outdoor environment.

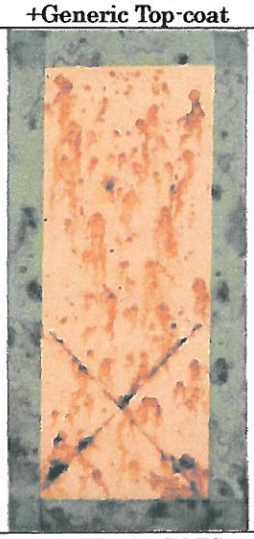
Test Results of CASS Test

SUS444(JIS) ISO/TS 15510 L-No.72 (X2CrMoTi18-2) Corrosion Resistant Steel	Galvalume Steel *Steel sheet with a coating of 55% aluminum and 45% zinc	Cold Finished Steel + Hot-dip Galvanizing (350gr/square meter)
		
264 Hrs in CASS	264 Hrs in CASS	264 Hrs in CASS
1.Reddish-brown corrosion product is observed.	1.Reddish-brown corrosion product is observed on whole surface. 2.Almost all Plating layer at cross-cut part is peeled off.	1.White corrosion product(Zink) is observed on whole surface. 2.Reddish-brown corrosion product is also observed.

Galvanized Steel Sheet +CCP Primer +Generic Top-coat	Cold Finished Steel +CCP Primer +Generic Top-coat	Rusted Cold Finished Steel +CCP Primer Without Top-coat
		
264 Hrs in CASS	264 Hrs in CASS	264 Hrs in CASS *Part of visible black is remaining rust of original rusted surface. *Expansion of remaining rust is not observed.
1.Any corrosion product is not observed on the coated surface. 2.Any corrosion product is not observed at cross-cut part. 3.Blistering of coating around cross-cut part is not observed.		
Remarks : 1.Rust fluid originated from cross-cut part which had been reached up to Steel surface. 2.Any expansion of cross-cut part is not observed.		

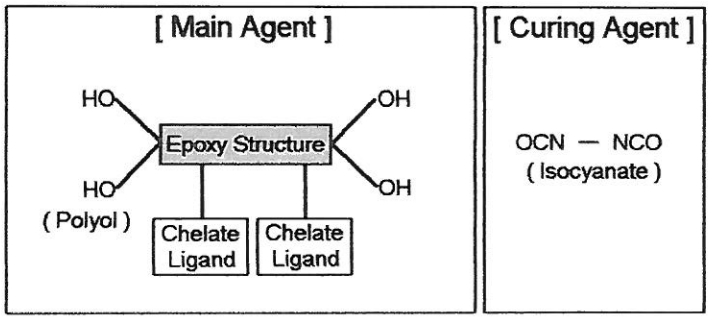
CCP provides a excellent performance against corrosion as compared with other generic primers.

It has proven by these two results of CASS test for its performance as below;

Cold Finished Steel +CCP Primer +Generic Top-coat	Cold Finished Steel +Generic Primer +Generic Top-coat
	
264 Hrs in CASS	**120 Hrs** in CASS
1.Any corrosion product is not observed on the coated surface. 2.Any corrosion product is not observed at cross-cut part. 3.Blistering of coating around cross-cut part is not observed.	1. Reddish-brown corrosion product is observed on whole surface. 2.Lifting of Coating film is observed on whole surface. 3.Blistering and lifting of coating around cross-cut part are observed.
Remarks : 1.Rust fluid originated from cross-cut part which had been reached up to Steel surface. 2.Any expansion of cross-cut part is not observed.	Remarks : 1.CASS test was interrupted by the reason of severe corrosion observed at 120 Hrs.

Structure and Functions of CCP

CCP has a strong Epoxy Resin Structure as main component, and Chelate Ligands by chemical side chains.
Moreover it converts terminal part(foaming element of coating film) into Polyol.



Structural Model of CCP

Epoxy Structure

It prevents water/vapor intrusion from outside.

*Water transmission rate : 0 mg/m^2 (at 25degree Centigrade, 24 Hrs)

*Vapor transmission rate : 2 mg/m^2 (at 25degree Centigrade, 90%RH, 24 Hrs)

Epoxy structure easily penetrates into corrosion and extrudes Oxygen and remaining water. As a result it fill the inside space of corrosion, instead of Oxygen and remaining(residual) water. (It works as immobilization material of corrosion.)

Chelate Ligand

Chelate Ligand has captured "Corrosions in growth(i.e. in unstable state)" and it is reacted with them. Consequently it converts them into "Chelated iron(i.e. in stable state)". Chelated iron inhaibits the growth of corrosion.

Terminal Polyol

To accelerate formation speed of coating film to avoid influence from outside during the drying process of primer.

*Lowest temperature of the reaction : -(minus) 5 degree Centigrade

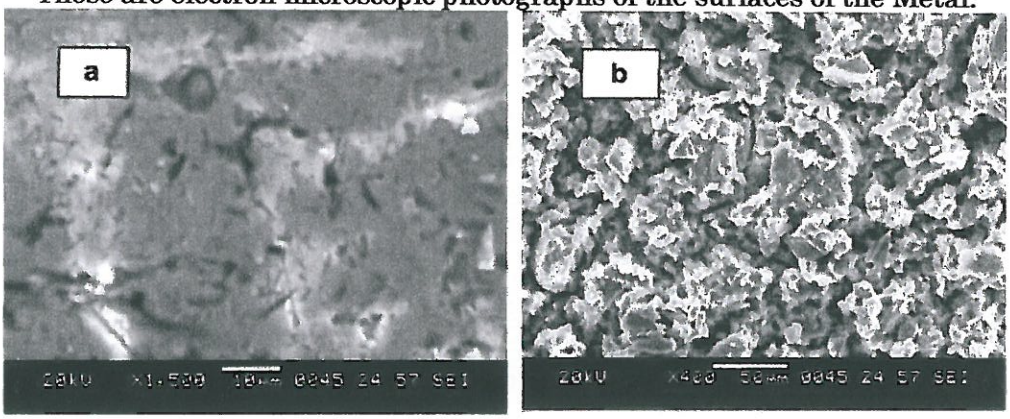
Isocyanate in Curing Agent

It forms coating film reacting with "Terminal Polyols in main agent".
Simultaneously it also reacts with "Cristallized Water in corrosion" and remove them. Moreover it penetrates into corrosions and immobilizes them.

The Greatest and Remarkable Feature of CCP

Residual Water in corrosion

These are electron microscopic photographs of the surfaces of the Metal.



(a) Original surface of metal before corrosion : uniform distribution of particles on metal matrix.
(b) Rusted surface : severe corrosion

As can be understood from photograph(b), there are space(void) inside of corrosion. The residual water in this space can be removed easily, for example, by extruding with penetrated resins.

Water of Crystallization in corrosion

Do you know Metal contains water in its molecular structure?

"Water of crystallization"(or Water of Hydration or Crystallization Water) is water that occurs in crystals. It refers to water that is found in the crystalline framework of a metal complex but which is not directly bonded to the metal ion.

(Water that is chemically bonded with a substance of which it is a part and that is undetectable in the form of H_2O is called water of constitution; the H_2O molecules form only at the moment of decomposition of the substance. Water that is part of a number of crystalline substances and is detectable in these crystals by means of X-ray crystallography is called water of crystallization or crystal hydrate water.)

Corrosion/Rust generated from iron, identically has Water of Crystallization in it.

Previously even able to get rid of residual water from the space of corrosion, it was very difficult to remove of this "Water of Crystallization" from corrosion.

The greatest and remarkable feature of CCP is that it removes this Water of Crystallization from corrosion !

The origin of the product name

The name of CCP is abbreviation of "Chemical Chelate Product".
The term "Chelate" is derived from Greek χηλή, chelè, meaning claw; the ligands lie around the central atom like the claws of a lobster.

Chelation is the formation or presence of two or more separate coordinate bonds between a polydentate (multiple bonded) ligand and a single central atom.
Usually these ligands are organic compounds, and are called chelants, chelators, chelating agents, or sequestering agents.

The ligand forms a chelate complex with the substrate. Chelate complexes are contrasted with coordination complexes composed of monodentate ligands, which form only one bond with the central atom.