

Chromate-Free Pre-Painted Galvanized Steel Sheets with Excellent Corrosion Resistance “J Craft”

1. Introduction

Pre-painted steel sheets for building and construction, which are used in roofs, walls, etc., are required to provide excellent corrosion resistance even under high temperature, high humidity environments and salt damage environments. A primer coating and pretreatment solution containing hexavalent chromium (Cr^{6+} , chromate) had generally been used to meet this requirement, as chromate has a large self-healing effect. However, hexavalent chromium has become the object of a various laws and regulations as an environmental load substance, and public standards and other standards, exemplified by the revisions of the Public Works Construction Standard Specifications of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) (conducted at intervals of 3 years), are also being reviewed. Thus, there is heightened social demand for chromate-free pre-painted steel sheets. Although chromate-free products are already available in some pre-painted steel sheets, their applications are limited, and products with high general applicability are desired.

In response to these expectations, JFE Galvanizing & Coating carried out full-scale development of a line of chromate-free pre-painted steel sheets called “J Craft” as standard products for retail sales¹⁾ and began production and marketing in April 2016. This article presents an outline of “J Craft.”

2. Product Outline of “J Craft”

Figure 1 shows the cross-sectional coating structure and main property requirements for “J Craft”. “J Craft” is produced by forming a chromate-free high corrosion resistance pretreatment film and primer coating film on the surface of 55% Al-Zn alloy coated steel sheets (Galvalume steel sheets), and then forming a topcoat film of the desired color on the primer coating. As the functions of each film, the pretreatment film provides corrosion resistance and adhesion with the substrate and primer coating film, the primer provides corrosion resistance and adhesion with the topcoat, and the topcoat provides color appearance and gloss

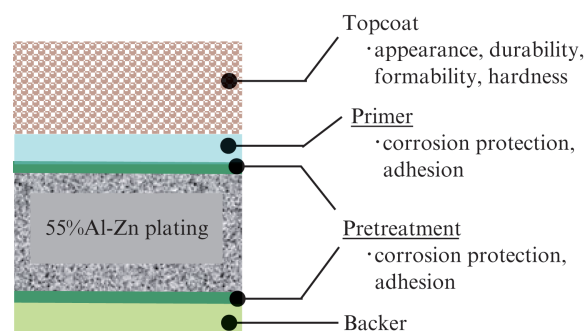


Fig. 1 The coating structure of “J Craft”

and many properties such as thermal barrier, anti-fouling, abrasion and scratch resistance, etc. The following two “J Craft” products, which were designed to enhance the performance and functions of the topcoat, are currently available.

- (1) “Nagomi-FIT”: Product that can respond to a wide range of customer needs from gloss to matte; 10 year red rust and perforation guarantee (warranty standard of Japan Iron and Steel Federation).
- (2) “Kiwami-MAX”: Matte finish paint film with enhanced durability by blending special aggregates; in addition to a 25 year perforation guarantee, also has a 15 year guarantee for paint film cracking, peeling and blistering.

Furthermore, the object region of the standard warranty for “J Craft” is areas 500 m or more away from the coastline (compared to conventional warranty of 1 km or more).

3. Features and Quality Characteristics of “J Craft”

3.1 Key Points of Corrosion Protection Design

With the chromate-free design of “J Craft”, corrosion resistance equal to that of chromate-type corrosion protection technologies is obtained by a combination of four functions: ① Corrosion protection by a self-healing effect, ② Suppression of the corrosion reaction by formation of a stable passive film, ③ Enhancement of the barrier effect against corrosive agents and ④ Strengthening of adhesion with the sub-

[†] Originally published in *JFE GIHO* No. 41 (Feb. 2018), p. 95–96

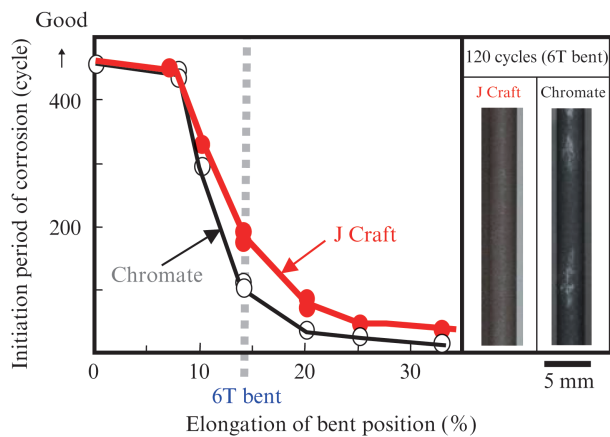


Fig. 2 Corrosion resistance of “J Craft”

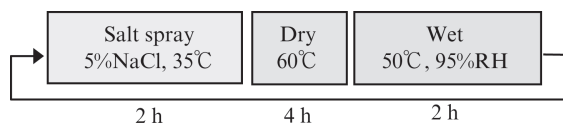


Fig. 3 Test conditions of cyclic corrosion test

strate plating. JFE Galvanizing & Coating also established a technology for further increasing the corrosion resistance of formed parts by introducing an original resin technology.

3.2 Corrosion Resistance of Formed Parts

Figure 2 shows the results of a test to evaluate the relationship between the degree of bending and corrosion resistance. (**Figure 3** shows the conditions of the accelerated cyclic corrosion test used as the test method.) Although the initiation period of corrosion (number of test cycles) decreases as the degree of bending increases (elongation becomes larger), the results revealed that “J Craft” has performance equal or superior to the conventional chromate-type pre-painted steel sheets, having a corrosion initiation period approximately 1.2 to 1.5 times longer than that of the chromate type in the 10–15% elongation range, which is the typical degree of forming of roofing and wall materials.

3.3 Abrasion and Scratch Resistance

Photo 1 shows the local surface appearance of “Nagomi-FIT” and a conventional material (chromate-type pre-painted steel sheet) when formed as roofing material with a roll former. The results confirmed that “Nagomi-FIT” has superior formability, with no abrasion or scratches, as a result of strengthening of the topcoat film.

3.4 Weathering Resistance

As an example of weathering resistance, **Fig. 4** shows the results of a natural exposure test of matte

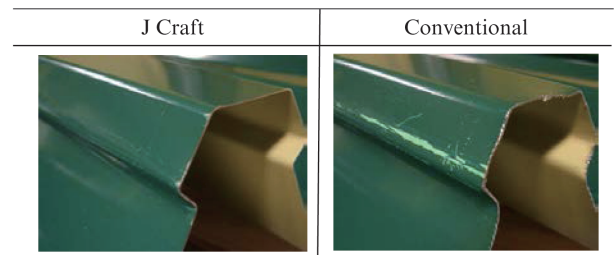


Photo 1 Surface appearance after roll forming

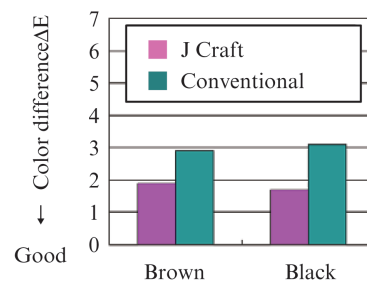


Fig. 4 Color difference after 3 years exposure in OKINAWA

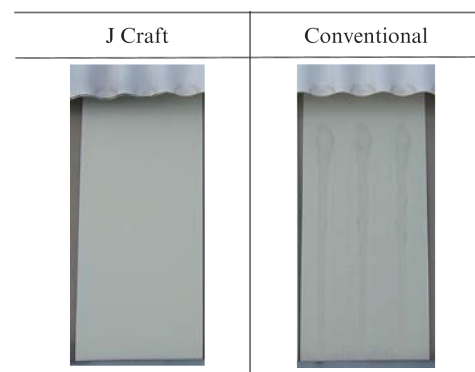


Photo 2 Appearance after 3 months exposure

paint films applied to “Nagomi-FIT.” Good weathering resistance was confirmed.

3.5 Anti-Fouling Property

For light colors, which are mainly used in wall materials, “J Craft” was given the function of an anti-fouling property against rain streak (function which prevents conspicuous traces of rain streaks) as a standard specification. As shown in **Photo 2**, fouling by rain streaks is improved with this product in comparison with the conventional product.

4. Conclusion

“J Craft” is a new brand of pre-painted steel sheets that realize a chromate-free design and improved performance. Since fiscal year 2016, the two “J Craft” products “Nagomi-FIT” and “Kiwami-MAX” have been widely used in roofing and walls of both residen-

tial and nonresidential buildings based on a mass production system.

Because the “J Craft” product line was developed based on a “Customer first” philosophy that considers the forming and installation of the final products, a further expansion of applications is expected in the future by satisfying customer needs.

Reference

- 1) JFE Galvanizing & Coating. “Chromate-Free Pre-Painted Steel Sheets, J Craft” (Catalog).

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