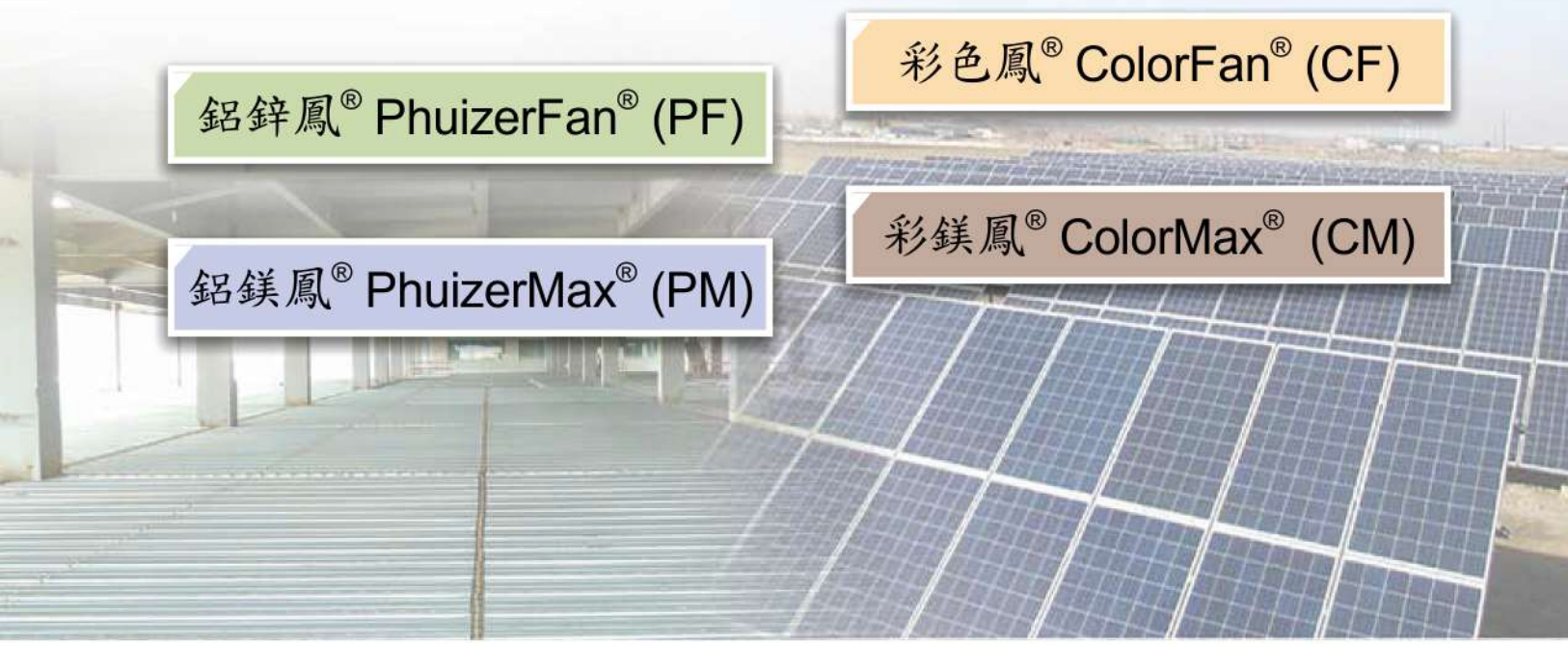
燁輝企業
YIEH PHUI

炸辉(中国)
YIEH PHUI (CHINA)

鋼之美　唯燁輝
Finest Steel at **Yieh Phui**

熱浸鍍5%鋁鋅(鋁鋅鳳®)、鋅鋁鎂(鋁鎂鳳®)、5%鋁鋅烤漆(彩色鳳®)及鋅鋁鎂烤漆(彩鎂鳳®)鋼捲

Hot-Dip 5%Al-Zn Coated (PhuizerFan®), Zn-Al-Mg Coated (PhuizerMax®), Pre-Painted 5%Al-Zn Coated (ColorFan®), & Pre-Painted Zn-Al-Mg Coated (ColorMax®) Steel Sheets



義联集團
E UNITED GROUP

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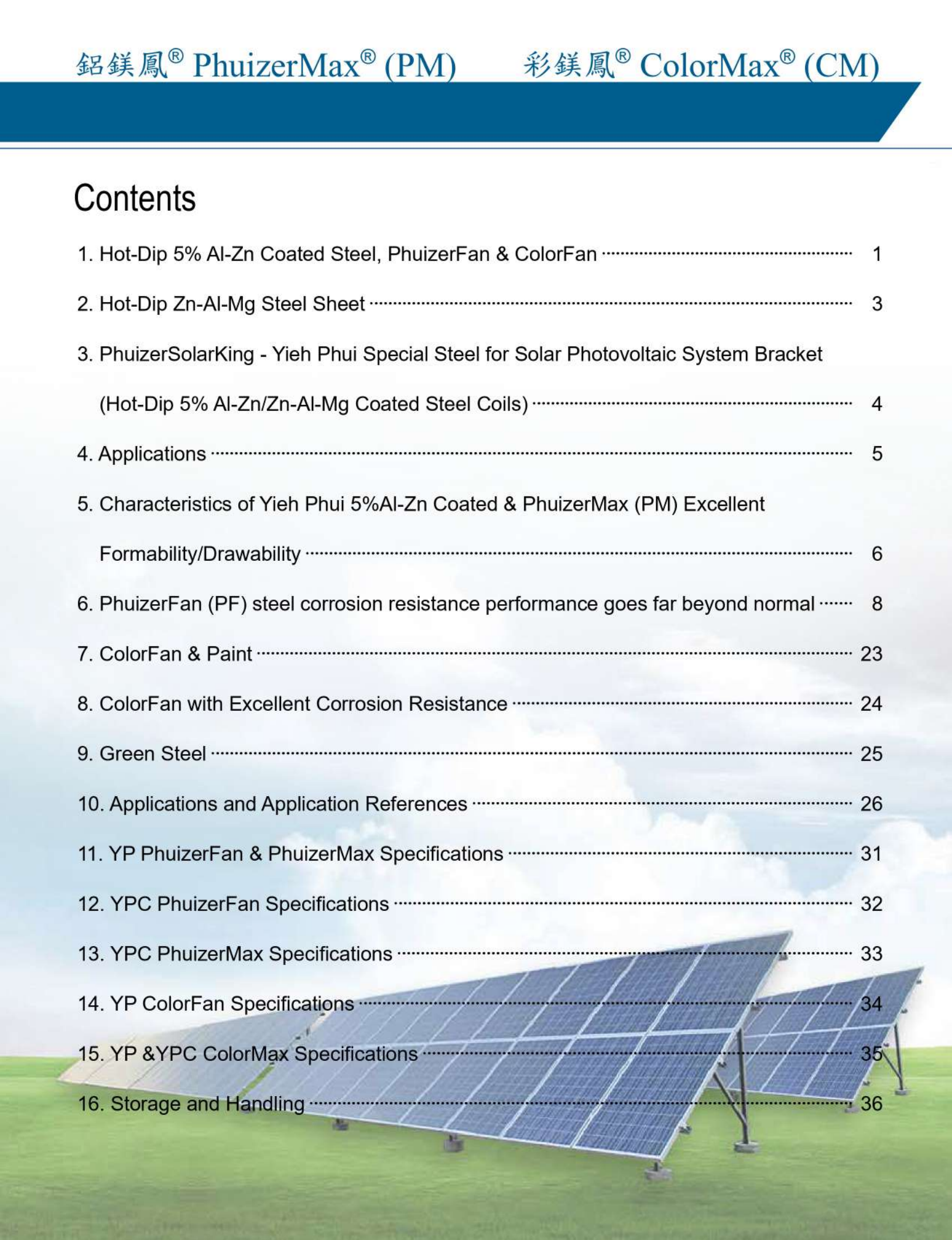


何謂熱浸鍍 5% 鋁鋅鋼捲、鋁鋅鳳及彩色鳳、鋁鎂鳳及彩鎂鳳?
What are 5%Al-Zn Coated Steel, PhuizerFan, ColorFan, PhuizerMax & ColorMax?

1. 熱浸鍍5%鋁鋅鋼捲、鋁鋅鳳及彩色鳳

1.1 熱浸鍍 5% 鋁鋅鋼捲 (Galfan®, GF)

熱浸鍍 5% 鋁鋅鋼材於 1977 年首先由美國內陸鋼鐵公司 (Inland Steel) 開發，並且擁有註冊專利。1979 年位於美國之國際鉛鋅組織 (ILZRO, International Lead & Zinc Research Organization) 取得該項專利後，並於 1981 年 7 月命名為 Galfan®。2000 年 10 月，ILZRO 將 Galfan® 專利權與技術轉移予為於美國賓州的 Galfan 技術中心 (GTC, Galfan Technology Centre Inc.)；以下 Galfan® 本公司簡稱為GF。

熱浸鍍 5% 鋁鋅鋼捲是在鋼板表面以熱浸方式鍍製一層鋁鋅合金鍍層的鋼品，其鍍層成分是由約 95% 鋅、5% 鋁與微量之鈰、鑭稀土元素 (mischmetal) 所組成之獨特共晶組織，如圖一。它具有遠超過傳統熱浸鍍鋅各項特性優點，並且可以抑制易脆之金屬間化合物之合金層 (intermetallic alloy layer) 的生長，使鋼材具有絕佳的防蝕性、優異的成形性及沖壓性，同時具備有優良的塗裝性及良好的熔接性，如表一。

1.2 鋁鋅鳳 (PhuizerFan®, PF)

熱浸鍍 5% 鋁鋅具有和傳統熱浸鍍鋅相近的鍍層厚度，適用於鋼板、鋼線及鋼管等產品。本公司所生產之熱浸鍍 5% 鋁鋅鋼捲，中文取名為鋁鋅鳳鋼板，簡稱鋁鋅鳳®，英文名為 PhuizerFan® (以下稱 PF)。

1.3 彩色鳳 (ColorFan®, CF)

本公司鋁鋅鳳提供廣泛之規格，可適用於多種用途，且因具有優良之耐蝕性與絕佳的成形性更可適用於塗漆用途或生產烤漆鋼品。本公司生產之熱浸鍍 5% 鋁鋅烤漆鋼捲稱為彩色鳳鋼板，簡稱彩色鳳®，英文名為 ColorFan® (以下稱 CF)。

Galfan® 為 GTC 之註冊商標名稱。
鋁鋅鳳®、彩色鳳® 為燁輝企業之註冊商標名稱。

1.Hot-Dip 5% Al-Zn Coated Steel, PhuizerFan & ColorFan

1.1 Hot-Dip 5% Al-Zn Coated Steel (Galfan®, GF)

Hot-dip 5% Al-Zn coated steel was developed and patented by United States Inland Steel company in 1977. The subsequent development of the 5% Al-Zn coated steel began in 1979 in research sponsored by the International Lead & Zinc Research Organization (ILZRO). In July 1981, it was named Galfan®. In October 2000, the ownership rights to Galfan® (Yieh Phui calls it "GF") were transferred to the Galfan Technology Centre Inc. (GTC) located at Pittsburgh, Pennsylvania, USA.

5% Al-Zn coating is a zinc alloy coating on the steel sheet. Its eutectic structure, as shown in Fig. 1, consists of 95% zinc, 5% aluminum, and a trace of mischmetal, which offers performance advantages that go far beyond the limits of conventional hot-dip galvanizing and inhibits the growth of brittle intermetallic alloy layer. The 5% Al-Zn alloy coating provides superior corrosion protection, extraordinary formability and drawability, excellent paintability, and good weldability. See Table 1.

1.2 PhuizerFan®, PF

Ideal for sheet steel, wires and tubes, 5% Al-Zn coating can be applied in the same coating thicknesses as conventional hot-dip galvanizing coatings. The 5% Al-Zn coated steel product produced by Yieh Phui is called PhuizerFan®.

1.3 ColorFan®, CF

Available in a wide range of specifications, 5% Al-Zn coated sheet steel can be used for almost any application. 5% Al-Zn coated sheet provides excellent corrosion resistance, superior formability and is available unpainted or coil coated. The pre-painted 5% Al-Zn coated steel product produced by Yieh Phui is called ColorFan®.

Galfan® is a registered trademark of GTC.
PhuizerFan® and ColorFan® are registered trademarks of Yieh Phui.

而本公司生產之熱浸鍍鋅鋁鎂鋼板係於 5% 鋁鋅鍍槽中添加低鎂之鍍面產品，中文取名為鋁鎂鳳鋼板或簡稱鋁鎂鳳®，英文名為 PhuizerMax®，簡稱 PM。鋁鎂鳳具有和傳統熱浸鍍鋅相近的鍍層厚度，適用於鋼板、鋼線及鋼管產品。

另本公司生產之鍍鋅鋁鎂烤漆鋼板，中文取名彩鎂鳳鋼板，簡稱彩鎂鳳®，燁輝 (中國) 取名輝鎂鳳，英文名同為 ColorMax®，簡稱 CM。

Ideal for steel sheet, wires and tubes, Yieh Phui's Zn-Al-Mg coating, a low magnesium product, can be applied in the same coating thicknesses as conventional hot-dip galvanizing coatings.

The Zn-Al-Mg coated steel product produced by Yieh Phui is called PhuizerMax® (called "PM" hereinafter). The prepainted Zn-Al-Mg coated steel product produced by Yieh Phui is called ColorMax® (called "CM" hereinafter).

1.4 GF/PF 顯著出眾優點之鍍層
The Remarkable GF/PF Coating with Remarkable Advantages

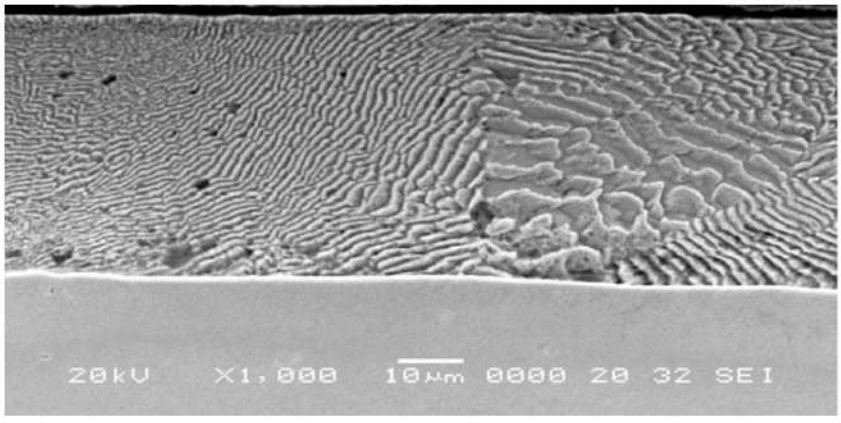
表一　鋁鋅鳳 (熱浸鍍 5% 鋁鋅鋼板) 和其他鍍層之比較
Table1 Comparison of 5% Al-Zn Coating to Other Coatings

鍍層種類及簡稱 Coating Type & Abbr. / 鍍層特性 Characteristics	鋁鋅鳳 (熱浸鍍 5% 鋁鋅) 5% Al-Zn Coated GF/PF	熱浸鍍鋅 Hot-Dip Galvanized GI	熱浸鍍 55% 鋁鋅 55% Al-Zn Coated GL	電解鍍鋅 Electro-Galvanized EG
鍍層成形性 Formability of Metallic Coating	1	3	3	1
犧牲保護性 Sacrificial Protection	1	1	3	3
防蝕性 (加工或塗裝前) Corrosion Resistance (bare)	2	3	1	3
防蝕性 (加工後) Corrosion Resistance (formed)	1	3	3	3
防蝕性 (塗裝後) Corrosion Resistance (painted)	1	2	3	2
塗裝附著性 Paint Adhesion	1	2	2	1
焊接性 Weldability	2	2	4	1
耐熱性 Heat Resistance/ Reflectivity	3	3	2	3
總評價 Total Evaluation	成形性、防蝕性、塗裝性均佳 Good Formability, Corrosion Resistance & Paint Adhesion	犧牲保護性佳 Good Sacrificial Protection	未成形之防蝕性較好 Good Corrosion Resistance for Unformed Sheet	鍍層較薄、防蝕性差 Poor Corrosion Resistance owing to Light Coating

備　註 Remark：等級 Grade　優 Best 1 ⟶ 5 劣 Worst

資料來源：燁輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

圖一 鋁鋅鳳 (熱浸鍍 5% 鋁鋅鋼板) 之鍍層顯微組織照片 (鍍層量 Y27)
Fig.1 The Microstructure of Intermetallic Alloy Layer of 5% Al-Zn Coated Steel (Y27)



鋁鋅鳳 (熱浸鍍 5% 鋁鋅鋼板) 之金屬鍍層：共晶組織
Intermetallic Alloy Layer of 5% Al-Zn Coated Steel: eutectic structure

底材 Base Metal

資料來源：燁輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

2. 熱浸鍍鋅鋁鎂鋼板 (鋁鎂鳳，PhuizerMax, PM)

熱浸鍍面產品自 1960 年代起即有將鎂加入鍍槽之研究，之後 30~40 年在日本、韓國、澳洲、歐洲均有相關之研究發展，並證實在平面及切邊部份之耐腐蝕能力均有所提昇。而藉由電化學及鹽霧測試等加速試驗可知，鍍層添加 3~7% Al 及 2~4% 的鎂 (Mg) 成分能形成較佳的防蝕鍍層。

2.1 添加鎂之鍍面產品，依鍍層鋁含量多寡可區分為高鋁 (Al) 及低鋁產品兩類，分別說明如下：

2.1.1 低鋁產品（Al：2~13%、Mg：0.06~4%)
此產品是以熱浸鍍 5% 鋁鋅 (GF) 為基礎，於鍍層添加鎂而成之新產品，ASTM A1046M 規定，依鎂含量分為低鎂 ≤ 1.0%、中鎂 1.0~2.0%、與高鎂 2.0~4.0%， 詳細規範請參閱 ASTM A1046M、ASTM A875M Type II、JIS G 3323、AS 1397 及 EN 10346。燁輝與燁輝 (中國) 生產之此類鍍面產品英文稱為 PhuizerMax (PM)，中文分別稱為鋁鎂鳳與輝鎂鳳。而以此為底材之烤漆彩塗產品英文稱為 ColorMax (CM)，中文稱為彩鎂鳳。

2. Hot-Dip Zn-Al-Mg Steel Sheet (PhuizerMax, PM)

Hot-dip coated products have been researched on adding magnesium to the coating pot since the 1960s. In the following 30-40 years, there have been related research and development in Japan, Korea, Australia, and Europe, and it has been confirmed that the corrosion resistance of the flat area and the cutting edge has been improved. According to accelerated tests such as electrochemical and salt spray tests, the addition of 3~7% Al and 2~4% Mg in the coating can form a better anti-corrosion coating.

2.1 Magnesium-added coatings are divided into high-aluminum and low-aluminum products according to the aluminum content, which are described as follows:

2.1.1 Low aluminum products (Al: 2~13%, Mg: 0.06~4%)
This product is a new product based on hot-dip 5% Al-Zn coated sheets (GF) with magnesium added to the coating. According to ASTM A1046M, this product is divided into low magnesium ≤1.0%, medium magnesium 1.0~2.0%, and high magnesium 2.0~4.0% regarding the magnesium content. For detailed specifications, please refer to ASTM A1046M, ASTM A875M Type II, JIS G 3323, AS 1397 and EN 10346. The product is named PhuizerMax in both Yieh Phui and Yieh Phui (China). And the color coated product based on this substrate is called ColorMax (CM).

2.1.2 高鋁產品 (Al：45~70%、Mg：0.3~10%)
此類產品是以熱浸鍍 55% 鋁鋅 (Galvalume®，下稱 GL) 為基礎，於鍍層添加 Mg 而成之新產品，燁輝與燁輝 (中國) 生產之此類鍍面產品英文稱為 PhuizerGLAM (LM)，中文分別稱為鋁鎂龍與彩鎂龍。而以此為底材之烤漆彩塗產品英文為 ColorGLAM (LM)，中文稱為彩鎂龍。。

2.2 鍍層添加鎂可提高其防蝕機制如下：

2.2.1 Zn-Al-Mg 腐蝕生成物比 Zn 或 Zn-Al 氧化物緻密，且能緊密附著在鍍層表面提高防蝕性能，且可抑制 ZnO 及 $Zn(OH)_2$ 形成，進而降低鍍層損耗量。

2.2.2 鍍層添加鎂後，鋅與鎂形成 $MgZn_2$ 相及層狀緻密的三元共晶相，其中 $MgZn_2$ 相之活性較 Zn 為高，可作為鍍層的犧牲陽極，並生成有保護性的腐蝕生成物，由於該生成物不易脫落且可牢固的覆著於板面刮傷及切邊等底材裸露位置，可提高鍍層保護能力及有效延緩整個腐蝕發生的速率。

2.2.3 綜合以上，Zn-Al-Mg 鍍層中，除純 Zn 相外，尚有 $MgZn_2$、Al-Zn Binary 等二元及三元相組織。除提高耐蝕特性外，其鍍層硬度高、耐磨性佳；但相對於加工成形時，因鍍層硬度高，鍍層較容易產生龜裂，會影響耐蝕性，此點對模具 r 角的設計及成形輥輪的調機必須加以注意。

2.1.2 High aluminum products (Al: 45~70%, Mg: 0.3~10%)
This product is a new product based on hot-dip 55% Al-Zn coated sheets (Galvalume®, GL) with magnesium added to the coating. The metallic product names produced by Yieh Phui and Yieh Phui (China) are called PhuizerGLAM (LM). And the color coated product based on this substrate is called ColorGLAM (LM).

2.2 Adding magnesium to the coating can improve its anti-corrosion mechanism as follows:

2.2.1 Zn-Al-Mg corrosion products are denser than Zn or Zn-Al oxides, and can adhere closely to the coated surface to improve corrosion resistance , the formation of ZnO and $Zn(OH)_2$, and further reduce coating loss.

2.2.2 After magnesium is added to the coating, zinc and magnesium form a $MgZn_2$ phase and a layered dense ternary eutectic phase. The $MgZn_2$ phase is more active than Zn and can be used as a sacrificial anode for the coating and generates protective corrosion resultants. The resultant is not easy to fall off and can be firmly covered on the exposed positions of the substrate such as scratches on the surface of the sheet and cut edges, which can improve the protective ability of the coating and effectively delay the rate of the entire corrosion.

2.2.3 In summary, in Zn-Al-Mg coating, in addition to pure Zn phase, there are still binary and ternary phase structures such as $MgZn_2$ and Al-Zn Binary. In addition to improving corrosion resistance, the coating has high hardness and good wear resistance, but the surface is prone to cracks during forming. However, due to the high hardness of the coating, the coating is more likely to crack during forming, which will affect the corrosion resistance. The design of the mold r angle and the adjustment of the forming rollers must be paid attention to.

3. 光支彩 (PhuizerSolarKing)—燁輝太陽光電系統支架專用鋼材 (熱浸鍍鋅鋁鎂烤漆彩塗鋼捲)

鍍 5% 鋁鋅鋼捲 (GF/PF) 之性能雖然優異，但為提供「ISO 9223 大氣腐蝕環境分類」中嚴苛腐蝕環境之 C5(非常高) 與 CX(極端高) 二類環境區域足夠的防蝕能力與耐用年限，本公司積極研發，突破產製技術能力，開發厚度 1.6~2.3mm、高強度 (抗拉強度 490Mpa 以上) 之熱浸鍍鋅鋁鎂烤漆鋼捲，命名為「光支彩，PhuizerSolarKing」，專用於太陽光電系統支架。因鋼材強度高，可以薄化減少鋼材使用重量，延長耐用年限，降低建置成本。

光支彩® 為燁輝企業之註冊商標名稱。

3.PhuizerSolarKing — Yieh Phui Special Steel for Solar Photovoltaic System Bracket (Pre-Painted Hot-Dip Zn-Al-Mg Coated Steel Coils)

Although the performance of 5% Al-Zn coated steel coils (GF/PF) are excellent, it is not sufficient to serve the C5 (very high) and CX (extreme) environment categorized in "ISO 9223: Corrosivity category of atmospheric environments". Yieh Phui strenuously researches and develops and breaks through the production technology, and develops thickness of 1.6~2.3mm, high-strength (tensile strength above 490Mpa) prepainted hot-dip Zn-Al-Mg coated steel coils. It is called "PhuizerSolarKing", dedicated to solar photovoltaic bracket system. Because of the high strength of steel, it can be thinned to reduce the weight of steel, prolong the years of useful life, and reduce the cost of installation.

本公司之光支彩鋼捲，採用高耐蝕之鍍鋅鋁鎂鋼捲為底材，及消光礦纖耐刮性優越之塗料塗烤製成，可提供太陽光電業主一個絕佳的鋼材選擇。光支彩鋼捲配合下游支架成形加工廠合適的加工成形及於切邊、沖孔部位，或安裝業者於運搬、施工產生之刮傷、碰傷部位施予塗料修補，搭配太陽能案場定期運維清洗體系，光支彩鋼捲可以提供太陽能支架長達 20 年的耐用年限[*1]。以光支彩預塗裝烤漆製程取代後噴塗製程，除具有低成本、短時間大量生產之優點外，光支彩具有減少大氣污染之環保節能概念，更讓國內太陽能支架的品質提升到更高的水準，領先世界各國。

4. 產品之應用

因熱浸鍍 55% 鋁鋅鋼板(GL)不適用於鹼性環境，如牛豬舍及與混凝土接觸之樓承板，強烈建議採用 GF/PF/PM 鋼材。GF/PF/PM 非常適用於鋼板厚度 1.2mm 以上，要求成形性、沖壓性及耐腐蝕性均要求之用途。這些應用包括：

- 商業大樓之樓承板 (鋼承板)
- 工業廠房之輕型鋼
- 電器組件及空調設備外殼
- 自動販賣機、電氣櫃、電氣箱
- 高成形之汽車零件
- 預塗覆彩色鋼板
- 農用筒倉與管件
- 太陽光電 (光伏) 系統支架
- 電纜橋架
- 儲能櫃
- 農業溫室支架管與棚架管、果樹支撐管
- 消防用管
- 牛豬養殖農舍

註 1 耐用年限與使用環境有密切關係，請事先與本公司諮商。

PhuizerSolarKing steel coils are made of high-corrosion-resistant Zn-Al-Mg steel coils as substrates, and are made of the paint of the superior scratch resistant Crystallite Silky prepainted steel coils, providing solar photovoltaic owners with an excellent steel choice. With the proper processing and forming of the bracket forming plant and the repair of the coating of the cut-edge and punched parts. Or installers shall apply paint to repair the scratched and bumped parts caused by transportation and installation together with the regular cleaning, operation & maintenance system of the solar power field, it can provide useful life of solar brackets up to 20 years[*1]. In addition to the low-cost, short-time mass production, replacing the post-spraying process with a pre-painting process, the most important thing is to have the concept of environmental protection, energy saving, and atmospheric pollution cutting, which has also improved the quality of domestic solar brackets to a higher level. In this area, Yieh Phui leads the world.

4.Applications

Because hot-dip 55% Al-Zn coated steel (GL) is not suitable for alkaline environments, such as cattle houses and floor decks in contact with concrete, GF/PF/PM is strongly recommended. Applications for the steel products are extremely diverse. Ideal applications for GF/PF/PM steel with thickness above 1.2mm are ones that require the combination of maximum formability, drawability and corrosion resistance. They include:

- flooring decks
- purlins
- electrical components and air conditioning unit covers
- vending machines, electrical cabinet/box
- highly formed automotive unexposed parts
- base metals for pre-painted steel sheets
- silos and piping
- solar panel brackets
- cable tray
- energy storage
- steel tube supporters and shacks for greenhouses
- steel sprinkler pipes
- cattle houses

Note 1 Years of useful life is closely related to the environment. Please consult with our company in advance.

5. 燁輝鋁鋅鳳 (PF) 之特性
成形性／沖壓性優越
鋁鋅鳳鋼板 (PF) 成形性設立新標準

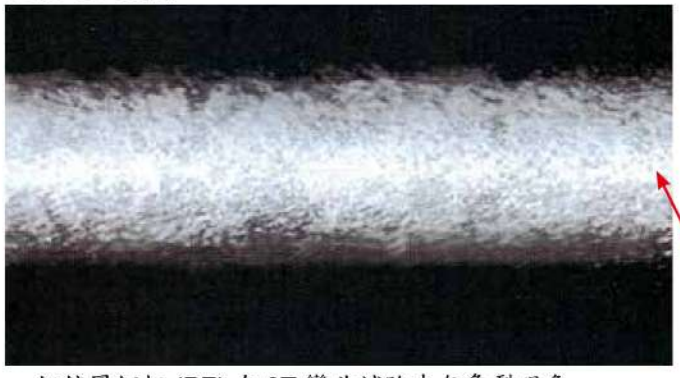
鍍 5% 鋁鋅鋼板 (GF)、鋁鋅鳳 (PF) 是第一個比其所保護的鋼材更具成形性的熱浸鍍層，介於鋼材及 GI 鍍層之間的脆性金屬間合金層幾乎不存在於鍍 5% 鋁鋅鋼板，一般在成形加工作業時所發生之鍍層龜裂大部分都是起於此合金層所造成，此乃傳統 GI 鍍層的缺點。

鍍 5% 鋁鋅鋼板 (GF/PF) 特別適合用在深沖、沖壓成形、輥輪成形及多重嚴厲彎曲，即使最嚴厲變形亦較 GI 鋼板及 GL 鋼板不易發生鍍層龜裂或剝落的現象，如圖二所示。

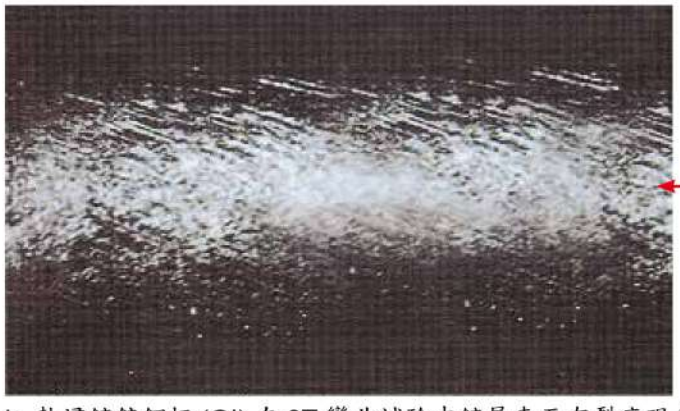
圖二　鍍 5% 鋁鋅鋼板 (GF/PF) 與 GI 鋼板零 T 彎曲試驗

Fig.2　Zero T Bend of 5%Al-Zn Coated (GF/PF) and GI Steel

零 T 彎曲試驗
Zero T Bend



a. 鋁鋅鳳鋼板 (PF) 在 0T 彎曲試驗中無龜裂現象
5%Al-Zn coated steel (PF) shows no cracking of flaking at zero T bend.



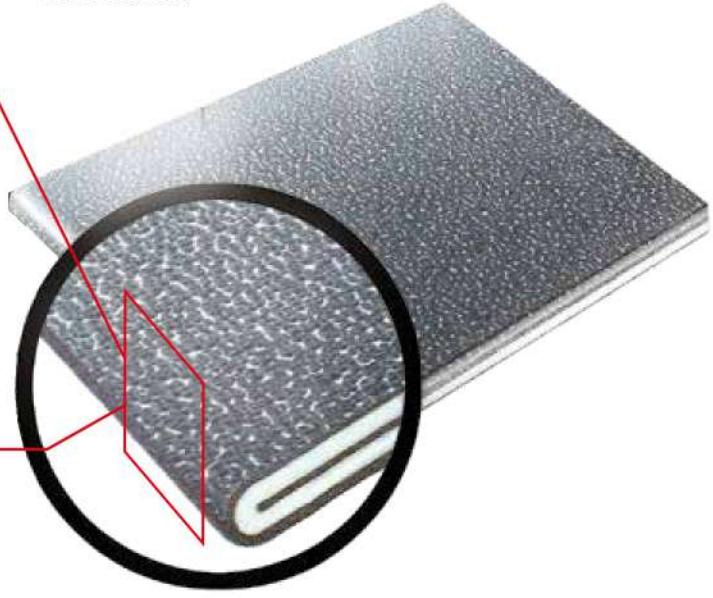
b. 熱浸鍍鋅鋼板 (GI) 在 0T 彎曲試驗中鍍層表面有裂痕現象
Hot-dip galvanized steel (GI) exhibits flaking on the coating surface at zero T bend.

5.Characteristics of Yieh Phui 5%Al-Zn Coated Steel's (PF's) Excellent Formability/Drawability
PhuizerFan (PF) steel sets new standards in formability

5%Al-Zn coated steel (GF/PF) is the first hot-dip coating that is more formable than the steel it protects. The brittle intermetallic layer between the steel substrate and GI coating is virtually eliminated with 5%Al-Zn coated steel (GF/PF). This layer is the site where most cracks originate during forming operations--a disadvantage of conventional hot-dip coatings.

Particularly suited for applications involving deep drawing, press forming, profiling and multiple severe bending, 5%Al-Zn coated steel (GF/PF) can take the most severe deformation with virtually no cracking or flaking compared with GI and GL. See Fig. 2.

鍍 5%鋁鋅鋼板 (GF/PF) 與 GI 鋼板 0T 彎曲試驗之情形 (示意圖)
Diagram below shows zero T bend of GF/PF and GI steel sheets.



資料來源：燁輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

表二 ISO 9223 大氣腐蝕環境分類與鋁鋅鳳 (PF) 及鋁鎂鳳 (PM) 依環境分類選用建議之鍍層量說明如下

Table 2 Proper coating mass of PhuizerFan (PF) & PhuizerMax (PM) for specific environment is recommended according to ISO 9223 as follows.

ISO 9223	大氣腐蝕環境分類 *1 Corrosivity category *1	典型環境案例 Typical cases	
C1	非常低 Very low	乾燥或寒冷地區、污染極低和潮濕時間極短的大氣環境，例如，沙漠、北極中部 / 南極	Dry or cold zone, atmospheric environment with very low pollution and time of wetness, e.g. certain deserts, Central Arctic/Antarctica
C2	低 Low	溫帶、低污染 (SO_2<5 μg/m^3) 的大氣環境，例如，農村、小城鎮 乾燥或寒冷地區，潮濕時間短的大氣環境，例如，沙漠、亞北極地區	Temperate zone, atmospheric environment with low pollution (SO_2 < 5 μg/m^3), e.g. rural areas, small towns Dry or cold zone, atmospheric environment with short time of wetness, e.g. deserts, subarctic areas
C3	中等 Medium	溫帶、中等污染 (SO_2：5μg/m^3 ~30μg/m^3）或有些氯化物影響的大氣環境，例如，城市地區、氯化物沉積量低的沿海地區 亞熱帶和熱帶、低污染大氣	Temperate zone, atmospheric environment with medium pollution (SO_2: 5 μg/m^3 to 30 μg/m^3) or some effect of chlorides, e.g. urban areas, coastal areas with low deposition of chlorides Subtropical and tropical zone, atmosphere with low pollution
C4	高 High	溫帶、高污染 (SO_2：30 μg/ m^3~90 μg/ m^3) 或氯化物大量影響的大氣環境，例如，受污染的城市地區、工業區、無鹽水噴濺的沿海地區或暴露於防結冰鹽的強烈影響 亞熱帶和熱帶、中等污染的大氣	Temperate zone, atmospheric environment with high pollution (SO_2: 30 μg/m^3 to 90 μg/m^3) or substantial effect of chlorides, e.g. polluted urban areas, industrial areas, coastal areas without spray of salt water or, exposure to strong effect of de-icing salts Subtropical and tropical zone, atmosphere with medium pollution
C5	非常高 Very high	溫帶和亞熱帶地區，具有非常高污染 (SO_2：90μg/m^3 ~ 250μg/m^3) 或氯化物影響顯著的大氣環境，例如，工業區、沿海地區、海岸線上具遮蔽位置	Temperate and subtropical zone, atmospheric environment with very high pollution (SO_2: 90 μg/m^3 to 250 μg/m^3) and/ or significant effect of chlorides, e.g. industrial areas, coastal areas, sheltered positions on coastline
CX	極端高 Extreme	亞熱帶和熱帶地區 (潮濕時間非常長)，SO_2 污染非常高 (高於 250μg/m^3) 的大氣環境，包括伴隨生產因素及/或氯化物的強烈影響，例如，極端工業區、沿海和近海地區，偶爾接觸鹽霧	Subtropical and tropical zone (very high time of wetness), atmospheric environment with very high SO_2 pollution (higher than 250 μg/m^3) including accompanying and production factors and/or strong effect of chlorides, e.g. extreme industrial areas, coastal and offshore areas, occasional contact with salt spray

ISO 9223	大氣腐蝕環境分類 Corrosivity category	C1	C2	C3	C4	C5	CX
年重量損失 Annual weight loss (g/m^2)		r_{CORR} *2 ≦ 0.7	0.7 < r_{CORR} ≦ 5	5 < r_{CORR} ≦ 15	15 < r_{CORR} ≦ 30	30 < r_{CORR} ≦ 60	60 < r_{CORR} ≦ 180
建議鍍層量 Recommended coating mass	鍍層代號 Coating mass designation PF/GF	Y27		Y35		Y45	
	PM/GM	ZM275/K27		ZM350/K35		ZM450/K45	
	兩面三點法平均最小鍍層量 Minimum triple spot, total both sides coating weight (g/m^2)	≧ 275		≧ 350		≧ 450	
噴塗處理部位 Spray painted parts		—	—	—	切邊、打孔部位 Cut-edge & punched parts	整支或整個表面 (含切邊打孔) Entire surface (cut-edge & punches included)	
預估耐用年限 *3 (年) Estimated useful life *3 (yrs)		20	20	20	20	20 *4	20 *4

註 1 此中文分類名稱由交通部運輸研究所訂定。
2 鍍層年重量損失。
3 耐用年限請直接與本公司諮商。
4 建議使用具高耐腐蝕性機能塗料或氟碳塗料。

Note 1 The categories in Chinese are defined by the Institute of Transportation, MOTC, Taiwan.
2 g/m^2/yr
3 Please consult our company directly for the years of useful life.
4 It is recommended to use functional coatings with high corrosion resistance or PVDF coating.

6. 鋁鋅鳳鋼板 (PF) 耐蝕性優越

鋁鋅鳳鋼板 (PF) 之獨特鍍層具有兩種方式保護鋼材表面，具有較傳統之熱浸鍍鋅鋼板 (以下簡稱 GI) 高二至三倍的防蝕性能。

首先是由 95% 鋅及 5% 鋁所形成均勻且緻密之共晶組織鍍層，它提供了絕佳的防護層，以阻礙腐蝕因子直接穿透鍍層到鋼材表面之速率，進而提高其防蝕壽命。

第二是因鍍層中有較低的鋁含量，與較多的富鋅成份，故對鍍層表面之刮痕或切邊、扣件孔，或成形彎曲部位，可利用鋅的氧化充當犧牲保護功能進而達到防蝕效果，故其切邊犧牲保護之功能，是遠優於高含鋁量之鍍 55% 鋁鋅鋼板(GL)。尤其厚板 (厚度1.2mm以上) 應選用鍍 5% 鋁鋅鋼材，才可提供足夠良好的切邊保護效果。

6.1 鋁鋅鳳鋼板 (PF) 之大氣曝曬試驗

鋁鋅鳳 (鍍 5% 鋁鋅) 鋼板與熱浸鍍鋅鋼板在不同地區大氣曝曬的鍍層重量損失比較

曝曬地點 : 1. 鄉村地區

2. 工業地區

3. 海邊地區→墾丁

(距海岸 50m)

在相同鍍層條件下，鍍 5% 鋁鋅鋼板比傳統鍍鋅鋼板高出約 2 倍的耐蝕能力。

6.PhuizerFan (PF) steel corrosion resistance performance goes far beyond normal

This ability to protect the steel surface is due to the unique 5% Al-Zn coating which provides protection in two ways. Thus, it provides two to three times the corrosion protection of conventional hot-dip galvanized coating (called "GI" hereinafter).

First, the two-phase eutectic structure of 95% zinc and 5% aluminum alloy provides a uniform barrier that helps prevent elements from reaching the steel surface.

Second, the coating also serves as a sacrificial protection against corrosion by oxidizing galvanically at any scratches, bare edges, fastener holes or bends at formed parts. 5%Al-Zn coating shows even more superior sacrificial protection than Al-rich 55% Al-Zn coating. Especially for thick sheets (thickness ≥1.2mm), 5%Al-Zn coated steel should be used in order to provide sufficient cut-edge protection.

6.1 Outdoor Exposure Test for PhuizerFan

Comparison of Coating Weight Loss between PF and GI under Different Outdoor Exposure Conditions

Test Site: 1. Rural

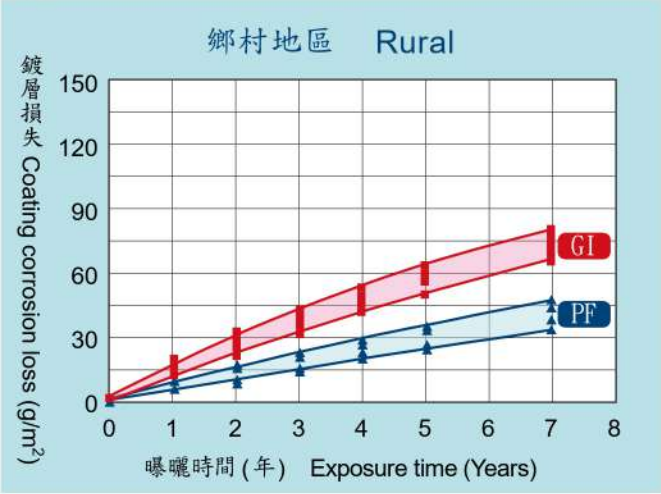
2. Industrial

3. Marine: Kenting, Taiwan
(50m to the coast)

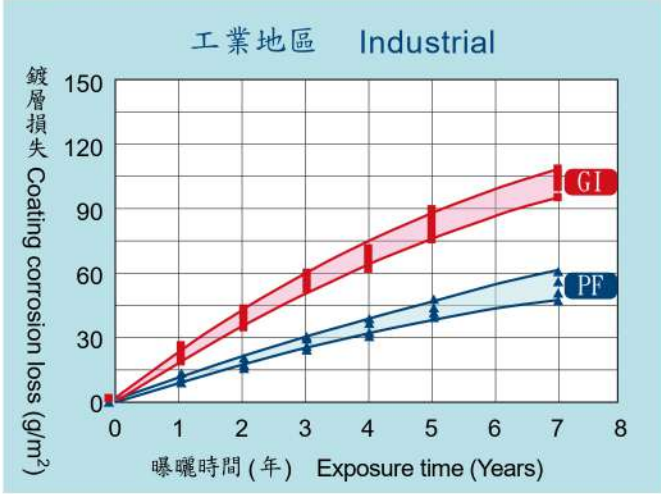
With the same coating weight, PF's corrosion resistance is approximately two times better than conventional GI.

大氣曝曬試驗
Outdoor Exposure Test

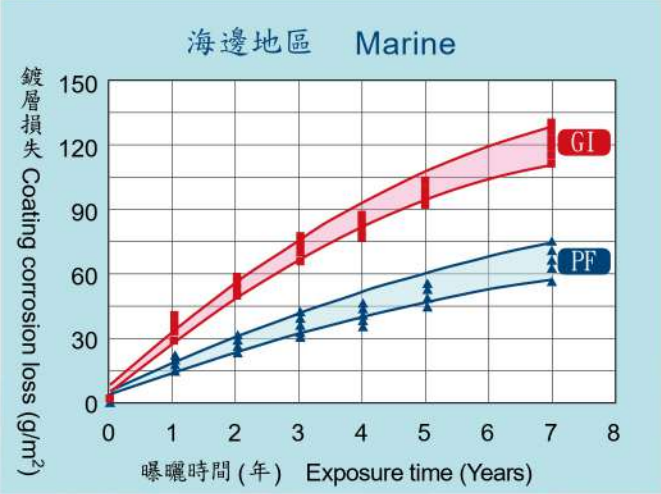
圖三　不同鋼板在鄉村地區之鍍層損失
Fig.3　Coating Loss in Rural Area



圖四　不同鋼板在工業地區之鍍層損失
Fig.4　Coating Loss in Industrial Area



圖五　不同鋼板在海邊地區之鍍層損失
Fig.5　Coating Loss in Marine Area



圖六　南台灣海邊地區試驗實景
Fig.6　Actual Test Site in Southern Taiwan

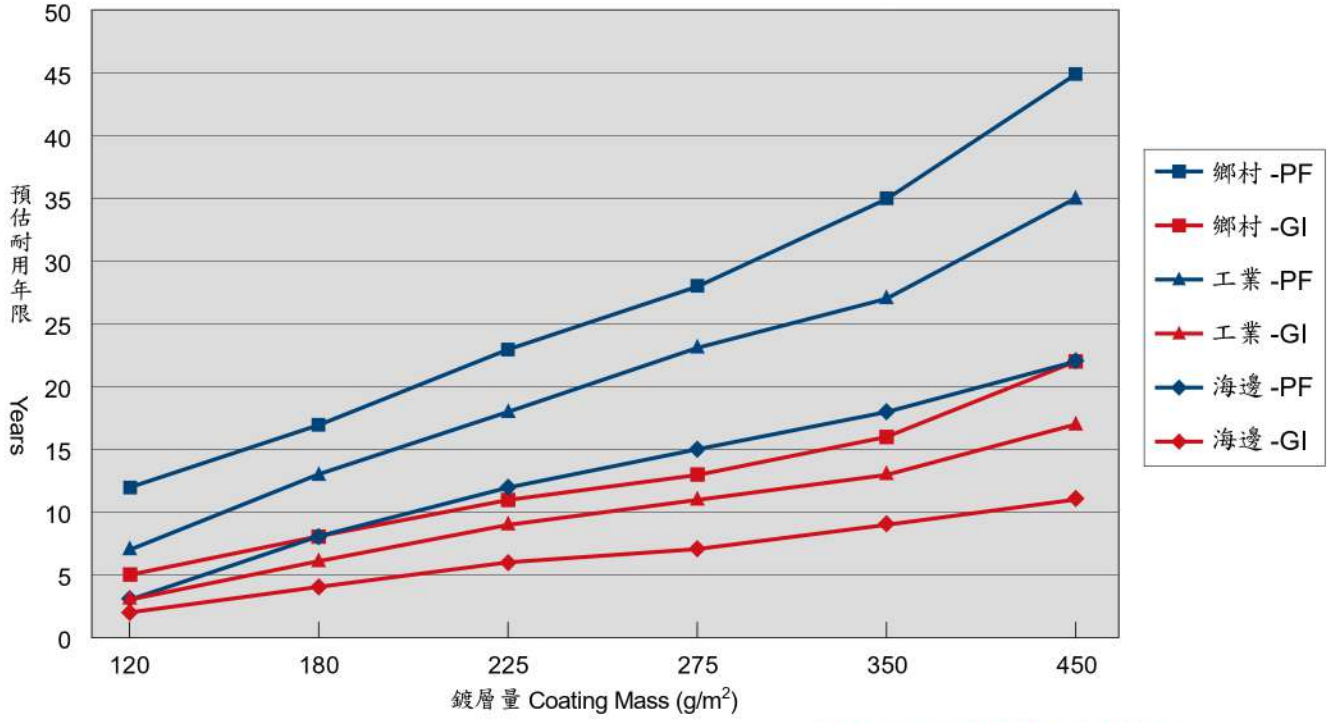
資料來源：燁輝企業檢測試驗室（圖三～六）
Source：Yieh Phui Testing and Measurement Laboratory (Fig. 3~6)

表三　鋁鋅鳳鋼板 (PF) 與鍍鋅鋼板 (GI) 在不同地區環境預估耐用年限 (年)[*1] 之比較
Table 3　Estimated Years of Useful Life[*1] of PhuizerFan (PF) & GI

最小雙面鍍層量 Min. Two-side Coating Mass (g/m²)			120	180	225	275	350	450
耐用年限 (年) Years of Useful Life	鄉村地區 Rural	PF	12	17	23	28	35	45
		GI	5	8	11	13	16	22
	工業地區 Industrial	PF	7	13	18	23	27	35
		GI	3	6	9	11	13	17
	海邊地區 Marine	PF	3	8	12	15	18	22
		GI	2	4	6	7	9	11

資料來源：燁輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

圖七　鋁鋅鳳鋼板 (PF) 與鍍鋅鋼板 (GI) 在不同地區環境之預估耐用年限 (年)[*1]
Fig.7　Estimated Years of Useful Life[*1] of PhuizerFan (PF) & GI



資料來源：燁輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

註　1　表三、圖七中之「預估耐用年限」係指鍍層厚度因腐蝕而完全消耗殆盡，且鋼材產生穿孔之時間。

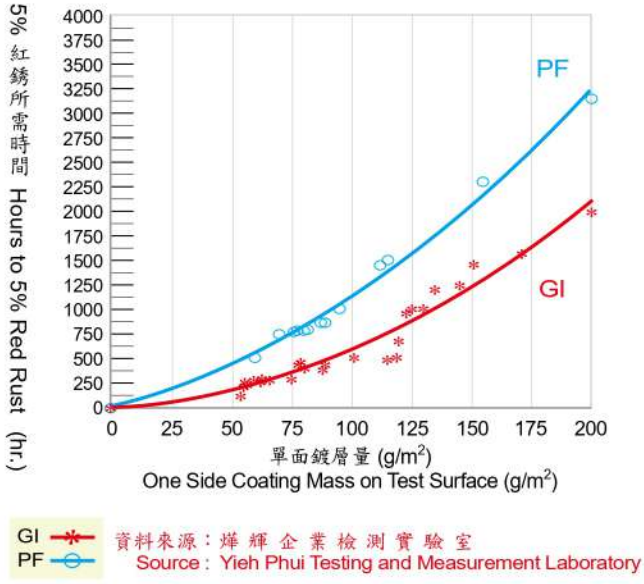
Note 1　"Estimated useful life" refers to the time when the coating is completely consumed due to corrosion and the steel is perforated in Table 3 & Fig. 7.

6.2 鹽水噴霧試驗性能

6.2.1 參照 ASTM B117 鹽水噴霧試驗之規定，分別測試 GI 及鍍 5% 鋁鋅 (PF) 產品於平板狀態 (未加工) 及零 T 彎曲狀態 (成形加工) 開始發生 5% 紅銹比率所需之時間，進一步證實鋁鋅鳳熱浸鍍 5% 鋁鋅鋼板優越之防蝕性能。

圖八　鍍 5% 鋁鋅鋼板 (PF) & GI 平板鹽霧試驗

Fig.8　SST on PhuizerFan (PF) & GI Steel Sheets



GI
PF

資料來源：燁輝企業檢測實驗室
Source : Yieh Phui Testing and Measurement Laboratory

6.2.2 GI 及 PF 產品於平板狀態 (未加工) 下各種不同的鍍層重量之鹽水噴霧試驗中，顯示 PF 鋼板紅銹發生達 5% 所需之時間明顯高於 GI 鋼板。依試驗結果所示，相同的鍍層厚度，PF 鋼板之使用壽命約為 GI 鋼板之 2 倍，如圖八所示。

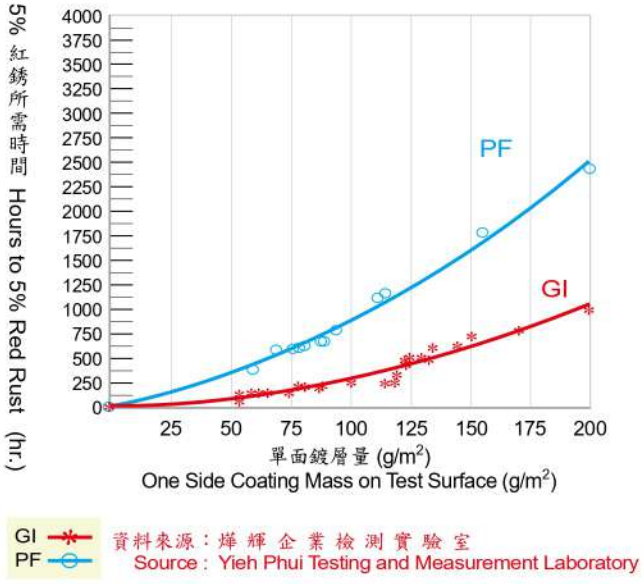
6.2.3 GI 及 PF 產品於零 T 彎曲狀態 (成形加工) 下各種不同的鍍層重量之鹽水噴霧試驗中，亦顯示 PF 鋼板發生 5% 紅銹所需之時間更是遠高於熱浸鍍鋅鋼板。圖四為試驗結果，在相同的鍍層厚度下，PF 鋼板之使用壽命甚至可達 GI 鋼板之 6 倍。其主要原因係 PF 鋼板之共晶

6.2 Salt Spray Performance

6.2.1We compared both PhuizerFan (PF) and GI in flat sheets (bare) and bent sheets (formed). In compliance with ASTM B117, salt spray test has proved excellent corrosion resistance of PF as measured by time to 5% red rust.

圖九　鍍 5% 鋁鋅鋼板 (PF) & GI 零 T 折彎試片之鹽霧試驗

Fig.9　SST on Zero T-Bent PhuizerFan (PF) & GI Samples



GI
PF

資料來源：燁輝企業檢測實驗室
Source : Yieh Phui Testing and Measurement Laboratory

6.2.2 When GI and PF were in flat sheets with various coating mass, the salt spray test showed that GI achieved 5% red rust significantly earlier than PF. Besides, under the same coating thickness, PF's useful life is two times as long as GI. See Fig. 8.

6.2.3 When GI and PF were in bent condition (formed) with various coating mass, the salt spray test showed that GI achieved 5% red rust much earlier than PF. Fig. 4 shows the test result that PF's useful life can reach up to six times as long as GI under the same coating mass. It is mainly due to the secondary dendrites of eutectic structures of PF providing

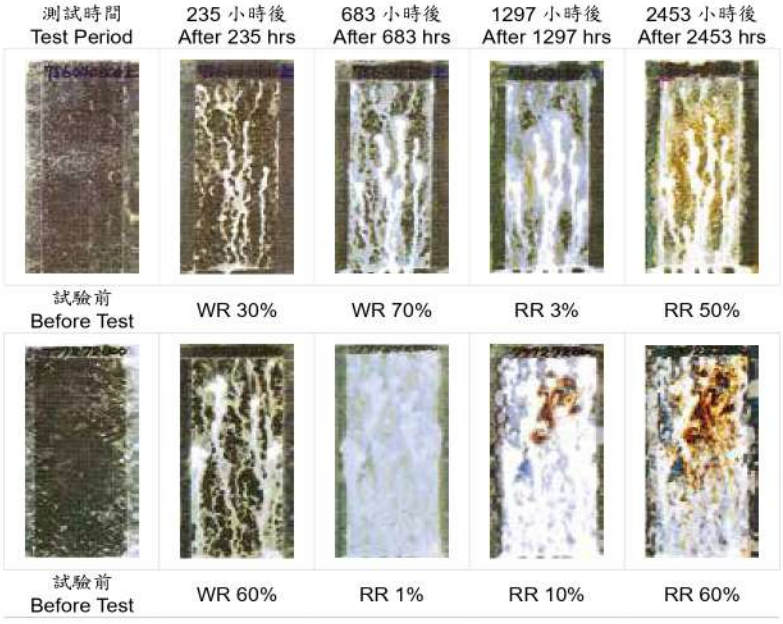
組織之二次樹枝晶愈密可提供較佳之腐蝕屏障，故其具優異之成形性與絕佳之防蝕性，此兩項性能皆遠勝於 GI 鋼板。

6.2.4 由實際的鹽水噴霧試驗與循環腐蝕試驗結果得知，在使用 PF 鋼板時，與 GI 鋼板比較，可採用較少的鍍層重量而達到相同的防蝕效果。例如在鹽水噴霧試驗中，試驗板在經過 235 小時之後，鍍層量 180g/m^2 (鍍層代號：Y18) 之 PF 鋼板表面發生之白銹面積，僅是鍍層量 275g/m^2 (鍍層代號：Z27) GI 鋼板之一半；而紅銹發生之時間亦較 GI 鋼板長一倍。同樣地，在循環腐蝕試驗中，180g/m^2 PF 鋼板表面在 40 個循環後才發生白銹，而鍍層量 275g/m^2 GI 鋼板在 10 個循環便發生，如圖十與圖十一所示。

denser and thus better corrosion resistance. Thus, its excellent formability and extraordinary corrosion resistance far exceed GI's.

6.2.4 From the salt spray test and cycling corrosion test results, we know that PF steel sheet with less coating mass achieved the same corrosion resistance performance as GI steel sheet. For example, after a 235-hour salt spray test was completed, red rust occurred on the surface area of PF steel sheet with 180g/m^2 (coating mass designation: Y18) coating mass was merely about half of the GI steel sheet with 275 g/m^2 (coating mass designation: Z27). Similarly, in the cycling corrosion test, PF steel sheet with 180g/m^2 coating mass had white rust after 40 cycles, whereas white rust appeared on the GI steel sheet with 275g/m^2 coating mass merely after 10 cycles. See Fig. 10 & 11 for the test results.

圖十 鋁鋅鳳 (PF) & GI 平板之鹽水噴霧試驗之比較
Fig.10 PhuizerFan (PF) & GI Salt Spray Test on Steel Sheets



備　註：　WR : White Rust, 白銹
Remark:　RR : Red Rust, 紅銹

PF 鋼板
一般鋅花，無調質，鉻酸處理
鍍層量 Y18，104.4g/m^2 (單面)，鍍層代號：Y18
PF sheet :
Regular Spangle, Non-skinpassed, Chromated
Coating Mass: 104.4g/m^2 (single side)
Coating Mass Designation: Y18

GI 鋼板
一般鋅花，無調質，鉻酸處理
鍍層量 Z27，146.0g/m^2 (單面)，鍍層代號：Z27
GI sheet :
Regular Spangle, Non-skinpassed, Chromated
Coating Mass: 146.0g/m^2 (single side)
Coating Mass Designation: Z27

資料來源：燁輝企業檢測實驗室
Source : Yieh Phui Testing and Measurement Laboratory

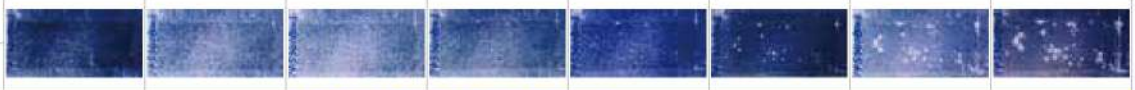
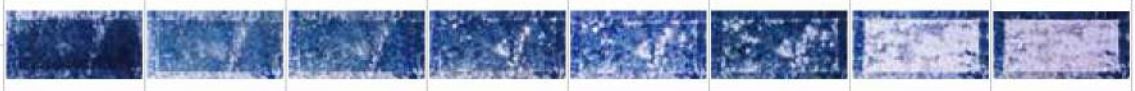
鋁鋅鳳鋼板之耐蝕性
PhuizerFan Steel Corrosion Resistance

圖十一　鋁鋅鳳 (PF) & GI 平板之循環腐蝕試驗之比較
Fig.11　PhuizerFan (PF) & GI Cycling Corrosion Test on Flat Steel Sheets

試驗條件：每循環 6 小時

Test Condition: Each cycle takes 6 hours.

鹽霧試驗(35°C-5%)1 小時 Salt Spray Test (35°C-5%)1hr. → 乾燥 (40°C) 2 小時 40 分鐘 Dry (40°C) 2hr. 40min. → 潤濕試驗 (50°C, RH: 95%) 1 小時 20 分鐘 Humidity Test (50°C, RH: 95%)1hr. 20min. → 乾燥 (50°C)1 小時 Dry (50°C) 1hr.

鋁鋅鳳鋼板 PhuizerFan (PF) Steel Sheet								
一般鋅花，無調質 Regular Spangle, Non-skinpassed	Before test	10 cycles	25 cycles	40 cycles	50 cycles	70 cycles	90 cycles	100 cycles
	WR 0%	WR 0%	WR 0%	WR 1%	WR 1%	WR 3%	WR 5%	WR 10%
鍍層量 Coating Mass: Y18 / 單面 Single side: 106.6 g/m²								
熱浸鍍鋅鋼板 GI Steel Sheet								
一般鋅花，無調質 Regular Spangle, Non-skinpassed	Before test	10 cycles	25 cycles	40 cycles	50 cycles	70 cycles	90 cycles	100 cycles
	WR 0%	WR 1%	WR 3%	WR 5%	WR 20%	WR 30%	WR 100%	WR 100%
鍍層量 Coating Mass: Z27 / 單面 Single side: 160 g/m²								

備註 Remark：WR : White Rust, 白銹

資料來源：煒輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

圖十二　鋁鋅鳳 (PF) & GI 折彎試片鹽水噴霧試驗之比較
Fig.12　PhuizerFan (PF) & GI Salt Spray Test on Bent Steel Sheets

試驗條件：試片以零 T 彎曲程度彎曲後，再以彎曲部位依據 JIS Z 2371 之鹽水噴霧試驗要求進行試驗。

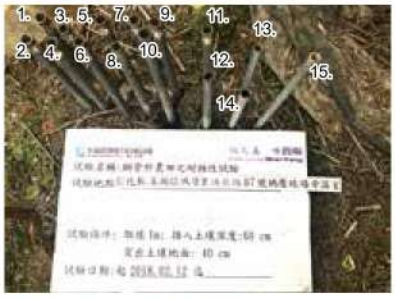
Test Condition: Samples with zero T Bend are tested according to the requirements of JIS Z 2371.

鋁鋅鳳鋼板 PhuizerFan (PF) Steel Sheet																											
PF	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
鍍層量 Coating Mass	Y18	Y18	Before test		72 hrs		170 hrs		235 hrs		324 hrs		418 hrs		518 hrs		583 hrs		683 hrs		801 hrs		983 hrs		1100 hrs			
板厚 Thickness	1.15 mm	1.15 mm	WR 0%		WR 100%		WR 100%		WR 100%		WR 100%		WR 100%		WR 100%		WR 100%		WR 100%		WR 100%		WR 100%		WR 100%			
單面 Single side	94.7 g/m²	106.2 g/m²																										
熱浸鍍鋅鋼板 GI Steel Sheet																												
GI	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
鍍層量 Coating Mass	Z27	Z27	Z27	Before test			72 hrs			170 hrs			235 hrs			324 hrs			418 hrs			518 hrs			583 hrs			683 hrs			801 hrs			983 hrs			1100 hrs		
板厚 Thickness	1.2mm	0.61mm	0.6mm	WR 0%			WR 100%			WR 100%			WR 100%			WR 100%			WR 100%			RR% 3, 1, 1			RR% 5, 5, 1			RR% 10, 10, 1			RR% 10, 10, 1			RR% 10, 30, 3			RR% 10, 40, 3		
單面 Single side	141.7 g/m²	158.2 g/m²	146 g/m²																																			

備　註：WR : White Rust, 白銹
Remark : RR : Red Rust, 紅銹

資料來源：煒輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

6.3 埋入土壤與農田耐蝕性試驗



圖十三　農地實測
Fig.13　Actual Farmland Test

- 試驗方法：將長度 1 米之 15 支鋼管插入溫室土壤中，插入土壤深度 60cm，突出土壤地面 40cm
- 鍍層量：見圖十四
- 鋼管尺寸：見圖十四
- 厚度：1.6mm
- 試驗地點：彰化縣溪湖鎮
- 試驗時間：2018 年 2 月~2021 年 8 月，共計 3 年 6 個月
- 試驗結果：GF 表現優於 GI

6.3 Soil Corrosion Test and Farming Test

- Test method: Insert 15 pcs of steel pipes with a length of 1 meter into the soil of the greenhouse. A depth of 60cm is inserted into the soil, and 40cm of it protrudes from the soil.
- Coating mass designation: See Fig. 14
- Steel pipe O.D.: See Fig. 14
- Thickness: 1.6mm
- Test location: Xihu Township, Changhua County, Taiwan
- Test period: February 2018 to August 2021, a total of 3 years and 6 months
- Test result: GF is superior to GI.

圖十四　農田耐蝕性試驗
Fig.14　Farmland Corrosion Resistance Test

	試片說明 Description				3 年 6 個月後 3.5 Years Later
1	預熱浸鍍鋅鋼管 Pre-hot-dip Zinc Coated Steel Pipe	鍍層量 Coating Mass Z120	外徑 O.D.	1/2"	
2				3/4"	
3				1"	
4				1/2"	
5				3/4"	
6				1"	
7	預熱浸鍍 5% 鋁鋅鋼管 Pre-hot-dip 5%Al-Zn Coated Steel Pipe	鍍層量 Coating Mass Y35	外徑 O.D.	1/2"	
8				3/4"	
9				1"	
10				1/2"	
11				3/4"	
12	後熱浸鍍鋅鋼管 Post-hot-dip Zinc Coated Steel Pipe	鍍層量 Coating Mass 300g/m^2	外徑 O.D.	1/2"	
13				3/4"	
14				1"	
15				1"	

圖十五　土壤試驗
Fig.15　Soil Corrosion Test

培養土
Cultured soil

表四　試驗樣品一覽表
Table 4 List of Pipe Specimens

No.	產品別 Specimen	鍍層類別 Coating	鍍層代號 Coating Mass	鋼管外徑 O.D.	鋼管鍍層量 Coating Mass on Pipe Body (g/m^2)
1	預熱浸鍍面鋼管 Pre-hot-dip Metallic Coated Steel Pipe	鍍鋅 Galvanized	Z120	1/2"	60~80
2				3/4"	
3				1"	
4			Z275	1/2"	120~150
5				3/4"	
6		鍍 5% 鋁鋅 5% Al-Zn	Y27	3/4"	120~150
7				1"	
8			Y35	1/2"	170~200
9				3/4"	
10				1"	
11		鍍 55% 鋁鋅 55% Al-Zn	AZ150	1/2"	70~90
12				3/4"	
13	後熱浸鍍面鋼管 Post-hot-dip Zinc Coated Steel Pipe	鍍鋅 Galvanized	300 g/m^2	1/2"	310~380
14				3/4"	
15				1"	

鋁鋅鳳鋼板之耐蝕性
PhuizerFan Steel Corrosion Resistance

6.3.1 試驗樣品：取不同鍍層種類、鍍層代號(鍍鋅附著量)、管徑的鋼管，計 15 組，如表三所示，再依試驗項目切取適當長度進行試驗。

6.3.2 試驗方法

埋入土壤試驗

將鋼管(長度約 20cm)一半插入在市售培養土內，試驗過程中每 3 天澆水乙次。

備註：所使用的培養土為 Floradur® ANZUCHT SUBSTRAT。

6.3.3 試驗結果：

試驗持續進行3個月，觀察結果如下(如圖十六)。

(1) 預熱浸鍍 5% 鋁鋅鋼管 (No. 6~7)、預熱浸鍍 5% 鋁鋅鋼管 (No. 8~10)、與後熱浸鍍 55% 鋁鋅鋼管 (No. 11~12) 表面皆出現黑變以及輕微白銹現象。

(2) 預熱浸鍍 55% 鋁鋅鋼管 (No. 11~12)，在 3 個月後觀察產生輕微點狀紅銹。

6.3.4 結論

於鹼性環境(如農業、畜牧)，預熱浸鍍 5% 鋁鋅鋼管的耐鹼性最佳，預熱浸鍍鋅鋼管次之，而預熱浸鍍 55% 鋁鋅鋼管最差。故建議農業用使用預熱浸鍍 5% 鋁鋅鋼管。

6.3.1 Test specimen: 15 pipe specimens with different metallic coating, coating mass, and outside diameter are acquired as shown in Table 3. Proper length of the specimens is cut according to test type.

6.3.2 Test Method

Soil Corrosion Test

Half length of the steel pipes was buried in the cultured soil. Full length of a steel pipe was around 20cm. The soil was watered every three days during the test period.

Remark: The cultured soil we used is Floradur® ANZUCHT SUBSTRAT.

6.3.3 Test Result:

The tests continued for three months. Below is the result. (Also see Fig. 16)

(1) Black tarnish and slight white rust occurred on the surface of the pre-hot-dip 5% Al-Zn coated steel pipes (No. 6~7), pre-hot-dip 5% Al-Zn coated steel pipes (No. 8~10), and post-hot-dip 55% Al-Zn coated steel pipes (No. 11~12).

(2) Spotted red rust occurred on the pre-hot-dip 55% Al-Zn coated steel pipes (No. 11~12).

6.3.4 Conclusion

In an alkaline environment, such as agriculture and pasturage, pre-hot-dip 5% Al-Zn coated steel pipes show the best performance against alkali. Pre-hot-dip galvanized steel pipes are the second, and pre-hot-dip 55% Al-Zn coated steel pipes are the worst. Thus, for agricultural use, we recommend pre-hot-dip 5% Al-Zn coated steel pipes.

圖十六　埋入土壤試驗—預熱浸鍍 5% 鋁鋅鋼管、預熱浸鍍 55% 鋁鋅鋼管

Fig.16　Soil Corrosion Test for Pre-hot-dip 5% & 55% Al-Zn Coated Steel Pipes

試片說明 Description					試驗前 Before Test		3 個月後 3 Months Later			
預熱浸鍍 5% 鋁鋅鋼管 (PF) Pre-hot-dip 5% Al-Zn Coated Steel Pipe		左 Left		右 Right	左 Left	右 Right	左 Left	右 Right	左 Left	右 Right
	鍍層量 Coating Mass	Y27		Y27						
	試片編號 Specimen No.	No.6		No.7						
	外徑 O.D.	3/4"		1"						
預熱浸鍍 5% 鋁鋅鋼管 (PF) Pre-hot-dip 5% Al-Zn Coated Steel Pipe		左 Left	中 Mid	右 Right	左 Left	中 Mid 右 Right	左 Left	中 Mid 右 Right	左 Left	中 Mid 右 Right
	鍍層量 Coating Mass	Y35	Y35	Y35						
	試片編號 Specimen No.	No.8	No.9	No.10						
	外徑 O.D.	1/2"	3/4"	1"						
預熱浸鍍 55% 鋁鋅鋼管 (PL) Pre-hot-dip 55% Al-Zn Coated Steel Pipe		左 Left		右 Right	左 Left	右 Right	左 Left	右 Right	右 Right	
	鍍層量 Coating Mass	AZ150		AZ150						
	試片編號 Specimen No.	No.11		No.12						
	外徑 O.D.	1/2"		3/4"						

10mm

資料來源：燁輝企業檢測試驗室

Source : Yieh Phui Testing and Measurement Laboratory

表五　因應不同環境「中華民國太陽光電發電系統商業同業公會」建議之支架防腐蝕標準

Table 5 Corrosion Resistance Standard Recommended for Brackets based on Different Environments from Taiwan's PV Generation System Association (PVGSA)

場址的大氣腐蝕性分類 Category of corrosive environment	位置特性 Site characteristics		裸鋼試片年質量損失 Annual loss of bare steel specimen (g/m^2)	IEC 60068-2-52 測試方法（達到近似一年的腐蝕作用） IEC 60068-2-52Test method (up to approx. one year of corrosion)
	離海水距離 Distance from sea (km)	年度相對濕度 80% 以上時間占比 Proportion of annual relative humidity above 80%		
C1			<10	無（依公會規範不需要測試） N/A (No test required according to PVGSA)
C2	≧ 10	<25%	10-200	試驗方法 3（依公會規範得不需要測試） Test method 3 (test can be excluded according to PVGSA)
C3	>10 -10	≧ 25% <25%	200-400	試驗方法 4 (14 天) Test method 4 (14 days)
C4	2-10 <2	≧ 25% <25%	400-650	試驗方法 5 (28 天) Test method 5 (28 days)
C5	<2	≧ 25%	650-1500	試驗方法 6 (56 天) Test method 5 (56 days)
CX	離岸 Coastal areas	--	1500-5500	試驗方法 8 (70 天) Test method 8 (70 days)

分類 Category	試驗方法 Test method	
C2	試驗方法 3 1 個循環為 7 天。 (1) 鹽霧噴灑：在溫度為 (35 ± 2)°C 之測試室（箱）內，以鹽液噴灑試體，持續 2 小時。 (2) 高濕靜置：在溫度為 (40 ± 2)°C、濕度為 (93 ± 3)% 之測試室（箱）內靜置試體，持續 22 小時。 (3) 重複執行程序 (1) 加上程序 (2)，共 4 次。	Test method 3 One cycle is seven days. One cycle shall consist of spraying the specimen with a salt solution at 35°C ± 2 .K for 2 h, followed by the humid condition at 40°C ± 2 K, 93 % ± 3 % RH for 22 h. This shall be repeated four times.
C3	試驗方法 4 本試驗執行 2 個試驗方法 3 所定之循環，即共執行 14 天。	Test method 4 The required number of cycles as specified in test method 3 shall be two (14 days).
C4	試驗方法 5 本試驗執行 4 個試驗方法 3 所定之循環，即共執行 28 天。	Test method 5 The required number of cycles as specified in test method 3 shall be four (28 days).
C5	試驗方法 6 本試驗執行 8 個試驗方法 3 所定之循環，即共執行 56 天。	Test method 6 The required number of cycles as specified in test method 3 shall be eight (56 days).
CX	試驗方法 8：1 個循環為 8 小時。 (1) 鹽霧噴灑：在溫度為 (35 ± 2)°C 之測試室（箱）內，以鹽液噴灑試體，採用加酸的鹽霧替代中性的鹽霧。持續 2 小時。 (2) 乾燥靜置：在溫度為 (60 ± 2)°C、RH ≦ 30% 之測試室（箱）內靜置試體，持續 4 小時。 (3) 高濕靜置：在溫度為 (50 ± 2)°C、RH ≧ 95% 之測試室（箱）內靜置試體，持續 2 小時。 本試驗共需執行 210 個循環，即共執行 70 天。	One cycle is 8 h. One cycle shall consist of spraying the specimen with a salt solution at 35°C ± 2 K for 2 h, using acidified salt solution instead of neutral salt solution, followed by the dry condition at 60°C ± 2 K, under 30 % RH for 4 h and then the humid condition at 50°C ± 2 K, over 95 % RH for 2 h. The required number of cycles shall be 210 (70 days).

鋁鋅鳳鋼板之耐蝕性
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圖十七　鋁鎂鳳 (PM) 平板試片鹽水噴霧試驗
Fig.17　Salt Spray Test on PhuizerMax's Flat Steel Sheets

測試方法：CNS 8886　中性鹽水噴霧試驗 NSS　環境溫度 25°C、濕度 58%

Test method: CNS 8886 Neutral Salt Spray Test　Ambient temperature: 25°C, humidity: 58%

鋼捲號碼 Coil no	01L092B00	01L088X00	01L063B00	01L066B00
尺寸規格 Size & Spec.	2.25mm E346G/M320	4.50mm E346G/M320	1.50mm PG400M2/M	1.60mm PG450M1/M
鍍層量 Coating mass	ZM180	ZM350	ZM450	ZM480
位置 Position	下 Bottom	上 Top	上 Top	上 Top
封邊處理 Sealing	封邊 Sealed	封邊 Sealed	封邊 Sealed	封邊 Sealed
測試時間 Test time	8976HRS	8352HRS	8352HRS	8352HRS
照片 Photo				
紅銹 Red rust	0%	0%	0%	0%
測試時間 Test time:	9960HRS	9960HRS	9960HRS	9960HRS
測試時間 Test time: 9960HRS				
紅銹 Red rust	3%	0%	0%	0%

圖十八　鋁鎂鳳 (PM) 折彎試片鹽水噴霧試驗
Fig.18　Salt Spray Test on PhuizerMax's Bent Steel Sheets

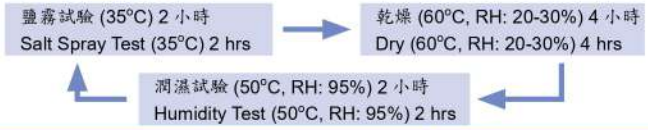
測試方法：CNS 8886　中性鹽水噴霧試驗 NSS　環境溫度 25°C、濕度 58%

Test method: CNS 8886 Neutral Salt Spray Test　Ambient temperature: 25°C, humidity: 58%

鋼捲號碼 Coil no	8CL680B00	8CL684B00		8CL686C00	
厚度 Thickness	2.00mm	2.25mm		2.25mm	
鍍層量 Coating mass	ZM180	ZM275		ZM350	
位置 Position	上 Top	上 Top	下 Bottom	上 Top	下 Bottom
測試時間 Test time: 2448HRS					
紅銹 Red rust	5%	3%	0%	0%	0%

圖十九　鋁鎂鳳 (PM) 平板試片循環腐蝕試驗
Fig.19　Cycling Corrosion Test on PhuizerMax's Flat Steel Sheets

測試方法：　CNS 8886　循環腐蝕測試 CCT
Test method: CNS 8886　Cycling Corrosion Test



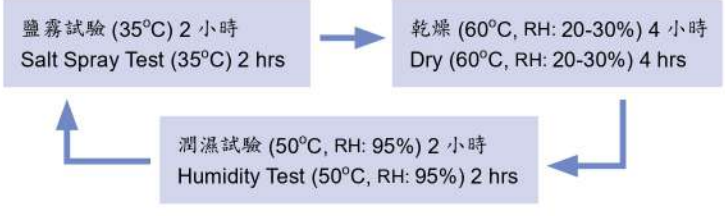
鋼捲號碼 Coil no	8CL686C00		8CB193B00		8CL684B00		8CL680B00		8CB192A00	
尺寸規格 Size & Spec.	2.250mm × 1219mm E346G/M320		1.150mm × 1219mm E346G/MD51		2.250mm × 1219mm E346G/M320		2.000mm × 1219mm E346G/M320		1.150mm × 1219mm E346G/MD51	
鍍層量 Coating mass	ZM350		ZM120		ZM275		ZM180		ZM120	
位置 Position	上 Top	下 Bottom	上 Top	下 Bottom	上 Top	下 Bottom	上 Top	下 Bottom	上 Top	
封邊處理 Sealing	封邊 Sealed		封邊 Sealed		封邊 Sealed		封邊 Sealed		封邊 Sealed	
測試時間 Test time: 2200HRS										
紅銹 Red rust	3%	1%	3%	5%	10%	0%	3%	8%	10%	
封邊處理 Sealing	未封邊 Unsealed		未封邊 Unsealed		未封邊 Unsealed		未封邊 Unsealed		未封邊 Unsealed	
測試時間 Test time: 2200HRS			停止實驗 [1] Stop Testing[1]							
紅銹 Red rust	0%	5%			1%	5%	5%	3%	8%	5%

註 1 紅銹超過 30%，故停止實驗。
Note 1　Stop testing due to red rust exceeding 30%

圖二十　鋁鎂鳳 (PM) 折彎試片循環腐蝕試驗
Fig.20　Cycling Corrosion Test on PhuizerMax's Bent Steel Sheets

測試方法：　CNS 8886　循環腐蝕測試 CCT
Test method: CNS 8886 Cycling Corrosion Test

鋼捲號碼 Coil no	8CL686C00
厚度、規格 Thickness & Spec.	2.25mm E346G/M320
鍍層量 Coating mass	ZM350
位置 Position	上 Top
測試時間 Test time: 2630HRS	
紅銹 Red rust	5%



資料來源：燁輝企業檢測試驗室（圖十七～二十）
Source : Yieh Phui Testing and Measurement Laboratory (Fig. 17~20)

6.4 混凝土試驗：試驗一

為評估鍍鋅與鍍鋁鋅產品用於工地建材之耐蝕性，特進行此項混凝土試驗。本試驗共歷時 1 年 8 個月。

試驗條件：

6.4.1 試片：

(1) 擇 GI、鍍 5% 鋁鋅、GL 產品，以不同鍍層量及不同化成處理 (CL、AF、N) 鋼板，共計 18 顆鋼捲。(備註：CL 表鉻酸處理、AF 表耐指紋藥劑、N 表無化成處理)

(2) 將上述鋼捲裁切成 75mm×150mm 試片，並以 3M 膠帶進行單邊封邊 (為評估腐蝕切邊保護)。每組試片為 18 片，共準備兩組試片。其試片資料 (表六) 以及試片封邊情況 (圖二十一) 如下。

6.4.2 泥漿：將市售預拌混凝土包，加入適量水分拌勻。其酸鹼值落於 pH11~12。

6.4.3 將上述試片插入泥漿中，並且試驗開始一個禮拜內，每日需在試片上澆水，以符合標準土木工程施工法 (試驗配置如圖二十二所示)。

6.4.4 於預定時間，將試片取出觀察試片腐蝕情形。

6.4 Concrete Test: Test 1

In order to evaluate the corrosion resistance among GI, PhuizerFan (PF), and GL when the steel products are used in a construction site, we conducted the test below. It has lasted one year and eight months.

Test Condition:

6.4.1 Specimen:

(1)Different coating weights and surface treatments were applied on the GI, PF, and GL products we prepared. The specimens were sourced from 18 coils. Surface treatments were chromate (CL), anti-fingerprint (AF), and non-surface treated (N).

(2)The size of the specimens is 75mm×150mm and 3M tape was adopted to seal single side of the specimens in order to see cut edge protection. Each set has 18 pieces of specimens, and there are 2 sets prepared. Table 6 shows the specimen information and Fig. 21 demonstrates cut edge sealing condition.

6.4.2 Concrete: Ready mixed concrete purchased from the market was properly mixed with water. The pH is around 11~12.

6.4.3 The specimens were inserted into the concrete. Within the first week of test, water was sprayed onto the concrete so as to simulate a standard civil engineering construction. (See Fig. 22.)

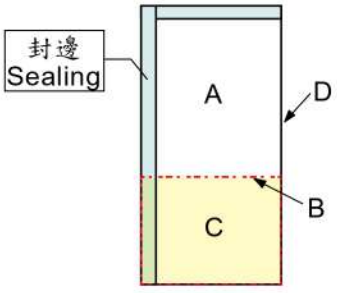
6.4.4 We removed the specimens and observed corrosion on them.

表六　試片資料

Table 6 Specification Information

No.	鍍層別 Coating	化成處理 Surface treatment	鍍層量 Coating mass	鋼捲號碼 Coil no.	試片厚度 Thickness (mm)
1	GI	CL	Z12	91A739A00	1.550
2			Z18	91A772A00	0.490
3			Z27	8CA993A00	0.483
4		AF	Z12	86C360B00	0.476
5			Z18	91A061X00	0.356
6			Z27	88B809B00	2.670
7	GL	CL	AZ100	93B691B00	0.584
8			AZ150	8AB285B00	1.000
9		AF	AZ70	85C500B00	0.254
10			AZ100	85D328B00	0.356
11			AZ150	85C665B00	0.500
12	PF	CL	Y45	94B443B00	0.700
13			Y60	7CA582B00	0.750
14			Y90	94L912B00	0.630
15		AF	Y40	91A585B00	0.762
16			Y60	92L054B00	0.711
17			Y115	7CA721B00	1.550
18		N	Y60	89L928B00	2.720

圖二十一　試片封邊、試驗示意圖
Fig. 21　Specimen Segments



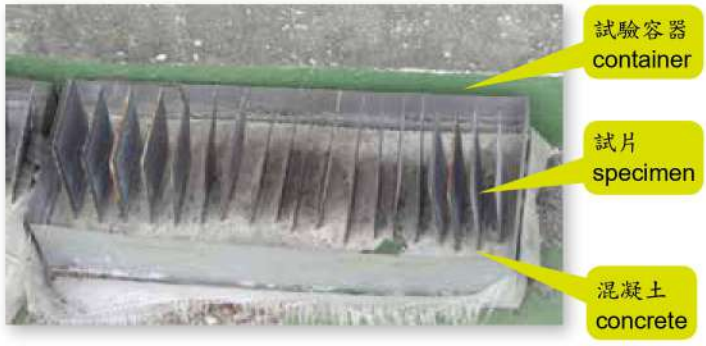
A 區：未與混凝土接觸。
Segment not contacting to concrete

B 區：空氣與混凝土界面。
Interface between air and concrete

C 區：混凝土試驗區。
Concrete where steel sheet was inserted

D ：試片切邊處（無封邊）
Cut edge (unsealed)

圖二十二　試驗配置圖
Fig. 22　Test Arrangement



6.4.5 試驗結果：

(1) 第一組試片於試片埋入第 10 天起出，觀察鋼板與混凝土初期反應，其結論如下：
　a.【空氣與混凝土界面】（見圖二十一，B 區）之腐蝕能力較強，其原因為空氣與混凝土界面含水量較高，鹼性水質依舊存在，繼續與鋼板鍍層起反應。
　b. 依實驗結果觀察可知，GL 普遍抗鹼能力較弱，PF 最佳。

(2) 第二組試片經 1 年 8 個月後取出，其試驗結果如附件所示，經觀察僅【空氣與混凝土界面】有明顯紅銹現象，其餘部分僅出現明顯白銹以及黑變。

(3) 針對試片紅銹面積大小，作為試片耐蝕能力之比較，其結果如表七；結果顯示 PF 耐蝕性表現優越，GI 次之，GL 最差。

6.4.5 Test Result:

(1)The first set of specimens was taken out 10 days later. We observe the initial reaction between the steel sheets and concrete. Below is the result.
　a. Only [B: Interface between air and concrete] in Fig. 21 demonstrates stronger corrosion. It is because the water content is higher in the interface. Alkaline water still reacted with the metallic coating.
　b. According to the test result, GL's alkali resistance basically is relatively weaker, whereas PF is the best.

(2)The second set of the specimens shows obvious red rust on Segment B, and the rest segments have obvious white rust and black tarnish.

(3)The size of red rust connects with corrosion resistance of the specimen. Table 7 also shows that PF's corrosion resistance is superior to the other two products. GL is the worst.

表七　空氣與混凝土界面之耐鹼能力
Table 7 Alkali Resistance of the Interface Between Air and Concrete

	塗鉻酸 (Cr+) 鈍化處理 (CL)	耐指紋處理 (AF)	表面無鈍化處理 (N)
GI	2	5	—
PF	2	1	2 ～ 3
GL	4 ～ 5	4	—

備　註：等級　優 1 ⟶ 5 劣
Remark　Grade　Best　Worst

資料來源：燁輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

圖二十三　熱浸鍍鋅 (GI) 與鍍鋁鋅 (PF, GL) 產品之混凝土試驗結果
Fig.23　Test Results of Concrete Test for GI, PF & GL

No.1: GI/CL/Z12	No.2: GI/CL/Z18	No.3: GI/CL/Z27	No.4: GI/AF/Z12	No.5: GI/AF/Z18	No.18: GI/AF/Z27
					
No.6:GL/CL/ AZ100	No.7:GL/CL/ AZ150	No.8:GL/AF/AZ70	No.9:GL/AF/ AZ100	No.10:GL/AF/ AZ150	No.11PF/CL/Y45
					
No.12: PF/CL/Y60	No.13: PF/CL/Y90	No.14: PF/AF/Y40	No.15: PF/AF/Y60	No.16: PF/AF/Y115	No.17: PF/N/Y60
					

資料來源：煒輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

6.5 混凝土試驗：試驗二

6.5.1 為比較鋁鋅鳳 (PF) 鋼板 (鍍層量 Y18，耐指紋處理) 與 GI 鋼板 (鍍層量 Z350，鉻酸處理) 之混凝土附著性與耐蝕性，將混凝土倒入不同鍍層種類鋼板為底部之圓柱內，乾燥 10 天後將凝固之混凝土移除。高鹼性混凝土 (pH 值約 11) 明顯地讓熱浸鍍鋅鋼板產生腐蝕與黑污，但鋁鋅鳳耐指紋皮膜尚未有腐蝕狀況產生，如圖二十四所示。

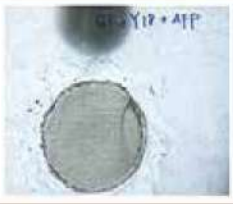
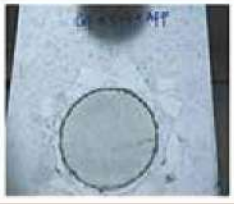
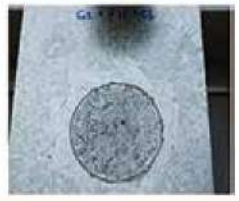
混凝土種類：
預拌混凝土，混凝土設計強度為 3000 psi (210 kg/cm^2)
試驗時間：一週

6.5 Concrete Test: Test 2

6.5.1 In order to compare concrete adhesion and corrosion resistance between PhuizerFan (PF) steel sheet (coating mass: Y18, surface treatment: anti-fingerprint) and GI steel sheet (coating mass: Z350, surface treatment: chromate), concrete was poured into cylinders with different materials of bottoms. 10 days later, the concrete was dried and removed. High alkali concrete (pH value about: 11) has apparently caused chromated GI to corrode and produce black tarnish, but the anti-fingerprint film of PF has not yet appeared corrosion condition in part, as shown in Fig. 24.

Concrete Type:
Ready mixed concrete, concrete strength is 3000 psi (210 kg/cm^2)
Test Time: 1 week

圖二十四　一週後混凝土測試結果
Fig.24　Test Result After One Week

鋁鋅鳳鋼板 PhuizerFan (PF)		熱浸鍍鋅鋼板 Galvanized	
A (Y18，1.00mm)	B (Y27，0.65mm)	C (Z270，1.20mm)	D (Z350，1.50mm)
			
			

資料來源：燁輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

6.5.2 試驗結果：

(1) 在本試驗中，表面施以耐指紋處理的 PF 鋼板比傳統鉻酸處理之 GI 鋼板具更佳之耐鹼性。

(2) 水泥之附著性：
PF 鋼板施以耐指紋處理之鋼板表面水泥附著性十分良好，無不良結果。

(3) 其他優點：
表面施以耐指紋處理的 PF 鋼板具較佳之潤滑性，在成形時可減少潤滑劑之使用量。

6.5.2 Test Result :

(1) In the concrete test, Y18 steel with AFP treatment could offer better caustic resistance than Z350 with traditional chromate treatment.

(2) Concrete adhesion:
According to the result of the concrete test, Y18 steel with the AFP treatment do not cause any adhesion problem since the concrete adhered to the coated sheet very tightly.

(3) Other advantage:
PhuizerFan with AFP treatment could offer better lubricity which could decrease the consumption of lubrication oil during forming.

7. 彩色鳳 (ColorFan, CF) 及塗料

表面處理最好的選擇

鋁鋅鳳 (PF) 鋼板適用於傳統熱浸及電鍍鍍鋅鋼材所使用之傳統及先進的表面前處理技術。如磷酸鋅、複合氧化物、鉻酸鹽及輥塗成膜 (Dry-in-Place) 處理。

塗 料

經適當的前處理，PF 鋼板是底漆及上面塗漆最佳之基材。風乾型底漆及面漆、烘乾型底漆及面漆、粉漆、PU 底漆及環氧樹脂底漆均可成功地塗覆於 PF 鋼板上。

已成形之 PF 鋼板施以粉漆塗裝亦可得到優良之表面附著性及外觀。

PF 鋼板的鋅／鋁成分提供了重要的表面均質性，免於外物沾附，及結晶方向等特性而形成良好的塗料附著力。和其他的鍍面鋼材比較，PF 鋼板鋼材對表面前處理及塗料附著力而言是一絕佳的底材。

即使經過了嚴厲的成形加工，PF 鋼板展現出最高的鍍層附著力，也因此改善耐塗料裂痕、耐邊緣銹蝕、耐腐蝕及耐起泡等性能。

7.ColorFan(CF) & Paint

Your pick of pre-treatments...

PhuizerFan (PF) readily accepts all conventional and advanced technology pre-treatments used on conventional hot-dip and electrogalvanized products. A few examples include zinc phosphate, complex oxide, chromate and Dry-in-Place treatments.

... and paints

When properly pre-treated, PF is an excellent base for primers and topcoats. Air-drying primers and topcoats, bake drying primers and topcoats, powder paints, urethane primers and epoxy primers can be successfully applied to PF.

Powder coating has also been used on formed PF components with excellent surface adherence and appearance.

PF's zinc/aluminum composition provides the important surface homogeneity, free from tramp elements, and crystal orientation required for good paint adhesion. Compared to other coated steels, PF products are a superior substrate for pre-treatment and paint adhesion.

Even after severe forming, PF exhibits the highest adhesion and substantially improved resistance to paint crazing, edge creep, corrosion, and blistering.

8. 彩色鳳鋼板 (CF) 耐蝕性優越

8.1 彩色鳳與鍍鋅烤漆鋼板 (PPGI) 之鹽水噴霧試驗結果

8.1.1 試驗條件：試驗片以 3T 彎曲程度彎曲及 7mm 之艾力生衝擊後，再依據 JIS Z 2371 之鹽水噴霧試驗條件進行試驗。

8.1.2 試驗結果：由圖二十五與圖二十六照片可知，在經過 2000 小時之鹽水噴霧試驗之後，彩色鳳鋼板之 Y18 鍍層 (經 2000hrs 後，白銹發生面積 8%)，其耐蝕性比預塗覆熱浸鍍鋅烤漆鋼板 (PPGI) 之 Z18 鍍層 (經 2000hrs 後，白銹發生面積 50%) 更為優越。

8.ColorFan with Excellent Corrosion Resistance

8.1 The Salt Spray Test Results of ColorFan & PPGI

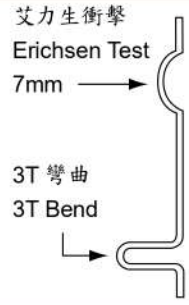
8.1.1 Test condition: Samples with 3T Bend and 7mm Erichsen mechanical process are tested according to the requirements of JIS Z 2371.

8.1.2 Test result: As shown in Fig. 25 & 26, the corrosion resistance property of ColorFan steel sheet with Y18 (8% white rust after 2000hrs salt spray test) is superior to pre-painted hot-dip galvanized coated steel sheet (PPGI) with Z18 (50% white rust after 2000hrs salt spray test).

圖二十五 熱浸鍍鋅烤漆鋼板 (PPGI)
Fig.25　Pre-painted Hot-Dip Galvanized Coated Steel Sheet (PPGI)

鍍層量 Coating Mass: Z18 (180g/m^2 min.)
塗層 Paint : PE 25μm

Before test	500 hrs	1000 hrs	1500 hrs	2000 hrs	剖面圖 Section
WR 0%	WR 0%	WR 0.5%	WR 30%	WR 50%	

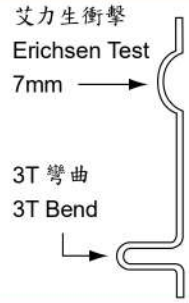


資料來源：煒輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

圖二十六 彩色鳳 (CF) 鋼板
Fig.26　ColorFan Steel Sheet

鍍層量 Coating Mass: Y18 (180g/m^2 min.)
塗層 Paint : PE 25μm

Before test	500 hrs	1000 hrs	1500 hrs	2000 hrs	剖面圖 Section
WR 0%	WR 0%	WR 0%	WR 0%	WR 8%	



備註 Remark：WR: White Rust, 白銹

資料來源：煒輝企業檢測試驗室
Source : Yieh Phui Testing and Measurement Laboratory

9. 綠色環保鋼材

燁輝鋁鋅鳳 (PF) 與鋁鎂鳳 (PM) 產品為符合歐盟 RoHS 指令之鋼品，鋼材表面可施以耐指紋處理，對於環境之永續發展貢獻良多。

節能利器

鋁鋅鳳與鋁鎂鳳鋼品由於具有優異的成型性與較 GI 鋼品更佳的耐蝕性能，對於目前各國積極開發的太陽光電產業提供最佳的鋼品應用。鋁鋅鳳與鋁鎂鳳鋼品可應用於不同環境之太陽光電系統之 PV 面板框架、底板及相關太陽光電設備結構 (桁架支架) 及五金固定扣件沖壓成型等用途，降低大氣腐蝕現象對設備結構侵蝕損壞設備情況，延長設備機組壽命。

對直接環境衝擊較小

與其他熱浸鍍面產品的比較試驗中，鋁鋅鳳與鋁鎂鳳的金屬鍍層流失量最少。

使用壽命更長

鋁鋅鳳與鋁鎂鳳可避免金屬鍍層提早受到破壞，讓產品使用壽命更長。

可回收

鋁鋅鳳與鋁鎂鳳鋼品 100% 可回收。

9.Green Steel

PhuizerFan (PF) and PhuizerMax (PM) comply with EU RoHS Directive, contributing a lot to a sustainable environment. Anti-fingerprint treatment can be applied on PhuizerFan surface.

Energy saving steel

PF and PM steel sheets possess excellent formability and better corrosion resistance compared with GI steel sheets. PF and PM provide the best products for solar energy industry that is vigorously developed by every country all over the world. For this industry, PF and PM can be used for PV panel brackets and base panels of solar photovoltaic power generation system, solar generator apparatus (beam or stand), and hardware fasteners for drawing in different conditions. The material lowers the atmospheric corrosion affecting apparatus structure and extends the useful life of the apparatus.

Less impact on the immediate environment

In tests against other hot-dip coatings, PF and PM demonstrated the least amount of coating loss.

Longer useful life

PF and PM avoid untimely coating deterioration, so the product lasts longer.

Recyclable

PF and PM is 100% recyclable.

10. 產品用途與應用實績

10. Applications and Application References

台電七股將軍光電工程 (150MW)
Taipower, Qigu & Jiangjun Dist. (150MW)

台泥綠能 彰化縣彰濱工業區 (12MW)
Taiwan Cement, Zhang Bin Industrial Zone, Changhua County (12MW)

雲林麥寮 (20MW)
Mailiao Township, Yunlin County (20MW)

儲能櫃
Energy Storage

電氣箱
Electrical Box

河南 南陽 臥龍地區 (100MW)
Henan, Nanyang Wolong District (100MW)

葡萄牙 光電案場支架使用
Portugal

電纜橋架
Cable Tray

註：上述實績使用燁輝及燁輝 (中國) 鍍 5% 鋁 (鎂) 鋅鋼品。
Note: The application references above adopt hot-dip 5%Al-(Mg)-Zn coated steel products produced by Yieh Phui and Yieh Phui (China).

高雄市大社區台灣菸酒公司發貨中心
鍍層量 Y30，SMP 塗料
Distribution center of Taiwan Tobacco & Liquor Corp., Kaohsiung, Taiwan
Coating mass: Y30; paint type: SMP

屏東農業生物科技園區
鍍層量 Y30，PVDF 塗料
Pingtung Agricultural Biotechnology Park, Pingtung, Taiwan
Coating mass: Y30; paint type: PVDF

台南市精剛精密科技股份有限公司
鍍層量 Y30，PVDF 塗料
S-Tech Corp., Tainan, Taiwan
Coating mass: Y30; paint type: PVDF

台南市森田印刷廠股份有限公司
鍍層量 Y27，PVDF 塗料
Sentien Printing Factory Co., Ltd., Tainan, Taiwan
Coating mass: Y27; paint type: PVDF

高雄市中鋼機械廠房
鍍層量 Y30，PE 塗料
Plant building of China Steel Machinery Corp., Kaohsiung, Taiwan
Coating mass: Y30; paint type: PE

苗栗縣裕隆汽車廠房
鍍層量 Y27，PVDF 塗料
Plant building of Yulon Motors, Miaoli, Taiwan
Coating mass: Y27; paint type: PVDF

樓承板(台北 101 大樓實照)
Floor decks (Photo of Taipei 101 Building)

樓承板(澳洲墨爾本皇家兒童醫院實照)
Floor decks of the Royal Children's Hospital in Melbourne, Australia

高雄市義大醫院及癌治療醫院樓承板
Floor decks of E-Da Hospital and Cancer Hospital, Kaohsiung, Taiwan

太陽能板支架
Solar Panel Bracket

汽車喇叭
Motor Speaker

汽車電動椅馬達蓋
Motor Housing of Power-Adjustable Automotive Seat

穀物筒倉
加拿大 Twister Pipe 公司提供
Grain bin
Courtesy of Twister Pipe Ltd., Canada

中國大陸福州高鐵站
使用燁輝 (中國) 熱浸鍍 5% 鋁鋅鋼板
China High-Speed Railway--Fuzhou Station
Hot-Dip 5% Al-Zn Coated Steel

自動化禽畜養殖設施用料
鍍層量 Y35
Frame of an automatic poultry feeding system
Coating mass: Y35

溫室棚架管，鍍層量 Y27
Steel tube shacks for greenhouse
Coating mass: Y27

溫室支架管，鍍層量 Y35
Steel tube supporters for greenhouse
Coating mass: Y35

家禽飼餵系統，鍍層量 Y35
Poultry trough
Coating mass: Y35

11. 燁輝鋁鋅鳳 (PF) 與鋁鎂鳳 (PM) 鋼捲規格與尺寸
11. YP PhuizerFan & PhuizerMax Specifications

品名 Product Name	規格 Specifications		底材厚度 Base Steel Thickness (mm)	鍍層量 Coating Mass	
鋁鋅鳳、鋁鎂鳳鋼捲 PhuizerFan & PhuizerMax	CNS 15236 (2013)	SZACC	0.20 – 1.5	鋁鋅鳳 PhuizerFan	Y08 Y10 Y12 Y14 Y18 Y20 Y22 Y25 Y27 Y30 Y35
		SZACD1	0.3 – 1.1		
		SZAC340 SZAC400 SZAC440 SZAC490	0.3 – 1.25		
		SZAHC SZAH340 SZAJ400 SZAJ440 SZAH490	1.3 – 4.5		
		SZAC570	0.75 – 2.0		
	JIS G 3317 (2019)	SZACC	0.2 – 1.5		Y08 Y10 Y12 Y14 Y18 Y20 Y22 Y25 Y27 Y30 Y35
		SZACD1	0.3 – 1.1		
		SZAC340 SZAC400 SZAC440 SZAC490	0.3 – 1.25		
		SZAHC SZAH340 SZAJ400 SZAJ440 SZAH490	1.3 – 4.5		
		SZAC570	0.75 – 2.0		
	ASTM A/875A 875M (2013)	Commercial Steel Type A B C	0.2 – 4.5		ZGF 90 ZGF135 ZGF180 ZGF225 ZGF275 ZGF350
		Forming Steel Type A B	0.2 – 1.5		
		DDS	0.3 – 1.1		
		Structural Steel Grade 230 255 275 340	0.3 – 4.50		
		Structural Steel Grade 550	0.75 – 2.0		
	AS 1397 (2011)	G1	0.2 – 4.5		ZA 90 ZA135 ZA180 ZA225 ZA275 ZA350
		G2	0.2 – 1.5		
		G3	0.3 – 1.1		
		G250 G300 G350	0.2 – 4.5		
		G450	0.6 – 1.75		
		G500	1.0 – 1.75		
		G550	0.75 – 2.0		
	EN 10346 (2015)	DX51D	0.20 – 4.5	鋁鋅鳳 PhuizerFan	ZA095 ZA130 ZA185 ZA200 ZA255 ZA300
		DX52D	0.20 – 1.5		
		DX53D	0.3 – 1.1		
		S220GD S250GD S280GD S320GD S350GD	0.30 – 4.5	鋁鎂鳳 PhuizerMax	ZM120 ZM130 ZM140 ZM150 ZM160 ZM175 ZM190 ZM200 ZM250 ZM300 ZM310 ZM350
		S420GD S450GD	1.55 – 4.5		
		S550GD	0.75 – 2.0		
表面精整 Surface Finish	一般鍍 5% 鋁鋅鋅花、微細鋅花 [1] Regular Spangle, Minimized Spangle[1]				
表面處理 Surface Treatment	鉻酸或塗油或有機樹脂 (耐指紋塗膜) 處理 Chromating Treatment, Oiled or Resin Coated (anti-fingerprint)				
備註 Remarks	1. 鋅花大小直徑 3mm 以上為一般鋁鋅鳳、鋁鎂鳳鋅花，3mm 以下為微細鋅花。 2. 厚度、寬度、平坦度……等之公差容許範圍，依各製品規範之要求。 3. 對各種表面精整厚度 2.0mm 以下，可再實施調質處理。 4. 客戶訂購厚度未滿 1.6mm 之 JIS G 3323 HGI 製品，其規格要求比照厚度 1.6mm JIS G3323 HGI 製品之規定。 5. 鋼捲內徑為 508 或 610mm；外徑之最大容許值為 2000mm。 6. 不在上述範圍之產品，如尺寸、鍍層、規格等，請以個案詢問專案開發方式進行。 1. Spangle diameter above 3mm is regular spangle. Under 3mm is minimized spangle. 2. Tolerance for thickness, width, flatness and so on conforms to individual product specification. 3. All products with thickness 2.0mm and under can be skinpassed. 4. The specification for thicknesses under 1.6mm for hot-rolled base metal according to JIS G 3323 will be the same as for thicknesses 1.6mm and above. 5. Coil inside diameters can be either 508mm or 610mm. Maximum coil outside diameter is 2000mm. 6. Please make inquires to our Sales & Marketing Division for products with special specifications.				

12. 燁輝（中國）鋁鋅鳳 (PF) 鋼捲規格與尺寸
12. YPC PhuizerFan Specifications

品名 Product Name	規格 Specifications		底材厚度 Base Steel Thickness (mm)	鍍層量 Coating Mass
鋁鋅鳳 (熱浸鍍5%鋁鋅) 鋼捲 PhuizerFan (5%Al-Zn Coated Steel Coil)	CNS 15236 (2013)	SZACD1	0.40 – 2.20	Y08 - Y35
		SZACC	0.26 – 2.20	
		SZAC340 SZAC400 SZAC440 SZAC490 SZAC540 SZAC570	0.28 - 2.20	
	JIS G 3317 (2017)	SZAHC SZAH 340 400 440 490	1.80 - 2.20	Y08 Y10 Y12 Y18 Y20 Y22 Y25 Y27 Y35
		SZACC SZAC 340 400 440 570	0.26 - 2.20	
		SZACD1	0.40 - 2.20	
	ASTM A875M (2013)	Commercial Steel Type A B C	0.26 - 2.20	ZGF 90 ZGF135 ZGF180 ZGF225 ZGF275 ZGF350
		Forming Steel Type A B	0.30 - 2.20	
		DDS	0.40 - 2.20	
		Structural Steel Grade 230 255 275 340	0.28 - 2.20	
		Structural Steel Grade 550	0.25 - 1.30	
	AS 1397 (2011)	G3	0.40 - 2.20	ZA90 | ZA450
		G1 G2	0.26 - 2.20	
		G250 G300 G350 G450 G500 G550	0.25 - 2.20	
	EN 10346 (2015)	DX51D	0.26 - 2.20	ZA 095 ZA 130 ZA 185 ZA 200 ZA 255 ZA 300
		DX52D DX53D	0.40 - 2.20	
		S220GD S250GD S280GD S320GD S350GD	0.30 - 2.00	
		S550GD	0.25 - 2.00	
表面精整 Surface Finish	微細鋅花[1] Minimized Spangle[1]			
表面處理 Surface Treatment	鉻酸或塗油或有機樹脂（耐指紋塗膜）處理 Chromating Treatment, Oiled or Resin Coated (anti-fingerprint)			
備註 Remarks	1. 鋅花大小 3mm 以下為微細鋅花。 2. 厚度、寬度、平坦度……等之公差容許範圍，依各製品規範之要求。 3. 對各種表面精整厚度 2.0mm 以下，可再實施調質處理。 4. 客戶訂購厚度未滿 1.6mm 之 JIS G 3323 HGI 製品，其規格要求比照厚度 1.6mm JIS G3323 HGI 製品之規定。 5. 鋼捲內徑為 508 或 610mm；外徑之最大容許值為 2000mm。 6. 不在上述範圍之產品，如尺寸、鍍層、規格等，請以個案詢問專案開發方式進行。 1. Spangle diameter under 3mm is minimized spangle. 2. Tolerance for thickness, width, flatness and so on conforms to individual product specification. 3. All products with thickness 2.0mm and under can be skinpassed. 4. The specification for thicknesses under 1.6mm for hot-rolled base metal according to JIS G 3323 will be the same as for thicknesses 1.6mm and above. 5. Coil inside diameters can be either 508mm or 610mm. Maximum coil outside diameter is 2000mm. 6. Please make inquires to our Sales & Marketing Division for products with special specifications.			

13. 燁輝 (中國) 鋁鎂鳳 (PM) 鋼捲規格與尺寸
13. YPC PhuizerMax Specifications

品名 Product Name	規格 Specifications		底材厚度 Base Steel Thickness(mm)	鍍層量 Coating Mass
鋁鎂鳳 (熱浸鍍鋅鋁鎂) 鋼捲 PhuizerMax (Zn-Al-Mg Coated Steel Coil)	JIS G 3323 (2019)	SGMHC SGMH 340 400 400Y 440 440Y 490	1.60 - 2.00	K08 K10 K12 K14 K18 K20 K22 K25 K27 K35
		SGMC 570	0.20 - 2.00	
		SGMC 400 440 440Y	0.35 - 2.00	
		SGMCC SGMC 340 400Y	0.25 - 2.20	
		SGMCD1	0.40 - 2.20	
	ASTM A1046M (2019)	Commercial Steel Type A B C	0.25 - 2.20	ZMM90 ZMM120 ZMM150 ZMM180 ZMM210 ZMM220 ZMM275 ZMM300 ZMM350
		Forming Steel Type A B	0.40 - 2.20	
		DDS	0.40 - 2.20	
		Structural Steel Grade 230 255	0.25 - 2.20	
		Structural Steel Grade 275 340 (Class 1&4) 380	0.35 - 2.00	
		Structural Steel Grade 410	0.55 - 1.60	
		Structural Steel Grade 550	0.20 - 2.00	
	AS 1397 (2011)	G2 G3	0.40 - 2.20	ZM90 ZM120 ZM150 ZM180 ZM220 ZM275 ZM350
		G1 G250	0.25 - 2.20	
		G300 G350 G450 G500 G550	0.35 - 2.00	
	EN 10346 (2015)	DX51D S220GD S250GD	0.25 - 2.20	ZM80 ZM90 ZM100 ZM120 ZM130 ZM140 ZM150 ZM160 ZM175 ZM190 ZM200 ZM250 ZM300 ZM310 ZM350
		DX52D DX53D	0.40 - 2.20	
		S280GD S320GD S350GD	0.35 - 2.00	
		S550GD	0.20 - 2.00	
表面精整 Surface Finish	微細鋅花[1] Minimized Spangle[1]			
表面處理 Surface Treatment	鉻酸或塗油或有機樹脂 (耐指紋塗膜) 處理 Chromating Treatment, Oiled or Resin Coated (anti-fingerprint)			

備註 Remarks

1. 鋅花大小 3mm 以下為微細鋅花。
2. 厚度、寬度、平坦度……等之公差容許範圍，依各製品規範之要求。
3. 對各種表面精整厚度 2.0mm 以下，可再實施調質處理。
4. 客戶訂購厚度未滿 1.6mm 之 JIS G 3323 HGI 製品，其規格要求比照厚度 1.6mm JIS G 3323 HGI 製品之規定。
5. 鋼捲內徑為 508 或 610mm；外徑之最大容許值為 2000mm。
6. 不在上述範圍之產品，如尺寸、鍍層、規格等，請以個案詢問專案開發方式進行。

1. Spangle diameter under 3mm is minimized spangle.
2. Tolerance for thickness, width, flatness and so on conforms to individual product specification.
3. All products with thickness 2.0mm and under can be skinpassed.
4. The specification for thicknesses under 1.6mm for hot-rolled base metal according to JIS G 3323 will be the same as for thicknesses 1.6mm and above.
5. Coil inside diameters can be either 508mm or 610mm. Maximum coil outside diameter is 2000mm.
6. Please make inquires to our Sales & Marketing Division for products with special specifications.

14. 燁輝彩色鳳 (CF) 鋼捲規格與尺寸
14. YP ColorFan Specifications

品名 Product Name	規格 Specifications		底材厚度 Base Steel Thickness(mm)	鍍層量 Coating Mass
彩色鳳鋼捲 ColorFan Steel Coil	CNS 15298 (2013)	CZACD1~3	0.30 - 1.10	Y08 - Y35
		CZACC	0.20 - 1.40	
		CZAC340 CZAC400 CZAC440 CZAC490 CZAC540 CZAC570	0.20 - 1.25	
	JIS G 3318 (2013)	CZACC CZAC 340 400 440 570	0.20 - 1.25	Y08 Y10 Y12 Y18 Y20 Y22 Y25 Y27 Y35
		CZACD1	0.30 - 1.10	
	ASTM A755M (2016)	Commercial Steel Type A B C	0.20 - 1.40	ZGF 90 ZGF135 ZGF180 ZGF225 ZGF275 ZGF350
		Forming Steel Type A B		
		DDS	0.30 - 1.10	
		Structural Steel Grade 230 255 275 340	0.20 - 1.25	
		Structural Steel Grade 550	0.20 - 1.25	
	AS 2728 (2013)	G3	0.30 - 1.10	ZA90 - ZA350
		G1 G2	0.20 - 1.40	
		G250 G300 G350 G450 G500 G550	0.20 - 1.25	
	EN 10169 (2010+A1)	DX51D	0.20 - 1.40	ZA 095 ZA 130 ZA 185 ZA 200 ZA 255 ZA 300
		DX52D DX53D	0.30 - 1.10	
		S220GD S250GD S280GD S320GD S350GD	0.20 - 1.25	
		S550GD	0.25 - 1.25	
鋅花 Coating Spangle	一般鍍 5% 鋁鋅鋅花、微細鋅花 Regular Spangle, Minimized Spangle			
樹脂種類 Paint Type	聚酯、矽質強化聚酯、氟碳、聚氟乙烯可塑溶膠、聚氨酯 PE, SMP, PVDF, PVC, PU			

15. 燁輝與燁輝 (中國) 彩鎂鳳 (CM) 鋼捲規格與尺寸
15. YP & YPC ColorMax Specifications

燁輝 YP 品名 Product Name	規格 Specifications		底材厚度 Base Steel Thickness(mm)	鍍層量 Coating Mass
彩鎂鳳鋼捲 ColorMax Steel Coil	EN10169 (2010+A1)	DX51D DX52D	0.25 - 1.40	ZM060 ZM070 ZM080 ZM090 ZM100 ZM120 ZM130 ZM140 ZM150 ZM160 ZM175 ZM190 ZM200 ZM250 ZM300 ZM310 ZM350
		DX53D	0.30 - 1.20	
		S220GD S250GD S280GD S320GD S350GD	0.30 - 1.50	
		S550GD	0.23 - 1.35	

燁輝 (中國) YPC 品名 Product Name	規格 Specifications		底材厚度 Base Steel Thickness(mm)	鍍層量 Coating Mass
彩鎂鳳鋼捲 ColorMax Steel Coil	EN10169 (2010+A1)	DX51D S220GD S250GD S280GD S320GD S350GD	0.23 - 2.00	ZM 80 ZM 90 ZM100 ZM120 ZM130 ZM140 ZM150 ZM160 ZM175 ZM190 ZM200 ZM250 ZM300
		DX52D	0.30 - 1.30	
		DX53D	0.40 - 1.20	
		S550GD	0.25 - 1.00	
	ASTM A755M (2018)	Commercial Steel Type A B C	0.23 - 2.00	ZMM 90 ZMM120 ZMM150 ZMM180 ZMM210 ZMM220 ZMM275 ZMM300
		Forming Steel Type A B	0.30 - 1.30	
		DDS	0.40 - 1.20	
		Structural Steel Grade 230 255 275 340	0.23 - 2.00	
		Structural Steel Grade 550	0.25 - 1.00	
	AS 2728 (2013)	G1 G250 G300 G350	0.23 - 2.00	ZM 90 ZM120 ZM150 ZM180 ZM220 ZM275
		G450	0.50 - 0.80	
		G500 G550	0.25 - 1.00	

表面精整 Surface Finish	燁輝 Yieh Phui	一般鍍 5% 鋁鋅鋅花、微細鋅花[1] Regular Spangle, Minimized Spangle[1]
	燁輝 (中國) Yieh Phui (China)	微細鋅花[1] Minimized Spangle[1]
樹脂種類 Paint Type	燁輝 Yieh Phui	聚酯、矽質強化聚酯、氟碳、聚氯乙烯可塑溶膠、聚氨酯 PE, SMP, PVDF, PVC, PU
	燁輝 (中國) Yieh Phui (China)	聚酯、矽質強化聚酯、氟碳、聚氨酯 PE, SMP, PVDF, PU

備註 Remarks

1. 鋅花大小直徑 3mm 以上為一般彩鎂鳳鋅花，3mm 以下為微細鋅花。
2. 厚度、寬度、平坦度……等之公差容許範圍，依各製品規範之要求。
3. 對各種表面精整厚度 2.0mm 以下，可再實施調質處理。
4. 客戶訂購厚度未滿 1.6mm 之 JIS G 3323 HGI 製品，其規格要求比照厚度 1.6mm JIS G 3323 HGI 製品之規定。
5. 鋼捲內徑為 508 或 610mm；外徑之最大容許值為 2000mm。
6. 不在上述範圍之產品，如尺寸、鍍層、規格等，請以個案詢問專案開發方式進行。

1. Spangle diameter above 3mm is regular spangle. Under 3mm is minimized spangle.
2. Tolerance for thickness, width, flatness and so on conforms to individual product specification.
3. All products with thickness 2.0mm and under can be skinpassed.
4. The specification for thicknesses under 1.6mm for hot-rolled base metal according to JIS G 3323 will be the same as for thicknesses 1.6mm and above.
5. Coil inside diameters can be either 508mm or 610mm. Maximum coil outside diameter is 2000mm.
6. Please make inquires to our Sales & Marketing Division for products with special specifications.

16. 貯存與裝卸

本型錄鋼捲產品，均由本公司施予適當的包裝，此包裝僅提供出貨後至客戶成形、加工前短期室內儲存之保護，而對此期間之儲存保護，相關業者（含成形廠）均負有妥善保管之責任。無論如何絕不可將鋼捲產品貯存於潮濕環境或戶外，濕氣結露或戶外雨水可能滲入鋼捲包裝，此時會因毛細管現象之作用汲入鋼板表面，導致水氣無法正常蒸發，而浸入油漆層（此時水氣更不容易蒸發脫離油漆層）。經一段時間後，易在鍍層與漆層間產生白銹，導致產品特性惡化，減短預期的使用壽命，並影響產品之外觀。

已成形之裁板的貯存，同樣必須特別注意此問題。

16.Storage and Handling

The steel sheets are properly packaged in our works. The packaging only provides short term protection indoors during the period when delivering from Yieh Phui's works till forming or further processing at customer's plant. For the storage of this duration, relevant parties, including roll forming factories, shall take mutual responsibility for proper storage. Never store these steel coils in a humid environment or outdoors. When packaging of steel coils soaks mist or raindrops, the capillarity may cause moisture inhaling into the laps of steel sheets and later immersing the paint. (The moisture is then unable to evaporate easily from the paint.) After some time, white rust easily occurs between metallic coating and paint. This can easily deteriorate steel properties, affect its appearance and shorten its life span.

The storage methods foresaid are recommended likewise for the cut-to-sheet products.

※ 備註：

1. 本型錄所提供的資料已力求準確。對該等資料，燁輝及其子公司不會就其所產生的錯誤陳述或失實陳述承擔任何責任。
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本型錄內規格變動時不另行通知

Specifications are subject to change without notice.

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