Annex-17：Material Safety Data Sheet (MSDS)

Contents

1. Plastic：Sabic 223R , PC-122 , ABS PA-757

Sabic PC 223R：

LEXAN™ Resin 223R
Asia Pacific: COMMERCIAL

17.5 MFR, for small, intricate parts. Improved flame retardance. Internal mold release. UV stabilized.

TYPICAL PROPERTIES[1]	TYPICAL VALUE	Unit	Standard
MECHANICAL			
Tensile Stress, yld, Type I, 50 mm/min	62	MPa	ASTM D 638
Tensile Stress, brk, Type I, 50 mm/min	65	MPa	ASTM D 638
Tensile Strain, yld, Type I, 50 mm/min	7	%	ASTM D 638
Tensile Strain, brk, Type I, 50 mm/min	110	%	ASTM D 638
Flexural Stress, yld, 1.3 mm/min, 50 mm span	93	MPa	ASTM D 790
Flexural Modulus, 1.3 mm/min, 50 mm span	2340	MPa	ASTM D 790
Hardness, Rockwell M	70	-	ASTM D 785
Hardness, Rockwell R	118	-	ASTM D 785
Taber Abrasion, CS-17, 1 kg	10	mg/1000cy	ASTM D 1044
IMPACT			
Izod Impact, unnotched, 23°C	3204	J/m	ASTM D 4812
Izod Impact, notched, 23°C	694	J/m	ASTM D 256
Tensile Impact, Type S	546	kJ/m²	ASTM D 1822
Falling Dart Impact (D 3029), 23°C	169	J	ASTM D 3029
Izod Impact, unnotched 80*10*3 +23°C	NB	kJ/m²	ISO 180/1U
Izod Impact, unnotched 80*10*3 -30°C	NB	kJ/m²	ISO 180/1U
Izod Impact, notched 80*10*3 +23°C	65	kJ/m²	ISO 180/1A
Izod Impact, notched 80*10*3 -30°C	11	kJ/m²	ISO 180/1A
Charpy 23°C, V-notch Edgew 80*10*3 sp=62mm	65	kJ/m²	ISO 179/1eA
Charpy -30°C, V-notch Edgew 80*10*3 sp=62mm	12	kJ/m²	ISO 179/1eA
Charpy 23°C, Unnotch Edgew 80*10*3 sp=62mm	NB	kJ/m²	ISO 179/1eU
Charpy -30°C, Unnotch Edgew 80*10*3 sp=62mm	NB	kJ/m²	ISO 179/1eU

(1) Typical values only. Variations within normal tolerances are possible for various colors. All values are measured after at least 48 hours storage at 23°C/50% relative humidity. All properties, except the melt volume and melt flow rates, are measured on injection molded samples. All samples tested under ISO test standards are prepared according to ISO 294.

(2) Only typical data for selection purposes. Not to be used for part or tool design.
(3) This rating is not intended to reflect hazards presented by this or any other material under actual fire conditions.
(4) Internal measurements according to UL standards.
(5) Measurements made from laboratory test coupon. Actual shrinkage may vary outside of range due to differences in processing conditions, equipment, part geometry and tool design. It is recommended that mold shrinkage studies be performed with surrogate or legacy tooling prior to cutting tools for new molded article.
(6) Needs hard coat to consistently pass 60 sec Vertical Burn.

Source GMD, last updated:

PLEASE CONTACT YOUR LOCAL SALES OFFICE FOR AVAILABILITY IN YOUR AREA.

Medscope Biotech

LEXAN™ Resin 223R

Asia Pacific: COMMERCIAL

TYPICAL PROPERTIES[1]	TYPICAL VALUE	Unit	Standard
THERMAL			
Vicat Softening Temp, Rate B/50	154	°C	ASTM D 1525
HDT, 0.45 MPa, 6.4 mm, unannealed	137	°C	ASTM D 648
HDT, 1.82 MPa, 6.4 mm, unannealed	132	°C	ASTM D 648
CTE, -40°C to 95°C, flow	6.84E-05	1/°C	ASTM E 831
Specific Heat	1.26	J/g-°C	ASTM C 351
Thermal Conductivity	0.25	W/m-°C	ASTM C 177
Relative Temp Index, Elec	100	°C	UL 746B
Relative Temp Index, Mech w/Impact	100	°C	UL 746B
Relative Temp Index, Mech w/o Impact	100	°C	UL 746B
PHYSICAL			
Specific Gravity	1.2	-	ASTM D 792
Specific Volume	0.83	cm^3/g	ASTM D 792
Density	1.19	g/cm^3	ASTM D 792
Water Absorption, 24 hours	0.15	%	ASTM D 570
Water Absorption, equilibrium, 23C	0.35	%	ASTM D 570
Water Absorption, equilibrium, 100°C	0.58	%	ASTM D 570
Mold Shrinkage, flow, 3.2 mm (5)	0.5 - 0.7	%	SABIC Method
Melt Flow Rate, 300°C/1.2 kgf	17.5	g/10 min	ASTM D 1238
OPTICAL			
Light Transmission, 2.54 mm	88	%	ASTM D 1003
Haze, 2.54 mm	1	%	ASTM D 1003
Refractive Index	1.586	-	ASTM D 542
ELECTRICAL			
Volume Resistivity	>1.E+17	Ohm-cm	ASTM D 257
Dielectric Strength, in air, 3.2 mm	15	kV/mm	ASTM D 149
Relative Permittivity, 50/60 Hz	3.17	-	ASTM D 150

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LEXAN™ Resin 223R

Asia Pacific: COMMERCIAL

TYPICAL PROPERTIES[1]	TYPICAL VALUE	Unit	Standard
ELECTRICAL			
Relative Permittivity, 1 MHz	2.96	-	ASTM D 150
Dissipation Factor, 50/60 Hz	0.0009	-	ASTM D 150
Dissipation Factor, 1 MHz	0.01	-	ASTM D 150
Hot Wire Ignition (PLC)	4	PLC Code	UL 746A
High Voltage Arc Track Rate (PLC)	2	PLC Code	UL 746A
High Ampere Arc Ign, surface (PLC)	1	PLC Code	UL 746A
Comparative Tracking Index (UL) (PLC)	2	PLC Code	UL 746A
FLAME CHARACTERISTICS			
UL Recognized, 94V-2 Flame Class Rating (3)	0.75	mm	UL 94
UL Recognized, 94V-0 Flame Class Rating (3)	5.99	mm	UL 94
UV-light, water exposure/immersion	F1	-	UL 746C

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LEXAN™ Resin 223R

Asia Pacific: COMMERCIAL

PROCESSING PARAMETERS	TYPICAL VALUE	Unit
Injection Molding		
Drying Temperature	120	°C
Drying Time	3 - 4	hrs
Drying Time (Cumulative)	48	hrs
Maximum Moisture Content	0.02	%
Melt Temperature	280 - 305	°C
Nozzle Temperature	275 - 300	°C
Front - Zone 3 Temperature	280 - 305	°C
Middle - Zone 2 Temperature	270 - 295	°C
Rear - Zone 1 Temperature	260 - 280	°C
Mold Temperature	70 - 95	°C
Back Pressure	0.3 - 0.7	MPa
Screw Speed	40 - 70	rpm
Shot to Cylinder Size	40 - 60	%
Vent Depth	0.025 - 0.076	mm

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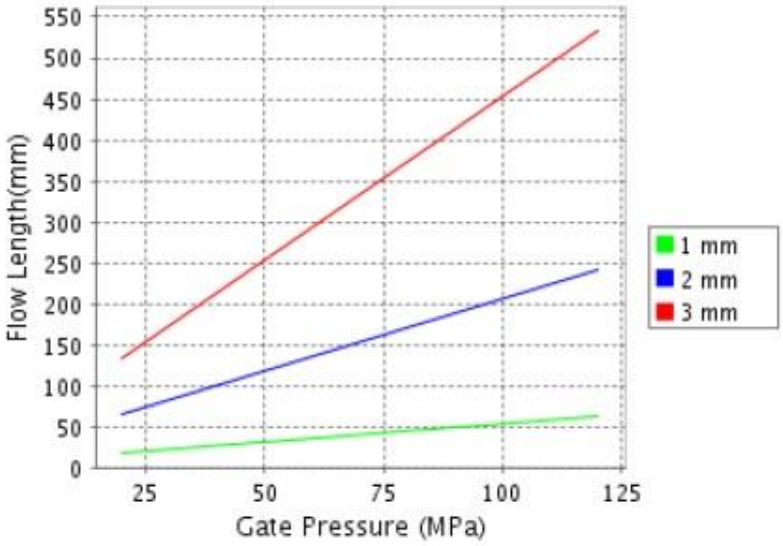
Source GMD, last updated:

LEXAN™ Resin 223R
Asia Pacific: COMMERCIAL

CALCULATED FLOW LENGTH INDICATION
Moldflow® Radial Flow Analysis
LEXAN* 223R
Melt Temperature : 290°C
Mold Temperature : 90°C



Note: Technical support is recommended if Gate Pressure is greater than 80 MPa. Contact your local representative.
® Moldflow is a registered trademark of the Moldflow Corporation.

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Source GMD, last updated:

PLEASE CONTACT YOUR LOCAL SALES OFFICE FOR AVAILABILITY IN YOUR AREA.

Chi Mei PC-122：

TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	0114058887m 001	Seite 1 von 6 *Page 1 of 6*
Auftraggeber: *Client:*	Chi Mei Corporation 59-1, San Chia, Jen Te, Tainan City 71702, Taiwan, R.O.C.	
Gegenstand der Prüfung: *Test Item:*	POLYCARBONATE	
Bezeichnung: *Identification:*	WONDERLITE® PC-122	
Anlieferungszustand: *Delivery condition:*	apparent good	**Eingangsdatum:** *Date of Receipt:* 2016-12-08
Prüfort: *Testing location:*	TÜV Rheinland (Shanghai) Co., Ltd.	
Prüfgrundlage: *Test specification:*	According to RoHS (recast): Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, 2011/65/EU last amended by (EU) 2015/863: Total Content of Lead, Cadmium, Mercury, Chromium VI, Polybrominated Biphenyls, Polybrominated Diphenyl Ethers; and Benzylbutyl phthalate (BBP), Dibutyl phthalate (DBP), Bis(2-ethylhexyl) phthalate (DEHP), Diisobutyl phthalate (DIBP) and Halogen (Fluorine, Chlorine, Bromine, Iodine)	
Prüfergebnis: *Test result:*	The test results are the measurements, stated in the test report.	

geprüft: *tested by:* **kontrolliert:** *checked by:*

Datum *Date*	Name/Stellung *Name/Position*	Unterschrift *Signature*	Datum *Date*	Name/Stellung *Name/Position*	Unterschrift *Signature*
2017-01-03	Anne Chen /Coordinator		2017-01-03	Carl Chang /Department Manager	

Sonstiges/ *Other Aspects:*

Test period: 2016-12-08 – 2017-01-03

Abkürzungen:			Abbreviations:		
	o.k. / P	= entspricht Prüfgrundlage		o.k. / P	= passed
	fail / F	= entspricht nicht Prüfgrundlage		fail / F	= failed
	n.a. / N	= nicht anwendbar		n.a. / N	= not applicable

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.

This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any safety mark on this or similar products.

TÜV Rheinland Taiwan Ltd. Softlines
4F., No.758, Sec. 4, Bade Rd., Songshan Dist., Taipei 105, Taiwan, R.O.C.
Tel.:+886 2 2172-7000 Fax: +886 2 2528-0018
Mail: service-gc@tuv.com · Web: www.twn.tuv.com

Medscope Biotech

ABS PA-757：

TÜVRheinland®
Precisely Right.

测试报告号码: **Test Report No.:**	**0154297908a2 001**

客户名称: **Client:**	奇美實業股份有限公司 Chi Mei Corporation 台灣台南市仁德區三甲里 59-1 號 59-1, San Chia, Jen Te, Tainan City 71702, Taiwan, R.O.C.
买家名称: **Buyer's name:**	ASUSTek
生产商名称: **Manufacturer's name:**	N/A
测试样品: **Test item(s):**	ACRYLONITRILE-BUTADIENE-STYRENE COPOLYMER
型号: **Identification/** **Model No(s):**	POLYLAC® PA-757
收样日期: **Sample Receiving date:**	2017-12-04
测试周期: **Testing Period:**	2017-12-04 – 2017-12-12

测试要求/Test specification:

测试结果依据所进行的测试出具/
Overall results according to tests performed

参照第 2-4 页/
Please refer to page 2-4

测试结果/ Test result:

参照第2-4页 /
Please refer to page 2-4

其他信息/ Other Information:
客户提供的其他信息:
Other information provided by client: N/A
原产地国:
Country of Origin: N/A
目的地国:
Country of Destination: N/A

For and on behalf of
TÜV Rheinland (Shanghai) Co., Ltd.

Date	Name/Position	Date	Name/Position
2018-01-02	Nicky Chen/ Project Manager	2018-01-02	Tina Jin/ Senior Manager

材料清单/ Material list:

材料编号/ No.	材料/Material	颜色/Color	位置/ Location
1	Plastic	Off white	TCL171201-35

缩写/ Abbreviation: n.d. = 未检出 (<报告限值) Not Detected (< Reporting Limit)
ppm = 百万分之一 parts per million
mg/kg =毫克/千克 milligram per kilogram
MDL =检出限值 Method Detection Limit

1 RoHS(2011/65/EU)

测试方法/Test method: 总镉，铅，汞，铬参考 IEC 62321-4:2013 和 IEC 62321-5:2013
Total Cadmium, Lead, Mercury, Chromium
- Ref. to IEC 62321-4:2013 and IEC 62321-5:2013

六价铬-塑料或者电子材料的六价铬含量 - 参考 IEC 62321-7-2:2017 (皮革中的六价铬参考 ISO 17075:2007)
Chromium (VI) - For Plastic or Electronic material – Ref. to IEC 62321-7-2:2017
(for Leather Material, Chromium (VI) - Ref. to ISO 17075:2007)

多溴联苯和多溴联苯醚参考 IEC 62321-6:2015
PBBs, PBDEs – Ref. to IEC 62321-6:2015

邻苯二甲酸酯 BBP, DBP, DEHP, DIBP 参考 IEC 62321-8:2017
BBP, DBP, DEHP, DIBP- Ref. to IEC 62321-8:2017

测试结果/ Test result:

测试参数/ Test Parameter	单位/Unit	MDL	测试结果 Result(1)
镉 Cadium (Cd)	mg/kg	2	n.d.
铅 Lead (Pb)	mg/kg	2	n.d.
汞 Mercury (Hg)	mg/kg	2	n.d.
六价铬 Hexavalent Chromium (CrVI)	mg/kg	2	n.d.
多溴联苯 Polybrominated biphenyls (PBBs) (1)	mg/kg	5	n.d.
多溴联苯醚 Polybrominated diphenyl ethers (PBDEs) (1)	mg/kg	5	n.d.
邻苯二甲酸丁苄酯 Benzylbutyl phthalate(BBP)	mg/kg	50	n.d.
邻苯二甲酸二丁酯 Dibutyl phthalate (DBP)	mg/kg	50	n.d.
邻苯二甲酸二(2-乙基己基)酯 Bis(2-ethylhexyl) phthalate (DEHP)	mg/kg	50	n.d.
邻苯二甲酸二异丁酯 Diisobutyl phthalate (DIBP)	mg/kg	50	n.d.

备注/Remark:

(*1) 单项多溴联苯和多溴联苯醚的报告限值如下/The reporting limit for each individual PBBs and individual PBDEs are:

MDL ppm (mg/kg)		
多溴联苯 (PBBs)	一溴联苯 Bromobiphenyl	5
	二溴联苯 Dibromobiphenyl	5
	三溴联苯 Tribromobiphenyl	5
	四溴联苯 Tetrabromobiphenyl	5
	五溴联苯 Pentabromobiphenyl	5
	六溴联苯 Hexabromobiphenyl	5
	七溴联苯 Heptabromobiphenly	5
	八溴联苯 Octabromobiphenyl	5
	九溴联苯 Nonabromobiphenyl	5
	十溴联苯 Decabromobiphenyl	5
多溴联苯醚 (PBDEs)	一溴联苯醚 Bromodiphenylether	5
	二溴联苯醚 Dibromodiphenyl ether	5
	三溴联苯醚 Tribromodiphenyl ether	5
	四溴联苯醚 Tetrabromodiphenyl ether	5
	五溴联苯醚 Pentabromodiphenyl ether	5
	六溴联苯醚 Hexabromodiphenyl ether	5
	七溴联苯醚 Heptabromodiphenyl ether	5
	八溴联苯醚 Octabromodiphenyl ether	5
	九溴联苯醚 Nonabromodiphenyl ether	5
	十溴联苯醚 Decabromodiphenyl ether	5

2 卤素含量/ Halogen content

测试方法/Test method: 参考 EN14582:2007 用离子色谱检测卤素含量/ Determination of Halogen content by IC with reference to EN14582:2007

测试结果/ Test result:

测试参数/ Test Parameter	单位/Unit	RL	测试结果 Result(1)
Chloride 氯(Cl)	mg/kg	50	n.d.
Bromide 溴(Br)	mg/kg	50	n.d.
Fluoride 氟(F)	mg/kg	50	n.d.
Iodide 碘(I)	mg/kg	50	n.d.

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Precisely Right.

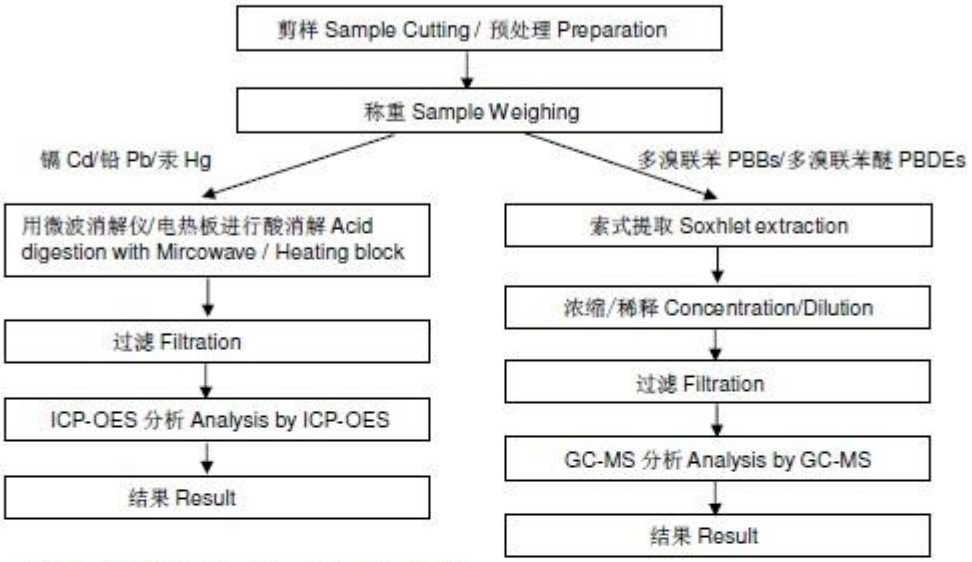
测试报告号码:
Test Report No.: 0154297908a2 001

第 5 页 共 8 页
Page 5 of 8

附件/ Annex:

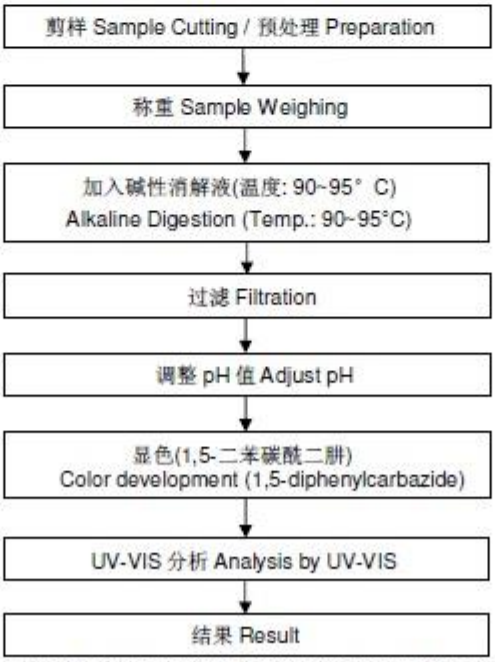
1. **镉 / 铅/ 汞 / 多溴联苯 & 多溴联苯醚/邻苯二甲酸酯测试流程图 Testing Flow Chart for Cd / Pb / Hg / PBBs & PBDEs/BBP&DBP&DEHP&DIBP**

测试人姓名：蔡秀兰/朱惠荣 The person who made testing: Xiulan Cai/Sally Zhu

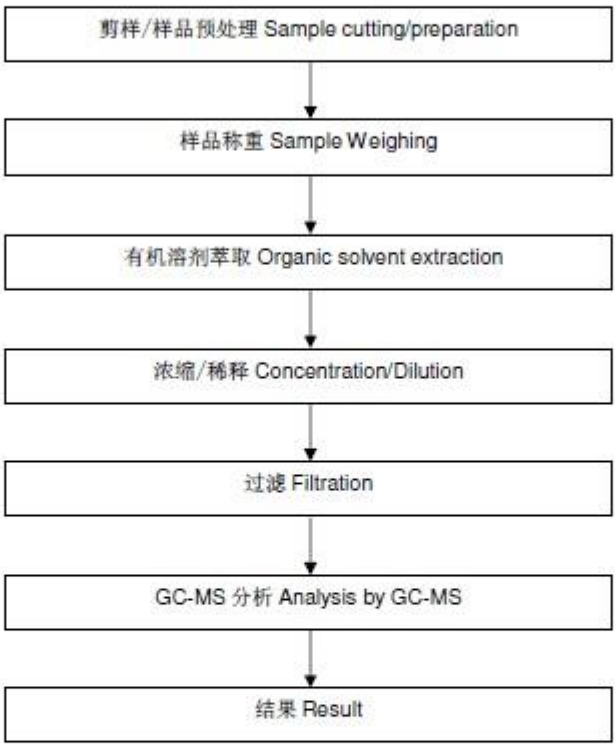


六价铬测试流程 Testing Flow Chart for Cr (VI)

测试人姓名：蔡秀兰 The person who made testing: Xiulan Cai

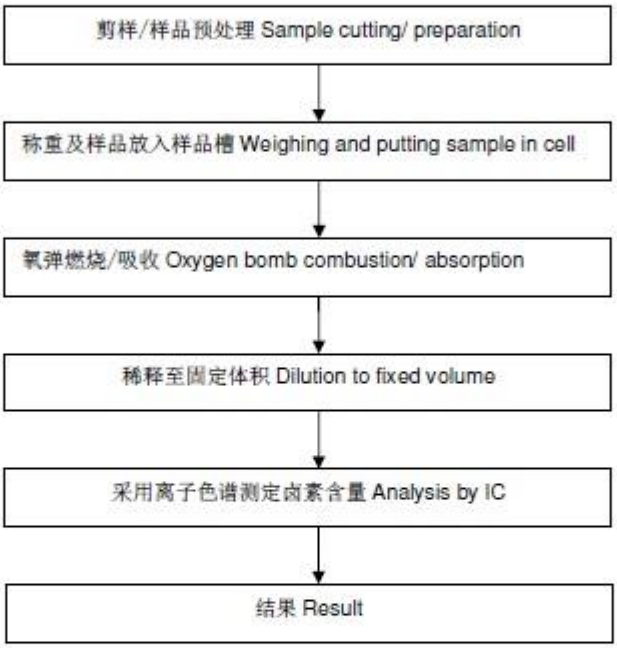


邻苯二甲酸酯含量测试流程图 Testing flow chart for BBP,DBP,DEHP,DIBP
测试人姓名：朱惠荣 The person who made testing: Sally Zhu



卤素含量测试流程图 Testing Flow chart for halogen content

测试人姓名：蔡秀兰 The person who made testing: Xiulan Cai

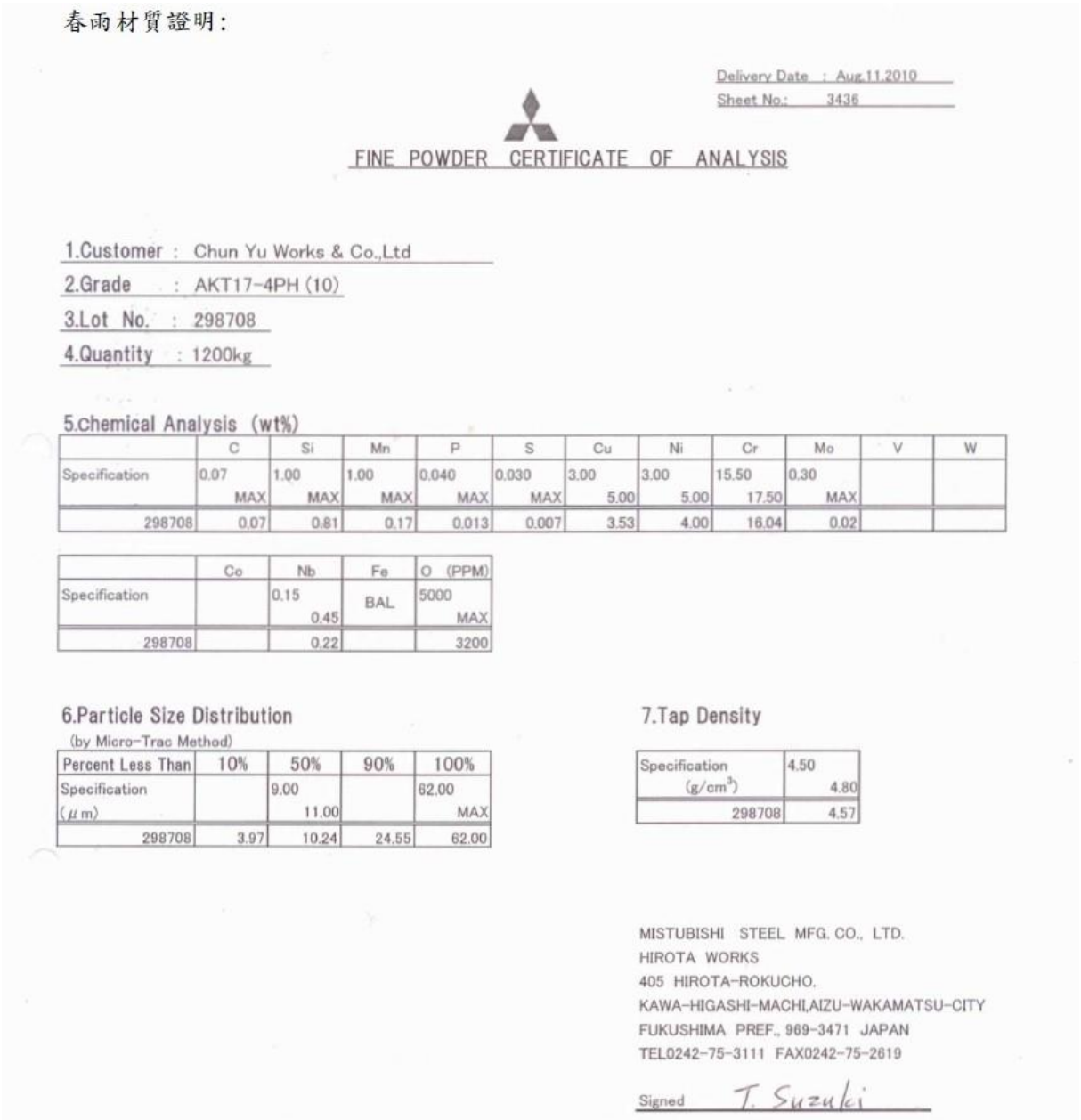


样品照片/ Sample Photo:

-- 结束 END --

2. Metal：AKT17-4PH, SUS301, SUS304, Ti Gr1

2.1 MIM：



春雨材質證明:

Delivery Date : Aug.11.2010
Sheet No: 3436

FINE POWDER CERTIFICATE OF ANALYSIS

1.Customer : Chun Yu Works & Co.,Ltd
2.Grade : AKT17-4PH (10)
3.Lot No. : 298708
4.Quantity : 1200kg

5.Chemical Analysis (wt%)

	C	Si	Mn	P	S	Cu	Ni	Cr	Mo	V	W
Specification	0.07 MAX	1.00 MAX	1.00 MAX	0.040 MAX	0.030 MAX	3.00 5.00	3.00 5.00	15.50 17.50	0.30 MAX		
298708	0.07	0.81	0.17	0.013	0.007	3.53	4.00	16.04	0.02		

	Co	Nb	Fe	O (PPM)
Specification		0.15 0.45	BAL	5000 MAX
298708		0.22		3200

6.Particle Size Distribution
(by Micro-Trac Method)

Percent Less Than	10%	50%	90%	100%
Specification (μm)		9.00 11.00		62.00 MAX
298708	3.97	10.24	24.55	62.00

7.Tap Density

Specification (g/cm^3)	4.50 4.80
298708	4.57

MISTUBISHI STEEL MFG. CO., LTD.
HIROTA WORKS
405 HIROTA-ROKUCHO,
KAWA-HIGASHI-MACHI,AIZU-WAKAMATSU-CITY
FUKUSHIMA PREF., 969-3471 JAPAN
TEL0242-75-3111 FAX0242-75-2619

Signed T. Suzuki

2.2 Metallic Ceramic Coating：

SGS

測試報告
Test Report

號碼(No.)：CE/2017/52138　日期(Date)：2017/05/18　　頁數 (Page)：2 of 7

德創奈米科技股份有限公司
DEXNANO CHEMICALS TECHNOLOGY CO., LTD.
新北市樹林區俊安街22號
NO. 22, JUN'AN ST., SHULIN DIST., NEW TAIPEI CITY 238, TAIWAN (R. O. C.)

測試結果(Test Results)

測試部位(PART NAME)No.1　：　綠色液體 (GREEN LIQUID)

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No.1	限值 (Limit)
鎘 / Cadmium (Cd)	mg/kg	參考IEC 62321-5 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.	100
鉛 / Lead (Pb)	mg/kg	參考IEC 62321-5 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.	1000
汞 / Mercury (Hg)	mg/kg	參考IEC 62321-4 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-4 (2013) and performed by ICP-AES.	2	n.d.	1000
六價鉻 / Hexavalent Chromium Cr(VI) (◆)	mg/kg	參考IEC 62321-7-2 (2017)，以UV-VIS檢測；參考IEC 62321-5 (2013)，以ICP-AES檢測. / With reference to IEC 62321-7-2 (2017) and performed by UV-VIS. ; With reference to IEC 62321-5 (2013) and performed by ICP-AES.	8	n.d.	1000
鄰苯二甲酸丁苯甲酯 / BBP (Butyl Benzyl phthalate) (CAS No.: 85-68-7)	mg/kg	參考IEC 62321-8 (2017), 以氣相層析儀/質譜儀檢測. / With reference to IEC 62321-8 (2017). Analysis was performed by GC/MS.	50	n.d.	1000
鄰苯二甲酸二丁酯 / DBP (Dibutyl phthalate) (CAS No.: 84-74-2)	mg/kg		50	n.d.	1000
鄰苯二甲酸二異丁酯 / DIBP (Di-isobutyl phthalate) (CAS No.: 84-69-5)	mg/kg		50	n.d.	1000
鄰苯二甲酸二 (2-乙基己基)酯 / DEHP (Di- (2-ethylhexyl) phthalate) (CAS No.: 117-81-7)	mg/kg		50	n.d.	1000

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Electrodeposition of black chromium–cobalt alloy based on trivalent sulfate electrolyte

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ABSTRACT

This study is aimed to improve the corrosion resistance, adhesion strength, and color of trivalent black chromium coatings on steel substrates by using chromium sulfate bath and chromium chloride bath. The effects of the electrodeposition current density on the trivalent black chromium coatings were studied. Surface morphology and chemical composition of coatings have been investigated using scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) techniques. The protective behavior from substrates of trivalent black chromium coatings was studied in (3.5 wt. % NaCl) solution by potentiodynamic polarization technique. The better protective behavior from substrates was shown by coatings that formed in chromium sulfate bath. The coatings deposited at low current densities (10 A/dm^2) showed high cobalt content because cobalt is more easily reduced than chromium on a cathode. The enhancement of the driving force caused chromium and cobalt to change into oxides and hydroxides when current density increased to more than 30 A/dm^2. The best homogeneity of the black color, the degree of blackening and the protective behavior from substrates of coatings occurred at current density 50 A/dm^2. The results of XPS indicated that the coatings contained not only chromium oxides and hydroxides but also cobalt oxides and hydroxides. Of all the constituent compounds, Co_3O_4 was the most dominant in influencing the degree of blackness.

1. Introduction

In solar thermal systems, a black chromium coating is commonly applied because of its excellent properties, such as a high absorption coefficient and low emittance coefficient in the wavelength range of solar radiation [1]. In solar thermal systems, the application of surface blackening treatment techniques are widely used and can be categorized into two types according to their purpose: for providing functional coatings with corrosion resistance and optical properties [2–4] and for providing coatings for decoration and camouflaging purposes [5–7].

Traditionally, black chromium coatings are electrodeposited from hexavalent chromium electrolytes based on chromic acid (CrO_3). Although hexavalent chromium coating has some excellent chemical and physical properties, it is a carcinogenic element and an environmental pollutant because of its high toxicity. Therefore, numerous rules and regulations exist to restrict its use [8–10]. Recently, trivalent chromium has gradually attracted the attention of researchers because of its lower toxicity and ease of waste liquid disposal. A literature survey indicated that functional and decorative trivalent chromium coatings can rival hexavalent chromium coatings [11–15]. Past studies have shown that trivalent black chromium coating obtained using the electrodeposition process has optical and mechanical properties appropriate for solar thermal applications [16]. However, black chromium coating might lose its optical properties due to thermal degradation at high temperature [17]. The addition of Co(II) ions in the Cr(III) bath to form a chromium–cobalt alloy not only enhanced the protective property of the coating from substrates but also had a favorable effect on the optical properties of black chromium coating [2].

It has been reported that cracks were frequently observed on the trivalent chromium deposits [18]. The formation of cracks deteriorates the protective properties of the deposit. The morphology of the deposits produced by electroplating is governed by numerous experimental factors, such as the deposition current, the metal ion

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concentration and source as well as the nature of the substrate. The most common trivalent chromium plating solutions typically contain a Cr(III) salt in the form of $CrCl_3$ or $Cr_2(SO_4)_3$ [19,20]. However, only $CrCl_3$-based plating solutions were used for electrodeposition of trivalent black chromium coatings [2–4,21–23]. The reason for this is not clear at this point. However, it can be observed that trivalent black chromium coatings obtained using a chromium chloride bath exhibit a porous structure and low protective behavior [2]. Improving the microstructure, protective behavior from substrates, and adhesion strength of trivalent black chromium coatings is crucial if trivalent black chromium coatings are to be used in the future.

Therefore, in this study, two trivalent chromium electrolytes containing sulfate or chloride with the addition of $Co(NO_3)_2$ as the second main component were used for electroplating to get black chromium coatings which was different to the source of Co^{2+} ions studied by Choi et al. [20]. The chemical composition, homogeneity, protective behavior from substrates, and adhesion strength of coatings deposited from different electrolytes were compared. In addition, the effect of current density on the chemical composition of the coatings and the degree of blackness was also studied.

2. Experimental

The trivalent black chromium coatings were electrodeposited onto a low-carbon steel electrode (as a substrate). The substrates were ultrasonically cleaned in acetone for 15 min, and then immersed in a 5 wt. % NaOH solution for 1 min, dipped in 5 wt. % HCl for 10 s, and finally rinsed with distilled water before electrodeposition. Electroplating was performed in a trivalent Cr bath composed of 2.7 M chromium sulfate ($Cr_2(SO_4)_3$) or chromium chloride ($CrCl_3{\cdot}6H_2O$), with the addition of $Co(NO_3)_2$ as the source of Co^{2+} ions, $NaNO_3$ as the blackening agent, and NH_4Cl as the pH conditioning agent. The detail of different operated conditions (Specimens No. S1, S3, S5, S7 and C5) used in the electroplating process are listed on Table 1.The pH of the electrolyte was adjusted to 3 and all the electroplating was conducted at 25 ± 2 °C, using a graphite plate as the anode and the substrate as the cathode.

The literatures indicated that the current efficiency of trivalent chromium electrodeposits would increase with an increase of current density from 10 to 50 A/dm^2 [24,25]. According to the above literatures, the trivalent black chromium was electrodeposited at different current densities from 10 to 70 A/dm^2 and at a bath temperature of 25 °C for 1 min in this study. The Hull-cell test was carried out to evaluate the influence of the current density on the deposited area of coatings. In addition, the trivalent black chromium coatings prepared using a chromium chloride bath was also operated under the same operated conditions. The experimental results presented that the optimal current density of Cr–Co coatings formed in chromium chloride bath occurred at 50 A/dm^2. Therefore, the Cr-Co coating formed in chromium chloride bath at 50 A/dm^2 was used in this work for comparison.

The surface morphology and composition of the coatings were investigated using scanning electron microscopy (SEM, JSM-6510) and X-ray photoelectron spectroscopy (XPS, ULVAC-PHI, PHI 5000 Versa Probe/Scanning), respectively. SEM was performed at a voltage of 30 kV. The pressure in the XPS spectrometer was approximately 10^{-9} torr during the measurement. The spectrometer was calibrated relative to Au 4f7/2 at 83.8 ± 0.1 eV. The Gaussian deconvolution of XPS spectra was accomplished by a computer. The deconvoluted peaks were identified from references in an XPS database. A superdepth surface profile measurement microscope (Keyence, VK-8550) was employed to precisely measure the surface roughness of tested specimens. Four random measurements presented by Ra were averaged to obtain the surface roughness. The potentiodynamic polarization measurements were carried out in an open-to-air conventional three-electrode cell. The measurements were performed in a 3.5 wt. % NaCl solution at room temperature. Potentiodynamic polarization tests were carried out in a three-electrode cell system in which a platinum sheet and an Ag/AgCl electrode (197 mV *versus* SHE) were used as the counter and reference electrode, respectively. The working electrode was a Cr–Co coated low carbon steel. All experiments were performed using an Autolab PGSTAT30 potentiostat/galvanostat controlled by GPES (General Purpose Electrochemical System) software. The linear polarization curves were measured in the potential range between –0.3 V and 0.5 V (SHE), with a scanning rate of 0.5 mV/s. Before the tests, all specimens were degreased and rinsed with deionized water. A fresh corrosion bath was used for each new specimen. Corrosion current densities (i_{corr}) and corrosion potentials (E_{corr}) were evaluated from the intersection of the linear anodic and cathodic branches of the polarization curves. The protective behavior from substrates of coatings was also characterized with a salt spray test (SST) in a 3.5% NaCl. The SST was carried out according to the ASTM-B117 standard in a salt spray test chamber (ST-BS-S, Yi Sang Electric Co. LTD.) at room temperature. The protective behavior from substrates of coatings is rated by examining the percentage of rusted area of specimen surface after 1, 3, 5, 7, 10, and 15 days during the test.

The adhesion between the black coating and substrate was evaluated by use of a 3 M adhesive tape test and cross hatch test according to ASTM D-3359 using a 3 M # 600 tape [26]. For adhesive tape test, a piece of adhesive tape was adhered to the surface of the sample using gentle thumb pressure. Then, the tape was peeled at an angle of 90° to the substrate. The tested specimens were observed by optical microscope. The cross-hatch test was conducted by cross-hatching the coating, after which a 3 M # 600 tape3 was firmly applied and then removed. The cross-hatches were judged by their appearances and marked with notes from 5 (not flaked off) to 0 (65% flaked off).

The shading value of coatings was measured by means of a Konica Minolta CM 2500C colorimeter. The shading value of the coating obtained from spectrophotometer was used to represent degree of blackness that the smaller is the shading value, the darker the coating is. Three different samples, produced under the same conditions, were prepared for shading value measurement.

3. Results and discussion

The current density effect on the thickness of trivalent black chromium coatings are also displayed in Table 1. It reveals that the deposition rate increases with an increase of current density for coating deposited from chromium sulfate bath. Additionally, the rate of

Table 1
The coating thickness *versus* the bath compositions and current densities of black chromium electrodeposition for 1 min.

Specimens no.	Bath solutions	Current density	Thickness (μm)	Component concentration (mol/L)		
				$Co(NO_3)_2$	NH_4Cl	$Na(NO_3)$
S1	Chromium sulfate (2.7 M)	10 A/dm^2	0.23 ± 0.05	0.02	0.5	0.1
S3	Chromium sulfate (2.7 M)	30 A/dm^2	0.64 ± 0.04	0.02	0.5	0.1
S5	Chromium sulfate (2.7 M)	50 A/dm^2	0.79 ± 0.05	0.02	0.5	0.1
S7	Chromium sulfate (2.7 M)	70 A/dm^2	1.36 ± 0.06	0.02	0.5	0.1
C5	Chromium chloride (2.7 M)	50 A/dm^2	1.98 ± 0.05	0.02	0.5	0.1

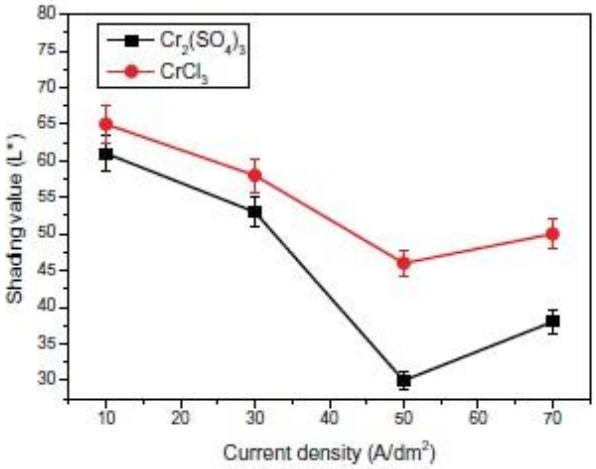

Fig. 1. The shading values of trivalent black chromium coatings formed at various current densities from different electroplating baths.

chromium deposition from trivalent chromium sulfate bath is significantly lower than that of chromium deposition from chromium chloride bath. It suggests that the anions in the bath would strongly influence the reduction of trivalent chromium ions and the existence of sulfate anions in the bath tends to inhibit deposition of chromium. On the contrary, the chloride anion scan accelerates the chromium deposition from Cr(III) compounds by inner-sphere mechanism.

Fig. 1 displays the variation of shading value of the black chromium coatings deposited from two different chromium baths, a chromium chloride-based and a chromium sulfate-based bath with the plating current density. The shading value of the coating obtained from spectrophotometer was used to represent degrees of blackness. It is observed that the shading value for both black chromium coatings deposited with either chromium chloride-based or chromium sulfate-based bath decreases initially with the current density and reaches a minimum at 50 A/dm^2. When current density is higher than 50 A/dm^2, the shading value increases. It is recognized that smaller is the shading value, the darker the coating is. Obviously, the blackest color is obtained for coating prepared at a current density of 50 A/dm^2. It is also shown from Fig. 1 that under the same current density, the shading value of the coating deposited with chromium chloride bath is higher than that of coating deposited with chromium sulfate bath. This indicates that the black color of the coating deposited with chromium chloride bath is not as intense as it is on the coating deposited with chromium sulfate bath and limits its applications when a dark black color is required.

Fig. 2 shows the photos of trivalent black chromium coatings deposited with chromium sulfate bath under different current densities. Clearly the blackness of the coatings is in the order of S5 > S7 > S3 > S1 (the definitions of specimens No. are listed in Table 1). The visual color determination is in good agreement with the spectrophotometric shade determination that the coating prepared at 50 A/dm^2 has the darkest appearance. The coating prepared at 50 A/dm^2 shows a very uniform pitch black color on the entire substrate. Therefore, the optimal current density formed trivalent black chromium coatings was 50 A/dm^2.

The SEM images of the coatings deposited from chromium sulfate bath with various current densities are shown in Fig. 3. The effect of the current density on the morphology of coating can be clearly seen when sample S1 (Fig. 3(a)) is compared with samples S3 (Fig. 3(b)), S5 (Fig. 3(c)) and S7 (Fig. 3(d)), respectively. It is observed that an increase in current density leads to the coating surface becomes rougher with more cracks appearing. It is believed that the

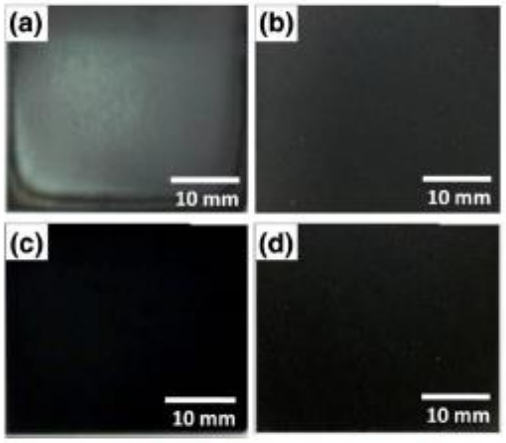

Fig. 2. The macro-morphology of black trivalent chromium coatings formed at various current density in a chromium sulfate bath: (a) 10 A/dm^2 (b) 30 A/dm^2 (c) 50 A/dm^2 (d) 70 A/dm^2.

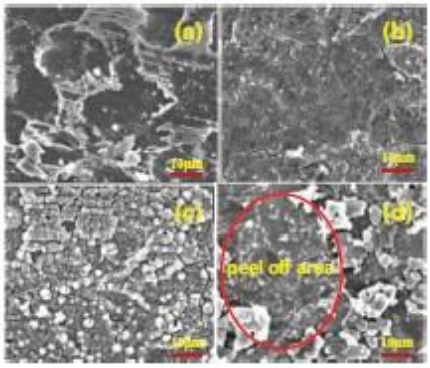

Fig. 3. SEM images of trivalent black chromium coatings formed at various current densities in a chromium sulfate bath: (a) 10 A/dm^2 (b) 30 A/dm^2 (c) 50 A/dm^2 (d) 70 A/dm^2.

Table 2
Roughness of black chromium coatings formed at various current densities.

Roughness	Specimens no. (current density)				
	S1 (10 A/dm^2)	S3 (30 A/dm^2)	S5 (50 A/dm^2)	S7 (70 A/dm^2)	C5 (50 A/dm^2)
(Ra)(μm)	0.21 ± 0.01	0.37 ± 0.02	0.65 ± 0.04	0.72 ± 0.03	0.96 ± 0.03

reduction of hydrogen ions during the electrodeposition process results in hydrogen evolution which causes crack formation [27]. Thus, higher tendency for micro-crack formation is expected by applying a high current density. The surface roughness data of the coatings deposited with different current densities are listed in Table 2, which clearly confirmed that the surface roughness increased with increasing current density. Since roughness can efficiently scatter the incidence light and reduce the reflection of light [28–30], it might be considered as one of the factors to cause the color of the coating become darker. By carefully comparing the colors of the coating with the surface roughness of the coating deposited at various current densities, it was observed that the color changes from dark black for coating electroplated at 50 A/dm^2 to less dark for coating electroplated at 70 A/dm^2 despite the surface roughness of the coating electroplated at 70 A/dm^2 is higher than that of coating electroplated at 50 A/dm^2. It is evident that the color of coating is not only related to its microstructure, other factors such as surface composition of the coating will also have influence on final coating's color. Furthermore, it was found that the coating S7 was peeling off seriously from substrate during the electrodeposition process, indicating that the adhesion strength between the coating and substrate is weak. The peeled off area is marked with a red circle in Fig. 3(d).

On the contrary, the surface morphology of the black chromium coating prepared at a current density of 50 A/dm^2 with a chromium chloride bath (Fig. 4) showed a loose structure with numerous cracks. Fig. 5 shows the cross-sectional TEM micrographs of the trivalent black chromium coatings prepared in chromium chloride bath and chromium sulfate bath, respectively. The TEM micrographs indicated that the microstructure of coating prepared with chromium sulfate bath indeed is much denser than that prepared with chromium chloride bath in present study. This result is also consistent with the literature report [2].

Table 3 shows the average atomic compositions, determined by EPMA analysis, of black coatings deposited at different current densities. It revealed that with an increase in the current density up to 50 A/dm^2, the percentage of cobalt in black chromium decreases,

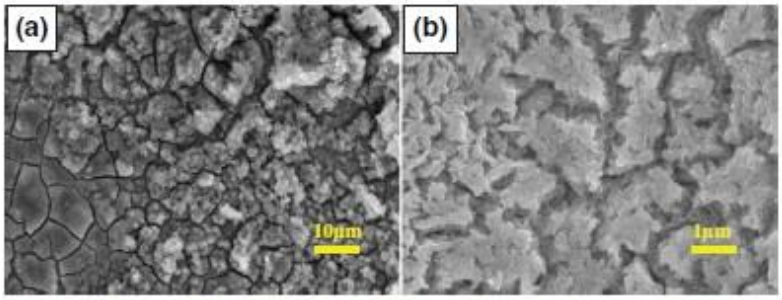

Fig. 4. (a) Low and (b) high magnification SEM surface morphology micrographs of trivalent black chromium coatings prepared with a chromium chloride bath at current density 50 A/dm^2.

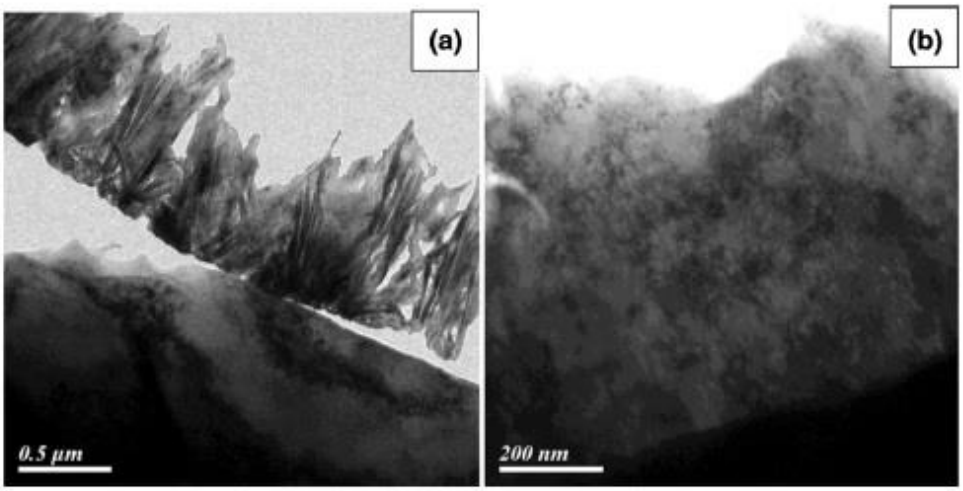

Fig. 5. The cross-sectional TEM micrographs of the trivalent black chromium coatings (a) chromium chloride bath, (b) chromium sulfate bath.

Table 3
EPMA of black chromium coatings formed at various current densities.

Elem. (at %)	Co	O	Cr
S1 (10 A/dm²)	62.09	36.09	1.82
S3 (30 A/dm²)	58.60	38.09	3.31
S5 (50 A/dm²)	48.65	44.06	7.29
S7 (70 A/dm²)	57.94	36.11	5.95
C5 (50 A/dm²)	42.98	39.13	17.89

whereas the percentages of oxygen and chromium increase. The result that the percentage of cobalt in the electroplated Co–Cr alloy increases with a decrease in the current density is in good agreement with the literature report [31]. A further increase of the current density to 70 A/dm², oxygen as well as chromium contents decreased. The peeling of the outer layer of the coating at 70 A/dm² may be the reason for a decrease in the chromium content and an increase in the cobalt content in the coating S7.

The potentiodynamic polarization curves of trivalent black chromium coatings deposited at various current densities are shown in Fig. 6. The approximate value of corrosion current density (i_{corr}) and corrosion potential (E_{corr}) are calculated from the intercept of the Tafel slopes, and are given in Table 4. The bare low-carbon steel was also included in the experiments for comparison purposes. The polarization curves of the Cr–Co coating deposited at 10 A/dm² from the chromium sulfate bath shows a lower corrosion current density (i_{corr}) of 1.7×10^{-5} A/cm² than bare steel (3.3×10^{-4} A/cm²), suggesting that the Cr–Co coating can improve the corrosion resistance. The corrosion current density (i_{corr}) of all tested specimens is in the order of bare steel > C5 > S1 > S3 > S5. On the other hand, the corrosion potential of all black chromium coatings is in the order of S5 (−0.519 V) > C5 (−0.594 V) ≈ S3 (−0.595 V) > S1 (−0.697 V). Based on the more positive E_{corr} and the decrease of i_{corr}, it can be concluded that the sample S5 exhibits the best protective properties among all Cr–Co alloys plated from the chromium sulfate bath. Although it did show the presence of cracks on the surface of

Table 5
Experimental results of salt spray test of black chromium coatings at various current densities.

Days	Specimens no. (current density)			
	S1 (10 A/dm²)	S3 (30 A/dm²)	S5 (50 A/dm²)	C5 (50 A/dm²)
1	○	○	○	○
3	△	○	○	○
5	※	○	○	△
7	※	○	○	※
10	※	△	○	※
15	※	※	○	※

※, lots of rust; △, little rust; ○, no rust

S5 deposit (Fig. 3), its highest corrosion resistance suggests that cracks did not penetrate through the deposit. The largest thickness of S5 might account for the improvement of the corrosion resistance as compared with S1 and S3. Moreover, it is also seen that Cr–Co alloy plated from chromium chloride bath has a lower protective property than that plated from chromium sulfate bath as a result of numerous microcracks formed on the Cr–Co alloy plated from chromium chloride bath (Fig. 3). However, it should be noted that in cases where one of the reactions is purely diffusion controlled, the corrosion current density will be equal to the diffusion limited current density, and the corrosion current density obtained by the Tafel analysis is not correct in this case. Thus, the Salt Spray Test was also performed to compare the protective ability of the coatings.

The results of the Salt Spray Test on the chromium–cobalt coatings were shown in Table 5. In Table 5, the term "little rush" and "lots rush" is defined as the percent of rusted area of the specimen surface was less or more than 10%, respectively. It is seen that the sample S1 could withstand only 24 h in the salt spray without rusting and S3 coating withstood 168 h without corrosion. However, sample S5 could withstand more than 360 h without corrosion, which is obviously better than that of C5 with a value of 72 h. The results of SST also confirmed that the trivalent black chromium coating formed at 50 A/dm² has the best protective properties, which is in good agreement with the results of the potentiodynamic polarization test.

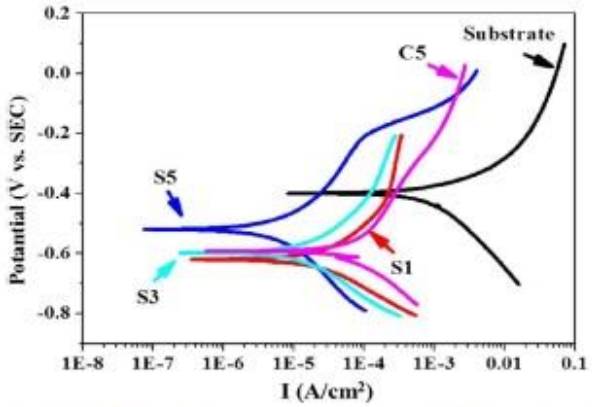

Fig. 6. Potentiodynamic polarization measurements for black chromium coatings formed at various current densities in a chromium sulfate bath and formed in a chromium chloride bath (the best condition).

Table 4
Approximate values of i_{corr} and E_{corr} of black chromium coatings formed at various current densities.

Specimens no. (current density)	Substrates	S1 (10 A/dm²)	S3 (30 A/dm²)	S5 (50 A/dm²)	C5 (50 A/dm²)
i_{corr} (A/cm²) (approximate value)	3.3E-4	1.7E-5	9.3E-6	2.3E-6	7.7E-5
E_{corr} (V)	−0.405	−0.697	−0.595	−0.519	−0.594

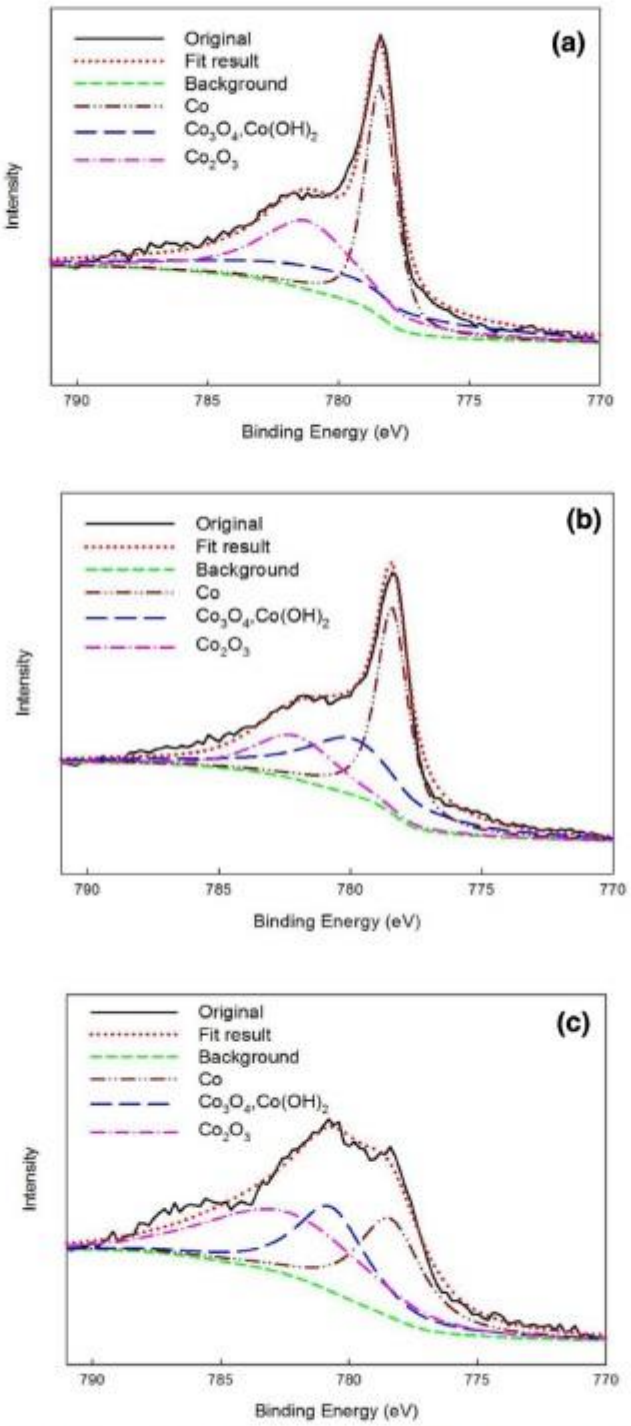

Fig. 7. Cobalt core level spectra from trivalent black chromium coatings formed at various current densities: (a) 10 A/dm² (b) 30 A/dm² (c) 50 A/dm².

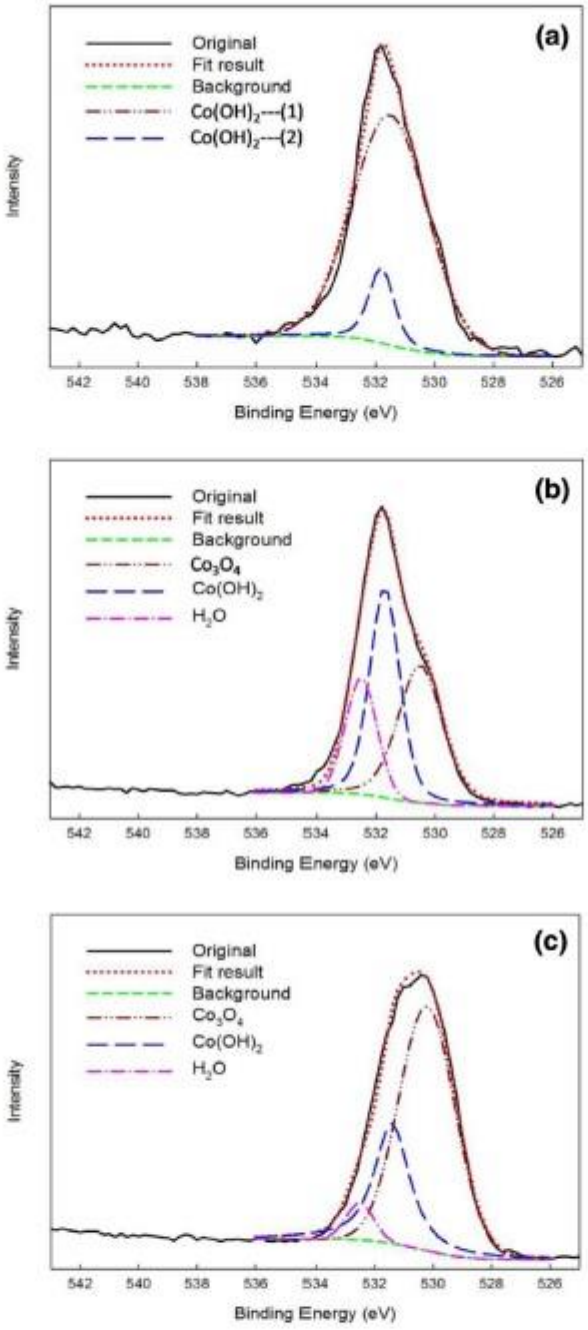

Fig. 8. Oxygen core level spectra from black chromium coatings formed at various current densities: (a) 10 A/dm² (b) 30 A/dm² (c) 50 A/dm².

Table 6
The composition ratio of electroplating black chromium coatings formed at various current densities.

Specimens no. (current density)	Composition ratio (%)				
	Cr 2p3/2		Co 2p3/2		
	$Cr(OH)_3$	Cr_2O_3	Co	Co_2O_3	Co_3O_4 ($Co(OH)_2$)
S1 (10 A/dm²)	–	100	57.15	31.42	11.43
S3 (30 A/dm²)	4.23	95.77	38.88	28.62	32.50
S5 (50 A/dm²)	2.46	97.54	33.30	32.24	34.46

Generally, it has been accepted that the black coating is composed of metallic hydroxide, oxide, and metallic particles. The metallic particles and oxide are in the bulk, and predominantly oxide and hydroxide are on the surface [31,32]. Aguilar et al. [31] prepared both white and black chromium coatings by electrodeposition from a trivalent chromium plating solution, with and without oxidative catalyst (KNO_3). Their result found that chromium was the main bulk chemical compound in both films, but there were differences in morphological and chemical surface profile. These results indicate that solar selectivity properties of coatings are influenced by the surface composition. To confirm the surface composition of the deposited black chromium coatings, XPS measurements were performed. Figs. 7, 8 and 9 show the cobalt ($Co2p_{3/2}$) core level spectra, oxygen (O1s) core level spectra and chromium ($Cr2p_{3/2}$) core level spectra, respectively, for black chromium coatings formed with different current densities. The relative percentages present in different components for Co, O and Cr are listed in Table 6. The spectra of the Co 2p3/2 band for black chromium coating S1(Fig. 7a) are decomposed into three major peaks. The three major peaks are located at 778.1 eV, 780.2 eV and 781.7 eV, which are attributed to metallic Co [33], Co in Co_3O_4 as well as Co in $Co(OH)_2$, and Co in Co_2O_3, respectively. It shows from Table 6 that the dominant component in the trivalent black chromium coatings deposited at 10 A/dm^2 is metallic Co (about 57.15%). Therefore, the surface of coating showed a metallic luster. The Co 2p XPS signals recorded for black coatings S3 and S5 are displayed in Fig. 7(b) and Fig. 7(c), respectively. A peak related to metallic cobalt was also observed around 778.1 eV for these two black coatings. However, for the Cr–Co coatings deposited at higher current density, the percentage of cobalt was found to be lower, whereas the percentage of Co_3O_4 as well as $Co(OH)_2$ was higher. The presence of cobalt hydroxide may be related to the alkalinity of the near-cathode layer owing to the increasing hydrogen evolution; therefore, $Co(OH)_2$ is formed in the outermost layer of the coating. The presence of Co_3O_4 can be ascribed probably to an electrochemical transition from $Co(OH)_2$ to Co_3O_4 under the alkaline environment in the near-cathode layer [34]. These results indicated that a high current density (high driving force) up to 50 A/dm^2 promoted these reactions of Co^{2+} ions to a greater extent in the chromium sulfate bath. The oxygen core level spectra for the black chromium coatings deposited at various current densities are shown in Fig. 8. Some of the cobalt oxides and hydroxides were present in the coatings and only the content of Co_3O_4 increased with an increase of current density, whereas Co_3O_4, $Co(OH)_2$ and H_2O formed at higher current densities because of the large driving force in the electroplating process with a high current density.

Chromium core level spectra for black chromium coatings deposited at various current densities are shown in Fig. 9. It is obvious from Fig. 9(a) that only one peak appears for chromium–cobalt coating deposited at 10 A/dm^2, at the binding energy of 576.7 eV [35], indicating that the Cr_2O_3 compounds are detected in chromium–cobalt coatings. On the contrary, the presence of $Cr(OH)_3$ compounds are detected in chromium–cobalt coatings deposited at 30 A/dm^2 and 50 A/dm^2, as shown in Fig. 9(b) and 9(c). By comparing Fig. 9(b) and Fig. 9(c), it is noted that the intensity of the peak corresponding to another binding energy of Cr_2O_3compounds about 577.5 eV [35] is much higher for chromium–cobalt coating deposited at 50 A/dm^2 than that for coating deposited at 10 and 30 A/dm^2. The XPS data reveal that the surface layer of black chromium coating is rich in chromium oxide and cobalt oxide, which is consistent with the literature report [2]. In addition to the surface roughness, the formation of Co_3O_4 on the surface layer of coating improves the quality of black color [36]. Therefore, it might be effective to enhance the solar selective characteristics of the coating. The actual mechanism for current density effect on the surface composition of black coatings is unclear right now. The existence of nitrate ions in our system might be the reason for that. During the electrodeposition process metal electrodeposits were formed accompanying with the reduction of nitrates on the growing surfaces of the metal deposit [37]. This might lead to the oxidation of deposited metals to form metal ion. On the other hand, electroreduction of nitrate to nitrite ions generates hydroxide ions at the cathode ($NO^{3-} + H_2O + 2e^- \rightarrow NO^{2-} + 2OH^-$). Therefore, the metallic ions would react with hydroxyl ions to form metallic hydroxides and are spontaneously dehydrated into metallic oxides [38]. The reduction

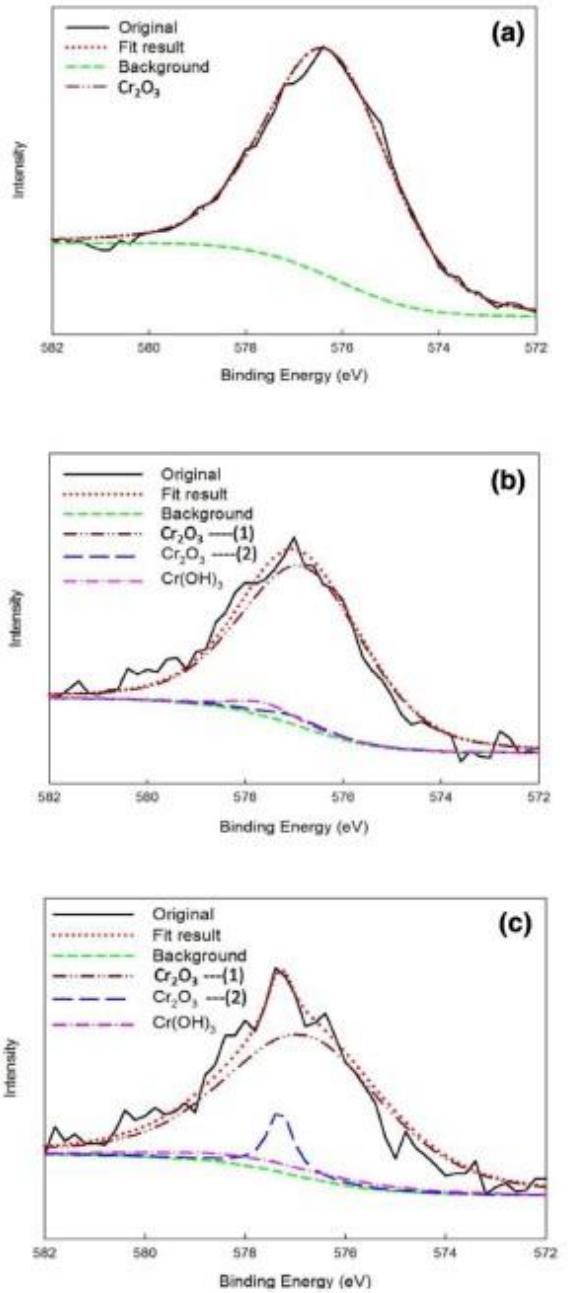

Fig. 9. Chromium core level spectra from black chromium coatings formed at various current densities: (a) 10 A/dm^2 (b) 30 A/dm^2 (c) 50 A/dm^2.

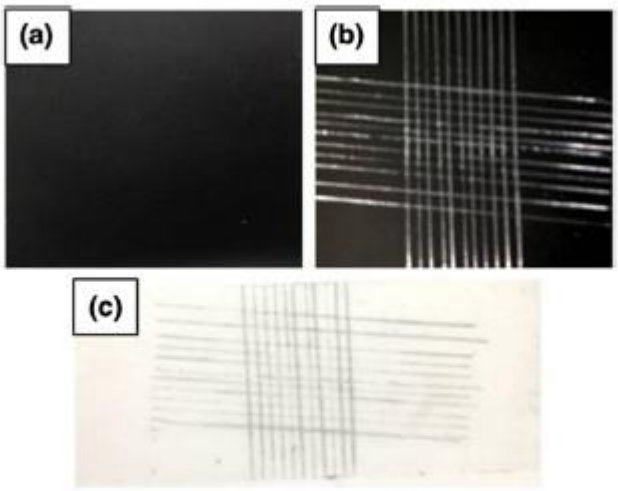

Fig. 10. The adhesion test of black chromium coating formed at 50 A/dm^2: (a) black chromium coatings before test, (b) cross cut test, (c) Scotch tape test.

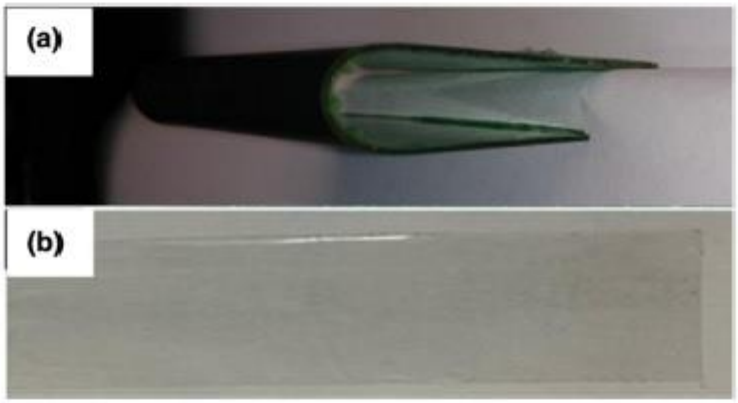

Fig. 11. The bending test of black chromium coating formed at 50 A/dm^2: (a) black chromium coatings after banding, (b) Scotch tape test.

rate of nitrates on the growing surfaces of the metal deposit increased with the current density. Therefore, a black deposit was obtained in which the coating was mainly composed by metallic oxides.

The adhesion of trivalent black chromium coating deposited at 50 A/dm^2 to the low carbon steel was evaluated using the cross-hatch method, as shown in Fig. 10. The deposited coating exhibited excellent adhesion strength and was classified as Class (5), according to the ASTM D-3359 classification. Our result shows the adhesion between trivalent black chromium coatings and substrate was as good as those coatings obtained by electroplated from a chromium chloride bath, the adhesion strength of which was also classified as Class (0), according to the ISO classification [2].

The adhesion between the deposited layer and substrate was also examined by bending the substrate simply with hand. The experimental result of the bending test for the trivalent black chromium coating is shown in Fig. 11. The coating was bent by approximately 180° and then tested using the tape. The result revealed that the coatings did not fall off after heavy bending.

4. Conclusion

Based on the results obtained in the present investigation on electrodeposited black chromium–cobalt coatings from a trivalent chromium sulfate bath and trivalent chromium chloride bath, the following conclusions have been drawn:

1. At the same current density, the rate of chromium deposition from trivalent chromium sulfate bath is significantly lower than that of chromium deposition from chromium chloride bath.
2. The plating current density affects the morphology, composition and blackness of the Cr–Co coatings obtained. The surface roughness and the intensity of black color increased as an increase of current density up to 50 A/dm^2.
3. The color of the black chromium coatings depends on the surface roughness and Co_3O_4 content on the surface.
4. Potentiodynamic polarization test results exhibited that the chromium coating plated at 50 A/dm^2 from trivalent chromium sulfate bath has the best protective behavior from substrates among all tested Cr–Co alloys plated from either chromium sulfate bath or chromium chloride bath. The salt spray tests support the results of potentiodynamic polarization tests.
5. The result of the cross-hatch indicated that the adhesion between trivalent black chromium coatings and substrate was classified as Class (5), according to the ASTM D-3359 classification.

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2.3 Metal Sheet：

檢驗證明書

INSPECTION CERTIFICATE

唐榮公司

TANG ENG IRON WORKS CO., LTD.

YEN HI 2ND ROAD, KAOHSIUNG, TAIWAN

客戶名稱：Customer

訂單號碼：P3610605057 Contract No.

信用狀號碼：L/C No.

本單編號：106070465 Certificate No.

列印日期：2017/7/20 Date

項次 Item	產品編號 Product ID.	爐號 Heat No.	產品型態 Product Form	鋼種 Steel Grade	表面 Finish	料別 Category	產品尺寸 Thickness × Width × Length	淨重 Net Weight	參照規範 Specification
1	S1802	B4403-3020	CS	304	2B	G	0.99mmX 1244mmX 1535m	15430 kg	ASTM A240
2	S1895	A8012-1020	CS	304	2B	G	1.19mmX 1244mmX 1436m	17334 kg	ASTM A240

項次 Item	化學成份 Chemical Composition (%)									機械性質 Mechanical Properties					
	C	Si	Mn	P	S	Cr	Ni	N	Cu	抗拉強度 T.S N/mm²	降伏強度 Y.S(0.2%) N/mm²	伸長率 Elong %	硬度 Hardness HRBW		Rp(1.0%) N/mm2
1	0.041	0.47	1.02	0.032	0.002	18.31	8.17	0.057	--	650	296	54.0	83.1	--	326
2	0.044	0.52	0.85	0.029	0.004	18.12	8.04	0.057	--	669	311	54.2	83.9	--	334

附註 Remarks:

a. Product form -- CS：Cold-rolled stainless steel sheet in coil.
b. Inspection certificate in accordance with EN10204/Type3.1.
c. Chemical composition and mechemical properties including T.S, Y.S(0.2%), Elong and Hardness in accordance with EN10028-7/Table 3/1.4301 and EN10088-2/Table 3/1.4301.
d. The material described above also in accordance with the requirement of AISI.
e. The material described above has been detected with free irradiation pollution.
f. The temperature of solution treatment is ranging 1040℃~1100℃ in accordance with EN10028-7/Table A.3/1.4301.
g. Grade designation originally assigned by the AISI (American Iron and Steel Institute).
h. Visual & Dimention inspection : conformity.
i. ASTM A480 NO1 finish same as EN 10028-7/EN10088-2 1D finish , ASTM A480 BA finish same as EN10028-7/EN10088-2 2R finish.
j. All the above products conform to the requirements specified in ASTM A480/A666 and ASME SA240M/SA480M.

※Certificate No. of Laboratory Accreditation (acc. to ISO/IEC 17025-2005) certified by TAF:L0365-140120
※Certificate No. of TEQMS-ISO9001:2008 registered by TUV Rheinland Taiwan:01 100 822 106199
※Certificate No. of QAS acc. to Directive 97/23/E (QMS acc. to EN 764-5, article 4.2 and AD2000 registered by TUV Rheinland:01 202 TWN/Q-10
※Certificate No. of factory production control acc. 305/2011/EU registered by TUV Rheinland:003

品保主管(Manager of QA Department)/Wo

Chih-Min Liu

與正

明輝企業 收發專用章

表號：DQ301A

Medscope Biotech

檢驗證明書
INSPECTION CERTIFICATE

客戶名稱：
Customer

訂單號碼：P3610607047
Contract No.

信用狀號碼：
L/C No.

本單編號：106070572
Certificate No.

列印日期：2017/7/24
Date

唐榮公司
TANG ENG IRON WORKS CO., LTD.
YEN HI 2ND ROAD, KAOHSIUNG, TAIWAN

項次 Item	產品編號 Product ID.	爐號 Heat No.	產品型態 Product Form	鋼種 Steel Grade	表面 Finish	料別 Category	產品尺寸 Thickness × Width × Length	淨重 Net Weight	參照規範 Specification
1	S3008	270532079	CS	304	2B	G	1.49mmX 1245mmX 1442m	21927 kg	ASTM A240

項次 Item	化學成份 Chemical Composition (%)										機械性質 Mechanical Properties					
	C	Si	Mn	P	S	Cr	Ni	N	Cu		抗拉強度 T.S N/mm²	降伏強度 Y.S(0.2%) N/mm²	伸長率 Elong %	硬度 Hardness HRBW		Rp(1.0%) N/mm2
1	0.022	0.47	1.06	0.022	0.002	18.26	8.15	0.035	--		678	262	49.6	81.7	--	295

附註 Remarks:
a. Product form -- CS：Cold-rolled stainless steel sheet in coil.
b. Inspection certificate in accordance with EN10204/Type3.1.
c. Chemical composition and mechanical properties including T.S, [illegible] in accordance with EN10028-7/Table 3/1.4301 and EN10088-2/Table 3/1.4301.
d. The material described above also in accordance with the requirem[illegible]
e. The material described above has been detected with free irradiation pollu[illegible]
f. The temperature of solution treatment is ranging 1040℃~1100℃ in accordance with EN10028-7/Table 4.3/1.4301.
g. Grade designation originally assigned by the AISI (American Iron and Steel Institute).
h. Visual & Dimention inspection : conformity.
i. ASTM A480 NO1 finish same as EN 10028-7/EN10088-2 1D finish , ASTM A480 BA finish same as EN10028-7/EN10088-2 2R finish.
j. All the above products conform to the requirements specified in ASTM A480/A666 and ASME SA240M/SA480M.

※Certificate No. of Laboratory Accreditation (acc. to ISO/IEC 17025-2005) certified by TAF:L0365-140120
※Certificate No. of TEQMS-ISO9001:2008 registered by TUV Rheinland Taiwan:01 100 822 106199
※Certificate No. of QAS acc. to Directive 97/23/EC(PED) (QMS acc. to EN 764-5, article 4.2 and AD200 registered by TUV Rheinland:01 202 TWN/Q-1
※Certificate No. of factory production control acc 305/2011/EU registered by TUV Rheinland:00

品保主管(Manager of QA Department)/W

Chih-Min Liu

興正本

明輝企業 收發專用章 電話：(02)8522-3631

表號：DQ301A

Medscope Biotech

檢 查 證 明 書

嘉發實業工廠股份有限公司

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材證編號 ： Y31-730132

This certificate is guaranteed for using in Taiwan only

客 戶 ： 卓揚五金股份有限公司

日 期 ： 2017/3/10

規 範 ： JIS G4313

項 目	產 品 名 稱	鋼卷號碼	爐 碼	鋼 種	板面	調質記號	產 品 尺 寸	載 量	重 量(KG)	箱 號
1	CSP	CAAWMTH2D9473	1612A0003-08	SUS 301		1/2H	0.198 X 495.0 X C mm	1	1209	
2	CSP	CAAWMTH2D9830	1612A0003-12	SUS 301		1/2H	0.196 X 504.0 X C mm	1	1099	

化 學 成 份 (%)														拉 力 試 驗			硬度試驗			
項 目	碳	矽	錳	磷	硫	鎳	鉻							抗拉強度 N/mm²	降伏強度 (0.2%) N/mm²	伸長率 %	硬度			
																	HRB	HV		
設大值	0.1500	1.000	2.000	0.04500	0.03000	8.000	18.00							930	510	10		420		
設小值						6.000	16.00													
1	0.0970	0.490	0.910	0.0360	0.0020	6.910	17.34							1118	702	24.2		321		
2	0.0970	0.490	0.910	0.0360	0.0020	6.910	17.34							1125	682	25.8		326		

註 記	
材質標準依據 EN 10204 3.1.B / EN 10088 2	CSC :冷乳不鏽鋼捲
材質標準依據 ASTM A240/A240M ASTM A480/A480M	CSS :冷乳不鏽鋼板
材質標準依據 JIS G4304 /G4305 /G4313	CSP :冷乳不鏽鋼條片
耐蝕性測試參照 EN3651-2 JIS Z2371	HSC :熱乳不鏽鋼捲
本產品符合GP&RoHS檢測規範	HSS :熱乳不鏽鋼板
檢測編號 : KA_2016_C1668 / C1674	
品質系統證書合 ISO 9001 / ISO 14001 / OHSAS 18001	

明輝企業 收發專用章

為保障用戶及廠商權益，凡對於仿冒、竄改檢查證明書者：嘉發實業工廠(股)公司將追訴相關法律責任

SGS

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www.sgs.com.tw

測試報告
Test Report

號碼(No.) : CE/2017/73546 日期(Date) : 2017/07/25 頁數(Page) : 1 of 10

卓揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

以下測試樣品係由申請廠商所提供及確認 (The following sample(s) was/were submitted and identified by/on behalf of the applicant as):

送樣廠商(Sample Submitted By)	:	卓揚五金股份有限公司 (SURSUN METALS CO., LTD.)
樣品名稱(Sample Description)	:	STAINLESS STEEL STRIP (不鏽鋼材)
樣品型號(Style/Item No.)	:	SUS304
收件日期(Sample Receiving Date)	:	2017/07/18
測試期間(Testing Period)	:	2017/07/18 TO 2017/07/25

測試需求(Test Requested) :

(1) 依據客戶指定，參考RoHS 2011/65/EU Annex II及其修訂指令(EU) 2015/863測試鎘、鉛、汞、六價鉻、多溴聯苯、多溴聯苯醚, DBP, BBP, DEHP, DIBP. (As specified by client, with reference to RoHS 2011/65/EU Annex II and amending Directive (EU) 2015/863 to determine Cadmium, Lead, Mercury, Cr(VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP contents in the submitted sample(s).)

(2) 依據客戶指定，進行全氟辛酸、全氟辛烷磺酸、鹵素-氟、氯、溴、碘測試. (As specified by client, to test PFOA, PFOS, Halogen-Fluorine, Chlorine, Bromine, Iodine contents in the submitted sample(s).)

測試結果(Test Results) : 請參閱下一頁 (Please refer to following pages).

結論(Conclusion) :

(1) 根據客戶所提供的樣品，其鎘、鉛、汞、六價鉻、多溴聯苯、多溴聯苯醚, DBP, BBP, DEHP, DIBP的測試結果符合RoHS指令暨(EU) 2015/863之限值要求. (Based on the performed tests on submitted sample(s), the test results of Cadmium, Lead, Mercury, Cr(VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP comply with the limits as set by RoHS and amending Directive (EU) 2015/863.)

SGS TAIWAN LTD

Troy Chang / Manager, Tech
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory - Taipei

SGS

測試報告
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卓揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

測試結果(Test Results)

測試部位(PART NAME)No.1 : 銀色金屬片 (SILVER COLORED METAL SHEET)

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No.1	限值 (Limit)
鎘 / Cadmium (Cd)	mg/kg	參考IEC 62321-5 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.	100
鉛 / Lead (Pb)	mg/kg	參考IEC 62321-5 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.	1000
汞 / Mercury (Hg)	mg/kg	參考IEC 62321-4 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-4 (2013) and performed by ICP-AES.	2	n.d.	1000
六價鉻 / Hexavalent Chromium Cr(VI)(#2)	$\mu g/cm^2$	參考IEC 62321-7-1 (2015), 以UV-VIS檢測. / With reference to IEC 62321-7-1 (2015) and performed by UV-VIS.	0.10	n.d.	-
全氟辛烷磺酸 / Perfluorooctane sulfonates (PFOS-Acid, Metal Salt, Amide)	mg/kg	參考US EPA 3550C (2007), 以液相層析/質譜儀檢測. / With reference to US EPA 3550C (2007). Analysis was performed by LC/MS.	10	n.d.	-
全氟辛酸 / PFOA (CAS No.: 335-67-1)	mg/kg	參考US EPA 3550C (2007), 以液相層析/質譜儀檢測. / With reference to US EPA 3550C (2007). Analysis was performed by LC/MS.	10	n.d.	-

SGS Taiwan Ltd. 台灣檢驗科技股份有限公司 | 3F, Wu Chyuan 7th Road, New Taipei Industrial Park, Wu Gu District, New Taipei City, Taiwan /新北市五股區新北產業園區五權七路3號 t+886 (02)2299 3279 f+886 (02)2299 3237 www.sgs.tw

Member of the SGS Group

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卓揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No. 1	限值 (Limit)
多溴聯苯總和 / Sum of PBBs	mg/kg	參考IEC 62321-6 (2015), 以氣相層析/質譜儀檢測. / With reference to IEC 62321-6 (2015) and performed by GC/MS.	-	n.d.	1000
一溴聯苯 / Monobromobiphenyl	mg/kg		5	n.d.	-
二溴聯苯 / Dibromobiphenyl	mg/kg		5	n.d.	-
三溴聯苯 / Tribromobiphenyl	mg/kg		5	n.d.	-
四溴聯苯 / Tetrabromobiphenyl	mg/kg		5	n.d.	-
五溴聯苯 / Pentabromobiphenyl	mg/kg		5	n.d.	-
六溴聯苯 / Hexabromobiphenyl	mg/kg		5	n.d.	-
七溴聯苯 / Heptabromobiphenyl	mg/kg		5	n.d.	-
八溴聯苯 / Octabromobiphenyl	mg/kg		5	n.d.	-
九溴聯苯 / Nonabromobiphenyl	mg/kg		5	n.d.	-
十溴聯苯 / Decabromobiphenyl	mg/kg		5	n.d.	-
多溴聯苯醚總和 / Sum of PBDEs	mg/kg		-	n.d.	1000
一溴聯苯醚 / Monobromodiphenyl ether	mg/kg		5	n.d.	-
二溴聯苯醚 / Dibromodiphenyl ether	mg/kg		5	n.d.	-
三溴聯苯醚 / Tribromodiphenyl ether	mg/kg		5	n.d.	-
四溴聯苯醚 / Tetrabromodiphenyl ether	mg/kg		5	n.d.	-
五溴聯苯醚 / Pentabromodiphenyl ether	mg/kg		5	n.d.	-
六溴聯苯醚 / Hexabromodiphenyl ether	mg/kg		5	n.d.	-
七溴聯苯醚 / Heptabromodiphenyl ether	mg/kg		5	n.d.	-
八溴聯苯醚 / Octabromodiphenyl ether	mg/kg		5	n.d.	-
九溴聯苯醚 / Nonabromodiphenyl ether	mg/kg		5	n.d.	-
十溴聯苯醚 / Decabromodiphenyl ether	mg/kg		5	n.d.	-
鄰苯二甲酸丁苯甲酯 / BBP (Butyl Benzyl phthalate) (CAS No.: 85-68-7)	mg/kg	參考IEC 62321-8 (2017), 以氣相層析儀/質譜儀檢測. / With reference to IEC 62321-8 (2017). Analysis was performed by GC/MS.	50	n.d.	1000
鄰苯二甲酸二丁酯 / DBP (Dibutyl phthalate) (CAS No.: 84-74-2)	mg/kg		50	n.d.	1000
鄰苯二甲酸二(2-乙基己基)酯 / DEHP (Di- (2-ethylhexyl) phthalate) (CAS No.: 117-81-7)	mg/kg		50	n.d.	1000
鄰苯二甲酸二異丁酯 / DIBP (Di-isobutyl phthalate) (CAS No.: 84-69-5)	mg/kg		50	n.d.	1000

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卓揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No. 1	限值 (Limit)
鹵素 / Halogen					
鹵素 (氟) / Halogen-Fluorine (F) (CAS No.: 14762-94-8)	mg/kg	參考BS EN 14582 (2016)，以離子層析儀分析. / With reference to BS EN 14582 (2016). Analysis was performed by IC.	50	n.d.	-
鹵素 (氯) / Halogen-Chlorine (Cl) (CAS No.: 22537-15-1)	mg/kg		50	n.d.	-
鹵素 (溴) / Halogen-Bromine (Br) (CAS No.: 10097-32-2)	mg/kg		50	n.d.	-
鹵素 (碘) / Halogen-Iodine (I) (CAS No.: 14362-44-8)	mg/kg		50	n.d.	-

備註(Note):
1. mg/kg = ppm；0.1wt% = 1000ppm
2. n.d. = Not Detected (未檢出)
3. MDL = Method Detection Limit (方法偵測極限值)
4. "-" = Not Regulated (無規格值)
5. (#2) =
   a. 當六價鉻結果大於0.13 μg/cm²，表示樣品表層含有六價鉻. / The sample is positive for Cr(VI) if the Cr(VI) concentration is greater than 0.13 μg/cm². The sample coating is considered to contain Cr(VI).
   b. 當六價鉻結果為n.d. (濃度小於0.10 μg/cm²)，表示表層不含六價鉻. / The sample is negative for Cr(VI) if Cr(VI) is n.d. (concentration less than 0.10 μg/cm²). The coating is considered a non-Cr(VI) based coating
   c. 當六價鉻結果介於 0.10 及 0.13 μg/cm² 時，無法確定塗層是否含有六價鉻. / The result between 0.10 μg/cm² and 0.13 μg/cm² is considered to be inconclusive - unavoidable coating variations may influence the determination.

PFOS參考資訊(Reference Information) : 持久性有機污染物 POPs - (EU) 757/2010
PFOS濃度在物質或製備中不得超過0.001%(10ppm)，在半成品、成品或零部件中不得超過0.1%(1000ppm)，在紡織品或塗層材料中不得超過1μg/m²。
(Outlawing PFOS as substances or preparations in concentrations above 0.001% (10ppm), in semi-finished products or articles or parts at a level above 0.1%(1000ppm), in textiles or other coated materials above 1μg/m².)

SGS Taiwan Ltd. 台灣檢驗科技股份有限公司 | 25, Wu Chyuan 7th Road, New Taipei Industrial Park, Wu Ku District, New Taipei City, Taiwan (新北市五股區新北產業園區五權七路25號) t+886 (02)2299 3939 f+886 (02)2299 3237 www.sgs.tw

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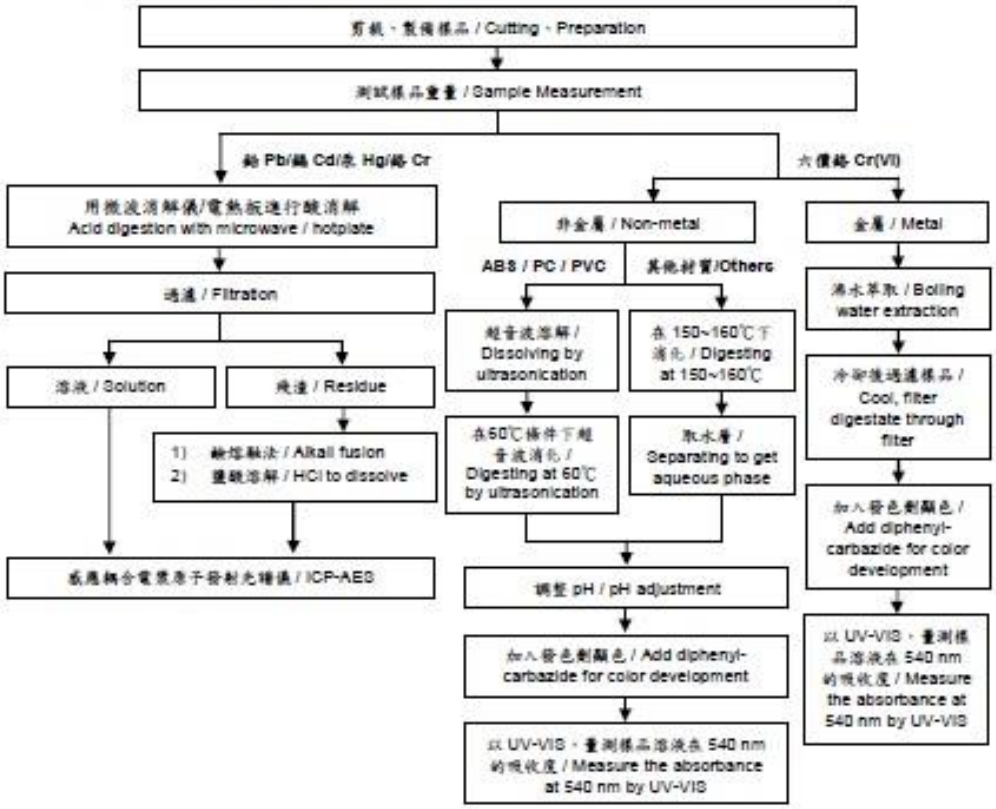
卓揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

重金屬流程圖 / Analytical flow chart of Heavy Metal

根據以下的流程圖之條件，樣品已完全溶解。（六價鉻測試方法除外）
These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr^{6+} test method excluded)

- 測試人員：王志瑋 / Technician : JR Wang
- 測試負責人：張啟興 / Supervisor: Troy Chang



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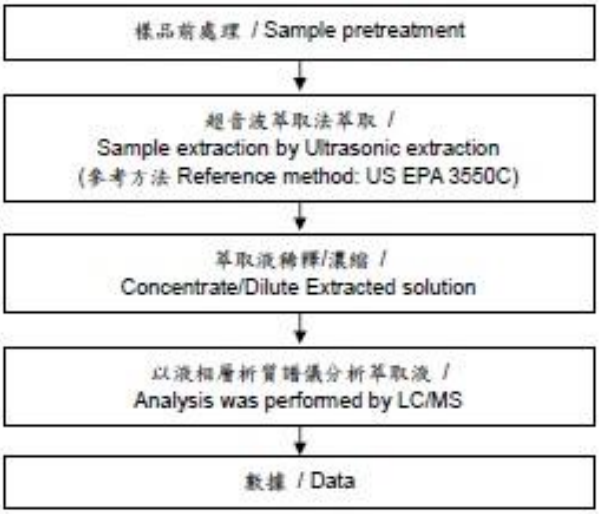
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

全氟辛酸/全氟辛烷磺酸分析流程圖 / Analytical flow chart - PFOA/PFOS

- 測試人員：涂雅苓 / Technician: Yaling Tu
- 測試負責人：張啟興 / Supervisor: Troy Chang



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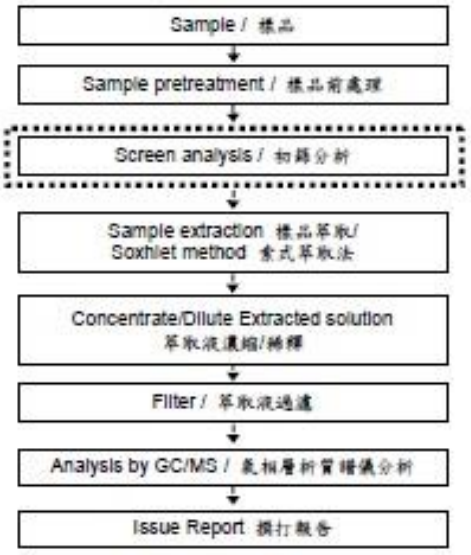
阜揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

多溴聯苯/多溴聯苯醚分析流程圖 / Analytical flow chart - PBB/PBDE

- 測試人員：涂雅等 / Technician: Yaling Tu
- 測試負責人：張啟典 / Supervisor: Troy Chang

初次測試程序 / First testing process ——→
選擇性篩檢程序 / Optional screen process ·····
確認程序 / Confirmation process — · — ·→



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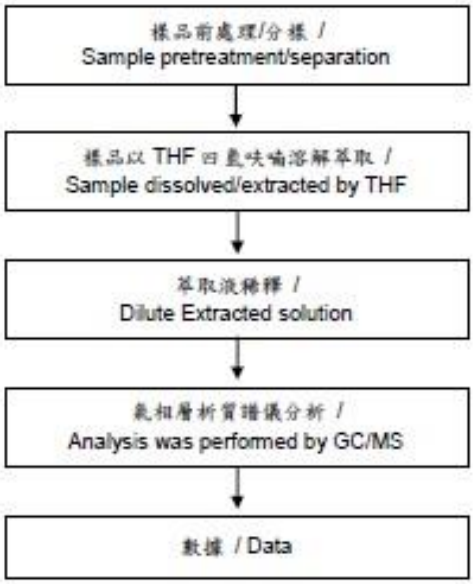
卓揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

可塑劑分析流程圖 / Analytical flow chart - Phthalate

- 測試人員：徐毓明 / Technician: Andy Shu
- 測試負責人：張啟典 / Supervisor : Troy Chang

【測試方法/Test method: IEC 62321-8】



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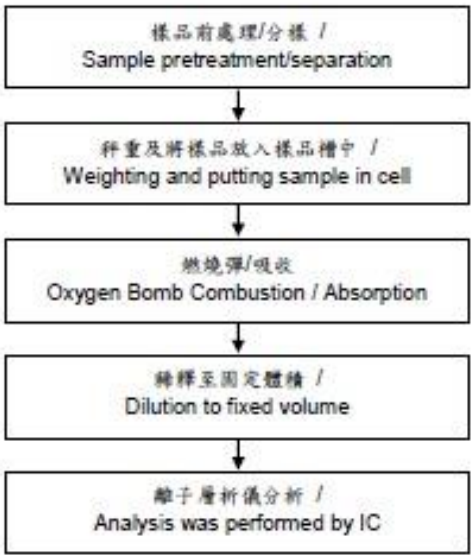
卓勝五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

鹵素分析流程圖 / Analytical flow chart - Halogen

- 測試人員：陳思綿 / Technician: Rita Chen
- 測試負責人：張啟興 / Supervisor: Troy Chang



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辛揚五金股份有限公司
SURSUN METALS CO., LTD.
新北市新莊區大安路9號
NO. 9, DA-AN RD., XINZHUANG DISTRICT, NEW TAIPEI CITY 24262, TAIWAN (R. O. C.)

* 照片中如有箭頭標示，則表示為實際檢測之樣品/部位, *
(The tested sample / part is marked by an arrow if it's shown on the photo.)

CE/2017/73546

** 報告結尾 (End of Report) **

2.4 Titanium Wire：

CERTIFICATE

TUV Rheinland of North America, Inc.
295 Foster Street, Suite 100, Littleton, MA 01460

TÜVRheinland®

Hereby certifies that

FORT WAYNE METALS
IRELAND LIMITED

Fort Wayne Metals Ireland Limited
Castlebar Technology Park Moneen Rd.
Castlebar Co. Mayo
Ireland

has established and maintains a quality management system for the

Manufacture and Distribution of Bars, Specialty Fine Wire, Cables, and other Assemblies for Aerospace & Defense, Industrial, Medical Device and other Applications.

The audit was performed in accordance with the requirements of SAE AS9104/1:2012-01 by an ANAB-accredited Certification Body under the Aerospace Registration Management Program administered by the Americas Aerospace Quality Group (AAQG) in accordance with the Aerospace Sector Scheme and documented in Report No. 4307.

Proof has been furnished that the requirements according to

AS9100D

based on the requirements of ISO 9001:2015

are fulfilled.

Further clarification regarding the scope of this certificate and the applicability of AS9100D / ISO 9001:2015 requirements may be obtained by contacting TRNA.

Certificate Registration No.

74 300 4307

Certificate Issue Date
November 8, 2017

Certificate Expiration Date
November 7, 2020

ANAB
ACCREDITED
MANAGEMENT SYSTEMS CERTIFICATION BODY

Site Structure: Single
Certificate Reissue Date:11/08/2017

Certification of Management Systems

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

FORT WAYNE METALS RESEARCH PRODUCTS CORP
9609 Ardmore Avenue
Ft. Wayne, IN 46809
Anna Henry Phone: 260 747 4154

MECHANICAL

Valid To: September 30, 2019 Certificate Number: 2577.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above as well as the satellite laboratory location listed below to perform the following tests on metals and alloys:

Test:	Test Method(s):
Rockwell Hardness (A, B, C)	ASTM E18
Rockwell Superficial Hardness (15N)	ASTM E18
Microindentation Hardness - Vickers (10, 25, 50, 100, 200, 300, 500, 1000) g - Knoop (10, 25, 50, 100, 200, 300,500, 1000) g	ASTM E384, E92
Tension Testing (-100 to 150)°C (Up to 60,000 lbf)	ASTM A370, E8, F2516
Torsion Testing - Shear Modulus	ASTM A938, E143; ISO 7800
Metallographic Evaluation - Detecting Susceptibility to Intergranular Attack[1] - Determining Grain Size[1]	ASTM A262 Practice A ASTM E112 Par. 10.0, Par. 14.3, E930
Conducting Rotating Bending Fatigue Tests of Solid Round Fine Wire	ASTM E2948
Corrosion Fatigue Testing of Metallic Implant Materials	ASTM F1801
Bend Testing of Needles Used in Surgical Sutures	ASTM F1874
Determination of Transformation Temperature of Nickel-Titanium Shaped Memory Alloys by Bend and Free Recovery	ASTM F2082
Surface Texture	ASME B46.1

[1] This accreditation covers testing performed at the main laboratory listed above, and the satellite laboratory listed below.

(Satellite Lab)
ADVANCED MATERIALS DEVELOPMENT
2300 E. Cardinal Drive
Columbia City, IN 46725

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8515 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

FORT WAYNE METALS RESEARCH PRODUCTS CORP
9609 Ardmore Avenue
Ft. Wayne, IN 46809
Anna Henry Phone: 260 747 4154

CHEMICAL

Valid To: September 30, 2019 Certificate Number: 2577.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory at the location listed above as well as the satellite laboratory location listed below to perform the following tests on metals and alloys:

Test:	Test Method(s):
Evaluation of Chemical Passivation Treatments for Stainless Steel Parts	ASTM A967 Practice D
Determination of Nitrogen and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys	ASTM E1019
Determination of Carbon and Sulfur in Steel, Iron, Nickel, and Cobalt Alloys[1]	ASTM E1019
Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys	ASTM E1409
Determination of Hydrogen in Titanium and Titanium Alloys	ASTM E1447
Determination of Carbon in Refractory and Reactive Metals[1]	ASTM E1941
Transformation Temperature of Nickel-Titanium Alloys by Thermal Analysis[2]	ASTM F2004
Electrochemical Corrosion Testing	ASTM F2129
Galvanic Corrosion	ASTM F3044

[1] This accreditation covers testing performed only at the satellite laboratory listed below.
[2] This accreditation covers testing performed at the main laboratory listed above, and the satellite laboratory listed below.

(Satellite Lab)
ADVANCED MATERIALS DEVELOPMENT
2300 E. Cardinal Drive
Columbia City, IN 46725

(A2LA Cert. No. 2577.02) Revised 10/30/2017

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8515 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Medscope Biotech

TÜVRheinland®

Certificate

The Certification Body of
TÜV Rheinland LGA Products GmbH

hereby certifies that the organization

Fort Wayne Metals Research Products Corporation
9609 Ardmore Avenue
Fort Wayne IN 46809
USA

has established and applies a quality management system for medical devices for the following scope:

Contract manufacturing of round wire and cable components, assemblies, extrusion coating and other components used in both non-implantable and implantable medical devices
Additional facilities: see attachment

Proof has been furnished that the requirements specified in

EN ISO 13485:2016

are fulfilled. The quality management system is subject to yearly surveillance.

Effective Date:	2018-06-09
Certificate Registration No.:	SX 60129377 0001
An audit was performed, Report No.:	31593020 003
This Certificate is valid until:	2021-06-08

Certification Body

DAkkS
Deutsche
Akkreditierungsstelle
D-ZM-14169-01-02

Date 2018-06-04

Roland Gruber

TÜV Rheinland LGA Products GmbH
TÜVRheinland®
Zertifizierungsstelle

TÜV Rheinland LGA Products GmbH - Tillystraße 2 - 90431 Nürnberg
Tel.: +49 221 806-1371 Fax: +49 221 806-3935 e-mail:cert-validity@de.tuv.com http://www.tuv.com/safety

TÜVRheinland

Doc. 1/1, Rev. 0

TÜV Rheinland
LGA Products GmbH
Tillystraße 2, 90431 Nürnberg

Attachment to
Certificate
Registration No.: SX 60129377 0001
Report No.: 31593020 003

Organization: Fort Wayne Metals Research Products Corporation
9609 Ardmore Avenue
Fort Wayne IN 46809
USA

Scope:

Additional facility:
Fort Wayne Metals Research Products Corporation
Ardmore G: 9823 Ardmore Avenue
Fort Wayne, IN 46809 USA

Scope:
Activities related to manufacturing

Certification Body

DAkkS
Deutsche
Akkreditierungsstelle
D-ZM-14169-01-02

Date: 2018-06-04

Roland Gruber

TÜV Rheinland LGA Products GmbH
TÜVRheinland
Zertifizierungsstelle

Facility
Products Listing

Annual Registration Successful

Facility: FORT WAYNE METALS RESEARCH PROD. CORP., FORT WAYNE, Indiana, UNITED STATES

You have successfully updated your registration and listing information for 2018.
Your registration will be valid through Dec 31, 2018.
Be sure to print this page for your records.
The next registration renewal period is October 1 - December 31, 2018.
Registering your facility and listing devices does not, in any way, constitute FDA approval of your facility or devices.
You may contact the FDA with any questions at reglist@cdrh.fda.gov.
The Owner/Operator Number for this Registration is: 1824313.

Facility Information

Registration Number:
1824313
Initial Importer:
N
Facility Name:
FORT WAYNE METALS RESEARCH PROD. CORP.
Address:
9609 Ardmore Ave,
FORT WAYNE, Indiana, 46809, UNITED STATES
DUNS Number:
Foreign Trade Zone:
N
Facility URL:
Other Business Trade Name(s):

Owner/Operator Information

Owner/Operator Number:
1824313
Contact Name:
Richard - Castaneda
Company:
FORT WAYNE METALS RESEARCH PROD. CORP.
Address:
9609 Ardmore Ave. , --
Fort Wayne, INDIANA, 46809, UNITED STATES
Telephone:
260 - 7474154 - 2106
Fax:
260 - 7470398
E-mail:
richard_castaneda@fwmetals.com
DUNS Number:

Official Correspondent Information

Contact Name:
Richard - Castaneda
Company:
FORT WAYNE METALS RESEARCH PROD. CORP.
Address:
9609 Ardmore Ave. , --
Fort Wayne, INDIANA, 46809, UNITED STATES
Telephone:
260 - 7474154 - 2106

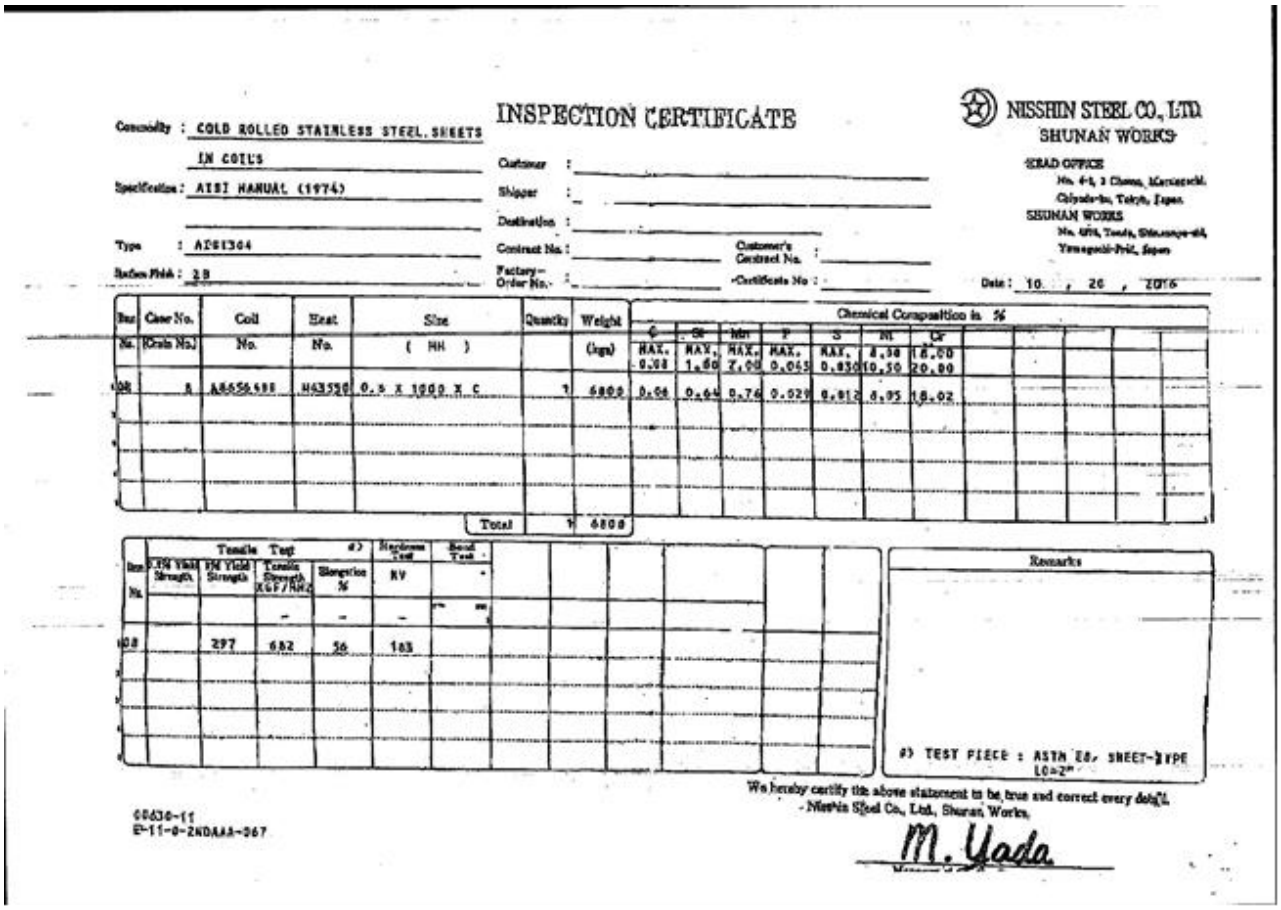
Fax:
260 - 7470398
E-mail:
richard_castaneda@fwmetals.com
DUNS Number:

Device Listings

Listing Number	Premarket Submission Number/Type	Product Code(s)	Device Name(s)	Activities
D179286	K980485	MNI	ORTHOSIS, SPINAL PEDICLE FIXATION	Contract Manufacturer
		KWQ	Appliance, fixation, spinal intervertebral body	
		KWP	APPLIANCE, FIXATION, SPINAL INTERLAMINAL	
		MNH	Orthosis, spondylolisthesis spinal fixation	
Q027319	Exempt	DZC	WIRE, ORTHODONTIC	Manufacturer
D179292	K101070	MNI	ORTHOSIS, SPINAL PEDICLE FIXATION	Contract Manufacturer
		KWQ	Appliance, fixation, spinal intervertebral body	
		NKB	Thoracolumbosacral pedicle screw system	
		KWP	APPLIANCE, FIXATION, SPINAL INTERLAMINAL	
		MNH	Orthosis, spondylolisthesis spinal fixation	
D295790	Exempt	LXH	ORTHOPEDIC MANUAL SURGICAL INSTRUMENT	Contract Manufacturer

Date of Initial Registration: 1977-01-07 00:00:00.0

2.5 Metal Sheet：



INSPECTION CERTIFICATE

NISSHIN STEEL CO., LTD
SHUNAN WORKS

Commodity : COLD ROLLED STAINLESS STEEL SHEETS IN COILS
Specification : AISI MANUAL (1974)
Type : AISI304
Surface Finish : 2B
Customer :
Shipper :
Destination :
Contract No. :
Customer's Contract No. :
Factory Order No. :
Certificate No :
Date : 10 , 26 , 2016

Item No.	Case No. (Grade No.)	Coil No.	Heat No.	Size (HH)	Quantity	Weight (kgs)	Chemical Composition in % C	Si	Mn	P	S	Ni	Cr
							MAX. 0.08	MAX. 1.00	MAX. 2.00	MAX. 0.045	MAX. 0.030	8.00 10.50	18.00 20.00
108	A	A6656488	H63550	0.5 X 1000 X C	1	6800	0.06	0.44	0.76	0.029	0.012	8.05	18.02
				Total	1	6800							

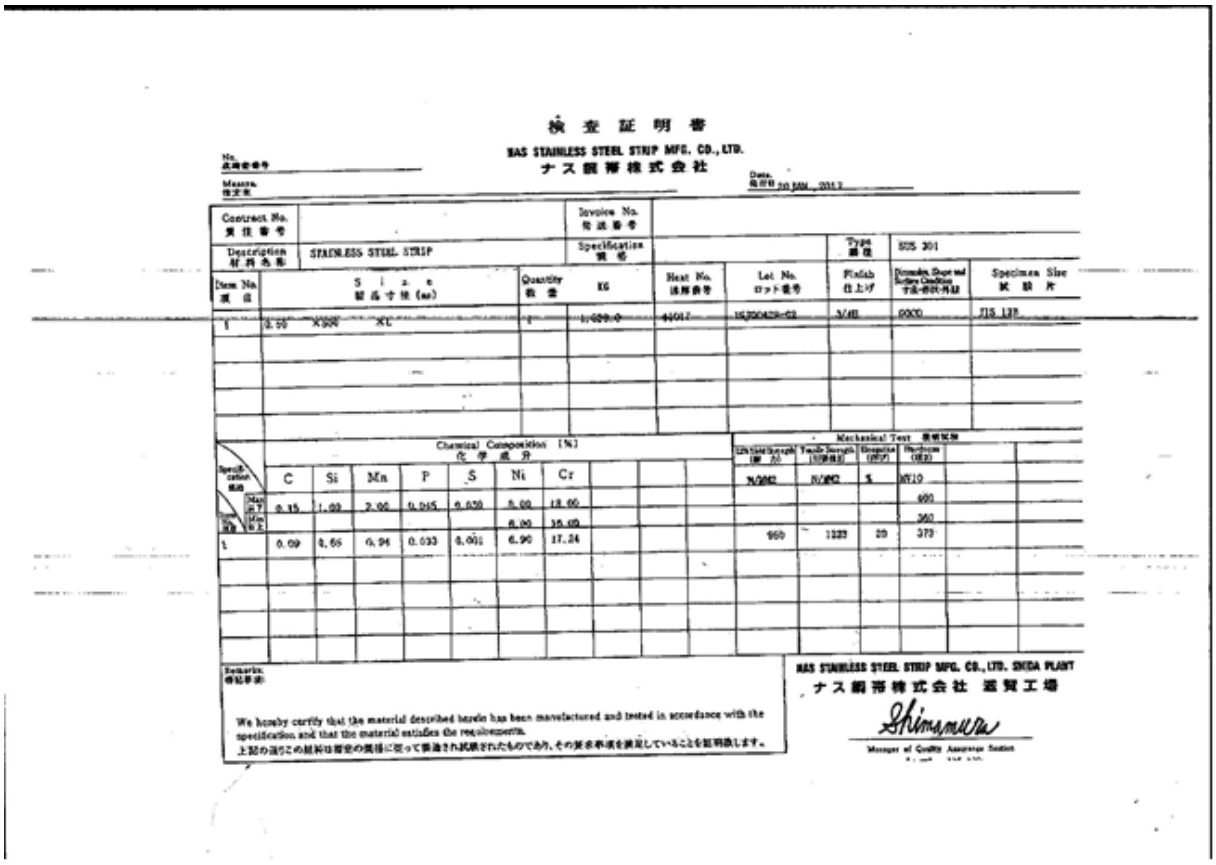
Item No.	Tensile Test 4) 0.2% Yield Strength	1% Yield Strength	Tensile Strength KGF/MM2	Elongation %	Hardness Test HV	Bend Test	Remarks
			-	-	-		
108		297	682	56	183		

4) TEST PIECE : ASTM E8, SHEET-TYPE L0=2"

We hereby certify the above statement to be true and correct every detail.
- Nisshin Steel Co., Ltd., Shunan Works

M. Yada

00030-11
E-11-0-2NDAAA-067



検 査 証 明 書

NAS STAINLESS STEEL STRIP MFG. CO., LTD.
ナス鋼帯株式会社

Date. 20 JAN., 2017

Contract No. 契約番号		Invoice No. 送状番号			
Description 材料名称	STAINLESS STEEL STRIP	Specification 規格		Type 種類	SUS 301

Item No. 項目	Size 製品寸法 (mm)	Quantity 数量	KG	Heat No. 溶解番号	Lot No. ロット番号	Finish 仕上げ	Dimension, Shape and Surface Condition 寸法・形状・外観	Specimen Size 試験片
1	2.00 X300 XL	1	1,409.0	44017	1630429-02	2/H	COIL	JIS 13B

Chemical Composition [%] 化学成分

Specification 規格	C	Si	Mn	P	S	Ni	Cr
Max. 以下	0.15	1.00	2.00	0.045	0.030	8.00	18.00
Min. 以上						6.00	16.00
1	0.09	0.66	0.94	0.033	0.001	6.90	17.24

Mechanical Test 機械試験

0.2% Yield Strength 耐力	Tensile Strength 引張強さ	Elongation 伸び	Hardness 硬さ
N/MM2	N/MM2	%	HV10
			400
			360
969	1323	29	379

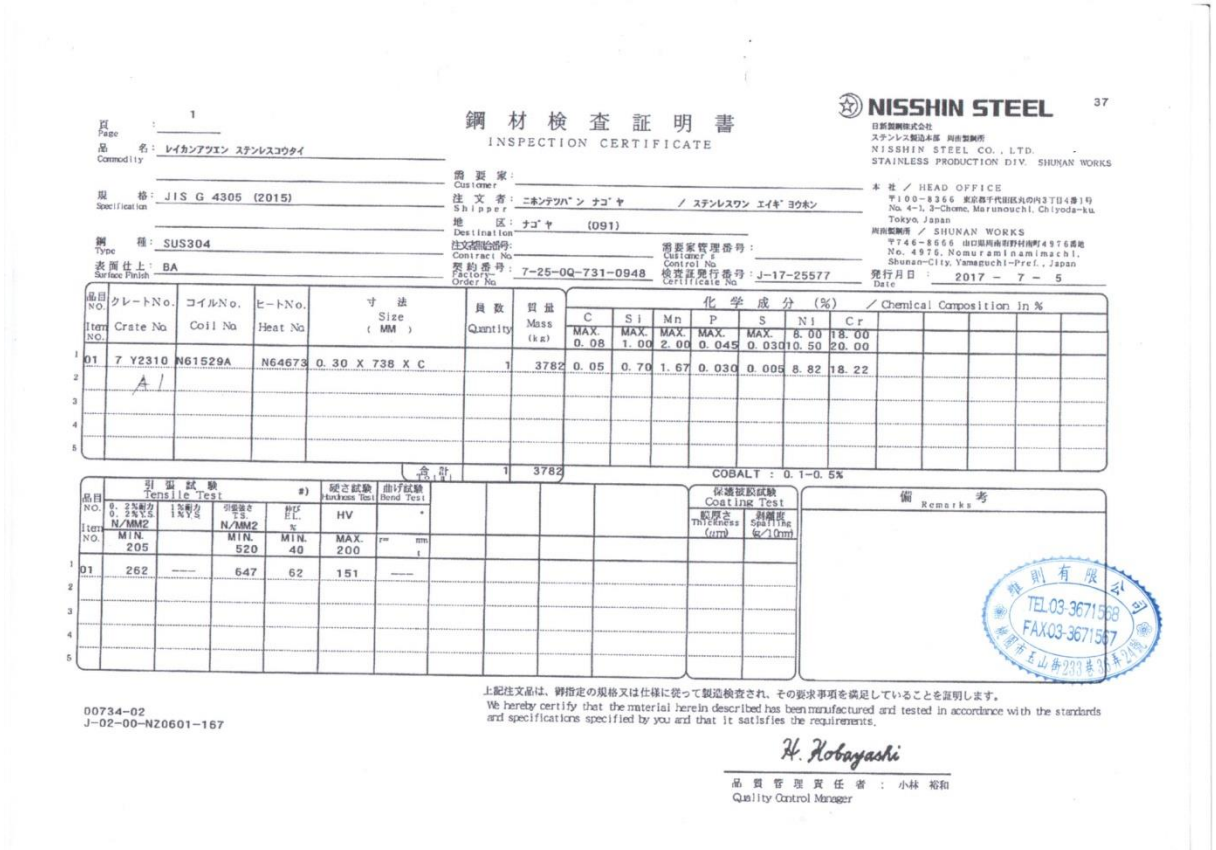
Remarks 特記事項

We hereby certify that the material described herein has been manufactured and tested in accordance with the specification, and that the material satisfies the requirements.
上記の通りこの鋼材は指定の規格に従って製造され試験されたものであり、その要求事項を満足していることを証明致します。

NAS STAINLESS STEEL STRIP MFG. CO., LTD. SHIDA PLANT
ナス鋼帯株式会社 志賀工場

Shimamura
Manager of Quality Assurance Section

2.6 Metal：



鋼 材 検 査 証 明 書
INSPECTION CERTIFICATE

NISSHIN STEEL 37
日新製鋼株式会社
ステンレス製造本部 周南製鋼所
NISSHIN STEEL CO., LTD.
STAINLESS PRODUCTION DIV. SHUNAN WORKS

本 社 / HEAD OFFICE
〒100-8366 東京都千代田区丸の内3丁目4番1号
No. 4-1, 3-Chome, Marunouchi, Chiyoda-ku, Tokyo, Japan
周南製鋼所 / SHUNAN WORKS
〒746-8666 山口県周南市野村南町4976番地
No. 4976, Nomuraminamimachi, Shunan-City, Yamaguchi-Pref., Japan

Page 頁 : 1
Commodity 品名 : レイカンアクエン ステンレスコウタイ
Specification 規格 : JIS G 4305 (2015)
Type 鋼種 : SUS304
Surface Finish 表面仕上 : BA
Customer 需要家 :
Shipper 注文者 : ニホンテツバン ナゴヤ / ステンレスワン エイギョウホン
Destination 地区 : ナゴヤ (091)
Contract No. 注文照合番号 :
Factory Order No. 荷姿番号 : 7-25-0Q-731-0948
Customer's Control No. 需要家管理番号 :
Certificate No. 検査証発行番号 : J-17-25577
Date 発行月日 : 2017 - 7 - 5

Item NO. 品目NO.	Crate No. クレートNo.	Coil No. コイルNo.	Heat No. ヒートNo.	Size 寸法 (MM)	Quantity 員数	Mass (kg) 質量	C	Si	Mn	P	S	Ni	Cr
							化学成分 (%) / Chemical Composition in %						
							MAX. 0.08	MAX. 1.00	MAX. 2.00	MAX. 0.045	MAX. 0.030	8.00 10.50	18.00 20.00
01	7 Y2310	N61529A	N64673	0.30 X 738 X C	1	3782	0.05	0.70	1.67	0.030	0.005	8.82	18.22
	A1												
				合計	1	3782							

COBALT : 0.1-0.5%

Item NO. 品目NO.	引張試験 Tensile Test 0.2%耐力 N/MM2	1%耐力 N/MM2	引張強さ T.S. N/MM2	伸び EL. %	硬さ試験 Hardness Test HV	曲げ試験 Bend Test	保護被試験 Coating Test 膜厚さ Thickness (μm)	剥離度 Spalling 6t/10mm
	MIN.		MIN.	MIN.	MAX.	r= mm t		
	205		520	40	200			
01	262	——	647	62	151	——		

備考 Remarks

00734-02
J-02-00-NZ0601-167

上記注文品は、御指定の規格又は仕様に従って製造検査され、その要求事項を満足していることを証明します。
We hereby certify that the material herein described has been manufactured and tested in accordance with the standards and specifications specified by you and that it satisfies the requirements.

H. Kobayashi
品質管理責任者 : 小林 裕和
Quality Control Manager

3. Blister：

SHINKONG 光	新光合成纖維股份有限公司 泛亞聚酯工業股份有限公司	台北市南京東路二段123號8樓	TEL：+886 2 2507-1251 FAX：+886 2 2506-8047
SHINKONG SYNTHETIC FIBERS CORPORATION PAN ASIAN PLASTICS CORPORATION		8F., 123, SEC. 2, NANKING E. ROAD. TAIPEI TAIWAN	DATE：2016.10.6 NAME：吳哲文 ext:7069

材質證明

M type SHEET:

Structure of M type Sheet
////////////////////////// 10% PET (partial PETG + partial PET)
\\\\\\\\\\\\\\\\\\\\\\\\\\ 80% PET (100% virgin grade of PET)
////////////////////////// 10% PET (partial PETG + partial PET)

A-PET Resin to A-PET Sheet Manufacture Procedure

乙 烯 (中 油) →→→→ TPA (對苯二甲酸) 及 EG (乙二醇)

聚 合
HOOC(C6H4)COOH + 2HOCH2CH2OH →→→→ PET CHIP
(TPA / 對苯二甲酸) (EG / 乙二醇) (對苯二甲酸二甲酯)

聚 合 押出
PET CHIP →→→→→→ PET CHIP + PET ADDITIVE + PETG CHIP→→→→→ PET SHEET

(I.V:0.64) (I.V:0.84) (I.V:0.72—0.75)

泛亞聚酯工業股份有限公司 營業部 TEL.25071251 25015319 台北市南京東路2段123號8樓

PAN ASIAN PLASTICS CORPORATION

4. Silicone Grease：

- C0014247

DOW CORNING

Dow Corning Taiwan Inc
10F, No. 246, Sec. 1, Nei Hu Road
Taipei-Nei Hu 11493

Telephone: 2-6600-3100
Fax: 2-6600-3199

Certificate of Analysis

Page 1 of 1

Fax(Ship-to: 1065565) 223885346		Date Generated 07Jan2016
Delivery Number 8611109332	Item Number 000010	Delivery Date 07Jan2016
Sales Order Number 7236721	Item Number 000010	Sales Order Date 11Dec2015
Purchase Order Number C0151205		PO Date

Ship-to: 1065565
Ms. hung emily
TAIREN (3AM)
NO.2-38 KULINGLIN, GUISHAN SHIANG
TAOYUAN 33373

Our Material 4109923
MOLYKOTE(R) 111 COMPOUND,200 KG drum

Customer Material

Batch 0008436156	Shelf Life Expiration Date 22Sep2020
Delivery Quantity 1 drum	Date of Manufacture 19Oct2015

Characteristic	Value	Unit of Measure	Lower Limit	Upper Limit
BLEED GREASE LIKE MATERIAL	0.3	%		0.5
EVAPORATION GREASE 24H/200C	0.9	%		2.0
PENETRATION (UNWORKED)	194	mm/10	170	230

This is to certify that the above designated material has been tested and did comply with the listed specifications (with listed exceptions) when supplied in original container. The material is subject to the conditions listed on the Dow Corning invoice. The above is a copy of information on file. The lot acceptance data are available for examination. This certificate is valid unsigned.

Internal reference: 4109923 External reference: 0006000048

5. Dry PFPE (Lubricant)：

有效性不詳
For Question, Please Contact with SGS
www.sgs.com.tw

SGS

測試報告
Test Report

號碼(No.)：CE/2018/16835　日期(Date)：2018/02/05　頁數(Page): 1 of 12

台灣富見維事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

以下測試樣品係由申請廠商所提供及確認 (The following sample(s) was/were submitted and identified by/on behalf of the applicant as)：

送樣廠商(Sample Submitted By)	:	台灣富見維事業股份有限公司 (FUMIO-TAIWAN LTD.)
樣品名稱(Sample Description)	:	FUMIO LUBRICANT
樣品型號(Style/Item No.)	:	FUMIO A-1080, A-1191EL, A-1259EL, A-1259ELF, A-1259F, A-1316, A-1316F, A-1319, A-1319F, A-2099, A-2107, A-2424EL, A-2429EL, A-2430EL, A-2430HT, A-3099, A-6063EL, AP-101, AP-101-2, AP-103-3, BM-357, DS-3308TH, DS-3308THL, DS-3308THLB, DS-11THF, DS-11THLF, DS-11THLBF, F-8308TH, FCN-5982, FCN-5987, FJ-8520, FJ-8570, FJ-9520, FOS-90MF, HF-800S, KD-1S, KD-1SF, MDF-1037, MZ-800SEL, MZ-1002, OS-90MEL, OS-90MELF, PL-1004, PL1004F, A-, AP-, DFG-, DS-, F-, FCN-, FCL-, FEC-, FG-, FGF-, FJ-, FOS-, FT-, HF-, HFD-, HLV-, KD-, L-, LC-, MDF-, MF-, OS-, PL-, SLV-, LORIS L-
收件日期(Sample Receiving Date)	:	2018/01/29
測試期間(Testing Period)	:	2018/01/29 TO 2018/02/05

測試需求(Test Requested)：

(1) 依據客戶指定，參考RoHS 2011/65/EU Annex II及其修訂指令(EU) 2015/863測試鎘、鉛、汞、六價鉻、多溴聯苯、多溴聯苯醚, DBP, BBP, DEHP, DIBP. (As specified by client, with reference to RoHS 2011/65/EU Annex II and amending Directive (EU) 2015/863 to determine Cadmium, Lead, Mercury, Cr(VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP contents in the submitted sample(s).)

(2) 其他測試項目請見下一頁 . (Please refer to next pages for the other item(s).)

測試結果(Test Results)　請參閱下一頁 (Please refer to following pages).

Troy Chang, Manager - Tech
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory - Taipei

SGS

測試報告
Test Report

號碼(No.) : CE/2018/16835　　日期(Date) : 2018/02/05　　頁數(Page): 2 of 12

台灣富見維事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

測試結果(Test Results)

測試部位(PART NAME)No.1　　:　白色液體 (WHITE LIQUID)

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result)
				No.1
鎘 / Cadmium (Cd)	mg/kg	參考IEC 62321-5 (2013)，以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.
鉛 / Lead (Pb)	mg/kg	參考IEC 62321-5 (2013)，以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.
汞 / Mercury (Hg)	mg/kg	參考IEC 62321-4 (2013)，以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-4 (2013) and performed by ICP-AES.	2	n.d.
六價鉻 / Hexavalent Chromium Cr(VI)	mg/kg	參考IEC 62321-7-2 (2017)，以UV-VIS檢測. / With reference to IEC 62321-7-2 (2017) and performed by UV-VIS.	8	n.d.
六溴環十二烷及所有主要被辨別出的異構物 / Hexabromocyclododecane (HBCDD) and all major diastereoisomers identified (α- HBCDD, β- HBCDD, γ- HBCDD) (CAS No.: 25637-99-4 and 3194-55-6 (134237-51-7, 134237-50-6, 134237-52-8))	mg/kg	參考IEC 62321 (2008)，以氣相層析/質譜儀檢測. / With reference to IEC 62321 (2008). Analysis was performed by GC/MS.	5	n.d.

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測試報告
Test Report

號碼(No.) : CE/2018/16835　日期(Date) : 2018/02/05　

台灣富見雄事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No.1
多溴聯苯總和 / Sum of PBBs	mg/kg	參考IEC 62321-6 (2015)，以氣相層析/質譜儀檢測. / With reference to IEC 62321-6 (2015) and performed by GC/MS.	-	n.d.
一溴聯苯 / Monobromobiphenyl	mg/kg		5	n.d.
二溴聯苯 / Dibromobiphenyl	mg/kg		5	n.d.
三溴聯苯 / Tribromobiphenyl	mg/kg		5	n.d.
四溴聯苯 / Tetrabromobiphenyl	mg/kg		5	n.d.
五溴聯苯 / Pentabromobiphenyl	mg/kg		5	n.d.
六溴聯苯 / Hexabromobiphenyl	mg/kg		5	n.d.
七溴聯苯 / Heptabromobiphenyl	mg/kg		5	n.d.
八溴聯苯 / Octabromobiphenyl	mg/kg		5	n.d.
九溴聯苯 / Nonabromobiphenyl	mg/kg		5	n.d.
十溴聯苯 / Decabromobiphenyl	mg/kg		5	n.d.
多溴聯苯醚總和 / Sum of PBDEs	mg/kg		-	n.d.
一溴聯苯醚 / Monobromodiphenyl ether	mg/kg		5	n.d.
二溴聯苯醚 / Dibromodiphenyl ether	mg/kg		5	n.d.
三溴聯苯醚 / Tribromodiphenyl ether	mg/kg		5	n.d.
四溴聯苯醚 / Tetrabromodiphenyl ether	mg/kg		5	n.d.
五溴聯苯醚 / Pentabromodiphenyl ether	mg/kg		5	n.d.
六溴聯苯醚 / Hexabromodiphenyl ether	mg/kg		5	n.d.
七溴聯苯醚 / Heptabromodiphenyl ether	mg/kg		5	n.d.
八溴聯苯醚 / Octabromodiphenyl ether	mg/kg		5	n.d.
九溴聯苯醚 / Nonabromodiphenyl ether	mg/kg		5	n.d.
十溴聯苯醚 / Decabromodiphenyl ether	mg/kg		5	n.d.

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測試報告
Test Report

號碼(No.) : CE/2018/16835　日期(Date) : 2018/02/05　

台灣富見維事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No.1
鄰苯二甲酸丁苯甲酯 / BBP (Butyl Benzyl phthalate) (CAS No.: 85-68-7)	mg/kg	參考IEC 62321-8 (2017)，以氣相層析儀/質譜儀檢測, / With reference to IEC 62321-8 (2017), Analysis was performed by GC/MS.	50	n.d.
鄰苯二甲酸二丁酯 / DBP (Dibutyl phthalate) (CAS No.: 84-74-2)	mg/kg		50	n.d.
鄰苯二甲酸二 (2-乙基己基)酯 / DEHP (Di- (2-ethylhexyl) phthalate) (CAS No.: 117-81-7)	mg/kg		50	n.d.
鄰苯二甲酸二異丁酯 / DIBP (Di-isobutyl phthalate) (CAS No.: 84-69-5)	mg/kg		50	n.d.
鄰苯二甲酸二異癸酯 / DIDP (Di-isodecyl phthalate) (CAS No.: 26761-40-0; 68515-49-1)	mg/kg		50	n.d.
鄰苯二甲酸二異壬酯 / DINP (Di-isononyl phthalate) (CAS No.: 28553-12-0; 68515-48-0)	mg/kg		50	n.d.
鄰苯二甲酸二正辛酯 / DNOP (Di-n-octyl phthalate) (CAS No.: 117-84-0)	mg/kg		50	n.d.
鄰苯二甲酸二戊酯 / Di-n-pentyl phthalate (CAS No.: 131-18-0)	mg/kg		50	n.d.
鄰苯二甲酸二正己酯 / DNHP (Di-n-hexyl phthalate) (CAS No.: 84-75-3)	mg/kg		50	n.d.
鄰苯二甲酸二 (2-甲氧基乙基)酯 / DMEP (Bis (2-methoxyethyl) phthalate) (CAS No.: 117-82-8)	mg/kg		50	n.d.

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測試報告
Test Report

號碼(No.) : CE/2018/16835　　日期(Date) : 2018/02/05　　頁數(Page): 5 of 12

台灣富見維事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result)
				No.1
鹵素（氯）/ Halogen-Chlorine (Cl) (CAS No.: 22537-15-1)	mg/kg	參考BS EN 14582 (2016)，以離子層析儀分析. / With reference to BS EN 14582 (2016), Analysis was performed by IC.	50	n.d.
鹵素（溴）/ Halogen-Bromine (Br) (CAS No.: 10097-32-2)	mg/kg	參考BS EN 14582 (2016)，以離子層析儀分析. / With reference to BS EN 14582 (2016), Analysis was performed by IC.	50	n.d.
全氟辛烷磺酸 / Perfluorooctane sulfonates (PFOS-Acid, Metal Salt, Amide)	mg/kg	參考US EPA 3550C (2007)，以液相層析/質譜儀檢測. / With reference to US EPA 3550C (2007), Analysis was performed by LC/MS.	10	n.d.
全氟辛酸 / PFOA (CAS No.: 335-67-1)	mg/kg	參考US EPA 3550C (2007)，以液相層析/質譜儀檢測. / With reference to US EPA 3550C (2007), Analysis was performed by LC/MS.	10	n.d.

備註(Note):
1. mg/kg = ppm；0.1wt% = 1000ppm
2. n.d. = Not Detected（未檢出）
3. MDL = Method Detection Limit（方法偵測極限值）
4. "-" = Not Regulated（無規格值）

PFOS參考資訊(Reference Information) : 持久性有機污染物 POPs - (EU) 757/2010

PFOS濃度在物質或製備中不得超過0.001%(10ppm)，在半成品、成品或零部件中不得超過0.1%(1000ppm)，在紡織品或塗層材料中不得超過1μg/m²。

(Outlawing PFOS as substances or preparations in concentrations above 0.001% (10ppm), in semi-finished products or articles or parts at a level above 0.1%(1000ppm), in textiles or other coated materials above 1μg/m².)

SGS

測試報告
Test Report

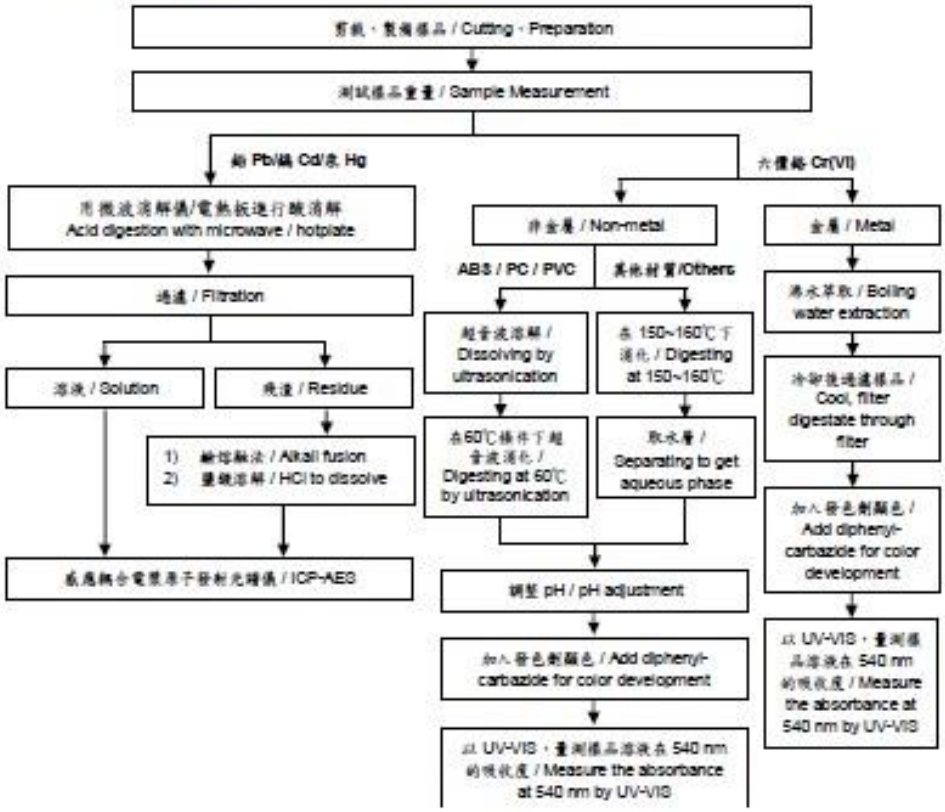
號碼(No.) : CE/2018/16835　日期(Date) : 2018/02/05　

台灣富見雄事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

重金屬流程圖 / Analytical flow chart of Heavy Metal

根據以下的流程圖之條件，樣品已完全溶解。（六價鉻測試方法除外）
These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr^{6+} test method excluded)

- 測試人員：王志偉 / Technician : JR Wang
- 測試負責人：張啟興 / Supervisor: Troy Chang



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測試報告
Test Report

號碼(No.) : CE/2018/16835　　日期(Date) : 2018/02/05　　

台灣富見雄事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

六溴環十二烷分析流程圖 / Analytical flow chart - HBCDD

- 測試人員：涂雅苓 / Technician: Yaling Tu
- 測試負責人：張啟興 / Supervisor: Troy Chang

樣品前處理 / Sample pretreatment

↓

樣品萃取 Sample extraction /
超音波萃取法 Ultrasonic method

↓

萃取液濃縮/稀釋 /
Concentrate/Dilute Extracted solution

↓

萃取液過濾 / Filter

↓

以氣相層析/質譜儀分析 /
Analysis was performed by GC/MS

↓

數據 / Data

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測試報告
Test Report

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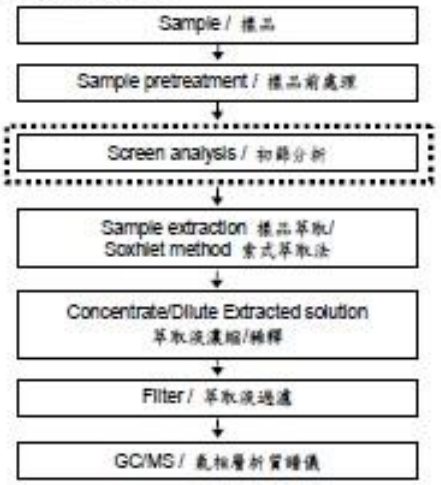
台灣富見雄事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

多溴聯苯/多溴聯苯醚分析流程圖 / Analytical flow chart - PBB/PBDE

- 測試人員：涂雅芩 / Technician: Yaling Tu
- 測試負責人：張啟典 / Supervisor: Troy Chang

初次測試程序 / First testing process ——→
選擇性篩檢程序 / Optional screen process ·····→
確認程序 / Confirmation process — · — →



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號碼(No.) : CE/2018/16835　日期(Date) : 2018/02/05　

台灣富見維事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

可塑劑分析流程圖 / Analytical flow chart - Phthalate

- 測試人員：徐毓明 / Technician: Andy Hsu
- 測試負責人：張啟興 / Supervisor : Troy Chang

【測試方法/Test method: IEC 62321-8】

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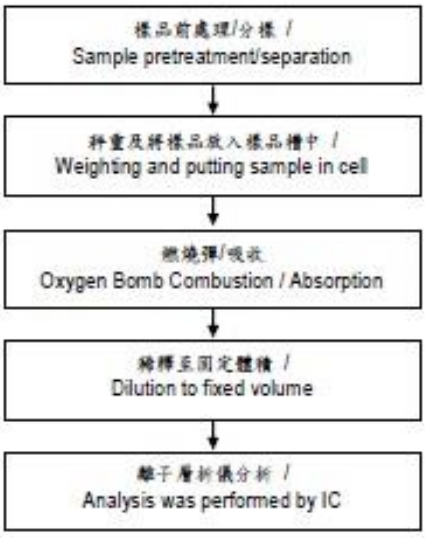
測試報告
Test Report

號碼(No.) : CE/2018/16835　日期(Date) : 2018/02/05　

台灣富見雄事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

鹵素分析流程圖 / Analytical flow chart - Halogen

- 測試人員：陳思婷 / Technician: Rita Chen
- 測試負責人：張啟興 / Supervisor: Troy Chang



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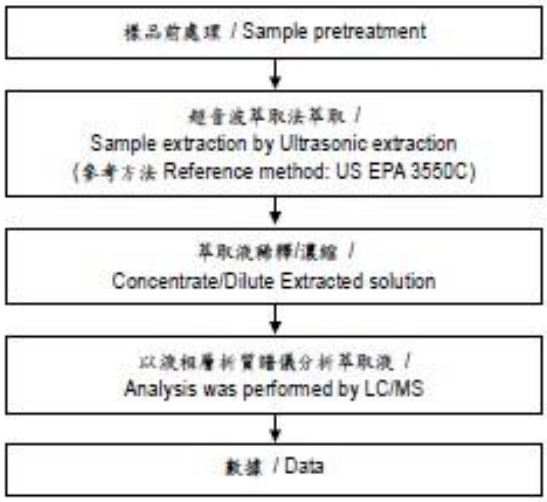
測試報告
Test Report

號碼(No.) : CE/2018/16835　日期(Date) : 2018/02/05　

台灣富見維事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

全氟辛酸/全氟辛烷磺酸分析流程圖 / Analytical flow chart - PFOA/PFOS

- 測試人員：涂雅苓 / Technician: Yaling Tu
- 測試負責人：張啟興 / Supervisor: Troy Chang



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測試報告
Test Report

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台灣富見維事業股份有限公司
FUMIO-TAIWAN LTD.
台北市內湖區新湖二路168號5樓
5F, NO. 168, XIN HU 2 RD., NEI-HU, TAIPEI, TAIWAN

＊ 照片中如有箭頭標示，則表示為實際檢測之樣品/部位。＊
(The tested sample / part is marked by an arrow if it's shown on the photo.)

CE/2018/16835

＊＊ 報告結尾 (End of Report) ＊＊

財團法人 塑膠工業技術發展中心
Plastics Industry Development Center

Verification Testing Laboratory Analysis/Test Report

Articles : Dry Lubricant BM-357 Assignment No : 105A011-K210371

1. Sample Description and Study Verification

Plastics Industry Development Center
Product Safety Data Sheet

Company Name : FUMIO-TAIWAN LTD Date: 2016/10/13

Address : 5F,NO.168,Xin hu 2 Road ,Nei-Hu,Taipei,Taiwan

Sample Description And Verification Information (Provided by Customer)

Product Name:	Dry Lubricant BM-357		
Model :	FUMIO BM-357	Manuf. Date:	Package: ☐ bag ■ Bottle ☐none ☐other:_____
Lot No.		Product Appearance: ☐Solid. ■Liquid. ☐Powder. ☐Average. ☐Capsule. Other:_____	Color : Suspension, milky white
Sterile :	■No ☐Yes ☐Autoclave (Temperature _____℃, Time_____min.) ☐γ-Ray + ☐70% Alcohol ☐EO Sterilization (Temperature :_____℃, Time_____min.) ☐Other:		
Product Appearance	☐Regular shape, thickness____mm (Non-planar object : provide surface area ____m²) ☐Irregular shape, weight____g ■Other: Suspension, milky white		
Main Component :	Hydantoinether, Fluoroadditives		
Extraction Condition	☐Provided by Customer (Temp.:_____℃ - time:_____ Extraction Solvent:_____) ■By PIDC		
Scope of Medical device:	■Contact with the skin or mucous membrane short-term (< 24 h) ☐Contact with skin or mucous membranes long-term (>24) The longest time :_____hrs ☐Implantable medical devices		
Storage Condition:	■Room Temperature. ☐Dark. ☐Other:_____		
Remark	• Based on the requirement of ISO-10993, if the result of cytotoxicity test was present high cytotoxicity potential, the pretest must be done before starting skin irritation and skin sensitization tests. For pretest need, the test samples are provided by customers and extra cost are also paid by customers. • pH : Not applicable (The animal test cannot be tested if there is no pH value except solid) • Other: Be sure to shake the product before use. • [illegible] Indication in report !		

Signature/Date:

TEL:(04)2359-5900
FAX:(04)2359-5885

VTL-QP-2.0-04

407台中市西屯區工業38路193號 http://www.pidc.org.tw
No.193, 38th Rd., Taichung Industrial TEL:(04)2359-5900
Park, Taichung, Taiwan, R.O.C. FAX:(04)2359-5885

財團法人 塑膠工業技術發展中心
Plastics Industry Development Center

Verification Testing Laboratory Analysis/Test Report

Articles : Dry Lubricant BM-357 Assignment No : 105A011-K210372S1

SAMPLE DESCRIPTION AND STUDY VERIFICATION

Plastics Industry Development Center
Product Safety Data Sheet

Company Name : FUMIO-TAIWAN LTD Date: 2016/10/13

Address : 5F.NO.168,Xin hu 2 Road.,Nei-Hu,Taipei,Taiwan

Sample Description And Verification Information (Provided by Customer)

Product Name:	Dry Lubricant BM-357		
Model :	FUMIO BM-357	Manuf. Date:	Package ☐ bag ■ bottle ☐none ☐other:____
Lot No. :		Product Appearance: ☐Solid ■Liquid ☐Powder ☐Lozenge, ☐Capsule, Other:____	Color : Suspension, milky white
Sterile :	■No ☐Yes ☐Autoclave (Temperature :_____℃ Time_____min) ☐γ-Ray、☐70% Alcohol ☐EO Sterilization (Temperature :_____℃ Time:_____min) ☐Other:_____		
Product Appearance:	☐Regular shape, thickness____mm (Non-planar object : provide surface area ____cm²) ☐Irregular shape, weight____g ■Other: Suspension, milky white		
Main Component :	Hydrofluoroether, Fluorosolditives		
Extraction Condition:	☐Provided by Customer (Temp:_____℃、time:_____ Extraction Solvent:_____) ■By PIDC		
Scope of Medical device:	■Contact with the skin or mucous membrane short-term (＜24 h) ☐Contact with skin or mucous membranes long-term (＞30) The longest time :_____hrs ☐Implantable medical devices		
Storage Condition:	■Room Temperature ☐Dark ☐Other:_____		
Remark:	• Based on the requirement of ISO-10993, if the result of cytotoxicity test was present high cytotoxicity potential, the pretest must be done before starting skin irritation and skin sensitization tests. For pretest need, the test samples are provided by customers and extra cost are also paid by customers. • pH : Not applicable (The animal test cannot be tested if there is no pH value except solid) • Other: Be sure to shake the product before use. • _____tion in report : _____		

Signature/Date: _____

TEL:(04)2359-5900
FAX:(04)2359-5885

VTL-QP-2.8-04

財團法人 塑膠工業技術發展中心
Plastics Industry Development Center

Verification Laboratory Analysis/Test Report

Articles : Dry Lubricant BM-357 Assignment No : 105A011-K210372S2

SAMPLE DESCRIPTION AND STUDY VERIFICATION

Plastics Industry Development Center
Product Safety Data Sheet

Company Name : FUMIO-TAIWAN LTD Date: 2016/10/15

Address : 5F,NO.168,Xin Ire 2 Road.,Nei-Hu,Taipei,Taiwan

Sample Description And Verification Information (Provided by Customer)

Product Name:	Dry Lubricant BM-357		
Model :	FUMIO BM-357	Manuf. Date:	Package ☐ bag ■ bottle ☐can ☐other:
Lot No. :		Product Appearance: ☐Solid. ■Liquid. ☐Powder. ☐Granule. ☐Capsule. Other:	Color : Suspension, milky white
Sterile :	■No ☐Yes ☐Autoclave (Temperature: ℃ Time: min.) ☐γ-Ray ☐NVs Alcohol ☐EO Sterilization (Temperature: ℃ Time: min.) ☐Other:		
Product Appearance:	☐Regular shape, thickness: mm (Non-planar object : provide surface area: cm²) ☐Irregular shape, weight: g ■Other: Suspension, milky white		
Main Component :	Hydrofluoroether, Fluoroadditives		
Extraction Condition:	☐Provided by Customer (Temp: ℃ · time: Extraction Solvent:) ■By FIDC		
Scope of Medical device:	■Contact with the skin or mucous membrane short-term (< 24 h) ☐Contact with skin or mucosa membranes long-term (>24) The longest time: hrs ☐Implantable medical devices		
Storage Condition:	■Room Temperature. ☐Dark. ☐Other:		
Remark:	• Based on the requirement of ISO-10993, if the result of cytotoxicity test was present high cytotoxicity potential, the pretest must be done before starting skin irritation and skin sensitization tests. For pretest need, the test samples are provided by customers and extra cost are also paid by customers. • pH : Not applicable (The animal test cannot be tested if there is no pH value, except solid) • Other: Be sure to shake the product before use. • [illegible] item in report :		

Signature/Date:

VTL-QP-3 8-04

407台中市西屯區工業38路193號 http://www.pidc.org.tw
No.193, 38th Rd., Taichung Industrial TEL:(04)2359-5900
Park, Taichung, Taiwan, R.O.C. FAX:(04)2359-5885

財團法人 塑膠工業技術發展中心
Plastics Industry Development Center

Verification Testing Laboratory
Analysis/Test Report

Application No : 105A011-K210373

Date Tested : 2016/10/24~2016/11/18

1. Sample Description and Verification Information

Plastics Industry Development Center
Product Safety Data Sheet

Company Name: FUMIO-TAIWAN LTD. Date: 2016/10/13

Address: 5F.NO.168,Xin hu 2 Road.,Nei-Hu,Taipei,Taiwan

Sample Description And Verification Information (Provided by Customer)

Product Name:	Dry Lubricant B66-157		
Model:	FUMIO B66-157	Mould. Date:	Package: ☐ bag ■ bottle ☐ none ☐ other:
Lot No:		Product Appearance: ☐Solid, ■Liquid, ☐Powder, ☐Sponge, ☐Capsule, Other:	Color: transparent, milky white
Sterile:	■No ☐Yes ☐Autoclave (Temperature: ℃, Time: min) ☐γ-Ray, ☐70% Alcohol ☐EO Sterilization (Temperature: ℃, Time: min) ☐Other:		
Product Appearance:	☐Regular shape, thickness: mm (Non-planar object: provide surface area: cm²) ☐Irregular shape, weight: g ■Other: Transparent, milky white		
Main Component(s):	Hydrofluoroether, Fluorosilicone		
Extraction Condition:	☐Provided by Customer (Temp.: ℃, time: Extraction Solvent:) ■By PIDC		
Scope of Medical device:	■Contact with the skin or mucous membranes short-term (<24h) ☐Contact with skin or mucous membranes long-term (>30d) The longest time: hrs ☐Implantable medical devices		
Storage Condition:	■Room Temperature ☐Dark, ☐Other:		
Remark:	• Based on the requirement of ISO-10993, if the result of cytotoxicity test was present high cytotoxicity potential, the pretest must be done before starting skin irritation and skin sensitization tests. For pretest need, the test samples are provided by customers and extra cost are also paid by customers. • pH: Not applicable (The animal test cannot be tested if there is no pH value except solid) • Other: Be sure to shake the product before use. •		

Signature/Date:

6. Spring：

測試報告
Test Report

號碼(No.)：CE/2018/36600　日期(Date)：2018/03/31　

旭崇企業股份有限公司
FERINOX CORP.
桃園市大溪區美山路一段180號
NO. 180, SEC. 1, MEISAN RD., DAXI DISTRICT, TAOYUAN CITY 335, TAIWAN (R. O. C.)

以下測試樣品係由申請廠商所提供及確認 (The following sample(s) was/were submitted and identified by/on behalf of the applicant as)：

送樣廠商(Sample Submitted By)	:	旭崇企業股份有限公司 (FERINOX CORP.)
樣品名稱(Sample Description)	:	STAINLESS (不銹鋼線)
樣品型號(Style/Item No.)	:	304
收件日期(Sample Receiving Date)	:	2018/03/26
測試期間(Testing Period)	:	2018/03/26 TO 2018/03/31

測試需求(Test Requested)：

(1) 依據客戶指定，參考RoHS 指令2011/65/EU Annex II測試鎘、鉛、汞、六價鉻. (As specified by client, with reference to RoHS Directive 2011/65/EU Annex II to determine Cadmium, Lead, Mercury, Cr(VI) contents in the submitted sample(s).)

(2) 依據客戶指定，進行全氟辛酸、全氟辛烷磺酸、鹵素-氟、氯、溴、碘測試. (As specified by client, to test PFOA, PFOS, Halogen-Fluorine, Chlorine, Bromine, Iodine contents in the submitted sample(s).)

測試結果(Test Results)　：　請參閱下一頁 (Please refer to following pages).

SGS TAIWAN LTD
Troy Chang / Manager - Tech
Signed for and on behalf of
SGS TAIWAN LTD.TAIWAN
Chemical Laboratory - Taipei

測試報告
Test Report

號碼(No.) : CE/2018/36600 日期(Date) : 2018/03/31

旭崇企業股份有限公司
FERINOX CORP.
桃園市大溪區美山路一段180號
NO. 180, SEC. 1, MEISAN RD., DAXI DISTRICT, TAOYUAN CITY 335, TAIWAN (R. O. C.)

測試結果(Test Results)

測試部位(PART NAME)No.1 : 銀色金屬線 (SILVER COLORED METAL WIRE)

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No.1
鎘 / Cadmium (Cd)	mg/kg	參考IEC 62321-5 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.
鉛 / Lead (Pb)	mg/kg	參考IEC 62321-5 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.
汞 / Mercury (Hg)	mg/kg	參考IEC 62321-4 (2013), 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321-4 (2013) and performed by ICP-AES.	2	n.d.
六價鉻 / Hexavalent Chromium Cr(VI)(#2)	$\mu g/cm^2$	參考IEC 62321-7-1 (2015), 以UV-VIS檢測. / With reference to IEC 62321-7-1 (2015) and performed by UV-VIS.	0.10	n.d.
全氟辛烷磺酸 / Perfluorooctane sulfonates (PFOS-Acid, Metal Salt, Amide)	mg/kg	參考US EPA 3550C (2007), 以液相層析/質譜儀檢測. / With reference to US EPA 3550C (2007). Analysis was performed by LC/MS.	10	n.d.
全氟辛酸 / PFOA (CAS No.: 335-67-1)	mg/kg	參考US EPA 3550C (2007), 以液相層析/質譜儀檢測. / With reference to US EPA 3550C (2007). Analysis was performed by LC/MS.	10	n.d.

測試報告
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旭崇企業股份有限公司
FERINOX CORP.
桃園市大溪區美山路一段180號
NO. 180, SEC. 1, MEISAN RD., DAXI DISTRICT, TAOYUAN CITY 335, TAIWAN (R. O. C.)

測試項目 (Test Items)	單位 (Unit)	測試方法 (Method)	方法偵測極限值 (MDL)	結果 (Result) No.1
鹵素 / Halogen				
鹵素 (氟) / Halogen-Fluorine (F) (CAS No.: 14762-94-8)	mg/kg	參考BS EN 14582 (2016)，以離子層析儀分析. / With reference to BS EN 14582 (2016). Analysis was performed by IC.	50	n.d.
鹵素 (氯) / Halogen-Chlorine (Cl) (CAS No.: 22537-15-1)	mg/kg		50	n.d.
鹵素 (溴) / Halogen-Bromine (Br) (CAS No.: 10097-32-2)	mg/kg		50	n.d.
鹵素 (碘) / Halogen-Iodine (I) (CAS No.: 14362-44-8)	mg/kg		50	n.d.

備註(Note)：

1. mg/kg = ppm；0.1wt% = 1000ppm
2. n.d. = Not Detected (未檢出)
3. MDL = Method Detection Limit (方法偵測極限值)
4. (#2) =
   a. 當六價鉻結果大於0.13 μg/cm²，表示樣品表層含有六價鉻. / The sample is positive for Cr(VI) if the Cr(VI) concentration is greater than 0.13 μg/cm². The sample coating is considered to contain Cr(VI).
   b. 當六價鉻結果為n.d. (濃度小於0.10 μg/cm²)，表示表層不含六價鉻. / The sample is negative for Cr(VI) if Cr(VI) is n.d. (concentration less than 0.10 μg/cm²). The coating is considered a non-Cr(VI) based coating
   c. 當六價鉻結果介於 0.10 及 0.13 μg/cm² 時，無法確定塗層是否含有六價鉻. / The result between 0.10 μg/cm² and 0.13 μg/cm² is considered to be inconclusive - unavoidable coating variations may influence the determination.

PFOS參考資訊(Reference Information) : 持久性有機污染物 POPs - (EU) 757/2010

PFOS濃度在物質或製備中不得超過0.001%(10ppm)，在半成品、成品或零部件中不得超過0.1%(1000ppm)，在紡織品或塗層材料中不得超過1μg/m²。
(Outlawing PFOS as substances or preparations in concentrations above 0.001% (10ppm), in semi-finished products or articles or parts at a level above 0.1%(1000ppm), in textiles or other coated materials above 1μg/m².)

旭崇企業股份有限公司
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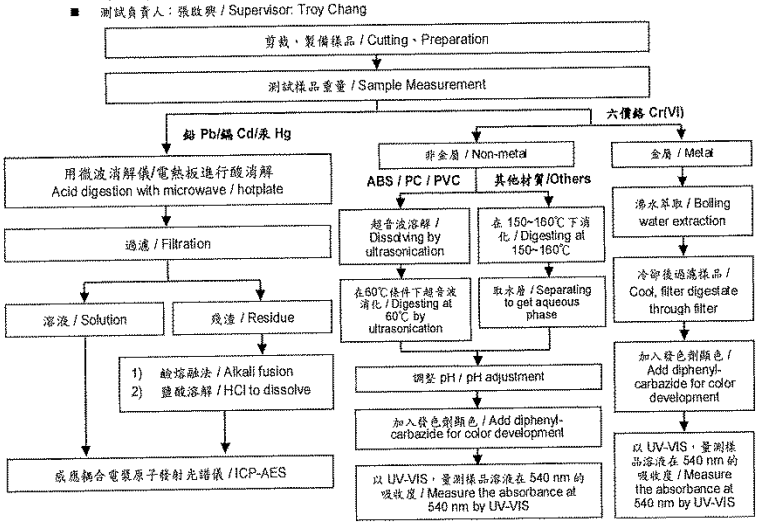
桃園市大溪區美山路一段180號
NO. 180, SEC. 1, MEISAN RD., DAXI DISTRICT, TAOYUAN CITY 335, TAIWAN (R. O. C.)

重金屬流程圖 / Analytical flow chart of Heavy Metal

根據以下的流程圖之條件，樣品已完全溶解。（六價鉻測試方法除外）
These samples were dissolved totally by pre-conditioning method according to below flow chart.（Cr^{6+} test method excluded）

- 測試人員：王志瑋 / Technician : JR Wang
- 測試負責人：張啟興 / Supervisor: Troy Chang



測試報告
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旭崇企業股份有限公司
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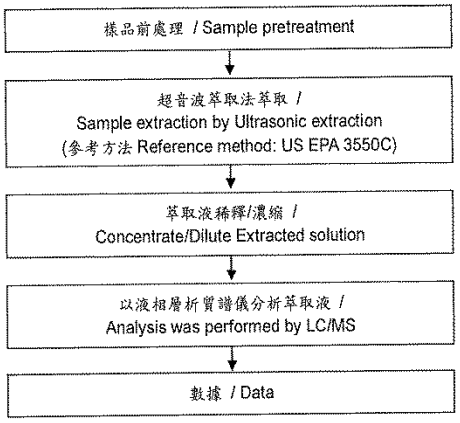
桃園市大溪區美山路一段180號
NO. 180, SEC. 1, MEISAN RD., DAXI DISTRICT, TAOYUAN CITY 335, TAIWAN (R. O. C.)

全氟辛酸/全氟辛烷磺酸分析流程圖 / Analytical flow chart - PFOA/PFOS

- 測試人員：涂雅岑 / Technician: Yaling Tu
- 測試負責人：張啟興 / Supervisor: Troy Chang

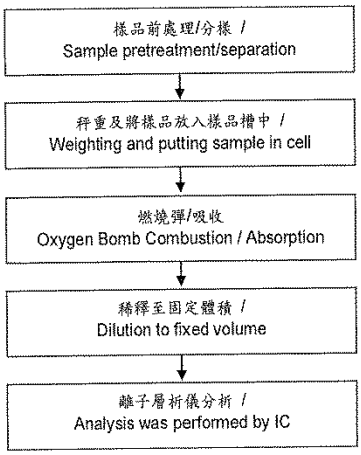


測試報告
Test Report

旭崇企業股份有限公司
FERINOX CORP.
桃園市大溪區美山路一段180號
NO. 180, SEC. 1, MEISAN RD., DAXI DISTRICT, TAOYUAN CITY 335, TAIWAN (R. O. C.)

鹵素分析流程圖 / Analytical flow chart - Halogen

- 測試人員：陳思臻 / Technician: Rita Chen
- 測試負責人：張啟興 / Supervisor: Troy Chang



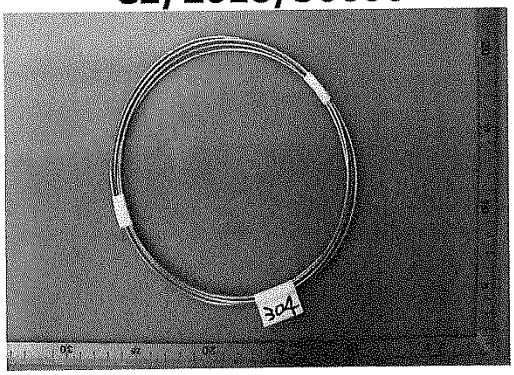
測試報告
Test Report

號碼(No.) : CE/2018/36600 日期(Date) : 2018/03/31

旭崇企業股份有限公司
FERINOX CORP.
桃園市大溪區美山路一段180號
NO. 180, SEC. 1, MEISAN RD., DAXI DISTRICT, TAOYUAN CITY 335, TAIWAN (R. O. C.)

* 照片中如有箭頭標示，則表示為實際檢測之樣品/部位. *
(The tested sample / part is marked by an arrow if it's shown on the photo.)

CE/2018/36600



** 報告結尾 (End of Report) **

7. Hardware：

燁興企業股份有限公司 YIEH HSING ENTERPRISE CO., LTD.

品 質 證 明 書
INSPECTION CERTIFICATE

82053 高雄市鳥山區白米里寶杉路 369 號
NO.369, Bao mi Rd., Baimi Village, Gangshan Dist.,
Kaohsiung City 82053, Taiwan, R.O.C.
TEL.: (07) 611-1111(10 Line) FAX: (07) 625-1280

客戶/住址 Client/Address	客戶編號 Client No.	交運日期 Delivery Date	證明書編號 Certificate No.	證明書日期 Issue Date
今陽工業股份有限公司 彰化縣大村鄉平和村山腳路 160 之 20 號 1 樓	D20334 36091481	03/03/2017	A1060303008	14/03/2017

品 名 Commodity: 不銹鋼熱軋固溶化酸洗線材 Stainless steel hot rolled, annealed, pickled wire rod
不銹鋼 304 線材

訂單編號 Order No.	鋼種名稱 Steel Grade	線徑 Dia.	軋製序號 Rolling No.	產品爐號 Heat No.	數量 Quantity	重量 (Wt.) Net(kg)	Gross(kg)
D2SP24105	304M4	5.50	712607	182215	2	3,301	3,303
D2SP24105	304M4	5.50	721503	182485	2	2,773	2,775
D2SP24105	304M4	5.50	721504	182486	6	9,341	9,347

1. We hereby certify that the material described herein has been manufactured and tested with satisfactory results in accordance with the requirement of the above material specification.
2. We certify that the material is free from radiation contamination.
【Atomic Energy Council：No.204(鋼搞偵字第 204 號)】
3. Quality Management System-ISO 9001:2008, Certificate No.7M8Y062-05.
4. Quality-Assurance System-PED:97/23/EC & AD2000-Merkblatt W0, Certificate No.01 202 TWN/Q-14 0272.
5. OHSAS 18001:2007-Certificate No.7M8H006-02.
6. The report can only be reproduced in full.

產品爐號 Heat No.		化學成分 (Chemical Composition) (%) C	Si	Mn	P	S	Ni	Cr	Mo	Cu	N
	Min						8.00	18.00			
	Max	0.080	1.00	2.00	0.045	0.030	10.50	20.00			0.100
		X100	X100	X100	X1000	X1000	X100	X100	X100	X100	ppm
182215 ✓		4.1	40	168	36	5	814	1806	16	30	340
182485		4.0	37	171	38	2	806	1823	13	24	300
182486		3.5	40	170	35	3	810	1818	14	24	370

機械性質 (Mechanical Properties) TS N/mm²	YS	EL (%)	RA (%)	Hv	晶粒 GS (#)
594		53	80	185	
604		54	80	186	
603		52	80	187	

備註 (Remarks):
This inspection certificate is issued acc. to EN 10204 2.2.

技術部主管
Manager of Technology Division
李炳泰

品質證明書
CERTIFICATE OF QUALITY

東盟開發實業股份有限公司
TUNG MUNG DEVELOPMENT CO.,LTD.
學甲廠：臺南市學甲區秀昌里13鄰一秀155號
Factory:No.155, Yi-Hsiu, 13 Lin, Hsiu-Chang Li, Hsueh-Chia District, Tainan City, Taiwan R.O.C.
Tel:886-6-7820280 Fax:886-6-7820494 E-mail:tung.mung@msa.hinet.net

客戶名稱 Customer	結進不銹鋼工業股份有限公司				客戶編號 Customer No.	M00036	證明書編號 Certificate No.	Q06031703	
鋼種名稱 Grade	304 板材		訂單編號 Order No.		依據規範 By Standard	CNS 8499:2016	開立日期 Issue Date	106/03/17	
項目 Item	鋼捲編號 Coil No.	爐號 Heat No.	表面加工 Surface Finish	厚度(mm) Thickness	寬度(mm) Width	長度(m) Length	數量 Quantity	重量(kgs) Weight	
1	139486-030000	170124B04	BA	0.31	1260	4046	1	12478	
2	139518-010000	170124A10	BA	0.41	1258	2485	1	10016	
3	139736-000000	270143006	No. 2B	0.48	1255	4046	1	19423	
4	139738-000000	270201024	No. 2B	0.39	1255	5028	1	19544	
5	139768-000000	270201012	No. 2B	0.48	1252	4034	1	19414	

規格 Spec.	化學成份 (Chemical Analysis Wt×%)									規格 Spec.	硬度 Hardness	抗拉強度(N/mm²) Tensile Strength	降伏強度(N/mm²) Yield Strength	伸長率(%) Elongation	彎曲試驗 Bend Test
項目 Item	C	Si	Mn	P	S	Ni	Cr	Mo	N	試片編號 Specimen No.	HV 200max.	520 min.	205 min.	40 min.	
1	0.045	0.50	1.07	0.031	0.003	8.03	18.15			6313K611	160.0	692	282	62	
2	0.039	0.48	1.11	0.031	0.004	8.03	18.22			6313L647	156.0	665	271	58	
3	0.050	0.45	1.02	0.022	0.003	8.11	18.25			6315B326	158.0	651	242	59	
4	0.034	0.44	1.03	0.023	0.004	8.17	18.20			6315B305	159.0	702	261	54	
5	0.048	0.43	0.95	0.024	0.004	8.13	18.31			6315B325	152.0	668	242	58	

茲證明本表所列產品，均依材料規格製造及試驗，並符合規格之要求。
We hereby certify that the products described herein have been manufactured and tested with satisfactory results in accordance with the requirement of the above material specification.
本產品無輻射污染，並且不含汞。
The material described above is free irradiation and free mercury.

備註：
Remark
106/2/12日
#304SUS 5×2×0.5 華司用

技術部經理
Manager,Technology Department
王俊評