


자재시방서(승인원)	기안자	강윤우 연구원/연구2팀 (032-650-6276)
	완료일	2012-06-04 11:45:30 AM

작성부서	기안	그룹장	팀장
	강윤우	곽귀동	유종은
			
	06-01 08:38	06-01 10:20	06-04 11:30

주관부서	사원
	정성엽
	
	06-04 11:45

문서번호	A연2613-0976-영(수시)		
이관항	승인원	공개 범위	사업담당 R&D센터 연구2팀
수신처	중국법인지원팀,구매3팀,구매1팀,구매2팀		
참조자	kuens, 강성모, 고만석, 김경성, 김경택, 김동현, 문형필, 안병준, 오철규, 이광열, 이기영, 정대혁, 정태희, 최민규		
문서제목	E606-00006-002-0S		
자 재 코 드	E606000060020S		
자 재 명	ANTENNA,MODULE		
규 격	ABM6020B2 BLUETOOTH CHIP ANT SMD(6*2)		

모 델 명	SA-SWR3		
설계변경 NO	REV NO.	일자	내 용
중점 Check 사항			
환경문서번호			
검 사 방 식	수입검사 규칙(B0-B701-01)에 준하여 검사할 것.		
구 입 방 법	<input checked="" type="checkbox"/> 내수 <input type="checkbox"/> LOCAL <input type="checkbox"/> 수입		
협력업체명	ARRO	제조업체명	ARRO
첨 부 자 료	<input checked="" type="checkbox"/> 협력업체승인원 <input type="checkbox"/> 도면 <input type="checkbox"/> 검사성적서 <input type="checkbox"/> 유해물질 불사용 확인서 <input type="checkbox"/> 부품재질별 성적서		
첨부파일경로	HTTP://HTE4SVR2.INKEL.CO.KR/WEBDIR/APPROVAL/E606-00006-002-0S.PDF		




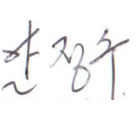
※ 첨부파일 경로 예시 : [HTTP://HTE4SVR2.INKEL.CO.KR/WEBDIR/APPROVAL/](http://HTE4SVR2.INKEL.CO.KR/WEBDIR/APPROVAL/)자재코드.PDF

IMS-B101-07/01(1)

개발 단가		부품 타입	SMD	LIB	
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안테나 부품 승인원

결 재	담 당	품질팀장	개발팀장	승 인
				
	이승찬	조병환	이승효	남정수
	5/8	5/8	5/8	5/8

BUYER	인켈
모 델 명	UPPER
부 품 명	BLUETOOTH CHIP ANTENNA
부품코드	
아로코드	ABM6020B2

경기도 안양시 만안구 안양7동 205-11
TEL : 031)448-8172 / FAX : 031)448-4194

안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	2/24	2/23

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12. 포장 사양

12.1 Carrier 및 Reel 사양

12.2 박스 포장 사양

* 부품 구성표, 유해물질 성적서 별첨

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1. 승인원 이력 LIST

NO	일자	변경 전	변경 후	근거 사유	REV
1	2012.05.08			ANTENNA 단품도면 신작	1.0
2					
3					
4					
5					

※ 상기 REV.은 승인 후 양산중의 변경사항에 대해서만 REVISION 변경 함.
개발중의 변경사항에 대해서는 REVISION 변경 없음.

2. 제품사양

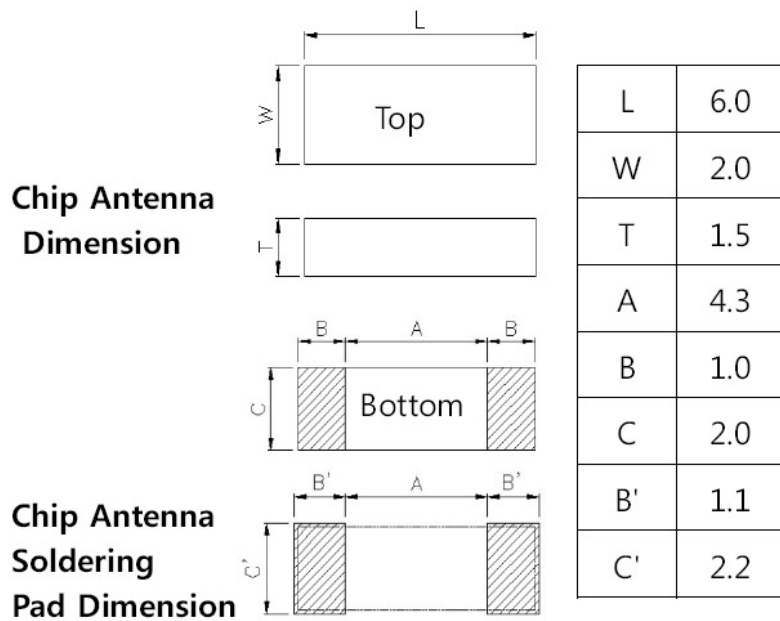
2.1 재질 증명서

구분	균질재질명	조성물질명	가공처리	원소재업체	가공업체	재료상태	비 고
1	POLYMER	480R	Tape 성형	ZEONEX	아로㈜	RESIN	
2	POWDER	strontium titanate	Tape 성형	FERRO	아로㈜	POWDER	
3	PREPLEG	GLASS FIBER	적층	DOOSAN	써키트로닉스	SHEET	두께 : 0.1mm
4	Cu Foil	Cu	적층	LS산전	써키트로닉스	Foil	두께 : 0.018mm
5	PSR	Epoxy acrylate pligomer	인쇄	서울화학	써키트로닉스	INK	
6	Ni Plate	Ni	도금	오알캠	써키트로닉스	용액	두께 Ni 3um 이상
7	Au Plate	Au	도금	오알캠	써키트로닉스	용액	두께 Au 0.03um 이상

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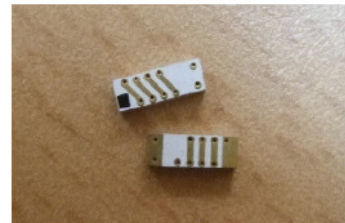
2.2 치수 규격

➤ Mechanical Dimension



(unit : mm , tolerance : ± 0.1)

Chip Antenna Real Product



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3. 기술적 사항

3.1 일반적 사양

MODEL	UPPER
ANTENNA TYPE	B.T CHIP ANTENNA
APPLICATIONS	Wi-Fi

3.2 전기적 사양

FREQUENCY RANGE[MHz] (SET MEASUREMENT)	2,400~2483 MHz	
MEASUREMENT FREQUENCY POINT[MHz] (SET MEASUREMENT)	2,400	2,483
V.S.W.R (SET MEASUREMENT)	MAX 1.5	MAX 1.6
TOTAL GAIN(PEAK/AVG)[dBi](F/O)	3.8/-5.6	
INPUT IMPEDANCE(Ω)	50 Ohm	
POLARIZATION	LINEAR	
RADIATION PATTERN	OMNIDIRECTIONAL	

3.3 기구적 사양

CONNECTOR	N/A
LENGTH	REF DRAWING (No 6.1)
TEMPERATURE	-20 ~ 70(℃)
WEIGHT	0.1(g)

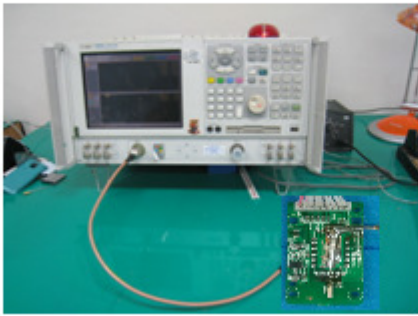
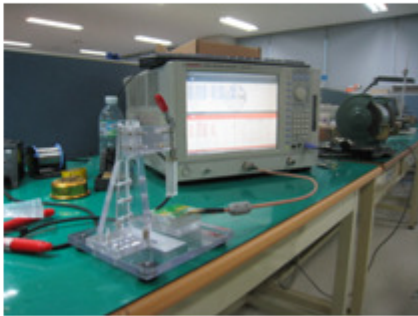
안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	7/24	7/23

4. 시험 조건

4.1 시험 환경 조건 및 시험 장비

4.1.1 SWR/Return Loss

Network Analyzer를 이용하여 SWR/Return Loss를 측정하여 표본 샘플을 선별, 수동 측정 지그 또는 자동화 검사 장비를 이용하여 양품과 불량품을 선별한다.

	시료 측정 조건	수동 지그 측정 조건
Network Analyzer	Agilent E8358A	Advantest R3768
cable	RF cable(300 mm)	RF cable(300 mm)
Test condition		

4.1.2 이득

당사가 보유한 무반사실에서 상기 4.1.1 에서 측정된 시료를 이용하여 안테나 이득을 측정한다.

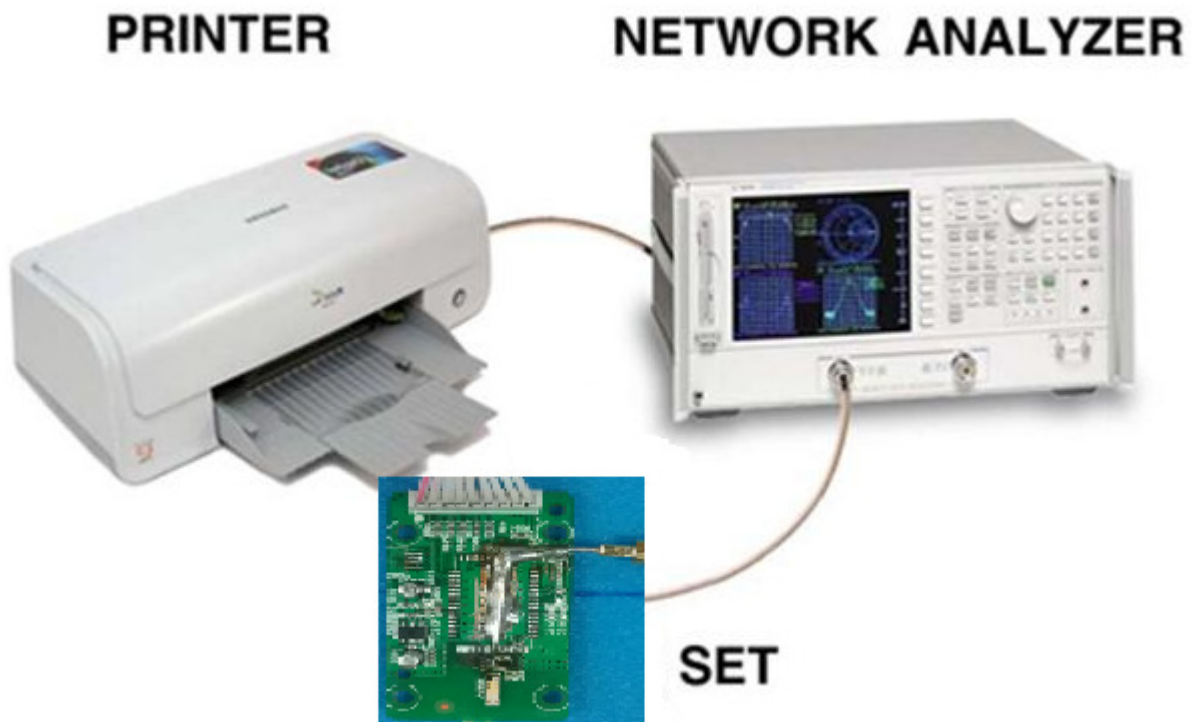
안테나 측정을 위한 무반사실	
	
	

안테나 승인원		DATE	2012. 05. 08	REV.	1.0
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5. 전기적 요구 사항

5.1 정재 파비 측정 조건

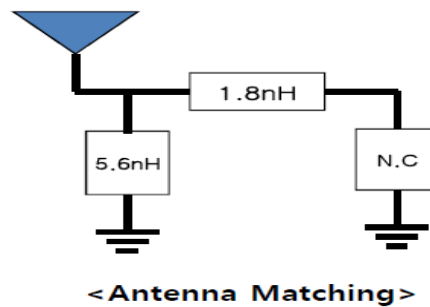
측정방법 : 그림 5-1과 같이 장비를 연결하고 NETWORK ANALYZER의 REFLECTION POINT에 안테나가 장착된 시료를 연결하여 사용주파수 대역 내에서의 IMPEDANCE를 측정한다.



(그림 5-1)

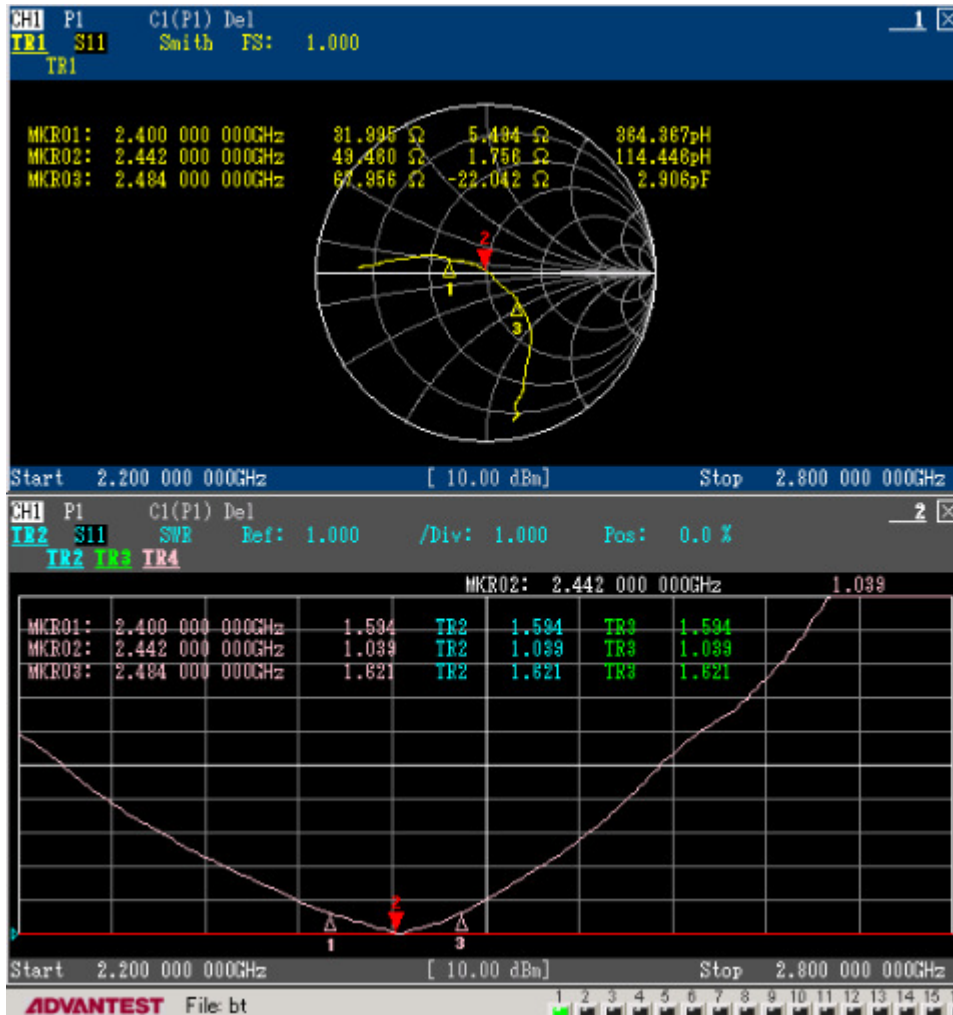
5.2 정재 파비

5.2.1 매칭회로



5.2.2 Network data

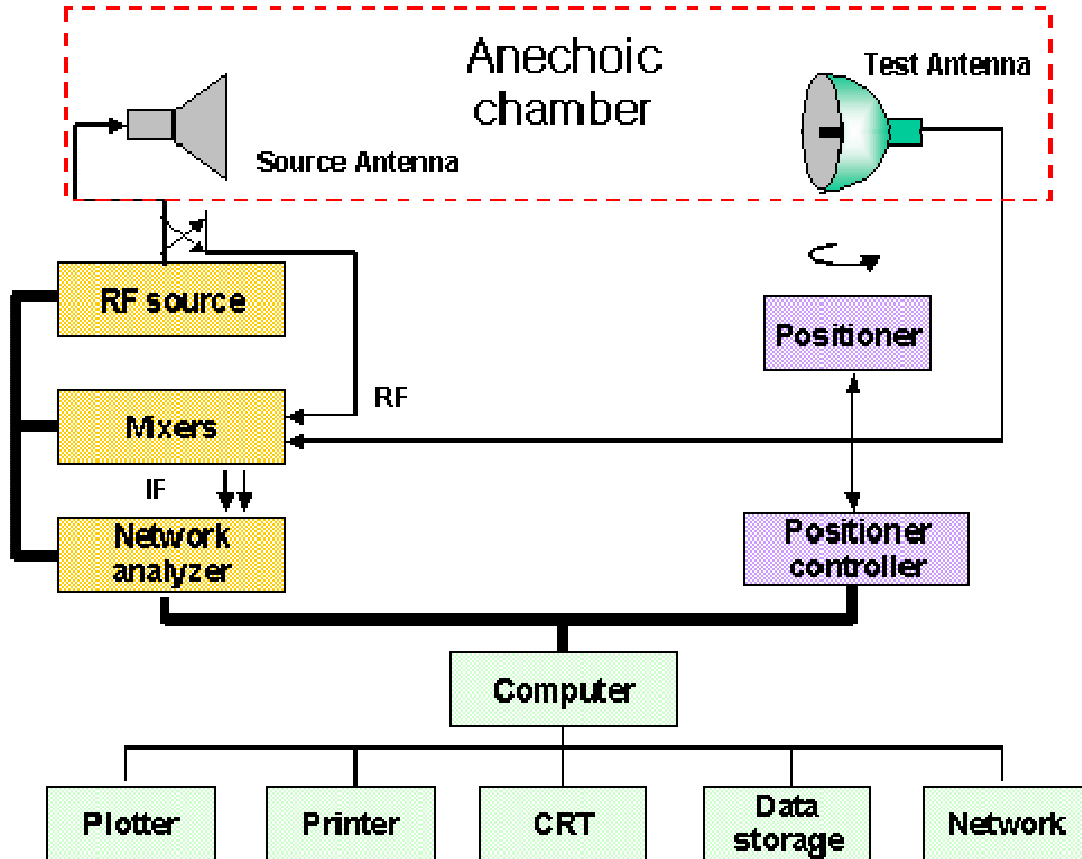
안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	9/24	9/23



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MODEL	UPPER	TYPE	BLUETOOTH CHIP	10/24	10/23

5.3 안테나 이득 측정 조건

측정 방법 : 그림 5-2와 같이 혼 안테나를 표준 안테나로 설정하여 [dBi]로 나타내었다.



(그림 5-2)

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5.4 안테나 이득

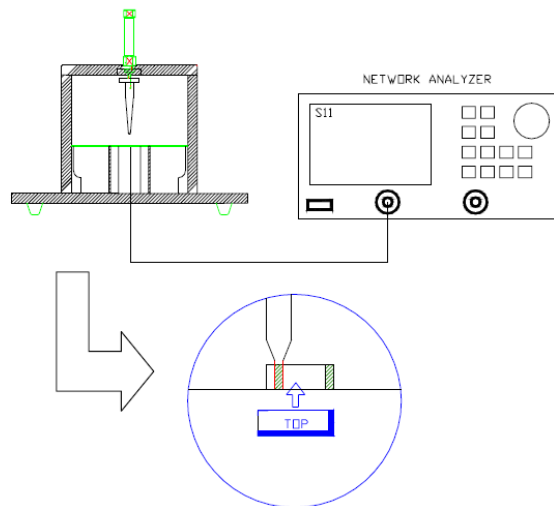
5.4.1 Passive data(3D Measurement)

Frequency	Efficiency	Average Gain			Max Gain			Max Position	Directivity
		Ver	Hor	Total	Ver	Hor	Total		
2400.000000 MHz	29.3 %	-4.3 dBi	-3.9 dBi	-0.4 dBi	3.4 dBi	3.0 dBi	0.4 dBi	Theta165/Pie105	0.78 dB
2420.000000 MHz	30.5 %	-4.3 dBi	-3.7 dBi	-0.6 dBi	3.4 dBi	3.1 dBi	0.3 dBi	Theta150/Pie165	0.97 dB
2440.000000 MHz	35.5 %	-4.0 dBi	-3.5 dBi	-0.5 dBi	3.3 dBi	3.1 dBi	0.2 dBi	Theta150/Pie165	0.79 dB
2460.000000 MHz	33.1 %	-4.2 dBi	-3.6 dBi	-0.6 dBi	2.5 dBi	2.3 dBi	0.2 dBi	Theta150/Pie165	0.85 dB
2483.000000 MHz	25.9 %	-4.7 dBi	-4.1 dBi	-0.6 dBi	2.4 dBi	2.1 dBi	0.3 dBi	Theta150/Pie165	0.87 dB

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5.5 수동 지그 측정 방법

측정방법 : 그림 5-3과 같이 장비를 연결하고 NETWORK ANALYZER의 REFLECTION POINT에 특성 측정지그를 연결하여 표본 샘플을 선별, 수동 측정 지그 또는 자동화 검사 장비를 이용하여 양품과 불량품을 선별한다

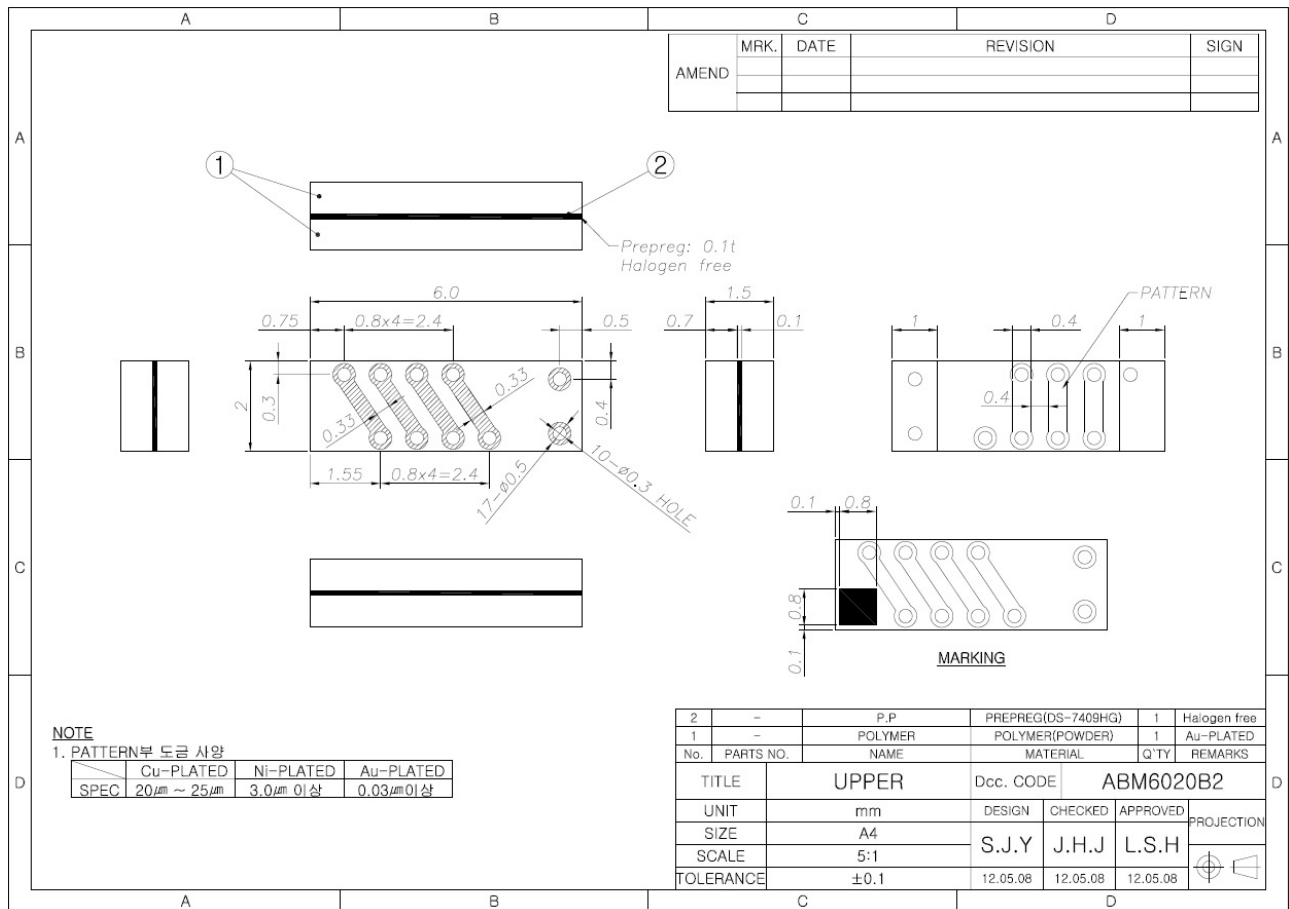


(그림 5-3)

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6. 기구적 요구 사항

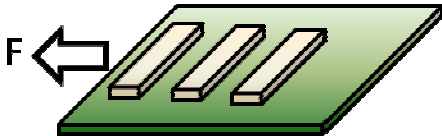
6.1 기구적 도면



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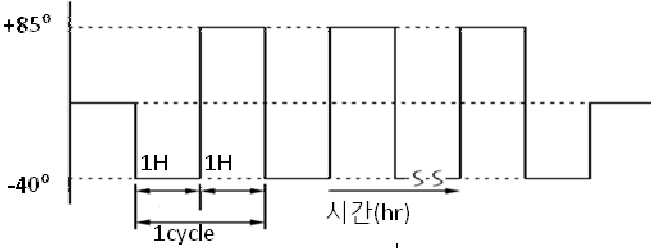
7. 신뢰성 요구 사항

7.1 기계적 실험

항목	시험방법	판정
낙하시험	<ul style="list-style-type: none"> 조건 : 높이 150 cm (10 면 = 6 면+모서리 4 개소) 1 회 실시 셋트무게 (인테나 실장 후 시험) 바닥 : 콘크리트 또는 철판. 	<ul style="list-style-type: none"> 외관및 전기적특성 확인
도금두께	<ul style="list-style-type: none"> 도금두께 측정기를 이용하여 하도 Ni 과 상도 Au 의 두께 측정 	<ul style="list-style-type: none"> Ni : 3 μm 이상 Au : 0.03 μm 이상
SMT 고착강도시험	<ul style="list-style-type: none"> SMT 완료된 제품을 F 방향으로 힘을 가하여 이탈되는 힘을 측정한다. (시험 speed 24 min/mm) 	<ul style="list-style-type: none"> 5 kgf 이상

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7.2 환경 시험










고습저장시험	<ul style="list-style-type: none"> 60°C 95%에서 48 시간 저장 	<ul style="list-style-type: none"> 외관및 전기적특성 확인
저온저장시험	<ul style="list-style-type: none"> -40°C 에서 48 시간 저장 	<ul style="list-style-type: none"> 외관및 전기적특성 확인
열충격시험	<ul style="list-style-type: none"> 온도 조건 : $-40\pm 3^{\circ}\text{C}/\text{min} \leftrightarrow +85\pm 3^{\circ}\text{C}/\text{min}$ 시험 CYCLE : 27cycle 온도 변환 시간 : 5min 미만일 것. 	<ul style="list-style-type: none"> 외관및 전기적특성 확인
염수분무시험	<ul style="list-style-type: none"> 5% 염수, 35°C에서 48hr 방치후 외관 , 전기적특성 확인 	<ul style="list-style-type: none"> 외관및 전기적특성 확인

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8. 칩 안테나 제조 공정도

제정일자		개정No		Page No		폴리머 칩 안테나 제조 공정도					관리No	작성부서	작성	검토	승인	
2012.05.08				1/1							ARQC-120508	품질관리	L.J.S		C.B.H	
MODEL		UPPER														
공정구분	투입재료 부품	FLOW CHART			공정명	관련표준	요인관리				특성관리				관련 불량	관리 담당
	재료 부품명	재료 부품	생산 공정	QC 검사			설비 지공구	관리 항목	관리 빈도	기록 방법	검사 항목	계측기	검사 빈도	기록 방법		
사내 공정	폴리머 원료				수입검사	-					수량 무게	육안 저울	每LOT SPL'	-		검사원
					배치 (1차,2차)	작업지 도서	교반기 탈포기 외				외관 교반상태	육안	전수	작업일지	조립 외관	작업자
					캐스팅 * CTQ (시트두께)	작업지 도서	캐스팅 장비	두께	每로트	작업 일지	외관 시트두께	육안 마이크로미터	每LOT SPL'	작업일지	외관 시트두께	작업자
외주 공정	폴리머 시트				입고검사	-					외관 두께	육안 h/g	每LOT SPL'	-	외관 두께	검사자
					적층	작업지 도서	적층장비	적층온도	每로트	작업 일지	외관 두께	육안 h/g	每LOT SPL'	작업일지	외관 두께	작업자
					post baking	작업지 도서	적층장비	온도	每로트		외관	육안	每LOT		외관 수축	작업자
					CNC드릴	작업지 도서	CNC머신	홀 내경: 300μm 12만RPM			홀 내경	확대경	每LOT		이물불량	작업자
					CNC 검사	검사기준서	현미경	홀 내경: 300μm 드릴 상태			홀 내경 외관 이물	확대경	每LOT	검사파일	이물불량 치수불량	검사자

안테나 승인원				DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER			TYPE	BLUETOOTH CHIP	17/24	17/23

공정 구분	FLOW CHART				공정명	관련표준	요인관리				특성관리				관련 불량	관리 담당
	투입재료 부품	재료 부품명	생산 공정	QC 검사			설비 지공구	관리 항목	관리 빈도	기록 방법	검사 항목	계측기	검사 빈도	기록 방법		
의주 공정					플라즈마	작업지도서	플라즈마 장비	70℃ , 15min		작업 일지	외관	육안	毎LOT SPL'	작업일지		작업자
					무전해 동도금	작업지도서	도금장비	clean 65℃ 화확동 40℃		작업 일지	외관	육안	毎LOT	작업일지	도금	작업자
					D/F 전해동도금 예칭	작업지도서	도금장비	도금두께: 55~60μm		작업 일지	외관	육안	毎LOT	작업일지	도금	작업자
					PSR	작업지도서	인쇄기	경화온도 130℃ 시간 15분		작업 일지	외관	육안	毎LOT	작업일지	균열	작업자
					금도금	작업지도서	도금장비	도금온도 80℃ Ni : 3μm 이상 Ai : 0.03μm 이상		작업 일지	외관 두께	육안 도금두께 측정기	毎LOT		이물 광택 두께	작업자
					검사	검사기준서	-	Ni : 3μm 이상 Ai : 0.03μm 이상			외관 두께	육안 도금두께 측정기	毎LOT		이물 광택 두께	검사자
					BBT 검사	-	검사장비	회로 연결상태		작업 일지	도통상태 외관	-	毎LOT		단선불량	검사자
	진공포장력					포장	작업지도서	진공포장기	포장상태 毎로트	-	수량 포장상태	육안	毎LOT		수량오류 포장불량	작업자
				아로납품												

공정 구분	투입재료 부품	FLOW CHART			공정명	관련표준	요인관리				특성관리				관련 불량	관리 담당
		재료 부품명	생산 공정	QC 검사			설비 지공구	관리 항목	관리 빈도	기록 방법	검사 항목	계측기	검사 빈도	기록 방법		
사내 공정	적층 완료품		수입검사 * CTQ (적층두께)	작업지도서	확대경 비니에틸리퍼스	두께	毎로트	작업 일지	외관 두께	육안 비니에틸리퍼스	毎LOT SPL'	검사파일	외관 적층두께	검사원		
			다이싱	작업지도서	다이싱saw	치수	毎로트	작업 일지	외관 치수	육안 비니에틸리퍼스	毎LOT SPL'	작업일지	외관 치수	작업자		
			공정검사 * CTQ (VSWR)	검사기준서	VNA 특성검사 JIG	VNA CAL-상태	毎로트	작업 일지	VSWR	VNA	전수	검사파일	특성	검사자		
	물품명세표 진공포장력		출하검사	검사기준서						외관 도금상태 치수 특성	육안 V/C VNA	SPL'	출하검사 영역서	외관 치수 특성	검사원	
			포장	작업지도서	진공포장기	전공정 양감 및, 실내화 확통										
		출하														

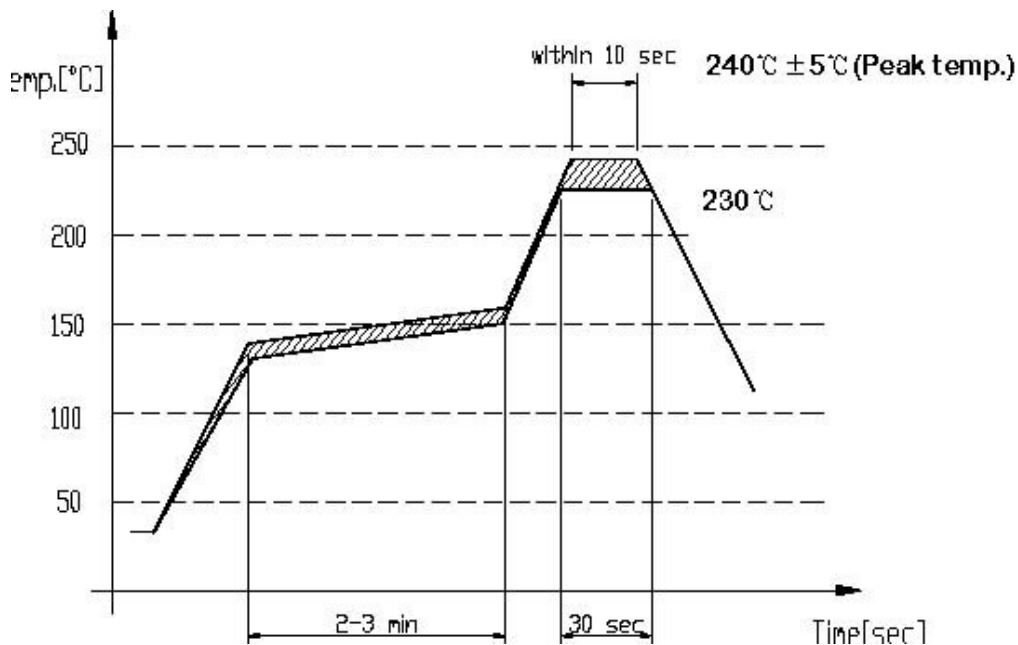
안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	18/24	18/23

안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	19/24	19/23

9. 납땜 조건(Pb Free)

- 안테나의 특성 저하를 막기 위해 다음과 같은 납땜 조건을 지켜야 한다.
 - Reflow soldering 조건으로 납땜을 진행하여야 하며, Flow soldering을 하여서는 안 된다.
 - 비활성 Flux 를 사용하여야 한다.(최대 CI 함량 0.2% 미만)
 - Reflow cycle 횟수는 3 회 이내로 해야 한다.

Solder paste : Ag/Sn/Cu:96.5/3.0/0.5



(그림 9-1)

10. 주의 사항

- 보관환경은 -5 ~ 40°C, 상대습도 70% 이내의 대기에서 보관되어야 한다. (MSL Level 1)
- Dielectric Chip Antenna는 고온/고습에서 사용하거나 또는 황이나 염소가스에 노출될 경우 전극의 납땜성 저하를 일으킬 수 있다.
- Dielectric Chip Antenna 자체 무게에 의한 재료의 crack을 막기 위해 기계적 충격(낙하 등)을 피해야 한다.
- Dielectric Chip Antenna는 6개월 이내에 사용되어야 하며 6개월이 경과한 칩은 사용하기 전에 반드시 납땜성을 확인하여야 한다.
- 안테나를 수동으로 납땜 시, 인두기의 온도를 360도 이하로 설정하고, 안테나와 직접 닿지 말아야 하며, 10초 이상 열을 가하지 말아야 한다.

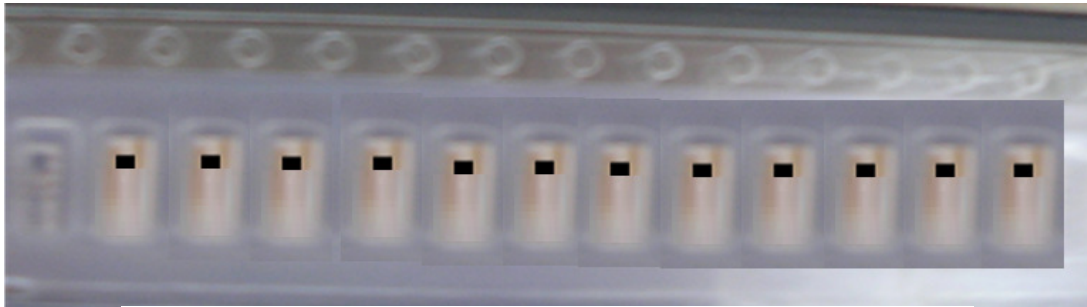
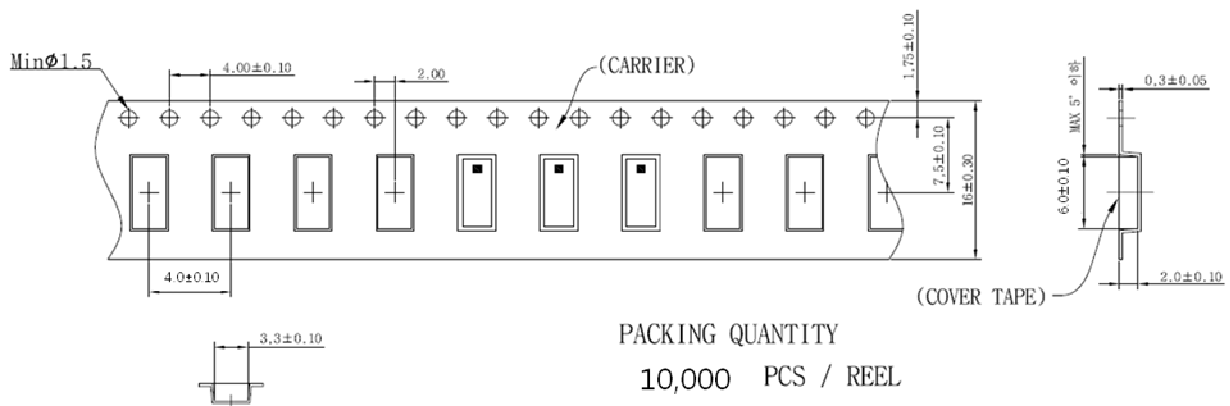
※ 수리 시 납땜 온도는 360 °C 이하로 관리요망.

안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	20/24	20/23

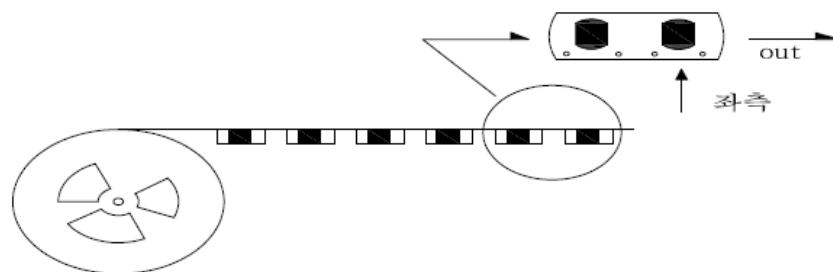
11. 포장 사양

11.1 CARRIER 및 REEL 사양

1) CARRIER 사양



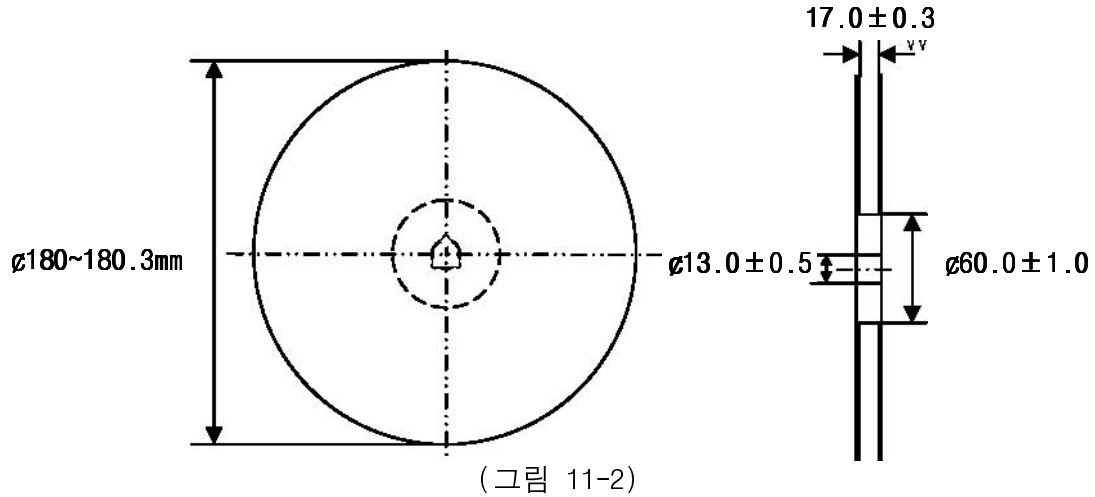
TAPING STYLE



(그림 11-1)

안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	21/24	21/23

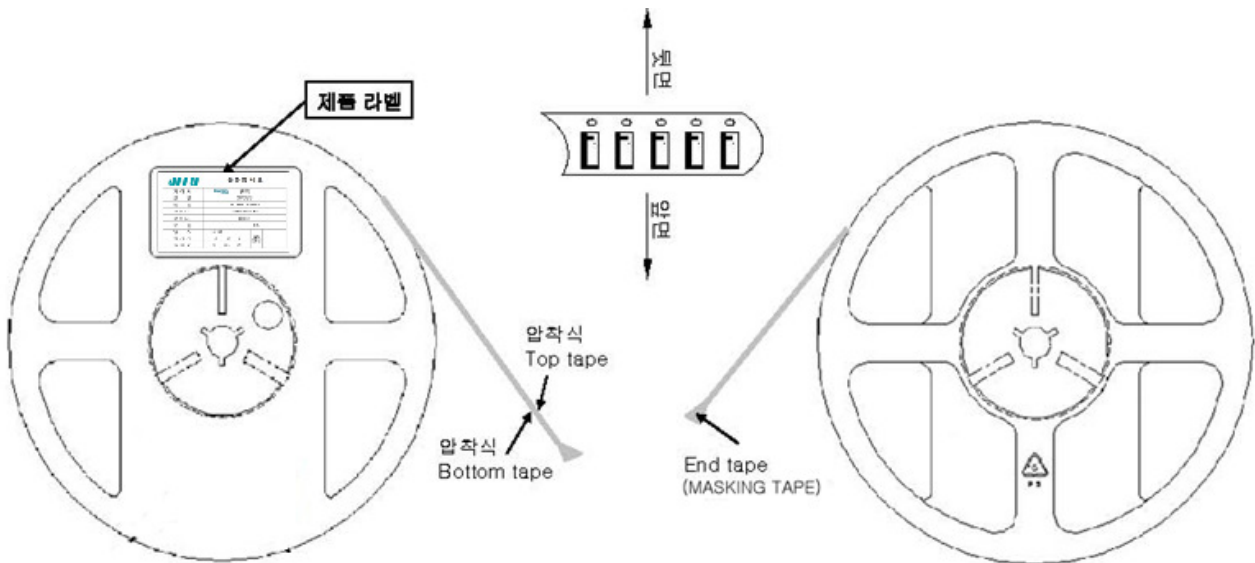
2) REEL 사양



3) 재질 및 표면 저항

품명	재질	표면저항
CARRIER	A-PET	$10^9 \sim 10^{11} \Omega$
COVER TAPE	PET	$10^8 \sim 10^{11} \Omega$
REEL	GPPS (General Purpose Poly Styrene) resin.	$10^9 \sim 10^{11} \Omega$

1) 라벨 부착 및 Winding 방법



(그림 11-3)

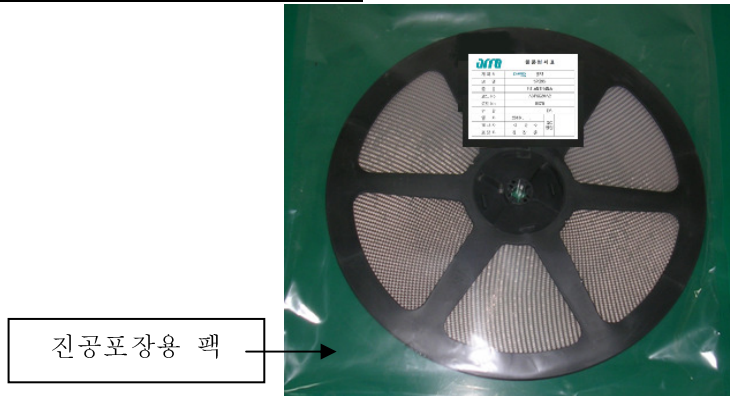
안테나 승인원		DATE	2012. 05. 08	REV.	1.0
MODEL	UPPER	TYPE	BLUETOOTH CHIP	22/24	22/23

11.2 박스 포장 사양

1) 진공 포장 사양 라벨 종류 및 내용

※ REEL 포장후 명세표를 부착후 (그림 11-4)와 같이 진공 포장을 한다.

[1REEL 에 10,000 pcs 포장]



(그림 11-4)

※ 포장작업 시 현품 표와 제품 및 수량을 필히 확인 한다.

2) 박스 포장 및 라벨 부착 방법

- 진공 포장된 제품을 BOX (340* 340 * 52)에 2개를 넣은 후, 그림 11-5와 같이 라벨을 부착한다. (1BOX = 2REEL = 20,000EA)



(그림 11-5)

취급 주의 사항

본 제품 취급 시 외부충격(낙하, 과부하 적재 등)이 있을 경우 제품에 이상이 발생할 수 있으니 취급 주의 할 것.



Test Report No. F690501/LF-CTSAYN11-001735

Issued Date: 2011. 02. 11 Page 1 of 3

To: **LS MTRON LTD.**
938-1, Jeongeup 3 Industrial Complex
Taegok-ri, Buk-myeon
Jeongeup-city
JEONBUK
Korea

The following merchandise was submitted and identified by the client as :

SGS File No. : AYAA11-04593
Product Name : Copper Foil
Item No./Part No. : UCF-STN
Received Date : 2011. 02. 09
Test Period : 2011. 02. 10 to 2011. 02. 11
Test Results : For further details, please refer to following page(s)
Test Performed : SGS Testing Korea tested the sample(s) selected by applicant with following results.

SGS Testing Korea Co. Ltd.

Jeff Jang / Chemical Lab Mgr

Timothy Jeon
Jinhee Kim
Cindy Park
Jerry Jung/ Testing Person

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Test Report No. F690501/LF-CTSAYN11-001735

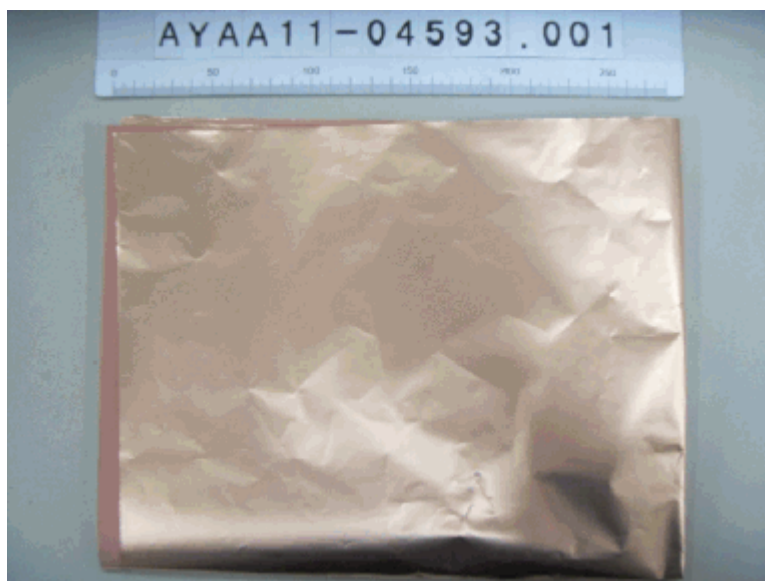
Issued Date: 2011. 02. 11 Page 2 of 3

Sample No. : 001
 Sample Description : Copper Foil
 Item No./Part No. : UCF-STN

Halogen Contents

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	BS EN 14582:2007 , IC	30	N.D.
Chlorine(Cl)	mg/kg	BS EN 14582:2007 , IC	30	N.D.
Fluorine(F)	mg/kg	BS EN 14582:2007 , IC	30	N.D.
Iodine(I)	mg/kg	BS EN 14582:2007 , IC	50	N.D.

Picture of Sample as Received:

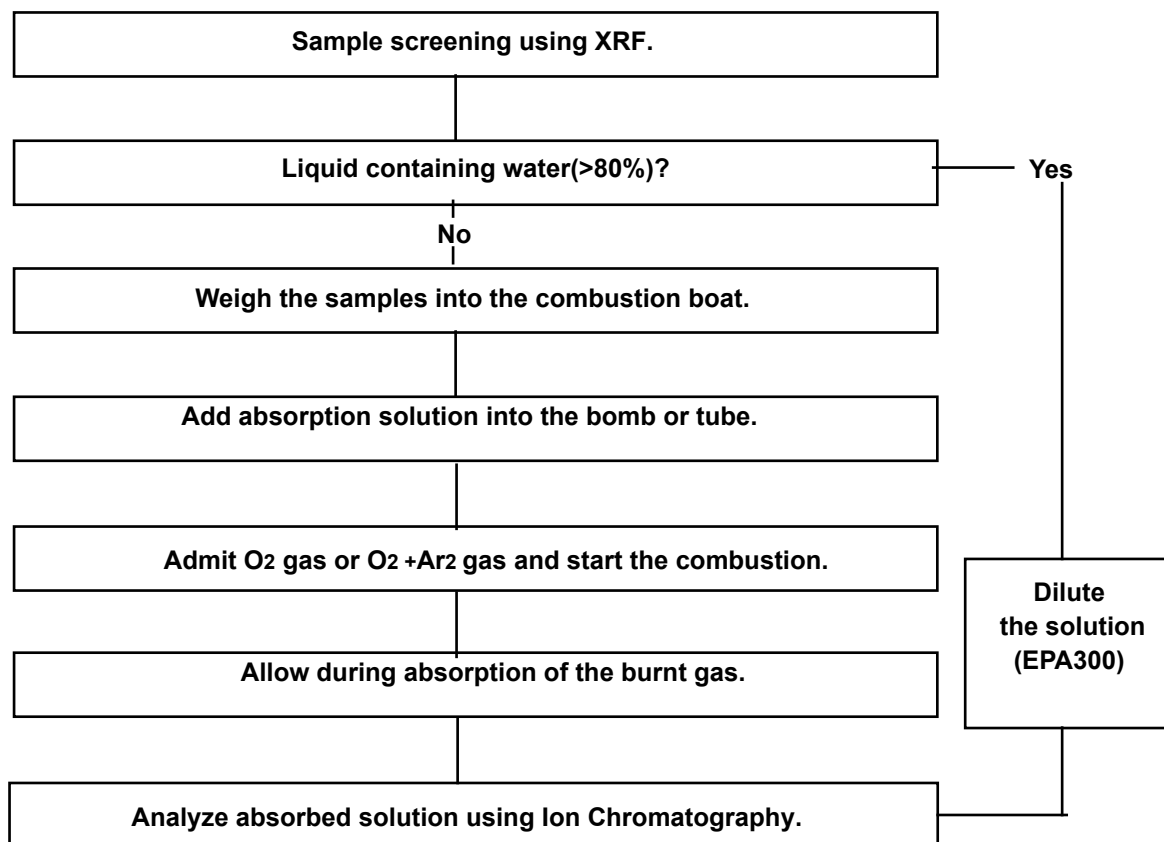


- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) Negative = Undetectable / Positive = Detectable

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Flow Chart for Halogen Test



*** End ***

- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) Negative = Undetectable / Positive = Detectable

according to Regulation (EC) No. 1907/2006 REGULATION (EC) No 1272/2008

1. PRODUCT AND COMPANY IDENTIFICATION**Product Identifier**

EC-No. 235-044-1
Product Name 218 Strontium Titanate 50 Lb Pail
Product Code: 1014629
CAS-No 12060-59-2

Relevant identified uses of the substance or mixture and uses advised against

Recommended Use For use in industrial installations only

Uses advised against Toys and food contact

Details of the supplier of the safety data sheet**Supplier**

Ferro Corporation
Electronic Material System
1789 Transelco Drive
Penn Yan, NY 14441 USA

For further information, please contact

E-mail address c-palkog@ferro.com

Emergency telephone number

Chemtrec: 1-800-424-9300 for US/ 703-527-3887 outside US

Emergency telephone §45 - (EC)1272/2008

2. HAZARDS IDENTIFICATION**Classification of the substance or mixture**

REGULATION (EC) No 1272/2008

Not classified

Classification according to EU Directives 67/548/EEC or 1999/45/EC

For the full text of the R-phrases mentioned in this Section, see Section 16

Symbol(s)

Not dangerous goods

Label Elements

Not classified

Other Hazards**3. COMPOSITION/INFORMATION ON INGREDIENTS**

Components	EC-No.	CAS Number	Weight %	Classification 67/548/EC	CLP Classification	REACH No.
Strontium Titanate	235-044-1	12060-59-2	100			

For the full text of the R-phrases mentioned in this Section, see Section 16

4. FIRST AID MEASURES

Description of first-aid measures

Eye contact:	Rinse immediately with plenty of water, also under the eyelids Get medical attention if irritation develops
Skin contact:	Wash off immediately with soap and plenty of water Remove and wash contaminated clothing before re-use If symptoms persist, call a physician
Ingestion:	Drink plenty of water. Do not induce vomiting without medical advice. Consult a physician if necessary.
Inhalation	Move to fresh air in case of accidental inhalation of vapors or decomposition products
Most important symptoms and effects, both acute and delayed	
No information available.	
Indication of immediate medical attention and special treatment needed	
Protection of first-aiders:	Treat symptomatically

5. FIRE-FIGHTING MEASURES

Extinguishing media

Suitable extinguishing media:	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment
Extinguishing media which must not be used for safety reasons:	No information available.

Special hazards arising from the substance or mixture

Special exposure hazards arising from the substance or preparation itself, combustion products, resulting gases	None in particular.
--	---------------------

Advice for emergency responders

Special protective equipment for fire-fighters	As in any fire, wear self-contained breathing apparatus and full protective gear.
---	---

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions:	Avoid dust formation Avoid contact with skin, eyes and clothing Use personal protective equipment Evacuate area of all unnecessary personnel
Other information	See Section 8 for additional information

Environmental precautions

Prevent further leakage or spillage if safe to do so Do not let product enter drains Do not flush into surface water or sanitary sewer system

Methods and materials for containment and cleaning up

Sweep up and shovel into suitable containers for disposal. Clean contaminated surface thoroughly. Dispose of promptly.

Reference to other sections

See Section 13 for additional information.

7. HANDLING AND STORAGE

Precautions for Safe Handling

Handling:	Handle in accordance with good industrial hygiene and safety practice
Hygiene measures	Safety glasses

Conditions for safe storage, including any incompatibilities

No information available.

Specific End Uses
Exposure Scenario
Other Guidelines

No information available

No information available

8. EXPOSURE CONTROLS / PERSONAL PROTECTION**Control parameters****Exposure Limits**

This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies.

Derivation of DNEL(s)

No information available

Derivation of the PNEC

No information available.

Exposure controls**Engineering measures:**

Provide appropriate exhaust ventilation at machinery and at places where dust or fumes can be generated Ensure that eyewash stations and safety showers are proximal to the work-station location

Personal protective equipment**Eye Protection:**

Safety glasses with side-shields.

Hand protection:

Impervious gloves

Skin and body protection:

Lightweight protective clothing

Respiratory protection:

Use NIOSH approved respirator when ventilation is inadequate

Hygiene measures

No information available

Environmental Exposure Controls

No information available

9. PHYSICAL AND CHEMICAL PROPERTIES**General Information****Physical state**

Powder

Color:

White

Odor:

Odorless

Important health safety and environmental information**Flash Point**

Not combustible.

Flammability (solid, gas):

No information available

Boiling point/boiling range

No information available.

pH

No information available

Vapor pressure :

No data available

Viscosity22 mm² s⁻¹**Water solubility:**

Insoluble

Specific gravity (Water =1):

4.600

Oxidizing properties

No information available

Evaporation Rate (Water = 1)

No information available

Relative density :

No information available

Vapor density:

No information available

Explosive properties:

No information available

Other information**Refractive index:**

No data available

Surface tension:

No data available

10. STABILITY AND REACTIVITY**Reactivity**

No data available

Chemical Stability

Stable under normal conditions.

Possibility of Hazardous Reactions

Hazardous Polymerization

None under normal processing.

Conditions to Avoid

Do not freeze

Incompatible materials

To avoid thermal decomposition, do not overheat

Hazardous Decomposition Products

None under normal processing

11. TOXICOLOGICAL INFORMATION

Information on toxicological effects

Acute Toxicity

Product information

Inhalation

Eye Contact

Skin Contact

Ingestion

Product does not present an acute toxicity hazard based on known or supplied information.

May cause irritation of respiratory tract.

May cause irritation.

Substance may cause slight skin irritation.

May cause irritation

Irritation

Corrosivity

Sensitization

Mutagenic Effects:

No information available.

No information available.

No information available

No information available

Carcinogenic Effects

Reproductive Toxicity

No information available.

No information available

Developmental Toxicity

STOT - single exposure

STOT-repeated exposure

Aspiration Hazard

Endocrine Disruptor Information

No information available

No information available

No information available

No information available

This product does not contain any known or suspected endocrine disruptors

12. ECOLOGICAL INFORMATION

Toxicity

Ecotoxicity Effects

Contains no substances known to be hazardous to the environment or that are not degradable in waste water treatment plants.

Persistence and degradability

No information available

Bioaccumulative potential

No information available

Mobility in soil

No information available

Results of PBT and vPvB assessment

Not classified

Other adverse effects

Endocrine Disruptor Information

This product does not contain any known or suspected endocrine disruptors

13. DISPOSAL CONSIDERATIONS**Waste treatment methods****Waste from Residues/Unused Products**

Dispose of in accordance with local regulations.

Contaminated Packaging

Empty containers should be taken to an approved waste handling site for recycling or disposal.

14. TRANSPORT INFORMATION**IMDG/IMO**

Not regulated

RID

not regulated

Adr:

Not regulated

IATA-DGR

not regulated

IATA

not regulated

15. REGULATORY INFORMATION**Safety, health and environmental regulations/legislation specific for the substance or mixture****International Inventories****TSCA 8(b):**

Listed or exempt.

EC-No.

Listed or exempt.

Canadian DSL/NDSL list

All ingredient(s) are listed on the DSL or NDSL

Philippines (PICCS):

Listed.

Japan (ENCS):

Listed or exempt.

China (IECS):

Listed.

Australia (AICS):

Listed.

Korea (KECL):

Listed.

Legend**TSCA** - United States Toxic Substances Control Act Section 8(b) Inventory**EINECS/ELINCS** - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances**DSL/NDSL** - Canadian Domestic Substances List/Non-Domestic Substances List**PICCS** - Philippines Inventory of Chemicals and Chemical Substances**ENCS** - Japan Existing and New Chemical Substances**IECSC** - China Inventory of Existing Chemical Substances**AICS** - Australian Inventory of Chemical Substances**KECL** - Korean Existing and Evaluated Chemical Substances**Chemical Safety Assessment****16. OTHER INFORMATION****List of relevant R-phrases**

No information available

16. OTHER INFORMATION

Key literature references and sources for data

www.ChemADVISOR.com

Prepared by:

Ferro Technical Center

Revision Note

A component has been added to the formulation. SEE SECTION 2.

Disclaimer:

The information and recommendations contained in this Material Safety Data Sheet have been compiled from sources believed to be reliable and to represent the most reasonable current opinion on the subject when the MSDS was prepared. No warranty, guaranty or representation is made as to the correctness or sufficiency of the information. The user of this product must decide what safety measures are necessary to safely use this product, either alone or in combination with other products, and determine its environmental regulatory compliance obligations under any applicable federal or state laws.

End of Safety Data Sheet



Test Report No. F690501/LF-CTSAYAA11-23009

Issued Date: 2011. 07. 18 Page 1 of 6

To: **HEESUNG METAL CO., LTD.**
#548-1
Gajwa-dong
Seo-gu
Incheon 404-250
Korea

The following merchandise was submitted and identified by the client as :

SGS File No. : AYAA11-23009
Product Name : KAu(CN)₂
Item No./Part No. : N/A
Received Date : 2011. 07. 12
Test Period : 2011. 07. 13 to 2011. 07. 18
Test Results : For further details, please refer to following page(s)
Test Performed : SGS Korea tested the sample(s) selected by applicant with following results.

Timothy Jeon
Jinhee Kim
Cindy Park
Jerry Jung/ Testing Person

SGS Korea Co. Ltd.

Jeff Jang / Chemical Lab Mgr



Test Report No. F690501/LF-CTSAYAA11-23009

Issued Date: 2011. 07. 18 Page 2 of 6

Sample No. : AYAA11-23009.001

Sample Description : KAu(CN)₂

Item No./Part No. : N/A

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2008, ICP	0.5	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321:2008, ICP	5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2008, ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	With reference to IEC 62321:2008, UV-VIS	1	N.D.
Antimony (Sb)	mg/kg	With reference to EPA 3052(1996), US EPA 6010B(1996), ICP	10	N.D.

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

NOTE: (1) N.D. = Not detected.(<MDL)

(2) mg/kg = ppm

(3) MDL = Method Detection Limit

(4) - = No regulation

(5) ** = Qualitative analysis (No Unit)

(6) * = Boiling-water-extraction:

Negative = Absence of CrVI coating

Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

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Test Report No. F690501/LF-CTSAYAA11-23009

Issued Date: 2011. 07. 18 Page 3 of 6

Sample No. : AYAA11-23009.001

Sample Description : KAu(CN)₂

Item No./Part No. : N/A

Inorganic Contents

Test Items	Unit	Test Method	MDL	Results
Bromide (Br ⁻)	mg/L	US EPA300.0, IC	30	N.D.
Chloride (Cl ⁻)	mg/L	US EPA300.0, IC	30	N.D.

Other(s)

Test Items	Unit	Test Method	MDL	Results
PFOA(Perfluorooctanoic acid)	mg/kg	US EPA 3540C/3550C, LC/MS	1	N.D.
PFOS(Perfluorooctane Sulfonates-Acid/Metal Salt/Amide)	mg/kg	US EPA 3540C/3550C, LC/MS	1	N.D.

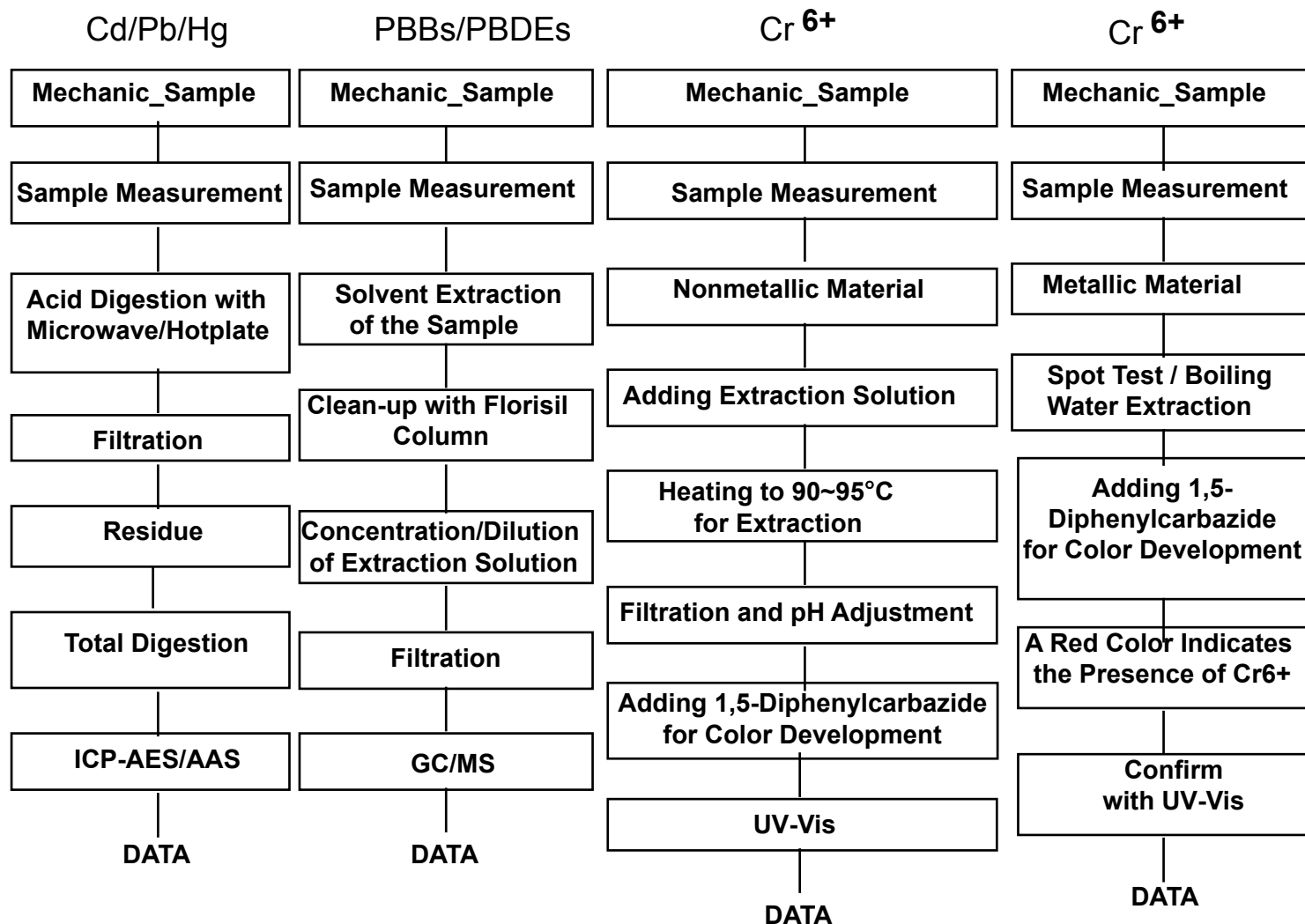
- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) * = Boiling-water-extraction:
 - Negative = Absence of CrVI coating
 - Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

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Picture of Sample as Received:



- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) * = Boiling-water-extraction:
 Negative = Absence of CrVI coating
 Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm2 sample surface area.

Flow Chart for RoHS: Cd/Pb/Hg/Cr⁶⁺/PBBs&PBDEs Testing

The samples were dissolved totally by pre-conditioning method according to above flow chart for Cd,Pb,Hg.

Section Chief : Gilsae Yi

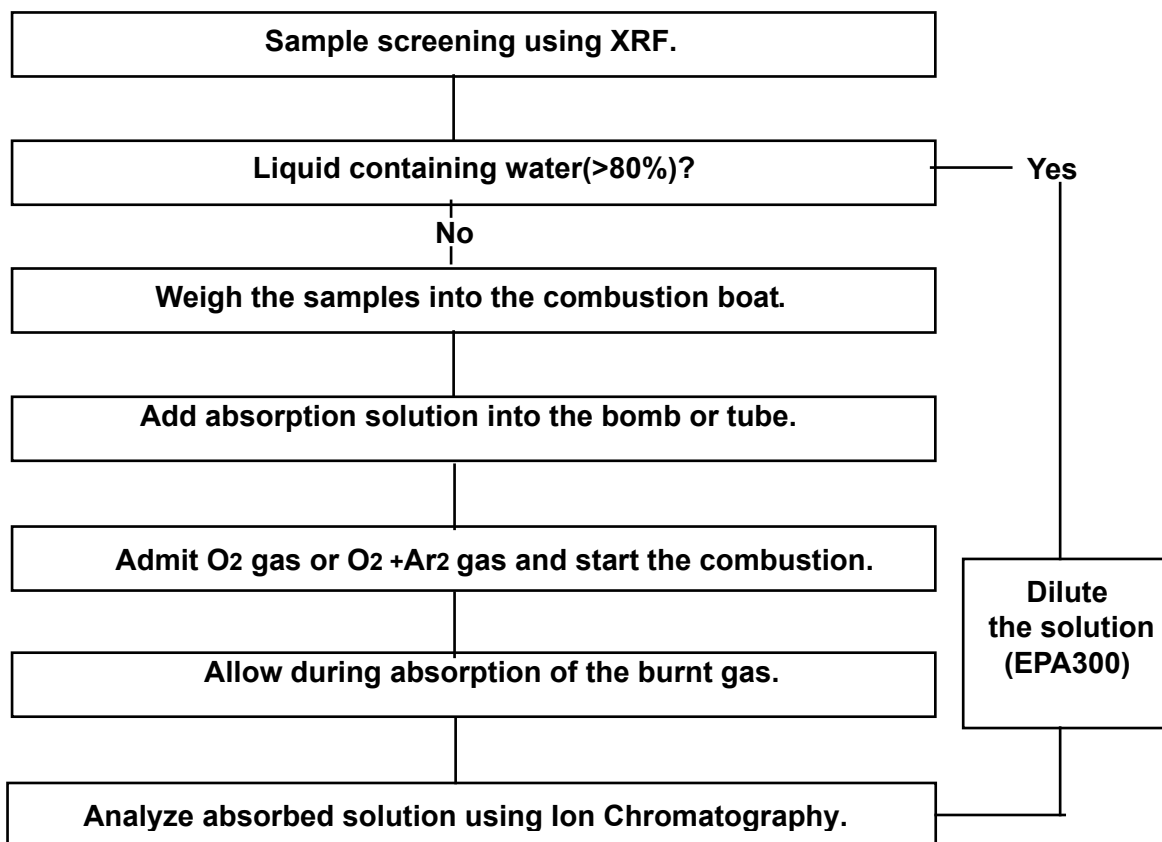
- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) * = Boiling-water-extraction:

Negative = Absence of CrVI coating

Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.



Flow Chart for Halogen Test



*** End ***

- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) * = Boiling-water-extraction:
 - Negative = Absence of CrVI coating
 - Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm2 sample surface area.



Test Report No. F690101/LF-CTSAYAA12-18573

Issued Date: 2012. 05. 14 Page 1 of 5

To: **ARRO CO., LTD.**
205-11, Anyang-dong,
Manan-gu,
Anyang-city
Gyeonggi-do
Korea

The following merchandise was submitted and identified by the client as :

SGS File No. : AYAA12-18573
Product Name : Strontume Titanate(SrTiO_3)
Item No./Part No. : N/A
Received Date : 2012. 05. 09
Test Period : 2012. 05. 10 to 2012. 05. 14
Buyer(s) : LG
Test Results : For further details, please refer to following page(s)
Test Performed : SGS Korea tested the sample(s) selected by applicant with following results.

SGS Korea Co. Ltd.

Jeff Jang / Chemical Lab Mgr

Timothy Jeon
Jinhee Kim
Cindy Park
Jerry Jung/ Testing Person

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Test Report No. F690101/LF-CTSAYAA12-18573

Issued Date: 2012. 05. 14 Page 2 of 5

Sample No. : AYAA12-18573.001
Sample Description : Strontium Titanate(SrTiO₃)
Item No./Part No. : N/A
Materials : N/A

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2008, ICP	0.5	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321:2008, ICP	5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2008, ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	With reference to IEC 62321:2008, UV-VIS	1	N.D.

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

NOTE: (1) N.D. = Not detected.(<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) - = No regulation
(5) Negative = Undetectable / Positive = Detectable
(6) ** = Qualitative analysis (No Unit)
(7) * = Boiling-water-extraction:
Negative = Absence of CrVI coating
Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

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Test Report No. F690101/LF-CTSAYAA12-18573

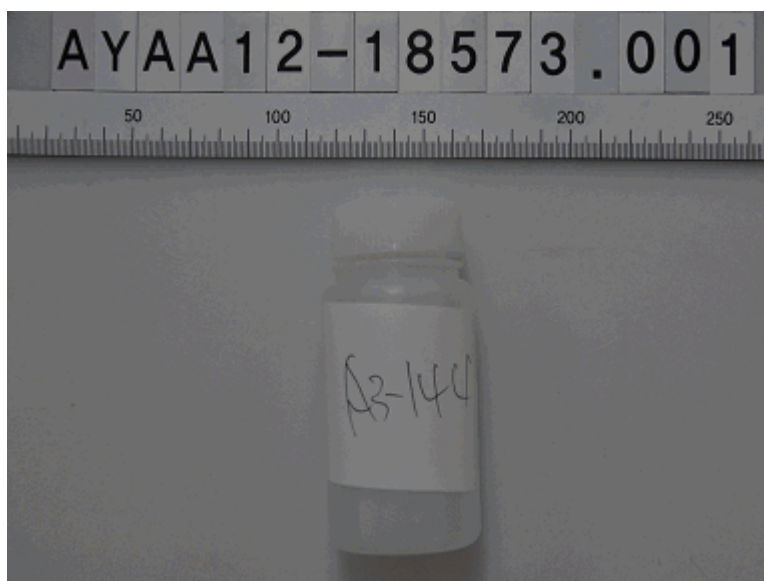
Issued Date: 2012. 05. 14 Page 3 of 5

Sample No. : AYAA12-18573.001
Sample Description : Strontium Titanate(SrTiO_3)
Item No./Part No. : N/A
Materials : N/A

Halogen Contents

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	BS EN 14582:2007 , IC	30	N.D.
Chlorine(Cl)	mg/kg	BS EN 14582:2007 , IC	30	N.D.

Picture of Sample as Received:



- NOTE: (1) N.D. = Not detected.($<$ MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) - = No regulation
(5) Negative = Undetectable / Positive = Detectable
(6) ** = Qualitative analysis (No Unit)
(7) * = Boiling-water-extraction:
Negative = Absence of CrVI coating
Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

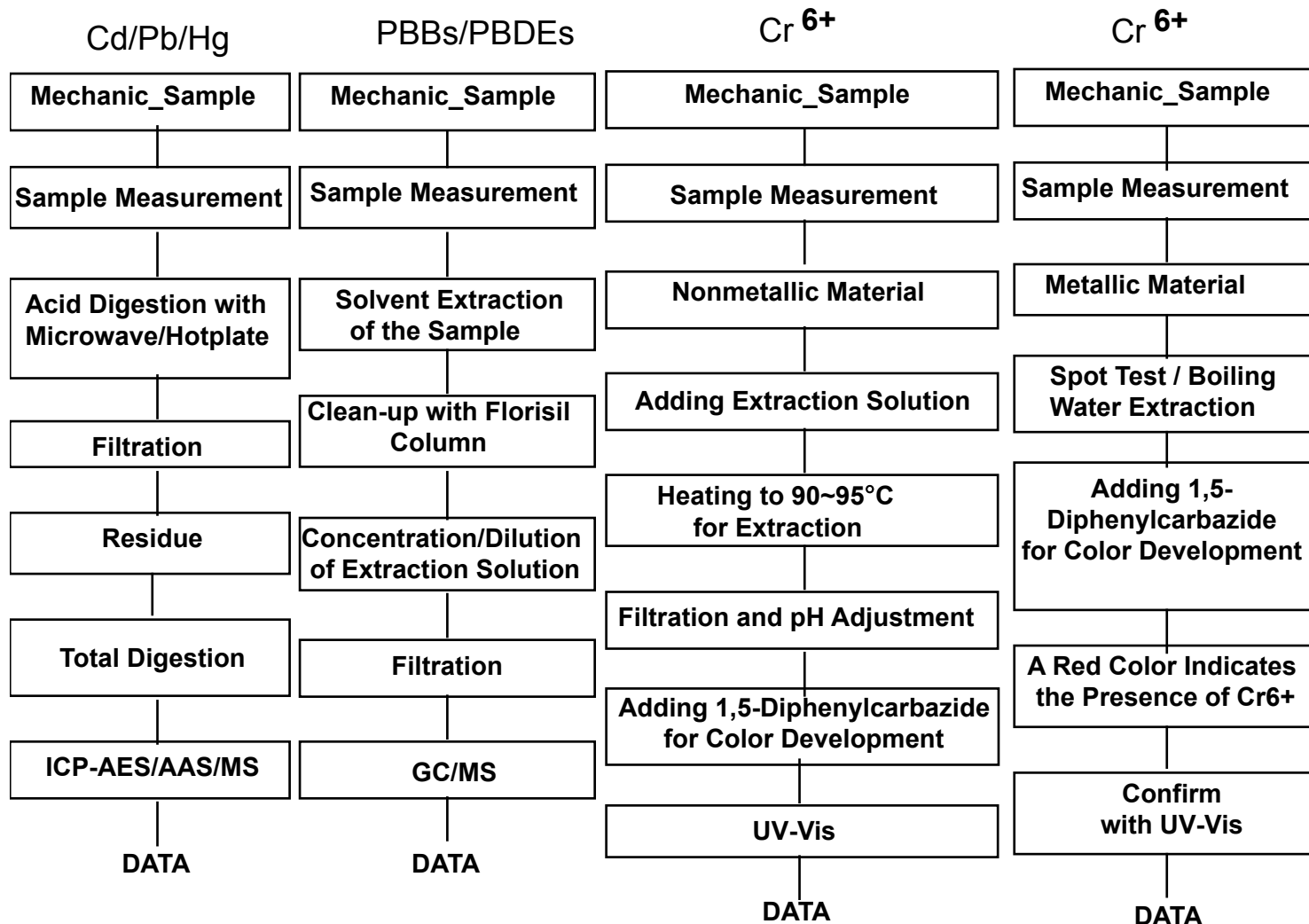
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Test Report No. F690101/LF-CTSAYAA12-18573

Issued Date: 2012. 05. 14 Page 4 of 5

Testing Flow Chart for RoHS: Cd/Pb/Hg/Cr⁶⁺ /PBBs&PBDEs Testing



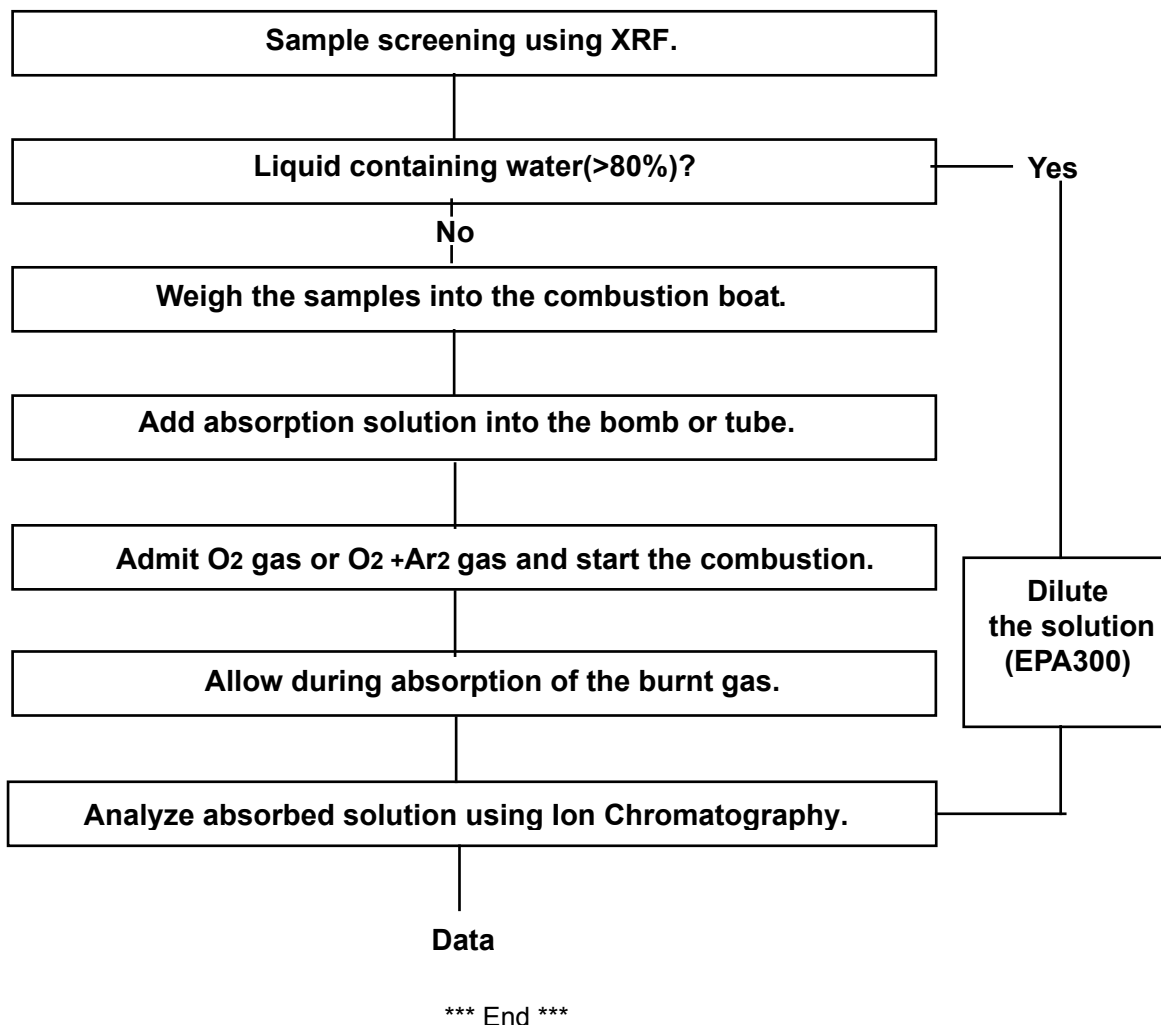
The samples were dissolved totally by pre-conditioning method according to above flow chart for Cd,Pb,Hg.
Section Chief : Gilsae Yi

- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) Negative = Undetectable / Positive = Detectable
 - (6) ** = Qualitative analysis (No Unit)
 - (7) * = Boiling-water-extraction:
 - Negative = Absence of CrVI coating
 - Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

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Flow Chart for Halogen Test



NOTE: (1) N.D. = Not detected.(<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) - = No regulation
(5) Negative = Undetectable / Positive = Detectable
(6) ** = Qualitative analysis (No Unit)
(7) * = Boiling-water-extraction:
Negative = Absence of CrVI coating
Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.



TEST REPORT

Applicant : Doosan Corporation Electro-Materials BG
Address : 5th Floor, Doosan Technical Center Bldg. 39-3 Sungbok-dong, Suji-gu,
Yongin-si, Kyungki-do, Korea

Page: 1 of 3

Report No. RT11R-S4159-009-E3

Date: Nov. 02, 2011

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : DS-7409HG BS
Sample ID No. : RT11R-S4159-009
Manufacturer/Vender : Doosan Corporation Electro-Materials BG

Sample received : Oct. 27, 2011
Testing Date : Oct. 27, 2011 ~ Nov. 02, 2011
Testing Environment : Temperature : (24 ± 2) °C, Humidity : (60 ± 5) % R.H.

Test Method(s) : Please see the following page(s).
Test Result(s) : Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.

* Note 2 : This report shall not be reproduced except in full without the written approval of the testing laboratory.

Approved by,

Jade Jang / Lab. Technical Manager

Authorized by,

Bo Park / Lab. General Manager

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Intertek Testing Services Korea Ltd.

Seoul Office: Tel : 02-6090-9500 Fax : 02-3409-0026 Daegu Office : Tel : 053-600-8647 Fax : 053-600-8645 Web Site : www.Intertek.co.kr
Seoul Lab. Address : 1/F, A-ju Digital Tower, #284-56, Seongsu 2-ga, Seongdong-Gu, Seoul, 133-833 Korea
Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea

TEST REPORT

Report No. RT11R-S4159-009-E3

Page: 2 of 3

Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Test Item	Unit	Test Method	MDL	Result
Bromine (Br)	mg/kg	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	N.D.
Chlorine (Cl)	mg/kg	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	99

Tested by : Nikkie Lee

Notes : mg/kg = ppm = parts per million

< = Less than

N.D. = Not detected (<MDL)

MDL = Method detection limit

* View of sample as received;-



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Intertek Testing Services Korea Ltd.Seoul Office: Tel : 02-6090-9500 Fax : 02-3409-0026 Daegu Office : Tel : 053-600-8647 Fax : 053-600-8645 Web Site : www.Intertek.co.kr

Seoul Lab. Address : 1/F, A-ju Digital Tower, #284-56, Seongsu 2-ga, Seongdong-Gu, Seoul, 133-833 Korea

Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea

TEST REPORT

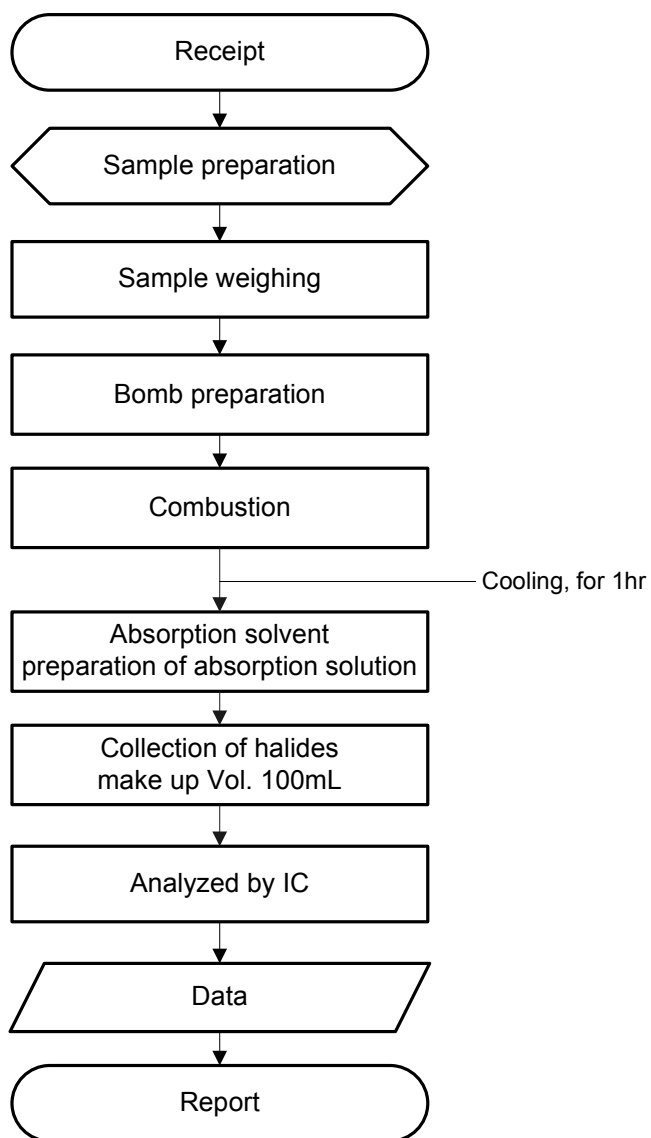
Report No. RT11R-S4159-009-E3

Page: 3 of 3
Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Flow Chart (Halogen)



***** End of Report *****

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Intertek Testing Services Korea Ltd.

Seoul Office: Tel : 02-6090-9500 Fax : 02-3409-0026 Daegu Office : Tel : 053-600-8647 Fax : 053-600-8645 Web Site : www.Intertek.co.kr

Seoul Lab. Address : 1/F, A-ju Digital Tower, #284-56, Seongsu 2-ga, Seongdong-Gu, Seoul, 133-833 Korea

Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea



TEST REPORT

Applicant : Doosan Corporation Electro-Materials BG
Address : 5th Floor, Doosan Technical Center Bldg. 39-3 Sungbok-dong, Suji-gu,
Yongin-si, Kyungki-do, Korea

Page: 1 of 4

Report No. RT11R-S4159-009-E7

Date: Nov. 02, 2011

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : DS-7409HG BS
Sample ID No. : RT11R-S4159-009
Manufacturer/Vender : Doosan Corporation Electro-Materials BG

Sample received : Oct. 27, 2011
Testing Date : Oct. 27, 2011 ~ Nov. 02, 2011
Testing Environment : Temperature : (24 ± 2) °C, Humidity : (60 ± 5) % R.H.

Test Method(s) : Please see the following page(s).
Test Result(s) : Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.

* Note 2 : This report shall not be reproduced except in full without the written approval of the testing laboratory.

Approved by,

Jade Jang / Lab. Technical Manager

Authorized by,

Bo Park / Lab. General Manager

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Intertek Testing Services Korea Ltd.

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Seoul Lab. Address : 1/F, A-ju Digital Tower, #284-56, Seongsu 2-ga, Seongdong-Gu, Seoul, 133-833 Korea
Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea

TEST REPORT

Report No. RT11R-S4159-009-E7

Page: 2 of 4
Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Test Item	Unit	Test Method	MDL	Result
Phthalates				
Dibutyl phthalate (DBP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Di(2-ethylhexyl) phthalate (DEHP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Di-n-octyl phthalate (DNOP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Diisononyl phthalate* (DINP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	100	N.D.
Diisodecyl phthalate** (DIDP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	100	N.D.
Benzyl butyl phthalate (BBP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Di(2-methoxyethyl) phthalate (DMEP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Di-n-hexyl phthalate (DNHP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Diethyl phthalate (DEP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Diisobutyl phthalate (DIBP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.
Dimethyl phthalate (DMP)	mg/kg	With reference to US EPA 8061A, by solvent extraction and determined by GC/MS	50	N.D.

Tested by : Ellen Jung

Notes : mg/kg = ppm = parts per million
 < = Less than
 N.D. = Not detected (<MDL)
 MDL = Method detection limit

* DINP include two types of phthalate (CAS No. 68515-48-0 and 28553-12-0).

** DIDP include two types of phthalate (CAS No. 68515-49-1 and 26761-40-0).

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TEST REPORT

Report No. RT11R-S4159-009-E7

Page: 3 of 4

Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

* View of sample as received:-



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TEST REPORT

Report No. RT11R-S4159-009-E7

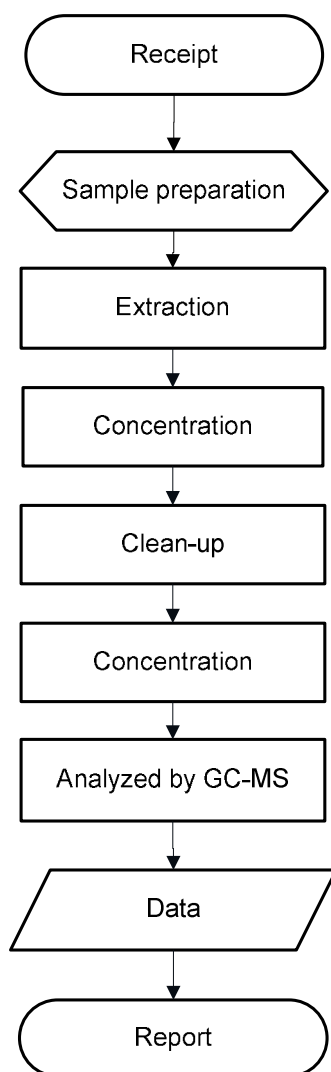
Page: 4 of 4

Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Flow Chart (Phthalates)



***** End of Report *****

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Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea



TEST REPORT

Applicant : Doosan Corporation Electro-Materials BG
Address : 5th Floor, Doosan Technical Center Bldg. 39-3 Sungbok-dong, Suji-gu,
Yongin-si, Kyungki-do, Korea

Page: 1 of 4

Report No. RT11R-S4159-009-E1

Date: Nov. 02, 2011

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : DS-7409HG BS
Sample ID No. : RT11R-S4159-009
Manufacturer/Vender : Doosan Corporation Electro-Materials BG

Sample received : Oct. 27, 2011
Testing Date : Oct. 27, 2011 ~ Nov. 02, 2011
Testing Environment : Temperature : (24 ± 2) °C, Humidity : (60 ± 5) % R.H.

Test Type : RoHS wet chemical analysis
Test Method(s) : Please see the following page(s).
Test Result(s) : Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.

* Note 2 : This report shall not be reproduced except in full without the written approval of the testing laboratory.

Approved by,

Jade Jang / Lab. Technical Manager

Authorized by,

Bo Park / Lab. General Manager

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TEST REPORT

Report No. RT11R-S4159-009-E1

Page: 2 of 4
Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Test Item	Unit	Test Method	MDL	Result
Cadmium (Cd)	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by acid digestion and determined by ICP-OES	0.5	N.D.
Lead (Pb)	mg/kg		2	N.D.
Mercury (Hg)	mg/kg		2	N.D.
Hexavalent Chromium (Cr ⁶⁺) (For non-metal)	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by alkaline digestion and determined by UV-VIS Spectrophotometer	1	N.D.
Polybrominated Biphenyl (PBBs)				
Monobromobiphenyl	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by solvent extraction and determined by GC/MS	5	N.D.
Dibromobiphenyl	mg/kg		5	N.D.
Tribromobiphenyl	mg/kg		5	N.D.
Tetrabromobiphenyl	mg/kg		5	N.D.
Pentabromobiphenyl	mg/kg		5	N.D.
Hexabromobiphenyl	mg/kg		5	N.D.
Heptabromobiphenyl	mg/kg		5	N.D.
Octabromobiphenyl	mg/kg		5	N.D.
Nonabromobiphenyl	mg/kg		5	N.D.
Decabromobiphenyl	mg/kg		5	N.D.
Polybrominated Diphenyl Ether (PBDEs)				
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by solvent extraction and determined by GC/MS	5	N.D.
Dibromodiphenyl ether	mg/kg		5	N.D.
Tribromodiphenyl ether	mg/kg		5	N.D.
Tetrabromodiphenyl ether	mg/kg		5	N.D.
Pentabromodiphenyl ether	mg/kg		5	N.D.
Hexabromodiphenyl ether	mg/kg		5	N.D.
Heptabromodiphenyl ether	mg/kg		5	N.D.
Octabromodiphenyl ether	mg/kg		5	N.D.
Nonabromodiphenyl ether	mg/kg		5	N.D.
Decabromodiphenyl ether	mg/kg		5	N.D.

Tested by : Nikkie Lee, Leo Kim, Ellen Jung, Jessica Kang

Notes : mg/kg = ppm = parts per million
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit

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TEST REPORT

Report No. RT11R-S4159-009-E1

Page: 3 of 4

Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

* View of sample as received;-



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TEST REPORT

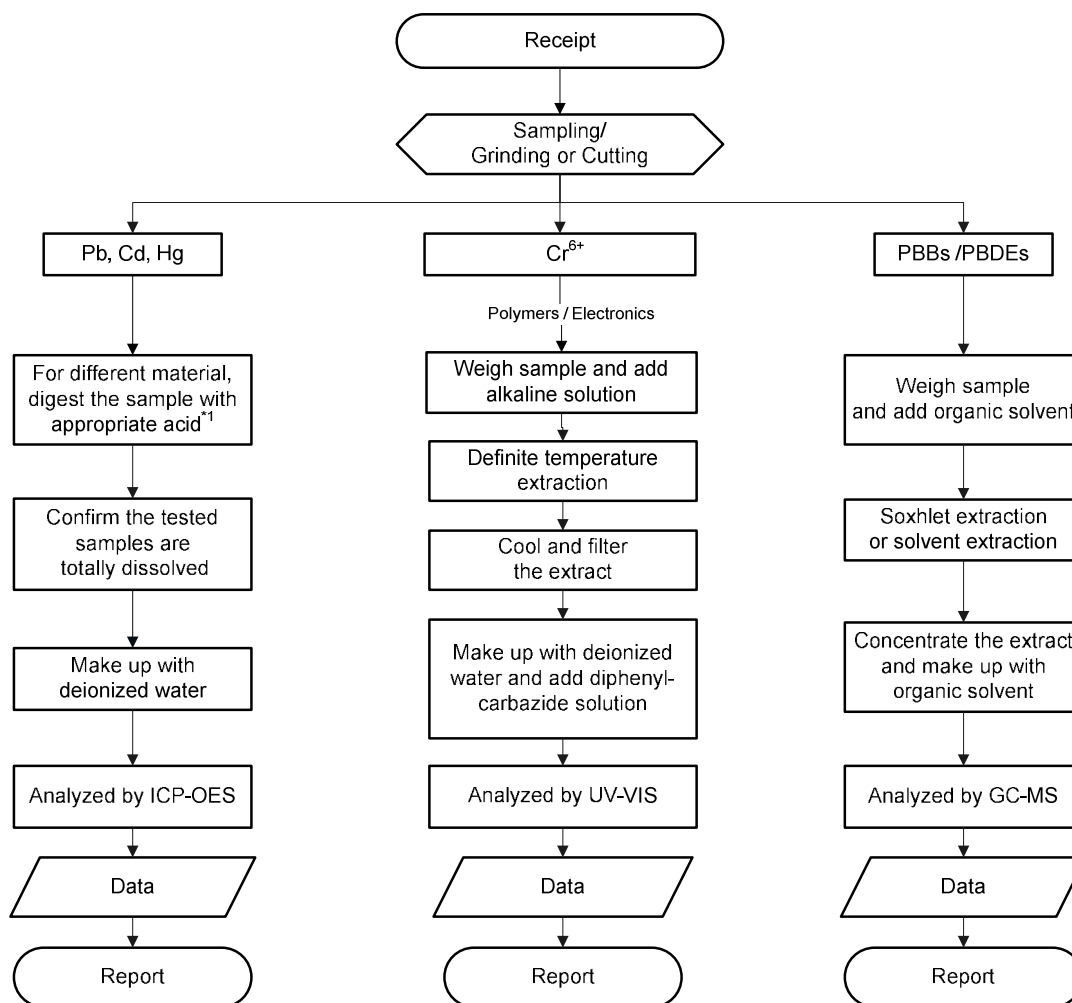
Report No. RT11R-S4159-009-E1

Page: 4 of 4
Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Flow Chart (IEC 62321 Edition 1.0 : 2008)



Remarks :

*1 : List of appropriate acid :

Material	Acid added for digestion
Polymers	HNO ₃ , HCl, HF, H ₂ O ₂ , H ₃ BO ₃
Metals	HNO ₃ , HCl, HF
Electronics	HNO ₃ , HCl, H ₂ O ₂ , HBF ₄

***** End of Report *****

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TEST REPORT

Applicant : Doosan Corporation Electro-Materials BG
Address : 5th Floor, Doosan Technical Center Bldg. 39-3 Sungbok-dong, Suji-gu,
Yongin-si, Kyungki-do, Korea

Page: 1 of 3

Report No. RT11R-S4159-009-E4

Date: Nov. 02, 2011

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : DS-7409HG BS
Sample ID No. : RT11R-S4159-009
Manufacturer/Vender : Doosan Corporation Electro-Materials BG

Sample received : Oct. 27, 2011
Testing Date : Oct. 27, 2011 ~ Nov. 02, 2011
Testing Environment : Temperature : (24 ± 2) °C, Humidity : (60 ± 5) % R.H.

Test Method(s) : Please see the following page(s).
Test Result(s) : Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.

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Approved by,

Jade Jang / Lab. Technical Manager

Authorized by,

Bo Park / Lab. General Manager

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TEST REPORT

Report No. RT11R-S4159-009-E4

Page: 2 of 3

Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Test Item	Unit	Test Method	MDL	Result
Antimony (Sb)	mg/kg	With reference to US EPA 3052, by acid digestion and determined by ICP-OES	2	N.D.

Tested by : Nikkie Lee

Notes : mg/kg = ppm = parts per million

< = Less than

N.D. = Not detected (<MDL)

MDL = Method detection limit

* View of sample as received;-



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TEST REPORT

Report No. RT11R-S4159-009-E4

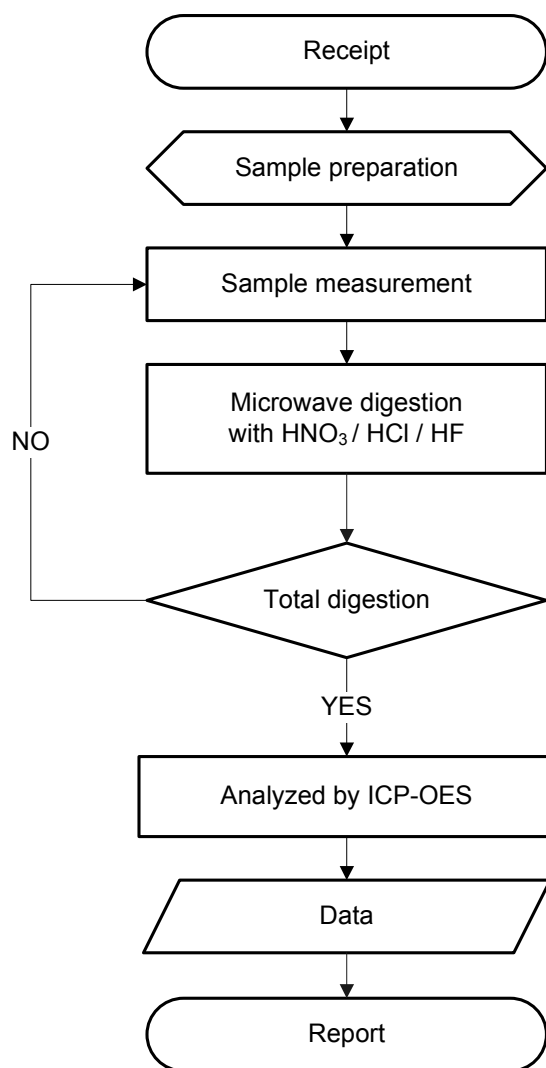
Page: 3 of 3

Date: Nov. 02, 2011

Sample ID No. : RT11R-S4159-009

Sample Description : DS-7409HG BS

Flow Chart (Metal Testing)



** Remarks : The samples were dissolved totally by pre-conditioning method according to above flow chart.

***** End of Report *****

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Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : DS-7409HG BS G
OTHER/GENERIC NAMES : Glass Fabric Reinforced Epoxy Bonding Sheet
PRODUCTS USE : Industrial Thermosetting Laminate for printed circuitry
MANUFACTURER : Doosan corporation Electro-Materials BG
39-3 Sungbok-Dong, Suji-Gu, Yongin-Si, Gyeonggi-Do, Korea

FOR MORE INFORMATION CALL :

(Monday-Friday, 8:30am-6:00pm)

82-31-260-6301

IN CASE OF EMERGENCY CALL:

(24 Hours/Day, 7days/Week)

82-31-260-6301

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS #	WEIGHT %
Glass cloth	(65997-17-3)	15 ~ 50
Epoxy	(7328-97-4)	5 ~ 25
Flame Resistant Epoxy Resin	-	5 ~ 25
Heat Resistant Resin	-	5 ~ 25
Inorganic Filler	-	25 ~ 45

3. HAZARDS IDENTIFICATION

EMERGENCY OVER VIEW :

A nonflammable, sheet material. When machined or punched, occurring dust may cause skin or eye irritation. Fumes, smoke, and gases from thermal decomposition may irritate eyes, nose, and throat.

POTENTIAL HEALTH HAZARDS :

SKIN : Dust may cause moderate skin irritation
EYES : Dust may cause moderate eye irritation. Fumes may irritate eyes
INHALATION : Dust or Fumes may cause irritation of the throat
INGESTION : Not determined
DELAYED EFFECTS : None

Although the information and recommendation in this Material Safety Data Sheet(information) are presented in good faith and believed to be correct as of the data stated above, Doosan Electro-Materials co., LTD. make no representation or warranty as to the completeness or accuracy of this information.

This information is supplied with the condition that the person receiving this MSDS will make their own determination as to its suitability for their purpose prior to implementation

For additional information, please contact our Quality Assurance Department

4. FIRST AID MEASURES

SKIN	Wash dust off in flowing water or shower. Change contaminated cloth.
EYE	Irritate with flowing water for 15 minutes. If irritation persists, consult a physician.
INHALATION	If overcome by dust or smoke, remove to fresh air. If not breathing, give mouth-to-mouth resuscitation. Call physician.
INGESTION	If large amounts are ingested, consult physician.
ADVICE TO PHYSICIAN :	Treat symptomatically

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES	N/A
FLASH POINT	N/A
FLASH POINT METHOD	Not determined
AUTOIGNITION TEMPERATURE	N/A
UPPER FLAME LIMIT(Volume % in air)	N/A
LOWER FLAME LIMIT(Volume % in air)	N/A
FLAME PROPAGATION RATE(Solids)	UL V-0
OSHA FLAMMABILITY CLASS	N/A
EXTINGUISHING MEDIA	Water, CO ₂ and dry chemical
UNUSUAL FIRE AND EXPLOSION HAZARD :	May give off toxic gases containing CO ₂ , CO, NO _x , hydrocarbon fragments, and HCN when burned or heated to thermal decomposition
SPECIAL FIREFIGHTING PRECAUTION/INSTRUCTIONS :	
Fireman should wear proper protective equipment and positive pressure self-contained breathing apparatus	

6. ACCIDENTAL RELEASE MEASURES

INCASE OF SPILL OR OTHER RELEASE:(Always wear recommended personal protection equipment)
Not applicable, material is an article.
Spills and releases may have to be reported to federal and/or local authorities.
See the Regulatory Information section(#15) regarding reporting requirements

7. HANDING AND STORAGE

NORMAL HANDLING :	(Always wear recommended personal protective equipment) The primary exposure route is inhalation of dust when machined/punched and fumes or vapors when heated to thermal decomposition
STORAGE RECOMMENDATIONS :	Avoid hot, humid and water condition

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS : Use local exhaust ventilation to control dust.

PERSONAL PROTECTIVE EQUIPMENT :

SKIN PROTECTION : For brief contact to dust, no precautions other than clean body-covering clothing should be needed. Use gloves and aprons when prolonged or frequently repeated contact occurs.

EYE PROTECTION : Use appropriate eye protection when machining material

RESPIRATORY PROTECTION : Atmospheric levels of Glass Fabric Dust should be maintained below exposure guidelines. When respiratory protection is required for certain operations, use a NIOSH-approved dust respirator.

ADDITIONAL RECOMMENDATIONS : N/A

EXPOSURE GUIDELINES : (Guidelines exist for the following ingredients)

<u>Ingredient Name</u>	<u>CAS. NO.</u>	<u>TLV-ACGIH</u>	<u>OSHA PEL</u>	<u>Other Limit</u>
Glass cloth	(65997-17-3)	10mg/m3	None	N/A
Epoxy	(7328-97-4)	5ppm	5ppm	N/A
Flame Resistant Epoxy Resin	-	N/A	N/A	N/A
Heat Resistant Resin	-	N/A	N/A	N/A
Inorganic Filler	-	0.1mg/m3	N/A	6mg/m3

Other exposure limits for the decomposition products normally associated with product use are as follows : None

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE : Yellow sheet material

PHYSICAL STATE : Solid

MOLECULAR WEIGHT : N/A

CHEMICAL FORMULA : N/A

ODOR : Very faint epoxy odor

SPECIFIC GRAVITY : (Water=1.0) 2.0+/-0.5

SOLUBILITY IN WATER : (weight %) Negligible in water

pH : N/A

BOILING POINT : N/A

MELTING POINT : N/A

VAPOR PRESSURE : N/A

VAPOR DENSITY : (Air=1.0) N/A

EVAPORATION RATE : N/A Compared to : N/A

% VOLATILES : N/A

FLASH POINT : N/A

(Flash point method and additional flammability data are found in section 5)

10. STABILITY AND REACTIVITY

NORMALLY STABLE ? (CONDITIONS TO AVOID)

Stable

INCOMPATIBILITIES :

Not determined

HAZARDOUS DECOMPOSITION PRODUCTS :

CO, CO₂, NO_x and HCN if heated in excess of 300 deg.C

HAZARDOUS POLYMERIZATION ?

None known

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS : Dust may cause moderate eye, skin and throat irritation.

DELAYED(SUBCHRONIC & CHRONIC) EFFECTS : None Known

OTHER DATA : N/A

12. ECOLOGICAL INFORMATION

Not Biodegradable

13. DISPOSAL CONSIDERATIONS

RCRA :

Is the unused product a RCRA hazardous waste if discarded ?

No

OTHER DISPOSAL CONSIDERATIONS : Disposal must be made in accordance with all applicable Local, State and Federal regulations. Copper should be recycled.

The information offered here is for the product as shipped. Use and/or alternations the such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT HAZARD CLASS : Not regulated

US DOT ID NUMBER : N/A

For additional information on shipping regulations affecting this material, contact the information number found on the first page.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TSCA) :

TSCA INVENTORY STATUS : The resin system components used to make this material are on the TSCA inventory list.

OTHER TSCA ISSUES : N/A

SARA TITLE III/CERCLA :

RQs & TPQs :

reportable Quantities "(RQs)" and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

	SARA/CERCLA	SARA EHS
Ingredient	RQ(1bs)	TPQ(1bs)
N/A	N/A	N/A

Spills/releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center (1-800-424-8802) and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS : N/A**SARA 313 TOXIC CHEMICALS :**

The following ingredients are SARA 313 " Toxic Chemicals". CAS#'s and wt.% are found in section #2.

Ingredient	CAS. NO.	Comment
Glass cloth	(65997-17-3)	None
Epoxy	(7328-97-4)	None

STATE RIGHT TO KNOW :

In addition to the ingredients found in section 2, the following are listed for state right-to-know purposes:

Ingredient	Wt. %	Comment
N/A	N/A	N/A

ADDITIONAL REGULATORY INFORMATION :

Doosan Electro-materials does not use polybromide-biphenyls or polybromide-biphenyloxides as a fire retardant in any our epoxy or phenolic systems.

WHMIS CLASSIFICATION (CANADA) : N/A

FOREIGN INVENTORY STATUS : N/A

16. OTHER INFORMATION

CURRENT ISSUE DATE : '06/01/24

PREVIOUS ISSUE DATE : -

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING :

(MSDS)

1

MARKING INK

(SCM-500 BLACK)

1. _____

가. : MARKING INK(SCM-500 BLACK)
· :
· : MARKING INK
· : ()
· : 1696-7(1 605-5)
· :
· : 1997. 6. 16.
· : 2003. 10. 20.

2. _____

	(%)	CAS. NO
EPOXY RESIN	42.0	Trade secret
IMIDAZOLE	3.0	931-36-2
PIGMENT	5.0	1333-86-4
INORGANIC FILLERS	30.0	7727-43-7
BUTYL CELLSOLVE ACETATE	10.0	112-07-2
SOLVENT NAPHTHA	10.0	8030-30-6
	100	

3. _____, _____

가. , : NA
· : NA
· : NA
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· : NA

4. _____

가. : 15 , .
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5. _____ , _____

가. : 180
 . : NA
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 . : NA
 . : CO₂
 . : NA
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6. _____

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7. _____

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 . : () .(TEL : 031-499-0321)

8. _____

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9. _____

가.	:	BLACK	MARKING INK
.	:		
. pH	:	NE	
.	:	NE	
. /	:	217	
. /	:	NA	
.	:	NA	
.	:	NA	
.	:	0.09 mm Hg at 25	
.	:	1.3 (H ₂ O = 1)	
.	:	NA(NE)	
.	:	6.1(Air = 1)	
.	:	280 300PS(at 25 , Viscotester VT-04)	

10. _____

가.	:	
.	:	NA
.	:	NA
.	가	: NA

11._____

가. : NA
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. () : NA
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12._____

가. : NA
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. 가 : NA

13._____

가. : 가 .
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14._____

가. : NA
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15._____

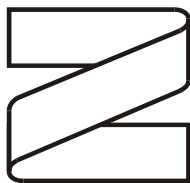
가. : 41 .
. : NA

16. _____

가. : MSDS 41

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NE : .
NA : 가 .



Zeon Chemicals L. P.

Material Safety Data Sheet

Form: 24
Issue Date: 01/13/10
Supersedes: 11/23/05
MSDS Number: Z01391

Section 1 - PRODUCT AND COMPANY IDENTIFICATION

Manufacturer / Importer:
Zeon Chemicals L.P.
4111 Bells Lane
Louisville, Kentucky 40211

Telephone Number:
1-800-735-3388
(502)-775-2000

Emergency Telephone Number:
1-800-776-2460 Ext 7650
(502) 774-8126

Chemical Family:
Polycycloolefin Resin

Uses:
Optics

This MSDS applies to the following product(s):

Zeonex 330R
Zeonex 480R

Zeonex 340R
Zeonex 480S

Zeonex 480
Zeonex E48R

Section 2 - COMPOSITION / INFORMATION ON INGREDIENTS

Hazardous Ingredients	CAS #	Amount	Exposure Limits	
			OSHA PEL	ACGIH TLV
None as defined by 29 CFR 1910.1200				

Other Ingredients	CAS #	Amount	Notes
Polycycloolefin Resin	Proprietary	>99 %	TWA = Time Weighted Average TLV = Threshold Limit Value AL = Action Level RD = Respirable Dust TD = Total Dust STEL = Short Term Exposure Limit Skin = Skin contact may be a significant route of exposure A2 = ACGIH Suspected Human Carcinogen A3 = ACGIH Animal Carcinogen A4 = ACGIH Not Classifiable as a Human Carcinogen PNOC = Particulates Not Otherwise Classified

Section 3 - HAZARDS IDENTIFICATION

Emergency Overview:	This product is a colorless transparent pellet, puck, or plaque with no distinctive odor. Processing operations may produce vapors or dust that may cause eye, skin, and respiratory tract irritation. Toxic combustion products may be released under fire conditions. A static charge may be generated during unloading and transport. The static charge may cause a flash fire in the presence of volatile or flammable materials.
----------------------------	---

Potential Health Effects From Overexposure: Possible routes of entry include skin & eye contact and process vapor or dust inhalation.

No adverse health effects are expected during normal processing when potential exposures are eliminated by good industrial hygiene practice and well ventilated conditions. At processing temperatures, the combined ingredients (Polycycloolefin Resin and other processing ingredients) may emit fumes and vapors that may cause irritation to the eyes, skin, nose, throat, and respiratory tract. Processing under conditions of inadequate ventilation may produce symptoms of nausea, dizziness, or headaches. Typically these effects are reversible upon removal from exposure and no lasting effects are expected. Most importantly, the potential for irritation will depend on the effectiveness of exhaust ventilation provided to the process area.

Contact with molten resin may cause thermal burns.

Overexposure to decomposition or combustion products may cause irritation of the eyes, skin, and respiratory tract. Symptoms such as coughing, tearing, and irritation should be regarded as potentially hazardous and measures taken to avoid exposure. See Section 10 for information on combustion products.

Section 4 - FIRST AID MEASURES

If irritation occurs or persists from any route of exposure, remove the affected individual from the area and seek medical assistance.

Eye Contact: Treat as any foreign particulate matter. Flush eyes with running water for several minutes while holding eyelids open. Consult a physician if irritation persists.

Skin Contact: Remove contaminated clothing. Wash contact area with soap and water for 15 minutes. Seek medical attention if irritation / allergic skin reaction develops. If molten resin contacts skin, cool rapidly with water. Do not attempt to remove resin from skin. Seek medical attention for thermal burn.

Particulate Inhalation: Remove affected individual to fresh air.

Vapor Inhalation (processing vapors or decomposition products): Remove the affected individual to fresh air. If breathing has stopped, administer artificial respiration and seek medical assistance immediately.

Section 5 - FIRE FIGHTING MEASURES

Extinguishing Media: Water, ABC dry chemical, or Protein type air foams are recommended media. Polycycloolefin Resins would be considered "ordinary combustibles" (NFPA defined Class A). Carbon dioxide is generally not recommended for use on Class A fires as a lack of cooling capacity may result in reignition.

Special Firefighting Procedures: Wear positive pressure self-contained breathing apparatus (SCBA) during the attack phase of firefighting operations and during cleanup in enclosed or poorly ventilated areas immediately after a fire. Personnel not having suitable respiratory protection must leave the area to prevent significant exposure to toxic combustion gases from any source.

Unusual Fire and Explosion Hazards: A static charge may be generated during unloading and transport. The static charge may cause a flash fire in the presence of volatile or flammable materials. Toxic gases may be formed upon combustion and represents a hazard to firefighters. See Section 10 for additional information on combustion products.

Section 6 - ACCIDENTAL RELEASE MEASURES

If the material is released or spilled, sweep, shovel, or vacuum crumbs or chunks into closed containers for reuse or disposal. Prevent pellets from entering waterways.

Section 7 - HANDLING AND STORAGE

Eliminate ignition sources, including static buildup; provide adequate ventilation; bond, ground, and properly vent containers, conveyors, process control devices, and other transfer equipment. Ground all equipment and pour the product slowly into chute or vessel under inert gas when flammable materials are present.

During normal processing, virtually all resins will emit fumes and vapors when heated to processing temperatures. The concentration and composition of these vapors will depend on variables such as the specific formulation and processing method and temperature. Always process resins under well ventilated conditions and avoid continued or prolonged breathing of process vapors. Wash thoroughly after processing compound, especially before eating, smoking, or using toilet facilities. Do not use or consume food in processing areas. Do not use processing equipment to heat food.

Clean up following normal processing should be performed under well ventilated conditions. Polycycloolefin Resins may be held at process temperatures for a short time without significant thermal degradation. However exposure to either elevated temperature or excessive time will result in decomposition. Equipment should not be shut down for extended time periods with compound in it or decomposition may occur.

Processing fume condensates, which may include toxic contaminants, may be combustible and should be periodically removed from exhaust hoods, ductwork, and other surfaces. Protective clothing, including impervious gloves, should be worn during cleanup operations to prevent skin contact.

Store in a cool, dry place away from direct light to maintain quality.

Abnormal conditions such as equipment malfunction or using improper equipment or procedures, or hangup or stagnation of material during processing may cause decomposition. Employees involved in removing decomposing material should be provided suitable air-supplied respirators, such as an approved positive pressure self-contained breathing apparatus.

Compounding ingredients added to Polycycloolefin Resin products may require special handling. It is the users responsibility to follow the recommended precautions of the individual additive suppliers.

Post-processing operations at your workplace or at your customer's workplace involving heat sufficient to result in polymer breakdown emitting smoke and fumes should always be conducted in such a manner to avoid inhalation of fumes. Local exhaust ventilation should be provided to prevent significant employee exposure.

Section 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Ventilation: Effective general and, if necessary, local exhaust ventilation must always be provided to draw fumes or vapors away from workers to prevent routine inhalation. Ventilation must be adequate to maintain the ambient workplace atmosphere below the limits listed in Section 2.

Respiratory Protection: Respiratory protection is not typically required during normal use and handling operations where general dilution or local exhaust ventilation is adequate to control exposures. NIOSH approved respiratory protection may be needed if vapor or dust is generated during processing or if the product is ground into a fine powder. Wear a positive pressure air-supplied respirator in situations where there may be potential for elevated airborne exposure such as during equipment malfunction, or product hangup or stagnation during processing that may result in decomposition.

Protective Equipment: During processing operations, safety glasses and/or goggles suitable for keeping dust or particulate matter out of the eyes should be worn when eye contact is anticipated. Protective gloves should be worn to prevent skin contact.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

Specific Gravity (H ₂ O=1):	1.01	% Volatile by Weight:	<0.01 (water vapor)
Glass Transition Temperature:	138 - 140° C	Solubility in Water:	Practically Insoluble

Appearance and Odor: Colorless, transparent pellet, puck, or plaque with no distinctive odor.

Section 10 - STABILITY AND REACTIVITY

Stability: Stable

Hazardous Polymerization: Will not occur

Conditions to Avoid: Overheating

Materials to Avoid: No specific information is available, however strong oxidizers or reducing agents which are generally not compatible with many organic compounds, are not compatible with Polycycloolefin Resins.

Hazardous Decomposition Products: Fumes produced when heated to decomposition temperatures may contain carbon monoxide, carbon dioxide and small amounts of aromatic and aliphatic hydrocarbons. Combustion products must be considered toxic.

Section 11 - TOXICOLOGICAL INFORMATION

No information available.

Section 12 - ECOLOGICAL INFORMATION

No information available.

Section 13 - DISPOSAL CONSIDERATIONS

Waste resulting from this product as supplied is not known to be classified as a hazardous waste per the current listings and characteristics contained in 40 CFR Part 261, and its Appendices. Resin pellets are classified as "significant materials" under EPA's Storm Water Discharge Regulations. Do not allow resin pellets to enter storm water runoff or other waterways. It is the generator's responsibility to determine, per the regulation, the applicability of the Resource Conservation and Recovery Act (RCRA), as well as all state, local, or other governmental agency waste disposal regulations, to the particular waste materials prior to treatment or disposal.

Section 14 - TRANSPORTATION INFORMATION

For domestic transportation purposes, this product is not defined or designated as a hazardous material by the U.S. Department of Transportation under Title 49 of the Code of Federal Regulations.

DOT Hazard Class	Not Regulated	UN/NA Hazard No.	Not Applicable
DOT Proper Shipping Name	Not Applicable	Reportable Quantity	Not Applicable
DOT Label	Not Applicable		

Section 15 - REGULATORY INFORMATION

TSCA Inventory Status: This product and all components are listed on the U.S. EPA Toxic Substances Control Act Inventory. Zeonex 480S contains a trace quantity of a substance subject to a TSCA SNUR, 40 CFR 721.3486, that prohibits any predictable or purposeful release into the waters of the United States.

TSCA 12(b) Export Notification Status: This product does not contain any components subject to export notification

requirements.

SARA 313 Status: This product does not contain any components exceeding the *de minimis* amount subject to reporting under Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40 CFR 372.

Additional Right-to-Know Information on Components:

Component	CAS #	Key (See below)	
Polycycloolefin Resin	Proprietary	7, 13	*

Key	Description	Key	Description
1.	Reserved	8.	MA Extraordinary Hazardous Substance above 1 ppm
2.	CA Listed Carcinogen	9.	MA Toxic or Hazardous Substance above 1%
3.	CA Listed Reproductive Toxin	10.	NJ Hazardous Substance above 1%
4.	PA Special Hazardous Substance above 0.01%	11.	NJ Special Health Hazard Substance above 0.1%
5.	PA Hazardous Substance above 1%	12.	NJ Environmental Hazardous Substance above 1%
6.	PA Non-Hazardous Substance above 3%	13.	NJ Non-Hazardous Substance above 1%
7.	PA Non-Hazardous Substance above 5%	14.	Canadian WHMIS Ingredient Disclosure List Substance

Section 16 - ADDITIONAL INFORMATION

Hazard Rating System Classifications:

	NFPA	HMIS	Key: 0=least; 1=slight; 2=moderate; 3=high; 4=extreme
Health	2	0	National Fire Protection Association rating identifies hazards during a fire emergency.
Flammability	1	1	Hazardous Materials Identification System rating applies to products as packaged.
Reactivity	0	0	

It may be possible under certain processing and handling conditions, e.g. processes that create vapors, mists, or dust, to release unreacted monomers and other substances in airborne concentrations in excess of their established exposure limits or guidelines. Customers and processors should do sufficient in-house industrial hygiene monitoring to assure compliance of their operations.

Reason for (Re)issue: Revalidate

User's Responsibility

This bulletin cannot cover all possible situations which the user may experience during processing. Each aspect of your operation must be examined to determine if, or where, additional precautions may be necessary. All health and safety information contained in this bulletin must be provided to your employees or customers. It is your responsibility to use this information to develop appropriate work practice guidelines and employee instructional programs for your operation.

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: 2003. 12. 15

	/
(GOLD POTASSIUM CYANIDE)	<p>(POTASSIUM CYANOAUROATE); (POTASSIUM GOLD CYANIDE); (1 -), (- C) - , (AUROATE(1 -), BIS(CYANO - C) - , POTASSIUM); (1 -), - , (AUROATE(1 -), DICYANO - , POTASSIUM); (I)(POTASSIUM DICYANOAUROATE(I)); (I)(POTASSIUM CYANOAUROATE(I)); (AUC(CN)2)(GOLD POTASSIUM CYANIDE (AUC(CN)2)); (KAU(CN)2)(GOLD POTASSIUM CYANIDE (KAU(CN)2)); (MONOPOTASSIUM DICYANOAUROATE); (POTASSIUM AUROCYANIDE); (KAU(CN)2)(POTASSIUM AUROCYANIDE (KAU(CN)2)); (POTASSIUM DICYANOAUROATE); (1 -)(POTASSIUM DICYANOAUROATE(1 -)); (- C) - CL -) (BIS(CYANO - C) - AUROATE CL -) POTASSIUM); (1 -) (DICYANOAUROATE (1 -) POTASSIUM); ACR 434 - (ACR 434 GOLD MAKE - UP SALT (AMERICAN CHEMICAL & REFINING CO., INC.)); C2AuKN2; OHS10550;</p>

CAS NO	RTECS NO	UN NO	EN NO
13967 - 50 - 5		1588	237 - 748 - 4

1.	
:	(GOLD POTASSIUM CYANIDE)
/ :	
	(POTASSIUM CYANOAUROATE); (POTASSIUM GOLD CYANIDE); (1 -), (- C) - , (AUROATE(1 -), BIS(CYANO - C) - ,

POTASSIUM); (1 -), - , (AURATE(1 -), DICYANO - , POTASSIUM);
(I)(POTASSIUM DICYANOAUROATE(I));
(I)(POTASSIUM CYANOAUROATE(I)); (AUK(CN)2)(GOLD
POTASSIUM CYANIDE (AUK(CN)2)); (KAU(CN)2)(GOLD POTASSIUM
CYANIDE (KAU(CN)2)); (MONOPOTASSIUM DICYANOAUROATE);
(POTASSIUM AUROCYANIDE);
(KAU(CN)2)(POTASSIUM AUROCYANIDE (KAU(CN)2));
(POTASSIUM DICYANOAUROATE);
(1 -)(POTASSIUM DICYANOAUROATE(1 -)); (- C) -
CL -) (BIS(CYANO - C) - AUROATE CL -) POTASSIUM); (1 -)
(DICYANOAUROATE (1 -) POTASSIUM); ACR 434 - (ACR 434 GOLD
MAKE - UP SALT (AMERICAN CHEMICAL & REFINING CO., INC.)); C2AuKN2; OHS10550

: 1985.1.7
: 2003.12.15

2.

:	(GOLD POTASSIUM CYANIDE)
CAS	: 13967 - 50 - 5
(EC)	(EINECS): 237 - 748 - 4
EC	: 006 - 007 - 00 - 5
(%)	: 100.0

3.

NFPA (0 - 4): =2 =0 =0

: -

(OSHA):

(NTP):

(IARC):

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(GOLD POTASSIUM CYANIDE):

(as CN)(CYANIDES (as CN)):

5 mg/m³ OSHA TWA ()

5 mg/m³ ACGIH TWA ()

4.7 ppm (5 mg/m³) NIOSH ceiling 10

2 mg/m³ DFG MAK (- II, 1) ()

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(NIOSH) / (OSHA)

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(CN)

25 mg/m³

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(GOLD POTASSIUM CYANIDE):
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DOT() 49 CFR() 172.101:
: , , ((GOLD POTASSIUM
CYANIDE))
ID : UN1588
: 6.1
: II
: 6.1

15.

(GOLD POTASSIUM CYANIDE)
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- : " - "
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CERCLA 103 (40CFR302.4):
, (CYANIDES, SOLUBLE SALTS AND COMPLEXES): 10 LBS
RQ
SARA 302 (40CFR355.30): .
SARA 304 (40CFR355.40): .
SARA , SARA 311/312 (40CFR370.21):
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SARA 313 (40CFR372.65):
, (CYANIDES, SOLUBLE SALTS AND COMPLEXES)
OSHA (29CFR1910.119): .
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R 32

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S 28

S 29

S 45

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S 60

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S 61

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(TSCA):

TSCA 12(b)

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(MSDS)

MDL

MDL 가

MSDS

41

MSDS

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(www.chems.co.kr,

02 - 551 - 0501)

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Test Report No. F690501/LF-CTSAYAA11-10960

Issued Date: 2011. 04. 08 Page 1 of 6

To: **SEOUL CHEMICAL RESEARCH LABORATORY CO., LTD.**
1ma 605-5 Shihwa Ind. Com.
1696-7 Jungwang-dong
Shiheung-si
Gyeonggi-do 429-450
Korea

The following merchandise was submitted and identified by the client as :

SGS File No. : AYAA11-10960
Product Name : SCM-500 Black
Item No./Part No. : SCM-500 Matt Black
Received Date : 2011. 04. 01
Test Period : 2011. 04. 04 to 2011. 04. 08
Test Results : For further details, please refer to following page(s)
Test Performed : SGS Korea tested the sample(s) selected by applicant with following results.

Timothy Jeon
Jinhee Kim
Cindy Park
Jerry Jung/ Testing Person

SGS Korea Co. Ltd.

Jeff Jang / Chemical Lab Mgr



Test Report No. F690501/LF-CTSAYAA11-10960

Issued Date: 2011. 04. 08 Page 2 of 6

Sample No. : AYAA11-10960.001
Sample Description : SCM-500 Black
Item No./Part No. : SCM-500 Matt Black

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2008, ICP	0.5	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321:2008, ICP	5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2008, ICP	2	N.D.
Hexavalent Chromium (Cr VI)	mg/kg	With reference to IEC 62321:2008, UV-VIS	1	N.D.
Beryllium (Be)	mg/kg	With reference to EPA 3050B(1996), US EPA 6010B(1996), ICP	0.5	N.D.
Sb (Sb2O3)	mg/kg	With reference to EPA 3052(1996), US EPA 6010B(1996), ICP	10	N.D.

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) * = Boiling-water-extraction:

Negative = Absence of CrVI coating

Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 180 days only.



Test Report No. F690501/LF-CTSAYAA11-10960

Issued Date: 2011. 04. 08 Page 3 of 6

Sample No. : AYAA11-10960.001
Sample Description : SCM-500 Black
Item No./Part No. : SCM-500 Matt Black

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

Phthalates

Test Items	Unit	Test Method	MDL	Results
Di-(2-ethylhexyl) phthalate (DEHP)	mg/kg	With reference to ASTM D3421-75, GC-MS	50	N.D.
Di-n-octyl phthalate (DNOP)	mg/kg	With reference to ASTM D3421-75, GC-MS	50	N.D.
Dibutyl phthalate (DBP)	mg/kg	With reference to ASTM D3421-75, GC-MS	50	N.D.
Butylbenzyl phthalate (BBP)	mg/kg	With reference to ASTM D3421-75, GC-MS	50	N.D.
Diisodecyl phthalate (DIDP)	mg/kg	With reference to ASTM D3421-75, GC-MS	50	N.D.
Diisononyl phthalate (DINP)	mg/kg	With reference to ASTM D3421-75, GC-MS	50	N.D.
Diisobutyl Phthalate (DIBP)	mg/kg	With reference to ASTM D3421-75, GC-MS	50	N.D.

Halogen Contents

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	BS EN 14582:2007, IC	30	N.D.
Chlorine(Cl)	mg/kg	BS EN 14582:2007, IC	30	337

Organotin Compounds

Test Items	Unit	Test Method	MDL	Results
Dibutyltin (DBT)	mg/kg	DIN 38407-13, GC/MS	0.1	N.D.
Tributyltin (TBT)	mg/kg	DIN 38407-13, GC/MS	0.1	N.D.
Triphenyltin (TPhT)	mg/kg	DIN 38407-13, GC/MS	0.1	N.D.
Diocetyl tin(DOT)	mg/kg	DIN 38407-13, GC/MS	0.1	N.D.

- NOTE:
- (1) N.D. = Not detected.(<MDL)
 - (2) mg/kg = ppm
 - (3) MDL = Method Detection Limit
 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) * = Boiling-water-extraction:

Negative = Absence of CrVI coating

Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.

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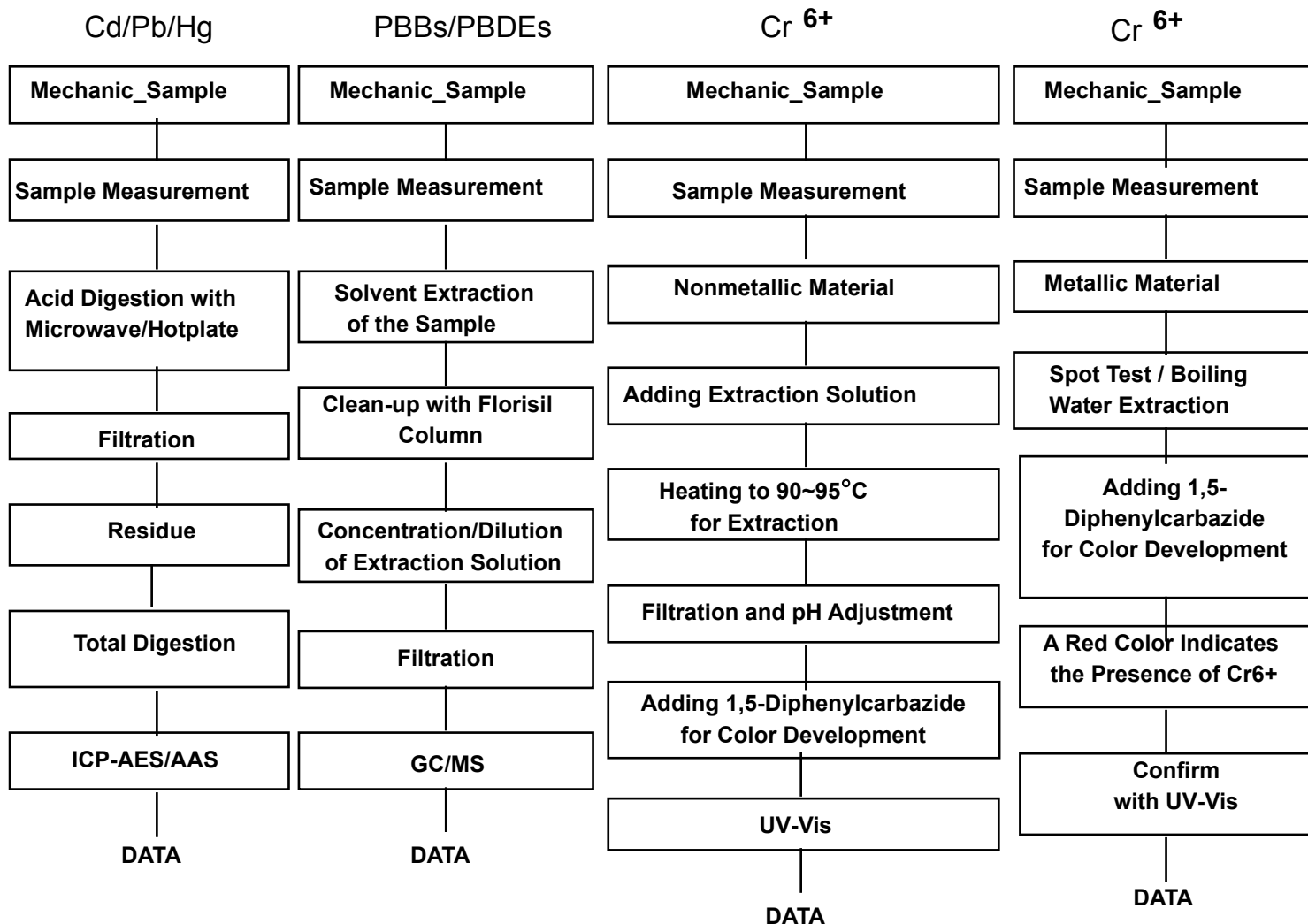
Picture of Sample as Received:



NOTE:

- (1) N.D. = Not detected.(<MDL)
- (2) mg/kg = ppm
- (3) MDL = Method Detection Limit
- (4) - = No regulation
- (5) ** = Qualitative analysis (No Unit)
- (6) * = Boiling-water-extraction:
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**Flow Chart for RoHS: Cd/Pb/Hg/Cr⁶⁺/PBBs&PBDEs Testing**

The samples were dissolved totally by pre-conditioning method according to above flow chart for Cd,Pb,Hg.

Section Chief : Gilsae Yi

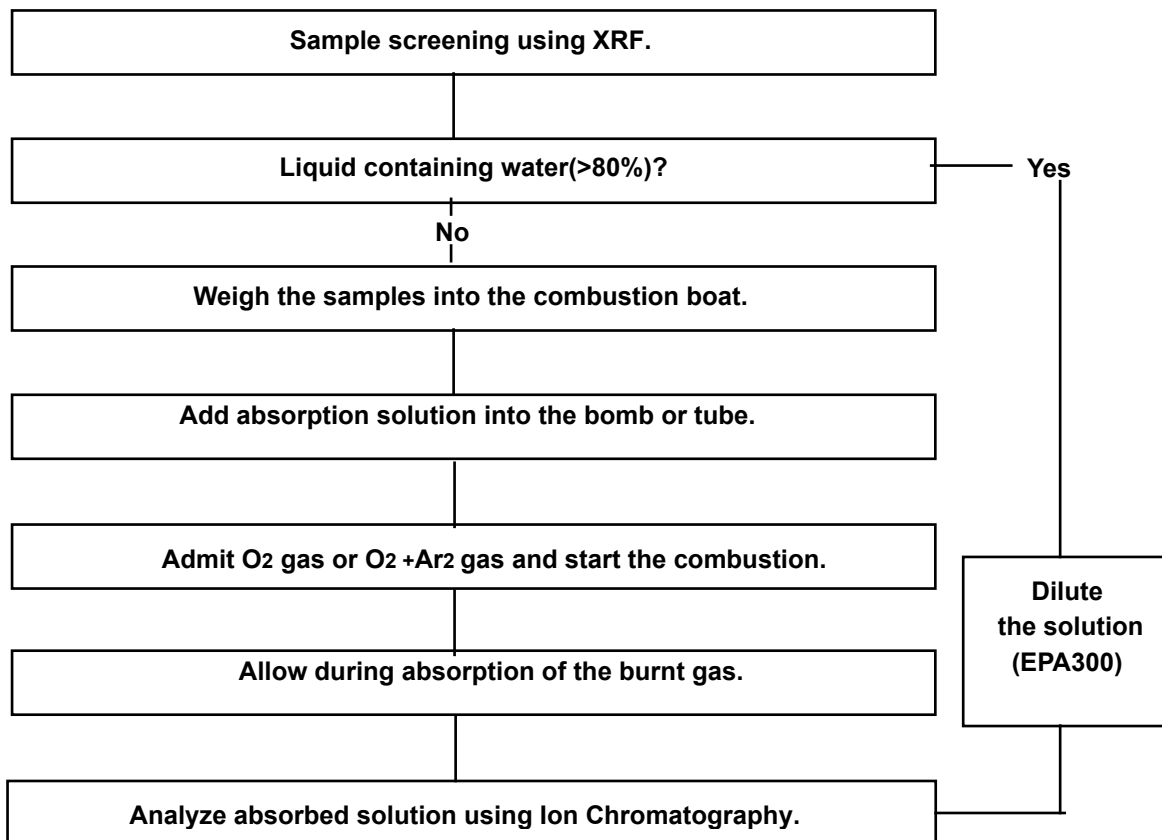
- NOTE:
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 - (2) mg/kg = ppm
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 - (4) - = No regulation
 - (5) ** = Qualitative analysis (No Unit)
 - (6) * = Boiling-water-extraction:

Negative = Absence of CrVI coating

Positive = Presence of CrVI coating; the detected concentration in boiling-water-extraction solution is equal or greater than 0.02 mg/kg with 50 cm² sample surface area.



Flow Chart for Halogen Test



*** End ***

NOTE:

- (1) N.D. = Not detected.(<MDL)
- (2) mg/kg = ppm
- (3) MDL = Method Detection Limit
- (4) - = No regulation
- (5) ** = Qualitative analysis (No Unit)
- (6) * = Boiling-water-extraction:
 - Negative = Absence of CrVI coating
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Test Report No. F690501/LF-CTSAYN11-001733

Issued Date: 2011. 02. 11 Page 1 of 4

To: **LS MTRON LTD.**
938-1, Jeongeup 3 Industrial Complex
Taegok-ri, Buk-myeon
Jeongeup-city
JEONBUK
Korea

The following merchandise was submitted and identified by the client as :

SGS File No. : AYAA11-04592
Product Name : Copper Foil
Item No./Part No. : UCF-STN
Received Date : 2011. 02. 09
Test Period : 2011. 02. 10 to 2011. 02. 11
Test Results : For further details, please refer to following page(s)
Test Performed : SGS Testing Korea tested the sample(s) selected by applicant with following results.

Timothy Jeon
Jinhee Kim
Cindy Park
Jerry Jung/ Testing Person

SGS Testing Korea Co. Ltd.

Jeff Jang / Chemical Lab Mgr



Test Report No. F690501/LF-CTSAYN11-001733

Issued Date: 2011. 02. 11 Page 2 of 4

Sample No. : 001
Sample Description : Copper Foil
Item No./Part No. : UCF-STN

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321:2008, ICP	0.5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321:2008, ICP	2	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321:2008, ICP	5	N.D.
Hexavalent Chromium (Cr VI) By boiling water extraction*	**	With reference to IEC 62321:2008	-	Negative

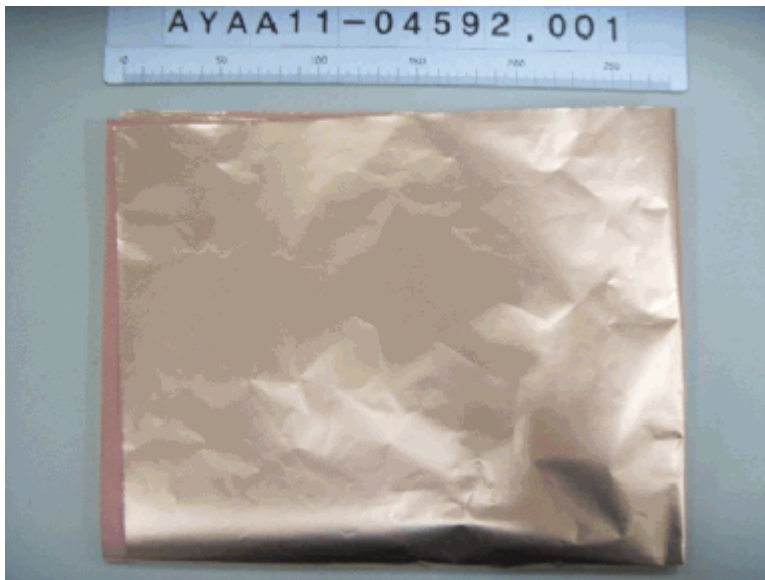
Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromobiphenyl	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321:2008, GC-MS	5	N.D.

NOTE: (1) N.D. = Not detected.(<MDL)
(2) mg/kg = ppm
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(4) - = No regulation
(5) ** = Qualitative analysis (No Unit)
(6) * = Boiling-water-extraction:
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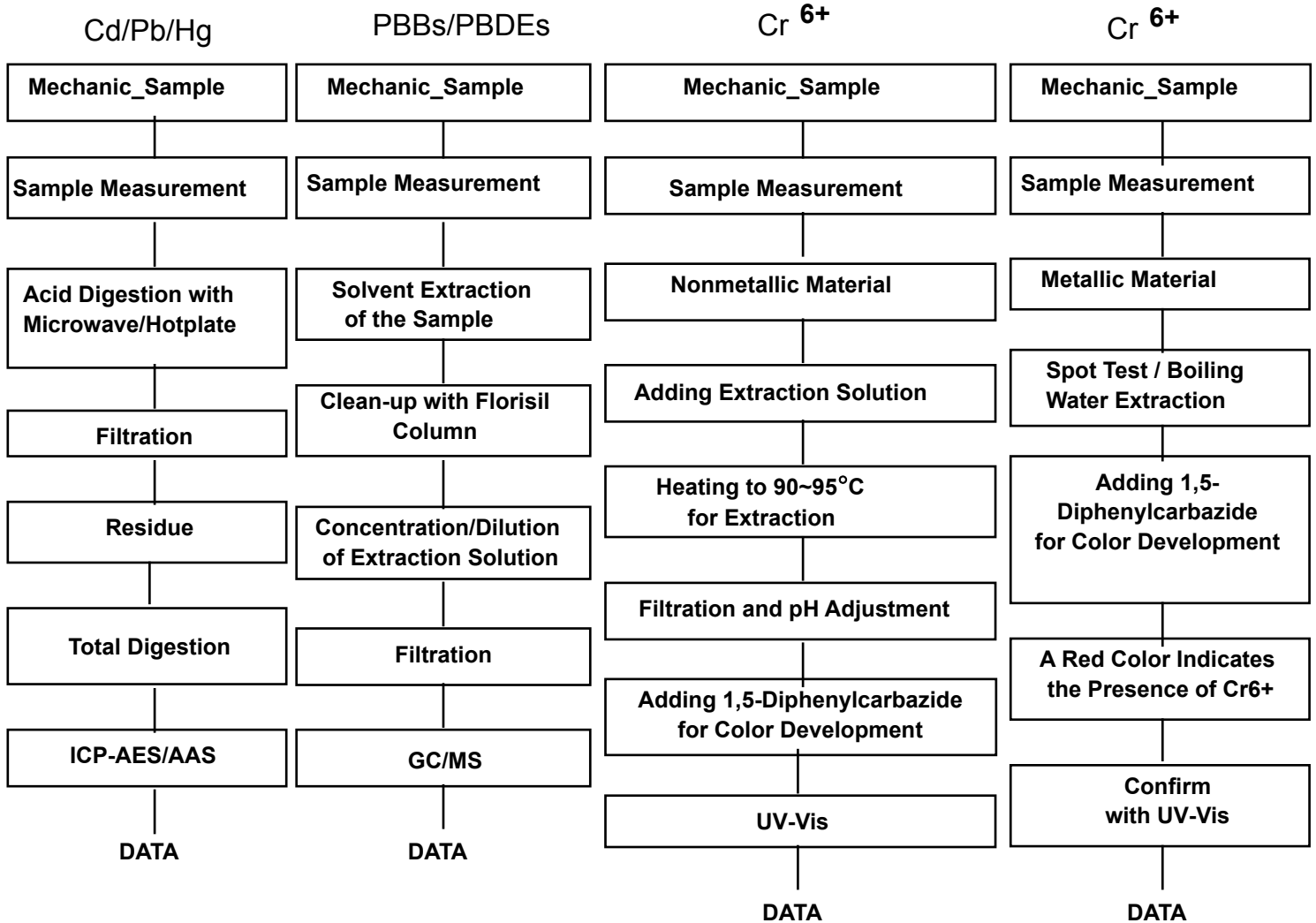
Picture of Sample as Received:



- NOTE:**
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Flow Chart for RoHS: Cd/Pb/Hg/Cr⁶⁺/PBBs/PBDEs Testing



The samples were dissolved totally by pre-conditioning method according to above flow chart for Cd,Pb,Hg.

Section Chief : Gilsae Yi

*** End ***

- NOTE:
- (1) N.D. = Not detected.(<MDL)
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測試報告 Test Report

號碼(No.) : CE/2011/75061 日期(Date) : 2011/08/02 頁數(Page) : 1 of 4

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



以下測試樣品係由客戶送樣，且由客戶聲稱並經客戶確認如下 (The following samples was/were submitted and identified by/on behalf of the client as) :

樣品名稱(Sample Description) : CYCLO OLEFIN POLYMER
樣品型號(Style/Item No.) : ZEONEX 480R (LOT NO.0Y03103)
收件日期(Sample Receiving Date) : 2011/7/27
測試期間(Testing Period) : 2011/7/27 TO 2011/08/02

=====
測試結果(Test Results) : 請見下一頁 (Please refer to next pages).


Shin-Jyh Chen
Shin-jyh Chen, Asst. Manager
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory - Taipei

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測試報告

Test Report

號碼(No.) : CE/2011/75061 日期(Date) : 2011/08/02 頁數(Page) : 2 of 4

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



測試結果(Test Results)

測試部位(PART NAME) No.1 : 透明色塑膠粒 (TRANSPARENT PLASTIC PELLETS)

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 14582:2007, 以離子層 析儀分析. / With reference to BS EN 14582:2007. Analysis was performed by IC.	50	n.d.
鹵素 (氯) / Halogen-Chlorine (Cl) (CAS No.: 22537-15-1)			50	n.d.
鹵素 (溴) / Halogen-Bromine (Br) (CAS No.: 10097-32-2)			50	n.d.
鹵素 (碘) / Halogen-Iodine (I) (CAS No.: 14362-44-8)			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)

測試報告 Test Report

號碼(No.) : CE/2011/75061 日期(Date) : 2011/08/02 頁數(Page) : 3 of 4

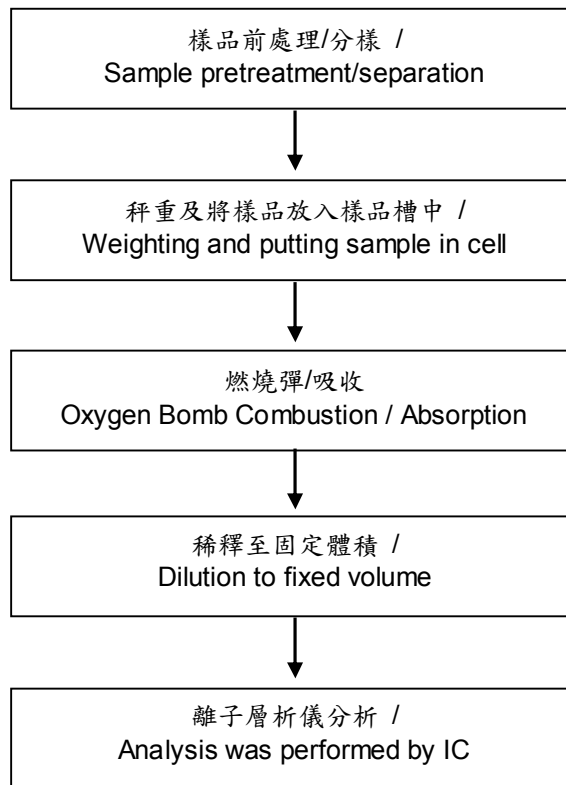
ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



鹵素分析流程圖 / Analytical flow chart of halogen content

- 1) 測試人員：陳恩臻 / Name of the person who made measurement: Rita Chen
- 2) 測試負責人：張啓興 / Name of the person in charge of measurement: Troy Chang



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號碼(No.) : CE/2011/75061 日期(Date) : 2011/08/02 頁數(Page) : 4 of 4

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



** 報告結尾(End of Report) **

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測試報告 Test Report

號碼(No.) : CE/2011/75060 日期(Date) : 2011/08/02 頁數(Page) : 1 of 4

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



以下測試樣品係由客戶送樣，且由客戶聲稱並經客戶確認如下 (The following samples was/were submitted and identified by/on behalf of the client as):

樣品名稱(Sample Description) : CYCLO OLEFIN POLYMER
樣品型號(Style/Item No.) : ZEONEX 480R (LOT NO.0Y03103)
收件日期(Sample Receiving Date) : 2011/07/27
測試期間(Testing Period) : 2011/07/27 TO 2011/08/02

=====
測試需求(Test Requested) : 依據客戶指定，檢測可塑劑含量。(As specified by client, determine Phthalates content in the submitted sample(s).)

測試方法(Test Method) : 請見下一頁 (Please refer to next pages.)

測試結果(Test Results) : 請見下一頁 (Please refer to next pages.)


Shin-Jyh Chen
Shin-jyh Chen, Asst. Manager
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory - Taipei

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SGS Taiwan Ltd.
台灣檢驗科技股份有限公司 Chemical-Taipei 33 WuChyuan Road, Wuku Industrial Zone, New Taipei City, Taiwan /新北市五股工業區五權路33號 + 886 (02)2299 3279 f + 886 (02)2299 3237 www.sgs.com

測試報告

Test Report

號碼(No.) : CE/2011/75060 日期(Date) : 2011/08/02 頁數(Page) : 2 of 4

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



測試結果(Test Results)

測試部位(PART NAME) No.1 : 透明色塑膠粒 (TRANSPARENT PLASTIC PELLETS)

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
可塑劑定量分析 / Phthalates				
鄰苯二甲酸甲苯基丁酯 / BBP (Benzyl butyl phthalate) (CAS No.: 85-68-7)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.003	n.d.
鄰苯二甲酸二 (2-乙基己基) 酯 / DEHP (Di- (2-ethylhexyl) phthalate) (CAS No.: 117-81-7)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.003	n.d.
鄰苯二甲酸二異癸酯 / DIDP (Di- isodecyl phthalate) (CAS No.: 26761-40-0)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.01	n.d.
鄰苯二甲酸二異壬酯 / DINP (Di- isononyl phthalate) (CAS No.: 28553-12-0)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.01	n.d.
鄰苯二甲酸二正辛酯 / DNOP (Di-n- octyl phthalate) (CAS No.: 117- 84-0)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.003	n.d.
鄰苯二甲酸二丁酯 / DBP (Dibutyl phthalate) (CAS No.: 84-74-2)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.003	n.d.
鄰苯二甲酸二己酯 / DNHP (Di-n- hexyl phthalate) (CAS No.: 84-75- 3)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.003	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)	%	參考EN 14372, 以氣相層析儀/質譜儀檢 測之。 / With reference to EN 14372. Analysis was performed by GC/MS.	0.003	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)

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測試報告 Test Report

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN

號碼(No.) : CE/2011/75060 日期(Date) : 2011/08/02 頁數(Page) : 3 of 4

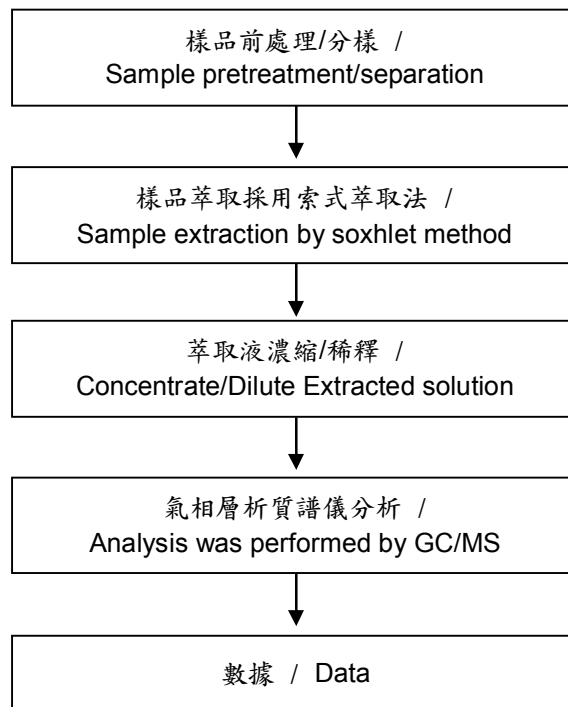


索式萃取(GC/MS)分析流程圖 /

Analytical flow chart of Soxhlet extraction (GC/MS) procedure

- 1) 測試人員：翁賜彬 / Name of the person who made measurement: Roman Wong
- 2) 測試負責人：張啓興 / Name of the person in charge of measurement: Troy Chang

■ 測試項目(Test Items): 可塑劑 / Phthalate



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測試報告 Test Report

號碼(No.) : CE/2011/75060 日期(Date) : 2011/08/02 頁數(Page) : 4 of 4

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



** 報告結尾(End of Report) **

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1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



以下測試樣品係由客戶送樣，且由客戶聲稱並經客戶確認如下 (The following samples was/were submitted and identified by/on behalf of the client as) :

樣品名稱(Sample Description) : CYCLO OLEFIN POLYMER
樣品型號(Style/Item No.) : ZEONEX 480R (LOT NO.0Y03103)
收件日期(Sample Receiving Date) : 2011/7/27
測試期間(Testing Period) : 2011/7/27 TO 2011/08/02

=====
測試需求(Test Requested) : 參照RoHS 2011/65/EU Annex II 指令要求. (In accordance with the RoHS Directive 2011/65/EU Annex II).

測試結果(Test Results) : 請見下一頁 (Please refer to next pages).


Chenyu Kung / Operation Manager
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory – Taipei

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測試結果(Test Results)

測試部位(PART NAME)No.1 : 透明色塑膠粒 (TRANSPARENT PLASTIC PELLETS)

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: 2008 方法, 以感應耦合電漿原子發射光譜儀檢測. / With reference to IEC 62321: 2008 and performed by ICP-AES.	2	n.d.
鉛 / Lead (Pb)	mg/kg		2	n.d.
汞 / Mercury (Hg)	mg/kg		2	n.d.
六價鉻 / Hexavalent Chromium Cr(VI)	mg/kg	參考 IEC 62321: 2008 方法, 以 UV-VIS 檢測. / With reference to IEC 62321: 2008 and performed by UV-VIS.	2	n.d.
多溴聯苯總和 / Sum of PBBs	mg/kg	參考 IEC 62321: 2008 方法, 以氣相層析儀/質譜儀檢測. / With reference to IEC 62321: 2008 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.

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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
多溴聯苯醚總和 / Sum of PBDEs	mg/kg	參考 IEC 62321: 2008 方法, 以氣相層析儀/ 質譜儀檢測. / With reference to IEC 62321: 2008 and performed by GC/MS.	-	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.

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)

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日期(Date) : 2011/08/02

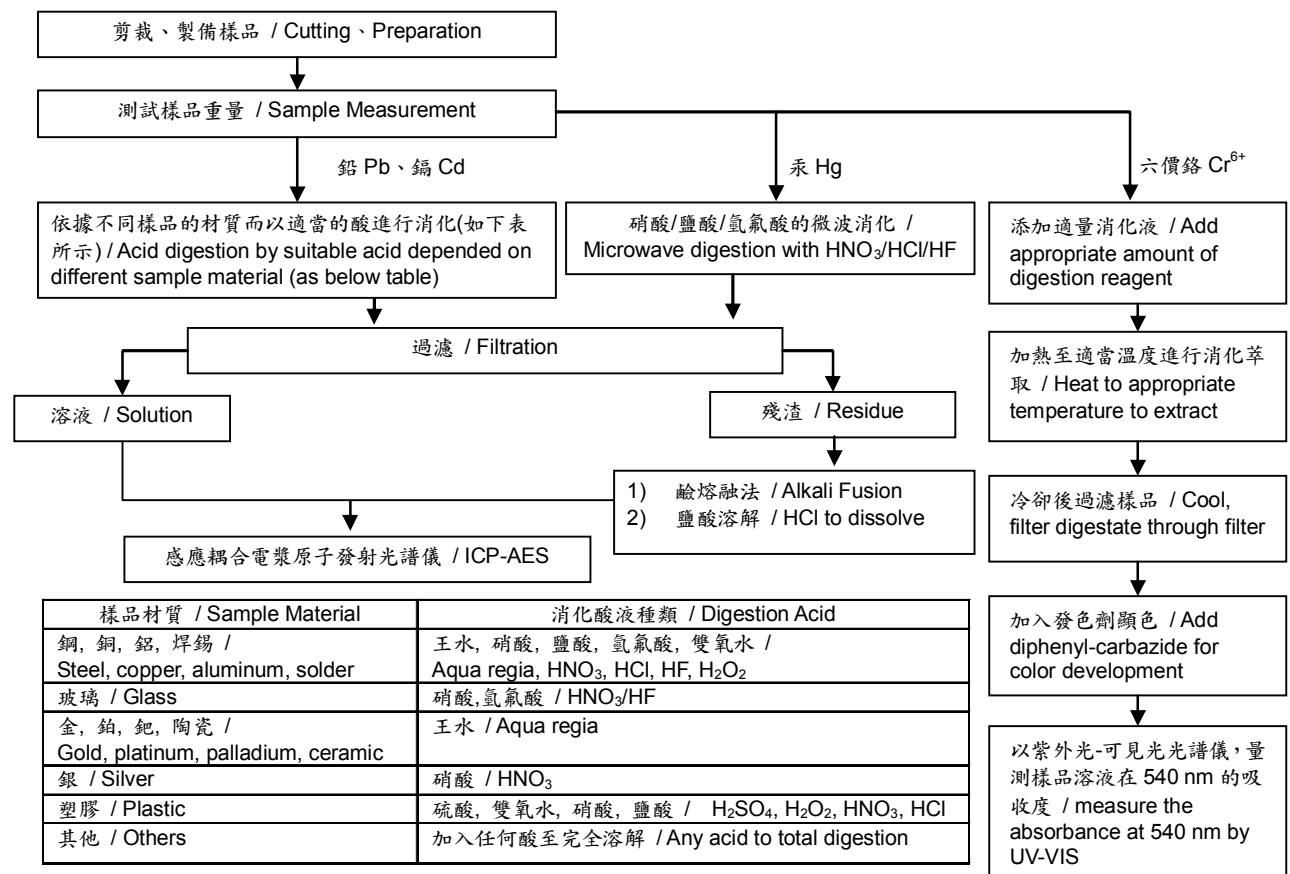
頁數(Page): 4 of 6

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1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



- 1) 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. (Cr⁶⁺ test method excluded)
- 2) 測試人員：楊登偉 / Name of the person who made measurement: Climbgreat Yang
- 3) 測試負責人：張啓興 / Name of the person in charge of measurement: Troy Chang



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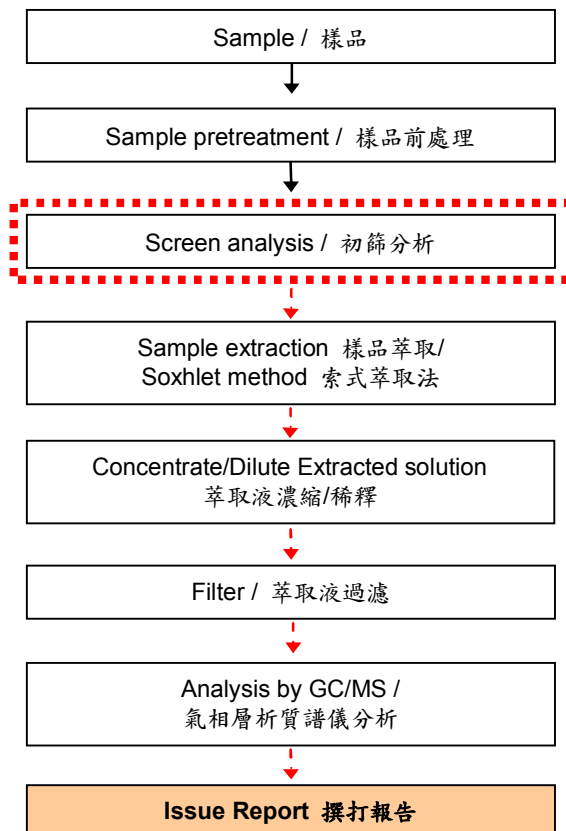
多溴聯苯/多溴聯苯醚分析流程圖 / PBB/PBDE analytical FLOW CHART

- 測試人員：翁賜彬 / Name of the person who made measurement: Roman Wong
- 測試負責人：張啓興 / Name of the person in charge of measurement: 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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測試報告 Test Report

號碼(No.) : CE/2011/75062 日期(Date) : 2011/08/02 頁數(Page) : 1 of 4

ZEON CORPORATION

1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



以下測試樣品係由客戶送樣，且由客戶聲稱並經客戶確認如下 (The following samples was/were submitted and identified by/on behalf of the client as) :

樣品名稱(Sample Description) : CYCLO OLEFIN POLYMER
樣品型號(Style/Item No.) : ZEONEX 480R (LOT NO.0Y03103)
收件日期(Sample Receiving Date) : 2011/7/27
測試期間(Testing Period) : 2011/7/27 TO 2011/08/02

=====
測試結果(Test Results) : 請見下一頁 (Please refer to next pages).



Chenyu Kung / Operation Manager
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory – Taipei

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測試結果(Test Results)

測試部位(PART NAME)No.1 : 透明色塑膠粒 (TRANSPARENT PLASTIC PELLETS)

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
銻 / Antimony (Sb)	mg/kg	參考US EPA 3050B方法, 以感應耦合電漿原子發射光譜儀檢測銻含量. / With reference to US EPA Method 3050B for Antimony Content. Analysis was performed by ICP-AES.	2	n.d.
鈹 / Beryllium (Be)	mg/kg	參考US EPA 3050B方法, 以感應耦合電漿原子發射光譜儀檢測鈹含量. / With reference to US EPA Method 3050B for Beryllium Content. Analysis was performed by ICP-AES.	2	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)

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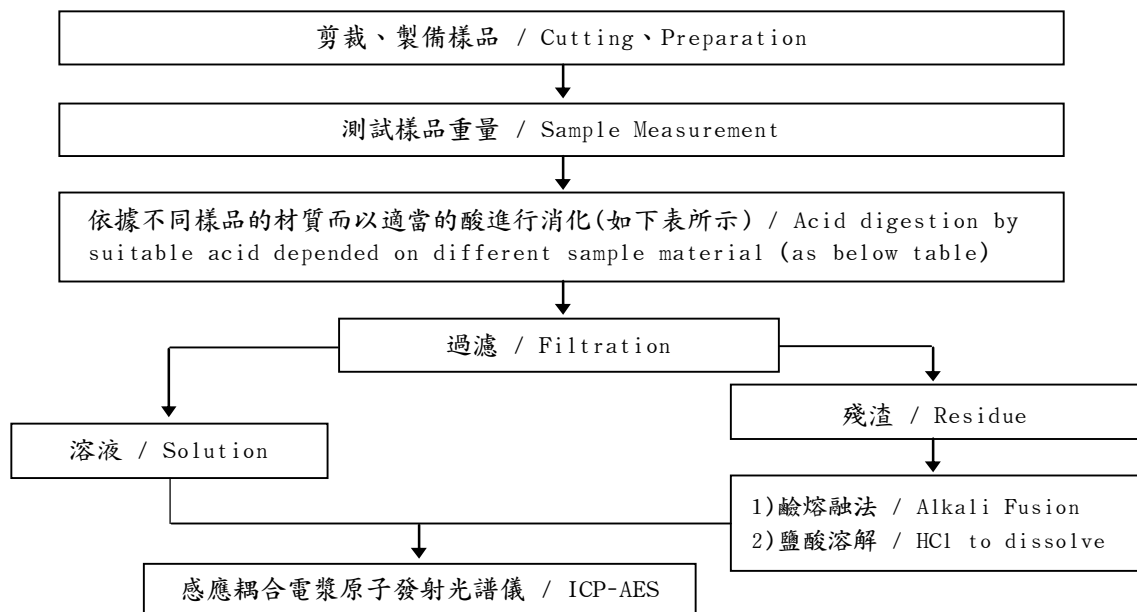
1-6-2 MARUNOUCHI, CHIYODA-KU, TOKYO, 100-8246, JAPAN



- 1) 根據以下的流程圖之條件，樣品已完全溶解。 / These samples were dissolved totally by pre-conditioning method according to below flow chart.
- 2) 測試人員：楊登偉 / Name of the person who made measurement: Climbgreat Yang
- 3) 測試負責人：張啓興 / Name of the person in charge of measurement: Troy Chang

元素以 ICP-AES 分析的消化流程圖

(Flow Chart of digestion for the elements analysis performed by ICP-AES)



鋼, 銅, 鋁, 焊錫 / Steel, copper, aluminum, solder	王水, 硝酸, 鹽酸, 氫氟酸, 雙氧水 / Aqua regia, HNO ₃ , HCl, HF, H ₂ O ₂
玻璃 / Glass	硝酸, 氫氟酸 / HNO ₃ /HF
金, 鉑, 鈀, 陶瓷 / Gold, platinum, palladium, ceramic	王水 / Aqua regia
銀 / Silver	硝酸 / HNO ₃
塑膠 / Plastic	硫酸, 雙氧水, 硝酸, 鹽酸 / H ₂ SO ₄ , H ₂ O ₂ , HNO ₃ , HCl
其他 / Others	加入任何酸至完全溶解 / Any acid to total digestion

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