QSOP					
	MATTEL	**3600 Heavy Elements**			
		Number **3600**	Revision 11.00	Date 2021-08-20	Assigned Author Ying Gao
		QUALITY SAFETY OPERATING PROCEDURE			**FOR QUESTIONS CONTACT** **Ying Gao**
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1 - SCOPE (3600)

1.1 - Products and Components Covered

1.1.1 - All toys and ***child care articles***

1.1.2 - Test the following to QSOP 3602, Heavy Elements- Children's Products and General Consumer Products

- Non- toy/non-child care article children's products
- General Consumer Products

1.1.3 - Test the following to QSOP 3604, Heavy Elements – Jewelry

- ***Jewelry*** intended to be worn by either a child or an adult
- Jewelry ornaments on clothing or shoes intended to be detachable so that they can be attached as a charm to a jewelry item such as a necklace, bracelet, etc.

1.1.4 - Test the following to QSOP 3606, Heavy Elements – Children's Apparel, Handbags and Similar Items

- Children's apparel
- Handbags and similar items

1.1.5 - Test the following to QSOP 3607, Heavy Elements – Cosmetics

- All cosmetics *
  *Cosmetic toys shall comply with the requirements in both QSOP 3600, Heavy Elements and QSOP 3607, Heavy Elements - Cosmetics

1.1.6 - Batteries and Battery- operated products must comply with the requirements in the QSOP 3274, Batteries and Battery Operated Products.

1.1.7 - All reusable packaging intended to be retained with the finished product

1.2 - Exemptions

1.2.1 - If sample material is <10 mg the material is exempt from soluble method 1 requirements. Total and soluble method 2 requirements still apply.

1.2.2 - Glass is exempt from total cadmium requirements. Soluble cadmium requirements still apply.

1.2.3 - The following items are exempt from all requirements in this document with the exception of § 2.1 and in §2.4:

- Components that are not accessible after use and foreseeable abuse

1.2.4 - ***Promotional items*** intended for adults.

1.2.5 - Items listed in **Appendix III** are exempt from the total Pb requirements.

1.2.6 - The following items are exempt from total nickel requirement

- Stainless steel
- Child care articles
- Material using nickel for electrical conductivity purpose.
- Nickel plated axles on toys suitable for >3 years old where the only accessible portion is the part that protrudes from the center of the wheel and the diameter of this portion is ≤ 2.0 mm. (Refer to §5 - Q&A 6)

1.2.7 - Items listed in **Appendix V** are exempt from §2.4.

1.2.8 - Metals are exempt from organotin requirements.

1.2.9 - Products intended for children over 6 years and packaging intended to be retained for children over 6 years are exempt from the organotin requirements unless

- they are intended or likely to be put in the mouth or to the mouth. Items considered likely to be put in the mouth include cosmetic toys or writing instruments.
- they are intended for ***prolonged skin contact***.

1.3 - Definitions (Words that are defined are ***italicized and bolded*** once per section)

1.3.1 - Accessible: Any area of the product that can be contacted by any portion forward of the collar of the accessibility probes when inserted to the depth determined in QSOP 3010, Accessibility.

1.3.2 - Art Materials: Any substance marketed or represented by the producer or repackaged for use in any phase of the creation of any work of visual or graphic art in any medium such as crayons, clay/modeling compounds, glues (liquid and stick), paints (finger, watercolor, liquid), markers and similar “wet” medium, colored pencils, chalk, ball point pens and pencils.

1.3.3 - Child Care Article: Any product intended for children to facilitate seating, sleeping, relaxation, transportation, physical protection, hygiene and feeding or sucking/drinking.

1.3.4 - Composite (Sample): A sample made from combining more than one material or color (e.g. paint: red, yellow and blue), vacuum metalized coating (silver and gold). It is not considered compositing when colors or materials that can not be separated (e.g. thin stripes, doll eyes, etc.) are tested together.

1.3.5 - Dry, Brittle, Powder Like or Pliable Materials: Dry, brittle, powder like or pliable materials include solid toy materials from which power-like materials is released during playing and semi-solid materials that may also leave residues on the hands during play. The material can be ingested. Refer to the Appendix IV for determining category.

1.3.6 - General Consumer Product: A consumer product that is not designed or intended primarily for use by children 14 years old or younger. It is designed or intended primarily for use by consumer older than age 14 or consumers of all ages.

1.3.7 - Jewelry Items: Ornamental items that are intended to be worn in the hair or on the body. Examples would include rings, necklaces, bracelets, watches etc. This definition also includes jewelry kits that are intended to create jewelry items.

1.3.8 - Liquid or Sticky Materials: Liquid or sticky materials include fluid or viscous toy materials, which can be ingested or to which dermal exposure may occur during playing. Refer to the Appendix IV for determining category.

1.3.9 - Prolonged Skin Contact: Items are intended to be in direct contact with children’s skin over one hour. Such as, clothes, jewelry, bedding, and costumes. Items that are intended to be worn over clothing are not considered as prolonged skin contact. Items that are intended for dolls are not considered as prolonged skin contact.

1.3.10 - Promotional Items: Items provided to the consumer to promote a product or brand. These items may or may not be included in, or with, a product. Examples include items such as booklets, catalogs, bookmarks, growth charts, and posters. In some instances, a promotional item may be an actual product in package that is given away.

1.3.11 - Scraped-off Materials: Scraped-off materials include solid toy materials with or without a coating, which can be ingested as a results of biting, tooth scraping, sucking or licking. Refer to the Appendix IV for determining category.

1.3.12 - Small Part: A part that fits within the truncated test cylinder when evaluated per QSOP 3020, Small Parts, Small Balls and Marbles.

1.3.13 - Substrate: The base material of an item, regardless of whether or not it has a ***surface coating***. Labels and electroplating are both considered substrate materials.

1.3.14 - Surface Coating: All layers of materials such as paint or similar materials, that dry to a solid film when applied to a substrate and that can be scraped off with a sharp blade or washed off with a solvent such as acetone or ethanol, without removing the substrate (base) material. These are factory applied coatings on products.

1.3.15 - Toy: Any product or material designed or clearly intended for use in play by children less than 14 years of age.

1.4 - Purpose

Evaluate product for compliance to worldwide safety standards for heavy metals content.

2 - PERFORMANCE REQUIREMENTS

- Performance requirements must be met both before and after all applicable Use and Abuse testing.
- Products intended to be assembled by an adult should be evaluated for accessibility and for small parts after assembly.

2.1 - All Products

All inaccessible materials must have ≤ 75 ppm Total Cadmium (Cd) as shown in **Table 1**.

Table 1 - Heavy Element Limits for Inaccessible Parts of All Products

ELEMENT	TOTAL (ppm)
Cadmium (Cd)	75

2.2 - Components Intended for Use Exclusively by Adults

2.2.1 - *Surface Coatings*

The following must have ≤ the limits listed in **Table 2**.

- All ***accessible*** surface coatings
- All surface coatings on packaging intended to be retained

Table 2 - Heavy Element Limits for Surface Coatings on Products Used Exclusively by Adults

ELEMENT	TOTAL (ppm)
Cadmium (Cd)	75
Lead (Pb)	90

2.2.2 - Plastics

The following must have ≤ the limits specified in **Table 3**.

- All accessible plastic parts
- All plastic in packaging intended to be retained

Table 3 - Heavy Element Limits for Plastics in Products Used Exclusively by Adults

ELEMENT	TOTAL (ppm)
Cadmium (Cd)	75
Lead (Pb)	90

2.3 - All Toys and *Child Care Articles* (Including Non-Silkston Collectible Fashion Dolls Intended for Brazil)

2.3.1 - *S*urface Coatings

The following must have ≤ the limits listed in Table 4

- **All accessible surface coatings except the ones in §2.3.1.1**
- All accessible surface coatings on non-paper/paper board packaging intended to be retained

- **Table 4** -Heavy Element Limits for Surface Coatings

ELEMENT	TOTAL (ppm)	SOLUBLE METHOD 1 (ppm)	SOLUBLE METHOD 2 (ppm)
Antimony (Sb)	-	60	1000
Arsenic (As)	-	25	1000
Barium (Ba)	-	1000	1000

Cadmium (Cd)	75	17	1000
Chromium (Cr)	-	60	-
Lead (Pb)	40	23	-
Mercury (Hg)	10	-	-
Selenium (Se)	-	460	1000
Aluminum (Al)	-	28130	-
Boron (B)	-	15000	-
Cobalt (Co)	-	130	-
Copper (Cu)	-	7700	-
Manganese (Mn)	-	15000	-
Nickel (Ni)	10000	930	-
Strontium (Sr)	-	56000	-
Tin (Sn)	-	180000	-
Zinc (Zn)	-	46000	-
Chromium (VI) (Cr VI)	-	0.053	-
Organic tin	-	12	-

2.3.1.1 - The following must have ≤ the limits listed in **Table 5**

- Accessible Surface Coating on Printed Paper and Paper Board including products and packaging intended to be retained.

Table 5, Heavy Element Limits for Surface Coating on Pri

nted Paper/Paper Board

ELEMENT	TOTAL (ppm)	SOLUBLE METHOD 1 (ppm)	SOLUBLE METHOD 2 (ppm)
Antimony (Sb)	-	60	1000
Arsenic (As)	-	25	1000
Barium (Ba)	-	1000	1000
Cadmium (Cd)	75	17	1000
Chromium (Cr)	-	60	-
Lead (Pb)	40	23	-
Mercury (Hg)	10	-	-
Selenium (Se)	-	460	1000

2.3.2 - Metal, Glass, Gemstone and Ceramic

2.3.2.1 - Non-Small Parts

Accessible metal, glass, gemstone and ceramic must have ≤ the limits listed in **Table 6**.

Table 6- Heavy Element Limits for Non-Small Part Metal, Glass, Gemstone & Ceramic

ELEMENT	TOTAL (ppm)
Cadmium (Cd)	75
Lead (Pb)	90
Nickel (Ni)	10000

2.3.2.2 - Small Parts Containing Accessible Glass, Ceramic, Metallic Materials

The following must have ≤ the limits listed in **Table 7**.

- All accessible metal, glass, gemstones, and ceramics must have ≤ the total limits listed in Table 7
- Small parts containing accessible glass, ceramic, metallic materials must have ≤ the soluble limits listed in Table 7
  - Apply the soluble method to the whole small part.
  - If the small part contains surface coatings, the surface coating shall be tested according to section 2.3.1. A small part testing shall be performed after removing any of coating.

Table 7 - Heavy Element Limits for Small Part Metal, Glass, Gemstone and Ceramic

ELEMENT	TOTAL (ppm)	SOLUBLE METHOD 1 (ppm)
Antimony (Sb)	-	60
Arsenic (As)		25
Barium (Ba)	-	1000
Cadmium (Cd)	75	17
Chromium (Cr)	-	60
Lead (Pb)	90	23
Mercury (Hg)	-	60
Selenium (Se)	-	460
Aluminum (Al)	-	28130
Boron (B)	-	15000
Cobalt (Co)	-	130
Copper (Cu)	-	7700
Manganese (Mn)	-	15000
Nickel (Ni)	10000	930
Strontium (Sr)	-	56000
Tin (Sn)	-	180000
Zinc (Zn)	-	46000
Chromium VI (CrVI)	-	0.053
Organic tin	-	12

2.3.3 - All Other Scraped-off Materials

The following must have ≤ the limits listed in **Table 8**.

- All accessible parts
- All other accessible material used in packaging intended to be retained

- Printed paper and paper board

Table 8 - Heavy Element Limits for Scrapped-off Materials

ELEMENT	TOTAL (ppm)	SOLUBLE METHOD 1 (ppm)
Antimony (Sb)	-	60
Arsenic (As)	-	25
Barium (Ba)	-	1000
Cadmium (Cd)	75	17
Chromium (Cr)	-	60
Lead (Pb)	90,40*	23
Mercury (Hg)	-	60
Selenium (Se)	-	460
Aluminum (Al)	-	28130
Boron (B)	-	15000
Cobalt (Co)	-	130
Copper (Cu)	-	7700
Manganese (Mn)	-	15000
Nickel (Ni)	10000	930
Strontium (Sr)	-	56000
Tin (Sn)	-	180000
Zinc (Zn)	-	46000
Chromium VI (Cr VI)	-	0.053
Organic tin	-	12

* 40 ppm total lead limits only apply to the child care articles intended to be placed into a child’s mouth.

2.3.4 - Dry, Brittle, Powder-like or Pliable Materials

The following must have ≤ the limits listed in **Table 9**.

- All accessible parts
- All other accessible material used in packaging intended to be retained

Table 9 - Heavy Element Limits for Dry, Brittle, Powder-Like or Pliable Materials

ELEMENT	TOTAL (ppm)	SOLUBLE METHOD 1 (ppm)
Antimony (Sb)	-	45
Arsenic (As)	-	3.8
Barium (Ba)	-	250
Cadmium (Cd)	75	1.3
Chromium (Cr)	-	37.5
Lead (Pb)	90	2
Mercury (Hg)	-	7.5

Selenium (Se)	-	37.5
Aluminum (Al)	-	2250
Boron (B)	-	1200
Cobalt (Co)	-	10.5
Copper (Cu)	-	622.5
Manganese (Mn)	-	1200
Nickel (Ni)	10000	75
Strontium (Sr)	-	4500
Tin (Sn)	-	15000
Zinc (Zn)	-	3750
Chromium VI (Cr VI)	-	0.02
Organic tin	-	0.9

2.3.5 - Liquid or Sticky Materials

The following must have ≤ the limits listed in **Table 10**.

- All accessible parts
- All other accessible material used in packaging intended to be retained

Table 10 - Heavy Element Limits for Liquid or Sticky Materials

ELEMENT	TOTAL (ppm)	SOLUBLE METHOD 1 (ppm)
Antimony (Sb)	-	10
Arsenic (As)	-	0.9
Barium (Ba)	-	350
Cadmium (Cd)	75	0.3
Chromium (Cr)	-	9.4
Lead (Pb)	90	0.5
Mercury (Hg)	-	1.9
Selenium (Se)	-	9.4
Aluminum (Al)		560
Boron (B)		300
Cobalt (Co)		2.6
Copper (Cu)		156
Manganese (Mn)		300
Nickel (Ni)	10000	18.8
Strontium (Sr)		1125
Tin (Sn)		3750
Zinc (Zn)		938
Chromium VI (Cr VI)		0.005
Organic tin		0.2

2.4 - Additional Requirements for All Electrical and Electronic Products

2.4.1 - All accessible and inaccessible parts must meet the flame retardant requirements of QSOP 3614, Flame Retardants.

2.4.2 - All accessible parts must comply with the requirements described from § 2.1 to §2.4 if applicable. All accessible and inaccessible parts must have ≤ the heavy element limits specified in **Table 11**.

Table 11 - Heavy Element Limits: All Parts of All Products

ELEMENT	TOTAL (ppm)
Cadmium (Cd)	75
Chromium VI (Cr VI)	1000
Lead (Pb)	1000
Mercury (Hg)	1000

2.5 - Additional Requirements

2.5.1 - Any PVC resin with a tin based stabilizer must be CKT series from Wofoo.

2.5.2 - Surface coatings are not allowed to be applied to PVC using a tin-based stabilizer.
Note: CKT series PVC from Wofoo uses tin-based stabilizers; Clear PVC sheeting uses tin-based stabilizers.

2.5.3 - PVC using a tin-based stabilizer must be tested after being subject to aging test per QSOP 4400, Simulated Aging and Storage.

3 - PROCEDURE

3.1 - Environment (N/A)

3.2 - Equipment
Use equipment specified in procedures referenced in §3.4

3.3 - General Requirements

3.3.1 - If feasible, samples are to be tested in the same form they appear on the finished product, e.g. paint is tested in the dry state.

3.3.2 - Coated surfaces require testing of both the surface coating and the substrate (base material) with the coating removed.

3.3.3 - Colors or materials can be combined if they cannot be physically separated (e.g. overlapping colors of paint, adhesive on a label). This is not considered ***composite*** testing. For example, glues or adhesives that cannot be physically separated from the substrate (e.g. adhesive on a paper label) should be tested together with the substrate.

3.3.4 - Composite testing is not permitted for Soluble 1 and 2 testing. This does not apply to Total digestion testing that is used to satisfy Soluble 1 and 2 limits per §3.4.1.

3.3.5 - The analytical correction factors in the **Table 12** should be applied to Soluble 1 results per GLOP 7409, Data Handling for the ICP. These correction factors should not be applied to total digestion results or Soluble 2 results.

Table 12 - Analytical Correction

Elements	Sb	As	Ba	Cd	Cr	Pb	Hg	Se
Analytical correction (%)	60	46.8	30	0	30	0	36.2	0

3.3.6 - Composite testing, when permitted, must meet the following criteria:
- No more than 3 samples may be used
- Equal weights of each sample should be used
- Compositing must be done using similar materials with similar properties

3.3.7 - Measures must be taken to ensure a failing result is not masked by the other samples in a composite. Acceptable methods for calculating the maximum possible concentration of an analyte in a single sample are detailed in CPSC test method CPSC-CH-E1003-09 and Mattel GLOP 7406, Total Digestion for Heavy Element Analysis

3.3.8 - Test frequency is per the following:

- GQMP 2112, Surface Coatings Material Control
- GQMP 2113, Heavy Elements Control on Surface Coatings for Vendors
- GQMP 2118, Substrate Material Control
- GQMP 2119, Heavy Elements Control on Substrates for Vendors

3.3.9 - Requirements of §2.4
A declaration of compliance must be obtained from each supplier certifying compliance to §2.4. The declaration of compliance form can be found in GQMP 2115, Supplier Approval Process, **Appendix III**.

3.3.10 - High risk materials for Cr VI under §2.3 shall be performed Cr VI testing. The compliance of other materials in §2.3 to Cr VI has been demonstrated by a product chemical safety assessment, therefore Cr VI testing is not required. High risk materials for Cr VI are **leather**.

3.4 - Method

3.4.1 - General

3.4.1.1 - Laboratories may use the results from the total test to satisfy soluble 1 and soluble 2 requirements, if they have demonstrated that the Total digestion and analysis methods they employ are capable of accurately testing for all analytes of interest (As, Ba, Cd, Cr, Hg, Pb, Sb, Se, Al, B, Co, Cu, Mn, Ni, Sr, Sn, and Zn).

3.4.1.1.1 - For As, Cd, Cr, Hg, Pb, Sb, Se , Al, B, Co, Cu, Mn, Ni, Sr, Sn, and Zn, if the total element test result is ≤ the total and soluble limits, soluble test methods 1 and 2 are not required. For Barium (Ba), total result must be ≤50% of the respective Soluble 1 or Soluble 2 limit. If result is >50% of the respective limit, then the related soluble test must be performed (e.g. if the result is greater than 50% of Soluble 1 requirement, then the Soluble 1 test must be performed).

3.4.1.1.2 - If the total test result is > the total limit, then the material fails and no further testing is performed. See **Appendix I** for examples.

3.4.1.1.3 - Follow **Appendix II** if sufficient sample to conduct the testing cannot be collected from 12 units.

3.4.1.1.4 - Materials falling into §2.3.4 and §2.3.5 need be tested by the external labs with ICP-MS per the following methods.

3.4.1.1.5 - For organic tin in scraped - off materials, If total tin ≤ 12 ppm, soluble 1 testing is not required. If total tin >12 ppm, soluble 1 testing is required. If soluble 1 tin >2.5 ppm, the further testing is required to confirm the organic tin content. If soluble 1 tin ≤ 2.5 ppm, the GC-MS testing is not required.

3.4.2 - Mattel Internal Labs

Mattel internal test laboratories must follow appropriate Global Laboratory Operating Procedure

3.4.2.1 - Total Test Methods

- Test Glass and Ceramic at an external laboratory.
- Test all other materials per GLOP 7406, Total Digestion for Heavy Element Analysis
- Follow **Appendix II** if sufficient sample to conduct the testing cannot be collected from 12 samples.

3.4.2.2 - Soluble Method 1

- Test per GLOP 7408, Soluble Extractions for Heavy Metal Analysis
- If 10 mg of sample cannot be collected from 1 sample, do not perform an analysis.

3.4.2.3 - Soluble Method 2

- Test per GLOP 7408, Soluble Extractions for Heavy Metal Analysis
- Follow **Appendix II** if sufficient sample to conduct the testing cannot be collected from 12 samples

3.4.3 - External Labs

3.4.3.1 - Total Test Methods

3.4.3.1.1 - External labs shall not check total nickel requirement for finished goods.

3.4.3.1.2 - Use one of the following digestion methods as applicable for all elements:

- AOAC Official Method 974.02, Lead in Paint
- EPA Method 3051A, Microwave Assisted Digestion of Sediments, Sludge, Soils, and Oils
- EPA Method 3052, Microwave Assisted Digestion of Siliceous and Organically Based Matrices
- CPSC-CH-E1003-09.1, Standard Operating Procedure for Determining Lead (Pb) in Paint and Other Similar Surface Coatings
- CPSC-CH-E1002-08, Standard Procedure for Determining Total Lead (Pb) in Non-Metal Children's Products
- CPSC-CH-E1001-08, Standard Procedure for Determining Total Lead (Pb) in Children's Metal Products (Including Children's Metal Jewelry)

3.4.3.1.3 - Use one of the following methods as applicable for RoHS Hexavalent Chromium (CrVI) :

- Laboratories may use the results from the total test on Cr to satisfy Cr VI requirement. If total Cr result is < 1000 ppm, the following Cr VI test is not required.
- ISO 3613, Chromate Conversion Coatings on Zinc, Cadmium, Aluminum-zinc Alloys, Zinc-aluminum – Test Methods or equivalent.
- EPA Test Method 3060, Alkaline Digestion for Hexavalent Chromium or equivalent.

3.4.3.1.4 - Variations of these extraction and analysis methods and/or use of an alternate method are acceptable if, in the expert opinion of the test laboratory, they are declared to be equivalent or better. Analyze the digestion utilizing any suitable method based on the equipment used (AA or ICP) and the element content to be determined.

3.4.3.1.5 - Follow **Appendix II** if sufficient sample to conduct the testing cannot be collected from 12 units.

3.4.3.2 - Soluble Method 1

3.4.3.2.1 - Follow the latest revision ASTM F963 and EN 71-3 for soluble method 1

3.4.3.2.2 - Analyze the solution for heavy elements content using either atomic absorption spectroscopy (AA) or inductively coupled plasma spectrometry (ICP).

3.4.3.2.3 - The test method on Chromium VI and organic tin (GC-MS) has not determined yet.

3.4.3.3 - Soluble Method 2

3.4.3.3.1 - Test and evaluate for soluble cadmium, barium, antimony, selenium and Arsenic per the latest revision of Health Canada Book 5 Laboratory Policies and Procedures, Part B, test method "C03-1, Determination of Leachable Cadmium, Barium, Antimony, Selenium and Arsenic in Applied Coatings".

3.4.3.3.2 - Follow **Appendix II**, if sufficient sample to conduct the testing cannot be collected from 12 samples

4 - DOCUMENT HISTORY AND SUPPORTING INFORMATION

4.1 - Significance

Compliance can be assured by using a testing and compliance system that will reduce the risk of finished products having an excessive amount of heavy elements.

Total Lead testing is required per CFR 1303 and the Consumer Product Safety Improvement Act of 2008 and per Amendment part II of Schedule I to Canadian Hazardous products Act (Consumer Products Containing Lead – Contact with Mouth).

Soluble test method 1 is required per ASTM F963-17, EN 71-3-2013, ISO 8124-3, Mexico's NOM's, and India's IS 9873-3. Soluble test method 2 is required per Canada's Hazardous Products Act (HPA). The HPA specifies that the test sample must be stirred in 5% hydrochloric acid for ten minutes at 20°C. A detailed methodology has been supplied by Health Canada (C03-1, Determination of Leachable Cadmium, Barium, Antimony, Selenium and Arsenic in Applied Coatings). Total Cadmium testing is based on European Regulation (EC) No 1907/2006 Restriction, Evaluation, Authorization, and Restriction of Chemicals (REACH) and Danish Ordinance prohibiting the importation, sale and manufacture of cadmium containing products (BEK nr 858 of 05 Sept 2009).

The total mercury testing is also required per Canada's Hazardous Products Act. The Canadian HPA does not allow mercury to be intentionally added to the surface coating materials (SCM). A test result of □10 mg/kg (ppm) total mercury is considered the most reliable way to determine that no mercury has been introduced. No testing methodology is specified in

the HPA.

§2.4 is is required per the Restriction of Hazardous Substances Directive (RoHS). RoHS is an EU directive which requires electrical and electronic products to meet specific chemical limits and required by California's RoHS as well. QSOP 3614, Flame Retardants also contain requirements that pertain to RoHS covering PBB and PBDE flame retardants in electrical and electronic products.
§2.3.1.1 is to reflect the different requirements on surface coating on paper and paper board from EN 71-3 and ASTM F963.

4.2 - Reason For Revision (3600)

Section	Revision11.00	Implementation
1.2.3	Revised to align with the update	Applied to all products manufactured on and after: Aug 21, 2021
2.3.1	Adjusted the sequence of two sections for surface coatings to accommodate LIMS	Applied to all products manufactured on and after: Aug 21, 2021
2.3.2/2.3.3 /2.3.4/2.3.5	Removed the requirement on the inaccessible parts contained in accessible small parts	Applied to all products manufactured on and after: **Aug 21, 2021**
2.3.2.2	Revised the requirement for small parts to align with ASTM/EN/ISO standards	Applied to all products manufactured on and after: **Aug 21, 2021**
5.1	Revised the Q/A for electroplating to align with the practice	Editorial
5.6	Added a Q/A for stainless steel application	Applied to all products manufactured on and after: **Releasing date**

Section	Revision 10.00	Implementation
2.3.1.1	Revised the requirements for surface coating on paper and paper board	Applied to all products manufactured on and after: **May 20, 2020**
Table 4	Added the table with the requirements for surface coating on paper and paper board	Applied to all products manufactured on and after: **May 20, 2020**
2.3.3	Added printed paper and paper board into this group	Applied to all products manufactured on and after: **May 20, 2020**

~~Section~~	~~Revision 9.00~~	~~Implementation~~
~~Table 4, 6, 7, 8, 9~~	~~Updated the requirement limit of Aluminum per EU Directive 2019/1922.~~	~~Applied to all products manufactured on and after: May 20, 2020~~

4.3 - Referenced Documents

The following link contains the source documents and requirements related to this procedure:

Detailed Procedure to Source Document Report

4.4 - Identification of Mattel Internal Requirements
Mattel internal requirements are requirements developed internally to minimize the potential for injuries to children but are not required by law.

4.4.1 - All requirements in this QSOP are based on regulations. This QSOP contains no Mattel internal requirements.

5 - FREQUENTLY ASKED QUESTIONS

5.1 - Question 1
Question: Should electroplating be tested as a surface coating or a substrate?

Answer: The process of electroplating deposits a layer of material that adheres to the substrate.~~,~~ it is not considered to be a surface coating and therefore must be tested as a substrate

5.2 - Question 2

Question: Should a label be tested as a surface coating or a substrate?

Answer: Labels are not considered surface coatings because they do not meet the definition of a surface coating in 16 CFR 1303. However, labels may contain surface coatings which should be tested accordingly. If the surface coating on a label is made inaccessible by way of a permanent seal, such as lamination, then the coating would no longer be considered a surface coating—the label should be tested as a substrate. The base material of the label should be tested according to the appropriate section for substrates.

5.3 - Question 3

Question: When testing the inaccessible parts of an electronic product for compliance, is it acceptable to only test the parts of the product that carry current?

Answer: All inaccessible parts of an electronic product must comply with the applicable limits described in §2.4, Additional Requirement for Electrical and Electronic Products. This includes not only current carrying components, but also non-current carrying components such as the inaccessible parts of the plastic housing of the product.

5.4 - Question 4

Question: After screening procedure, if GC-MS testing is triggered, which organic tins shall be tested?

Answer: Methyl tin (MeT), Di-methyl tin(DMT), Di-n-propyl tin(DproT), n-Octyl tin(MOT), Dibutyl tin(DBT), Di-n-octyl tin(DOT), Diphenyl tin(DphT), Tributyltin(TBT), Triphenyl tin(TphT),Tetrabutyl tin(TeBT), Butyl tin(BuT)

5.5 - Question 5

Question: What kinds of Nickel plated axles are exempt from total nickel requirement?

Answer: Nickel plated axles on toys suitable for > 3 years old where the only accessible portion is the part that protrudes from the center of the wheel and the diameter of this part is ≤ 2.0 mm are exempt as shown in **Figure 1**. Axles with other accessible portion not shown in **Figure 1** or the diameter of this accessible portion > 2.0 mm must comply with the total nickel requirement.

Figure 1: Example of an axle protruding from the center of the wheel.

5.6 - Question 6

Question: Stainless steel contains high Chromium content (e.g.: SUS304 contains 18-20% Cr), What shall we do when stainless steel is used as a small part in toys?

Answer: It is recommended to use low carbon steel with other electroplating as a substitution when stainless steel is designed in a small part. As stainless steel contains high content of of Cr, it may fail the small part soluble Cr test.

6 - ATTACHMENTS

6.1 - APPENDICES

- **Appendix I** - Total Method Results to Satisfy Soluble Method Requirements
- **Appendix II** - Heavy Element Sample Requirements for Surface Coatings
- **Appendix III** - Exemptions from the Total Method Lead (Pb) Requirements of §2.3.2 and §2.3.3
- **Appendix IV** - Categories of Common Toy Materials
- **Appendix V** - Exemptions for §2.4

Appendix I - Total Method Results to Satisfy Soluble Method Requirement

Example 1: Antimony Result in Surface Coating

Total Result Antimony (ppm)	Soluble Antimony Method 1 limit: 60 ppm	Soluble Antimony Method 2 limit: 1000 ppm
40	Less than soluble limit; do not test	Less than soluble limit; do not test
65	Exceeds soluble limit; test	Less than soluble limit; do not test
1200	Exceeds soluble limit; test	Exceeds soluble limit; test

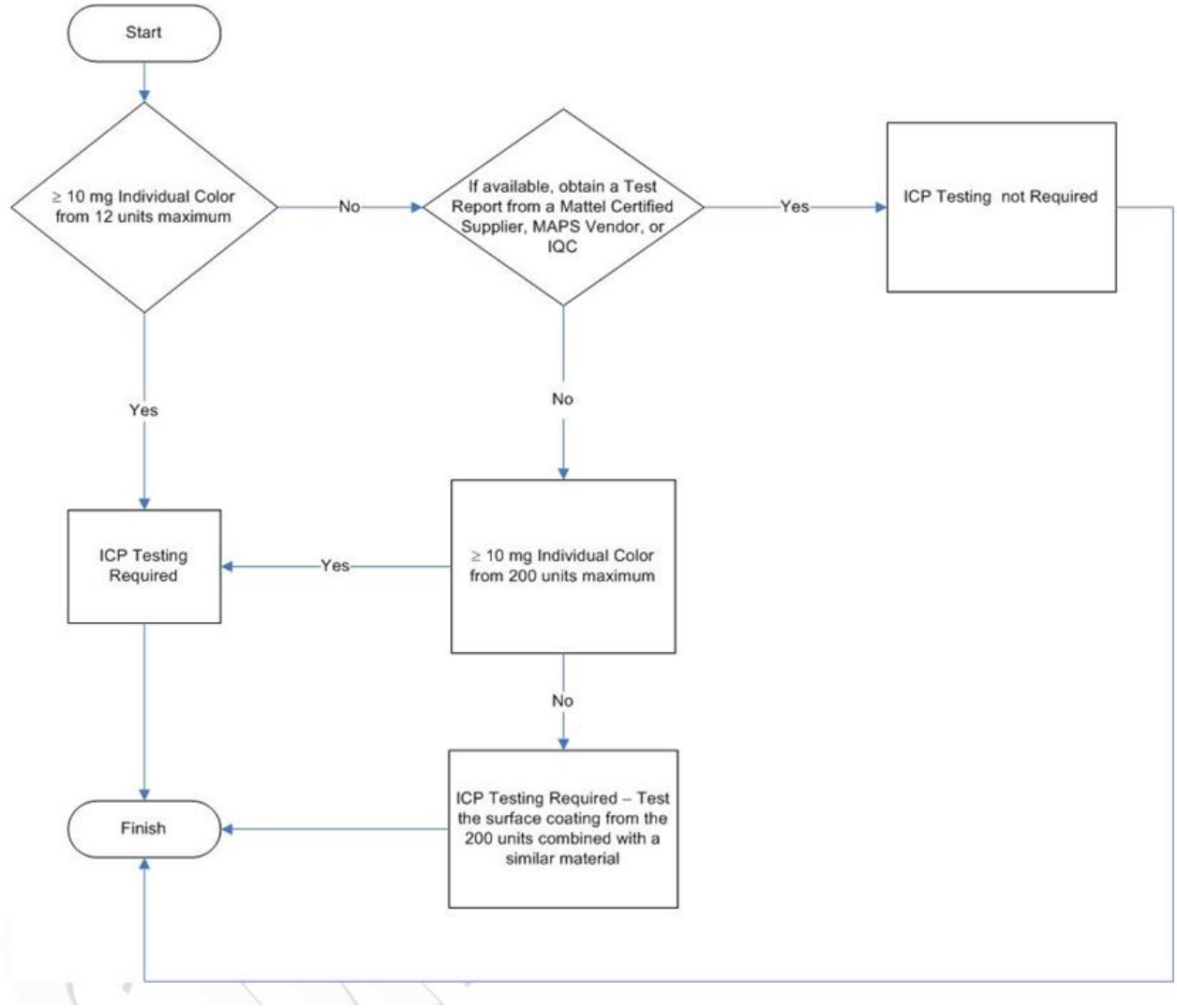
Example 2: Barium Result in Surface Coating

Total Result Barium (ppm)	Soluble Barium Method 1 limit: 1000 ppm	Soluble Barium Method 2 limit: 1000 ppm
40	≤ 500 ppm; do not test	≤ 500 ppm; do not test
250	≤ 500 ppm; do not test	≤ 500 ppm; do not test
750	Exceeds 500 ppm; test	Exceeds 500 ppm; test
1200	Exceeds 500 ppm; test	Exceeds 500 ppm; test

Example 3: Lead Result in Surface Coating

Total Result Lead (ppm)	Soluble Lead Method 1 limit: 90 ppm
30	Less than soluble limit; do not test
100	Exceeds **total** limit; sample fails, no further testing

Appendix II - Heavy Elements Sample Size Requirements



Considerations:

- Applicable for finished goods testing (Reference GQMP 2112, Surface Coating Material Control and GQMP 2113, Heavy Elements Control on Surface Coatings for Vendors).
- Applicable for surface coatings and substrates
- Limit of 12 units applies to initial testing for Total digestion if ≥10 mg individual color is obtained from12 units maximum
  - If the results indicate that Soluble 1 and/or Soluble 2 testing is required, then additional samples should be used to perform those tests (1 sample for Soluble 1 testing and a maximum of 12 units to perform soluble 2 testing).
  - If all three tests are needed, a maximum of 25 units should be used: twelve (12) for Totals, one (1) for Soluble 1, and twelve (12) for Soluble 2.
  - ***Composite*** testing should not be used when performing Soluble 1 or Soluble 2 testing.
- Limit of 200 units applies to the initial testing for total digestions if ≥10 mg individual color is not obtained from 12 units maximum following the above flow chart. When less than 10mg of individual color is obtained from 200 units combine this color with another similar material to obtain 10mg of total sample weight. Calculate the concentration using the sample weight of the combined sample.
- Any facility that manufactures products that Mattel sells as finished goods to a wholesale or retail customer is considered a vendor. Vendor is also known as Mattel Original Equipment Manufacturer (Mattel OEM). There are 2 Vendor categories

  Major Vendor: A manufacturer that has demonstrated acceptable finished goods manufacturing capabilities to supply Mattel's on-going needs, and who typically produces a significant quantity of Mattel product.
  Specialty Vendor: A manufacturer that fulfills unique finished goods needs, and that typically produces a small quantity of Mattel product with infrequent production runs.

Appendix III - Exemptions from the Total Lead (Pb) Requirements of §2.3.2 and §2.3.3

The following materials, when untreated or unadulterated by the addition of materials or chemicals and which has not undergone any processing which could introduce lead are considered exempt from Total Method lead (Pb) testing:

- Precious gemstones: diamond, ruby, sapphire, emerald.
- Semiprecious gemstones and other minerals, provided that the mineral or material is not based on lead or lead compounds and is not associated in nature with any mineral based on lead or lead compounds (excluding any mineral that is based on lead or lead compounds including, but not limited to, the following: aragonite, bayldonite, boleite, cerussite, crocoite, galena, linarite, mimetite, phosgenite, vanadinite, and wulfenite).
- Natural or cultured pearls.
- Wood.
- Paper and similar materials made from wood or other cellulosic fiber, including, but not limited to, paperboard, linerboard and medium, and coatings on such paper which become part of the substrate.
- CMYK process printing inks (excluding spot colors, other inks that are not used in CMYK process, inks that do not become part of the substrate under 16 CFR part 1303, and inks used in after-treatment applications, including screen prints, transfers, decals, or other prints).
- Textiles (excluding after-treatment applications, including screen prints, transfers, decals, or other prints) consisting of:
  - Natural fibers (dyed or undyed) including, but not limited to, cotton, kapok, flax, linen, jute, ramie, hemp, kenaf, bamboo, coir, sisal, silk, wool (sheep), alpaca, llama, goat (mohair, cashmere), rabbit (angora), camel, horse, yak, vicuna, qiviut, guanaco;
  - Manufactured fibers (dyed or undyed) including, but not limited to, rayon, azlon, lyocell, acetate, triacetate, rubber, polyester, olefin, nylon, acrylic, modacrylic, aramid, spandex.
- Other plant-derived and animal-derived materials including, but not limited to, animal glue, bee's wax, seeds, nut shells, flowers, bone, sea shell, coral, amber, feathers, fur, leather.
- Surgical steel and other stainless steel within the designations of Unified Numbering System, UNS S13800–S66286, not including the stainless steel designated as 303Pb (UNS S30360).
- Precious metals: Gold (at least 10 karat); sterling silver (at least 925/1000); platinum; palladium; rhodium; osmium; iridium; ruthenium, titanium

- Exemptions for total lead as used in certain electronic components parts in children's electronic devices include:

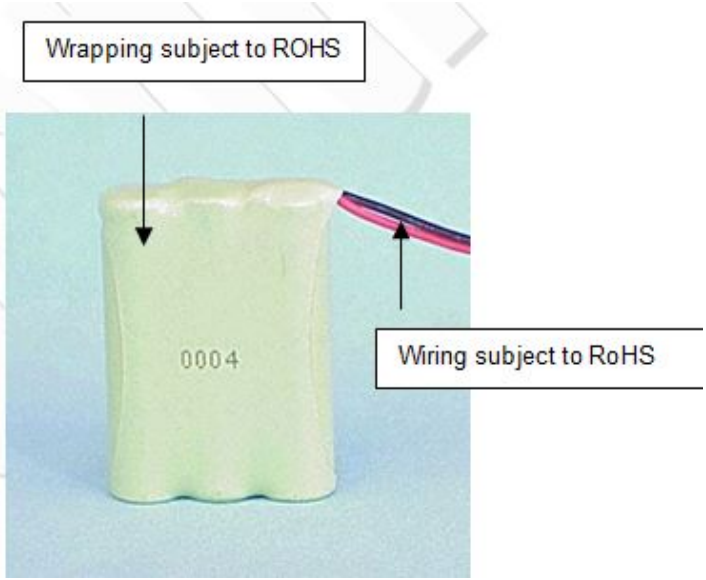
(1) Lead blended into the glass of cathode ray tubes, electronic components, and fluorescent tubes.
(2) Lead used as an alloying element in steel. The maximum amount of lead shall be less than 0.35% by weight (3,500 ppm).
(3) Lead used in the manufacture of aluminum. The maximum amount of lead shall be less than 0.4% by weight (4,000 ppm).
(4) Lead used in copper-based alloys. The maximum amount of lead shall be less than 4% by weight (40,000 ppm).
(5) Lead used in lead-bronze bearing shells and bushings.
(6) Lead used in compliant pin connector systems.
(7) Lead used in optical and filter glass.
(8) Lead oxide in plasma display panels (PDP) and surface conduction electron emitter displays (SED) used in structural elements; notably in the front and rear glass dielectric layer, the bus electrode, the black stripe, the address electrode, the barrier ribs, the seal frit and frit ring, as well as in print pastes.
(9) Lead oxide in the glass envelope of Black Light Blue (BLB) lamps

Appendix IV - Categories of Various Toy Materials - Cross-Reference Table for Determining Category

Toy Material	Dry, brittle, power-like or pliable toy materials	Liquid or sticky toy materials	Scrapped off toy materials
Coatings of paints, varnishes, lacquers, printing inks, polymers, foams and similar *coatings*			X
Polymeric and similar materials, including			X

laminates, whether textile reinforced or not, but excluding other textiles			
Paper and paper board			X
Textiles, whether natural or synthetic			X
Glass, ceramic, metallic materials			X
Other materials whether mass coloured or not (e.g. wood, fibre board, hard board, bone and leather)			X
Compressed paint tablets, materials intended to leave a trace or similar materials in solid form appearing as such in the toy (e.g. the cores of colouring pencils, chalk, crayons)	X		
Pliable modelling materials, including modelling clays and plaster	X		
Liquid paints, including finger paints, varnishes, lacquers, liquid ink in pens and similar materials in liquid form appearing as such in the toy (e.g. glue sticks, slimes, bubble solution)		X	

Appendix V - Exemptions to §2.4

	EXEMPTIONS	GUIDANCE
1	Battery cells	Battery Cells are exempt; however, any wires connected to batteries are not exempt and any materials used to wrap batteries are not exempt (e.g., wires and wrapping materials used in battery packs. Batteries must be tested per QSOP 3274, Batteries and Battery Operated Products. 

2	Mercury in compact fluorescent lamps not exceeding 5 mg per lamp.	A compact fluorescent lamp (CFL) is usually defined as a single-ended fluorescent lamp with a bent discharge tube of small diameter, of around 10-16 mm, to form a very compact unit. These lamps can be either integral, whereby the lamp and ballast are combined (also known as self-ballasted or self-supporting), or pin-based. For the purpose of this exemption, CFLs can contain no more than 5 mg of mercury per lamp.
3	Mercury in straight fluorescent lamps for general purposes not exceeding: • 10 mg in halophosphate lampls • 5 mg in triphosphate lamps with a normal lifetime. • 8 mg in triphosphate lamps with a long lifetime.	A straight, or linear, fluorescent lamp is a fluorescent lamp of straight tubular form and bi-pin electrical connections at either end. The color properties of straight fluorescent lamps are determined by the phosphors used to coat the inside of the tube. Halophospate and triphospate are examples of such fluorescent materials. Straight fluorescent lamps for general purpose can be defined as lamps used for general lighting solutions, in contrast to lamps used for special purposes (see item 4 below).
4	Mercury in straight fluorescent lamps for special purposes.	Examples of such lamps are LCD back light lamps, disinfection lamps, medical/therapy lamps, pet care lamps (e.g. aquaria lamps), lamps with special components (e.g. integrated reflectors or external protection sleeves), lamps with special ignition features (e.g. designed for low temperatures), long length lamps (length > 1800 mm) and amalgam lamps. In this context, there is no restriction on the quantity of mercury in these lamps.
5	Mercury in other lamps not specifically mentioned in this Appendix.	Examples of other lamps containing mercury are high intensity discharge (HID) lamps (e.g. sodium lamps and metal halide lamps), circular fluorescent lamps and U-shaped fluorescent lamps. In this context, there is no restriction on the quantity of mercury in these lamps.
6	Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.	Lead, or more specifically lead oxide, is often used in glass for electrical and electronic equipment to obtain specific characteristics, such as radiation protection (CRTs, medical applications), filtering (photography, image processing) and strengthening purposes (e.g. production of fluorescent tubes). This exemption has been introduced because viable alternatives for these applications have not yet been identified. For clarity, the exemption applies to lead as a constituent in the glass used in cathode ray tubes, lead as a constituent in the glass used in electronic components and lead as a constituent in the glass used in fluorescent tubes.
7	Lead as an alloying	Lead is often used as an alloying element to obtain specific

	element in steel containing up to 0.35 % lead by weight, aluminum containing up to 0.4 % lead by weight and as a copper alloy containing up to 4% lead by weight.	properties of a metal alloy. This exemption applies to the use of lead in steel up to 0.35% by weight, in aluminum up to 0.4% by weight and in copper alloys up to 4% by weight. In the context of this exemption, “percentage by weight” has to be interpreted as “the percentage of lead per homogeneous material per discreet part”. For example, if the steel housing of a computer consists of two separate parts, each part can contain up to 0.35% lead by weight of that part.
8	Lead in high melting temperature type solders (i.e. lead based alloys containing more than 85% by weight or more lead).	For the purposes of applications 8, 9 and 10 in this Appe/ndix, it is useful to clarify the term “solder”. In this appendix, “solder” is defined as “alloys used to create metallurgical bonds between two or more metal surfaces to achieve an electrical and/or physical connection”. In this context, the term “solder” also includes all materials that become part of the final solder joint, including solder finishes on components or printed circuit boards. The high melting temperature type solder exemption has been introduced to allow the use of lead in solders for specific applications (such as in power semiconductor package manufacturing), for which viable lead-free alternatives have not yet been identified. This exemption is permitted as there are no alternative alloys with similar melting point and which are ductile. The high electrical conductivity and unique mechanical properties of such a high melting point tin-lead alloy make the material malleable and better able to withstand both temperature and physical stress. Such properties ensure fewer defects during manufacturing and high reliability throughout the life of the component, thereby also resulting in fewer components going into the waste stream.
9	Lead in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission as well as network management for telecommunication,	See definition of “solder” given for application 8 above. This exemption has been introduced to allow the use of lead in solders for professional, high reliability applications, such as servers and network infrastructure equipment, for which viable lead-free alternatives have not yet been identified. In this context, a “server” is seen as a computer that meets one of the technology criteria that are set out in section (a) below, and the functional criteria set out in section (b) below. *(a) Technology criteria for a server* 1) Designed and placed on the market as a Class A product as per EN55022:1994 under the EMC Directive 89/336/EEC (intended primarily for use in the professional environment) and designed and capable of having a single or dual processor capability (one or more sockets on board); or 2) Designed and placed on the market as a Class B product (intended primarily for use in the domestic environment) as per EN55022:1994 under the EMC Directive 89/336/EEC and designed and capable of having at least dual processor capability (two sockets on board). *(b) Functional design criteria for a server* 1) Designed and capable of operating in a mission-critical, high-reliability, high-availability application in which use may be 24

hours per day and 7 days per week, and unscheduled downtime is extremely low (minutes per year).

Examples of typical server functions are the provision of network infrastructure, gateway or switching services, the hosting and management of data on behalf of multiple users, or the running of server-capable operating systems (e.g. as for a web server).

It is the view of the UK's Department for Business Innovation and Skills (BIS) that this exemption is viewed as applying to lead in the solder of the whole of the computer and its components including processors, memory boards, power converters, power supplies, enclosed housings, modular power subsystems and adapter cards. It would also seem to apply to the lead in the solder of the components that are integrated into the whole computer or that are sold separately for use in an exempt server. The lead in the solder of cable assemblies, and all connectors and connector assemblies used to provide interconnections for the server, would also be covered by this exemption.

It should be noted that this exemption is not viewed as applying to parts or components that are peripheral to the server, nor does it apply to parts or components when they are used other than in an exempt server.
For the purpose of the RoHS Regulations, a "storage or storage array system" is viewed as any storage device or subsystem that meets one of the following criteria:
1) Designed and placed on the market as a Class A product as per EN55022:1994 under the EMC Directive 89/336/EEC; or
2) Designed and placed on the market as a Class B product as per EN55022:1994 under the EMC Directive 89/336/EEC and designed to meet one of the following two criteria: -
a) Any storage device capable of accepting direct or switched input from more than one computer, for example fibre channel and SCSI devices, or
b) Any storage fabric or switching device for interconnecting storage devices to server products.
It is the view of BIS that this exemption is viewed as applying to the whole of the device or subsystem and their components including processors, memory boards, power converters, power supplies, enclosed housings, modular power subsystems and adapter cards. It would also seem to apply to the components that are integrated into the whole storage or storage array system or that are sold separately for use in an exempt storage or storage array system. Cables and cable assemblies, and all connectors and connector assemblies used to provide interconnections for the storage or storage array system, would also be covered by this exemption.

It should be noted that this exemption does not apply to parts or components that are peripheral to the storage or storage array system, nor does it apply to parts or components when they are used other than in an exempt storage or storage array system.

For the purpose of the RoHS Regulations, "network

		infrastructure equipment for telecommunication purposes" is viewed by BIS as equipment meeting one of the two following criteria: 1) Any system used for routing, switching, signalling, transmission, or network management or network security; or 2) Any system which can simultaneously enable more than one end user terminating equipment to connect to a network. It is also any such system in a network, except for end user terminating equipment such as voice terminals and facsimile machines. This would include all servers, power suppliers, display devices and similar electronic units that are incorporated into network infrastructure equipment. It would also include all cables and cable assemblies, and all connectors and connector assemblies used to provide interconnections for network infrastructure equipment but is not intended to include desktop or notebook computers, telephones, fax machines or consumer – type modems or switches etc.
10	Lead in electronic ceramic parts (e.g. piezoelectronic devices).	Ceramic materials are used in a variety of electronic devices including capacitors, insulators, piezoelectrics, magnets and integrated circuit packages. Some of these ceramic materials contain lead, for example lead zirconate titanate and lead magnesium niobate. The specific chemical composition and manufacturing process of these materials determine their electrical parameters, such as dielectric constant and the dissipation that is essential for the functioning of the component in which they are used. Hence, lead used in the ceramic parts of electronic components in electrical and electronic equipment is exempt from these Regulations.
11	Cadmium and its compoints in electrical contacts and cadmium plating except for applications banned under Directive 91/338/EEC (OJ No. L 186, 12 July 1991, p. 59) amending Directive 76/769/EEC (OJ No. L262, 27 September 1976, p. 201) relating to restrictions on the marketing and use of certain dangerous substances and preparations.	Directive 91/338/EEC amending Directive 76/769/EEC relating to restrictions on the marketing and use of certain dangerous substances and preparations, gives the following definition of cadmium plating: "Within the meaning of this Directive, 'cadmium plating' means any deposit or coating of metallic cadmium on a metallic surface." This definition is seen as applying for the purpose of the RoHS Regulations. Subsequently, the Marketing and Use Directive (as amended) bans the use of cadmium plating in a variety of product sectors. As a result, in this context cadmium plating is viewed as being permitted for electrical contacts in all the WEEE categories to which the RoHS Regulations apply except for products manufactured in the household goods and central heating and air conditioning plant sectors because the latter are restricted by the Marketing & Use Directive. However, that Directive does allow the use of cadmium plating for "electrical contacts in any sector of use, on account of the reliability required of the apparatus on which they are installed."
12	Hexavalent chromium as an anti-corrosion of the carbon steel cooling system in absorption refrigerators.	As absorption cooling works on several different types of energy sources such as gas, kerosene, batteries or electricity, absorption fridges are often used in recreational vehicles (e.g. motor homes and caravans) or remote places where electricity is not available. Another typical application is for minibars in hotel rooms as these fridges are virtually noiseless.

		The applied heat and use of a water-ammonia mixture results in a corrosive environment that warrants the use of hexavalent chromium. This exemption has been introduced, since viable alternatives for this specific application have so far not been identified.
13	Lead in lead-bronze bearing shells and bushes.	Lead-bronze bearing shells and bushes are used, amongst others, in compressors for stationary refrigeration and air conditioning equipment. Typical characteristics of such compressors include a long design life (over 50,000 hours for residential applications and over 100,000 for commercial applications) and a hermetic sealing to prevent refrigerant leakage and ensure reliable, uninterrupted operation without service for up to 15 years. Combined with the unique technical aspects of the refrigeration cycle (dry-starts, miscibility of the lubricant, repeated condensing and boiling, etc.), the bearings need excellent self-lubrication properties to meet the high durability and reliability requirements. Due to its lubricious nature, the use of lead as a bearing constituent is critical in these applications. This exemption has been introduced because so far no suitable alternative has been identified, although other materials have been extensively tested.
14	Lead used in compliant pin connector systems.	Compliant pin contacts are used to attach connectors or components to a double-sided printed circuit board. This connector system avoids the need for soldering during manufacturing, thereby avoiding the overheating of components and damaging the integrity of the connectors and board material and allows separation for repair. Such pins are coated with a tin-lead alloy to ensure good electrical conductivity, maintain sufficient spring-back force and facilitate insertion of the pins into the boards. The use of tin-lead also reduces the risk of tin whiskers, which may affect reliability. This exemption has been introduced because suitable alternatives to the tin-lead alloy have not yet been identified.
15	Lead as a coating material for the thermal conduction module c-ring.	A thermal conduction module c-ring serves a specific purpose in the manufacturing of high performance electronic modules. Such modules are the key components of a mainframe central processing unit and typically contain multiple chips. The c-ring functions as a hermetical seal, continuously dissipating heat and preventing oxidation of solder joints. While substitutes for lead in this application have been investigated, no feasible alternative has so far been identified.
16	Lead and cadmium in optical and filter glass.	Lead and cadmium are used in optical glass and filter glass to obtain specific properties and meet quality standards, for a wide variety of applications including in the photo industry (e.g. camera lenses), in projectors, scanners, printers and copiers. This exemption has been introduced because suitable alternatives for many of these applications have not yet been identified.
17	Lead in solders consisting of more than two elements for the connection between the pins and	Microprocessors are mounted onto boards or substrates by way of a socket. Such sockets require that a large number of pins (up to 950) are mounted onto the microprocessor for completing the necessary electrical connections. The high customer quality demands for these products mean that such packages are

	the package of microprocessors with a lead content of more than 80% and less than 85% by weight.	extensively tested, which necessitates high adhesion strength of the pins. This is even more critical at higher pin counts and the application of lead in the proportions specified in this exemption is essential to achieve the necessary properties. Substitute materials without lead are used by some manufacturers but for high pin counts, the development of alternatives before July 1, 2006 would create significant quantities of waste. This exemption has been introduced to allow for the development of alternative designs without generating excessive amounts of waste.
18	Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit Flip Chip packages	Flip chips are attached to their packages or PCBs using very small solder bumps and many types use solder bumps containing lead. Lead is used for two main reasons. Its ductility reduces the risk of damage to brittle parts of flip chip circuitry. Lead also protects against the possibility of thermal fatigue, which results from cyclic temperature changes and is not well understood with lead-free solders. High melting point solder bumps are attached using solder containing typically 37% – 40% lead to the package because this combination has a high resistance to a phenomenon called “electromigration” which in higher power flip chip packages would otherwise cause premature failure of the device. The solder connections to the chip are known as level 1 and level 1 flip-chip connections may contain lead. The external solder connections between packages and PCB known as level 2 are excluded from this exemption as viable alternatives have been developed.
19	Lead in linear incandescent lamps with silicate coated tubes.	An incandescent lamp generates light using a glowing filament heated to white-hot by an electrical current. This light-giving process is known as incandescence. A linear incandescent lamp is a tubular filament lamp with pin connectors at either end. The glass is coated on the inside with silicate that contains lead. The lead assists in binding the silicate to the glass. In this context there is no restriction on the use of lead in these lamps.
20	Lead halide as radiant agent in High Intensity Discharge (HID) lamps used for professional reprography applications.	High Intensity Discharge (HID) lamps produce light by striking an electrical arc across tungsten electrodes housed inside a specially designed inner fused quartz or fused alumina tube. This tube is filled with both gas and metals. The gas aids in the starting of the lamps and the metals produce the light once they are heated to a point of evaporation. Certain HID lamp types contain lead-iodide (PbI_2) as a component in the filling. These lamps are used in professional U.V. applications: the curing, reprography and label printing industries. The lead is used for creating the correct lamp emission spectrum and lamp effectiveness. In this context there is no restriction on the use of lead halide as a radiant agent in these lamps.
21	Lead as activator in the fluorescent powder	Discharge lamps work by sending an electric current through a special gas. Depending on the gas, this either generates light

	(1% lead by weight or less) of discharge lamps when used as sun tanning lamps containing phosphors such as BSP (BaSi2O5:Pb) as well as when used as specialty lamps for diazo-printing reprography, lithography, insect traps, photochemical and curing processes containing phosphors such as SMS ((Sr,Ba)2MgSi2O7:Pb).	directly or the current generates ultra-violet light, which is converted to visible light by fluorescent powders. Lead is used as an activator in fluorescent powders for two classes of special fluorescent lamp products: - 1. Sun tanning lamps contain phosphors such as BSP ($BaSi_2O_5$:Pb), with an emission peak of 350 nm; and 2. Certain specialty lamps (applications: diazo-printing reprography, lithography, insect traps, photochemical and curing processes) contain the phosphors such as SMS ($(Sr,Ba)_2MgSi_2O_7$:Pb), generating a broad emission peak centered at 360 nm. The presence of lead creates the proper lamp emission spectrum and optimum lamp effectiveness. This exemption applies to the use of lead as an activator in the fluorescent powder of discharge lamps used in the above applications up to 1% by weight.
22	Lead with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact Energy Saving Lamps (ESL).	There are two main parts to a compact fluorescent lamp (CFL): the gas-filled tube and the magnetic or electronic ballast. Electrical energy from the ballast flows through the gas in the tube causing it to give off ultraviolet light. The ultraviolet light excites a white phosphor coating on the inside of the tube. This coating then emits a visible light, which is the final product of the CFL. Very compact Energy Saving Lamps (ESL) with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and PbSn-Hg as auxiliary amalgam The substances (both main & auxiliary amalgams) control the Hg-vapour pressure inside small CFLs, stabilizing the light output and lamp effectiveness over a wide temperature range. This makes it possible to replace incandescent lamps by CFLs in a wide range of applications, both indoor and outdoor. In this context there is no restriction on the use of lead in the form of an amalgam or auxiliary amalgam in these lamps.
23	Lead oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCD)	Lead is currently used in the glass panel of Liquid Crystal Display (LCD) screens. Two glass substrates are bonded with high precision by inserting glass spacers in between, to keep the same gap. Lead is used there to prevent overheating of the glass, which would result in image distortion and malfunction. It is found in the form of a solder with a concentration of 70% lead by weight, used to create a safe electrical contact on the plane glass surface. Lead containing glass solder is also used to assemble the flat-panel glass envelope. In this context there is no restriction on the use of lead in the form of an oxide in the glass.
24	Lead and cadmium in printing inks for the application of enamels on borosilicate glass.	Borosilicate glass items are printed with scales and warnings in order to improve usability and ensure consumer safety. These markings must be permanently readable. The printing on the glass uses an ink, which is fired and melts

		together with the glass surface, and contains significant amounts of lead oxide (37%-48% by weight) and cadmium oxide (11% by weight). Applications using this process to print onto borosilicate glass include: coffee jugs; water boilers; electric water kettles; lamp covers; laser tubes; ozone tubes; and medical devices. In this context, there is no restriction on the use of lead and cadmium in the printing inks.
25	Lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with NiFe lead frames and lead in finishes of fine pitch components other than connectors with a pitch of 0.65 mm or less with copper lead frames.	The electrical terminations of virtually all electronic components (integrated circuits, memory “chips,” diodes, resistors for example) must be plated with a thin layer of metal to make them capable of being soldered to the printed circuit board. Today, these terminal platings are most commonly comprised of a tin-lead (Sn-Pb) alloy. One of the main reasons lead is included in the plating is to mitigate the formation and growth of tin “whiskers”. Tin whiskers are electrically conductive, crystalline structures of tin that sometimes grow from surfaces where tin (especially electroplated tin) is used as a final finish. Tin whiskers have been observed to grow to lengths of several millimeters (mm) and in rare instances to lengths up to 10 mm. Numerous electronic system failures have been attributed to short circuits caused by tin whiskers that bridge closely-spaced circuit elements maintained at different electrical potentials. Lead is used as a whisker suppresser in electroplated Sn coating. The concentration of Pb in the plating alloy is typically below 20%, and the thickness of the plating is only about 10 micrometers. These tin whiskers can cause functional failure of electronic products once they grow long enough to create short circuits between adjacent electrical terminations. Fine-pitch parts are the most susceptible to such failures because the distance between the conductive leads is small. Modern electronic equipment requires the use of such fine-pitch parts to meet the computation speed and/or small size requirements of the market. For the purpose of this exemption, fine-pitch components are defined as those with electrical terminations spaced with centers 0.65 mm or less apart. In such parts, the distance between adjacent leads is considerably smaller than the centre-to-centre spacing, and is typically 125 to 300 micrometers.
26	Lead in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors.	RFI signal line filters are manufactured by soldering axial leads into machined ceramic multi layer through hole devices (discoidal capacitors or planar arrays) and mounting into metal bodies or connector shells. Due to the novel construction of the capacitor, it is necessary to use ductile solders to make these solder joints so as to prevent the ceramic cracking as a result of tensile stresses generated during the cooling of the assembly.

		The solders used contain lead along with other alloys (primarily indium) to maintain the ductility required. These solders are typically 50% lead and 50% indium. In this context there is no restriction on the use of lead in the form of lead in solders for these components.
27	Lead oxide in plasma display panels (PDP) and surface conduction electron emitter displays (SED) used in structural elements; notably in the front and rear glass dielectric layer, the bus electrode, the black stripe, the address electrode, the barrier ribs, the seal frit and frit ring as well as in print pastes	The front substrate consists of the bus electrode and the dielectric layer for the protection of the bus electrodes. The rear substrate consists of the address electrode, the dielectric layer, the barrier rib and fluorescent material. By sealing the front and rear substrates together, a gas (usually Ne-Xe) is injected into the panel. PDPs emit light by producing an ultraviolet ray that excites the fluorescent material. The main substance of PDP material consists of PbO, SiO2, B-2 O3, Al2O3, CaO, TiO2, ZnO, etc. PbO renders the melting point lower with its presence in the paste and tends to optimize the sintering characteristics of the material. In this context there is no restriction on the use of lead in the form of PbO in these components.
28	Lead oxide in the glass envelope of Black Light Blue (BLB) lamps.	Black light (also Wood's light) is the common name for a lamp emitting electromagnetic radiation that is almost exclusively in the soft near ultraviolet range, and very little visible light. BLB lamps produce black light that peaks in the soft ultraviolet at a wavelength of 365 nm, with almost no light in the visible spectrum; they appear deep purple violet to the human eye when operating, and black when turned off. These lamps are used to excite UV-sensitive paints and dyes and for other purposes, especially in special effects, security applications, and medicine. The amount of PbO in the glass envelope is typically 20 wt%, = 18 wt% Pb. The lead in the form of PbO is essential for creating the proper lamp emission: optimal optical properties: maximum transmission of UV light, and minimum visible light transmission. In this context there is no restriction on the use of lead in the form of PbO in these components.
29	Lead bound in crystal glass.	The use of lead in glass leads to a high refractive index (brilliancy), a strong dispersion and a high transmission of the light. Additionally, the use of lead in glass introduces further favorable thermal and mechanical properties in melting, forming, cutting and in post-processing. In electric and electronic equipment this form of glass is used in pure (colorless) or colored form for decorative and/or functional purposes, such as lamps, chandeliers, decoration of mobile phone covers, clocks and watches. According to Council Directive 69/493/EEC, full lead crystal consists at least of 28% lead calculated as lead oxide (therefore

		>30% lead oxide). Lead is bonded in the silicate matrix of glass and therefore immobilized and not biologically available. The absolute amount of lead depends on the mass of the article. In this context there is no restriction on the use of lead bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC.
30	Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more.	This exemption allows for the use of special high melting point solders that contain about 70% cadmium, to solder the voice-coil wires of a novel design of small and light-weight but high-powered loudspeakers. The loudspeakers that require this exemption are a patented design and operate at close to 300°C and with very high g-forces due to the vibration of the loudspeaker. Few cadmium-free solders have a suitable melting temperature; even so-called high melting point solders which are covered by the exemption mentioned in paragraph 8 above melt at about 300°C. The light-weight design is achieved by the use of aluminum wires and the few cadmium-free solders with a suitably high melting point such as zinc/aluminum are too aggressive and dissolve the aluminum.
31	Lead in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting).	This exemption permits the use of lead in the material used to form a gas tight bond for a new type of flat fluorescent lamp that is mercury free and has an unusually long life. Research has not yet identified a material that can form a permanent gas tight bond without lead. Although referred to as a “soldering material”, this is a lead based low melting point glass with ~70% lead oxide which melts on heating the lamp assembly to form the bond and seal the lamp. These lamps can be used as backlights for LCDs, as well as for lighting and other applications. They are thicker than the narrowest types of special straight fluorescent lamps that do need to contain mercury and are used where there is limited space available such as in laptop computers. Lead in these special lamps is already covered by the exemption in paragraph 23 above, but this exemption allows lead in special thin flat lamps but only for LCD.
32	Lead oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes.	The optical windows of Argon and Krypton lasers are sealed using special glass frit materials that contain lead oxide. Frit seals are made with low melting point glasses in powder form and these form a glass bond when heated to above their melting point. The optical windows and the laser tube are both quartz and only seals made with lead based glass provide the correct combination of properties that allow the vacuum tight bond to be made and precisely align the windows with a high yield. Argon and Krypton lasers are used as tools for cutting materials. They are also used for medical applications such as eye surgery although medical lasers are in Category 8 of the WEEE Directive and, therefore, currently outside the scope of the RoHS Directive.
33	Lead in solders for the soldering of thin copper wires of 100	Copper transformer wires are connected to terminals by soldering but copper dissolves in the liquid solder. In the time taken to make a solder joint, it is possible for all of the copper to

	µm diameter and less in power transformers	dissolve if the wire is very thin resulting in weak bonds. The rate at which copper dissolves depends on the solder composition, the temperature and time at high temperature. The rate of dissolution is faster in lead-free solder than in tin/lead solder at the same temperature. The slowest dissolution rate is achieved with tin/lead solder alloys that also contain ~3% copper. Standard lead-free solders with <1% copper dissolve the copper wire much more rapidly. Another issue is that it can take longer to make a lead-free bond than a tin/lead bond so that more copper dissolves. High power transformers use very fine wires and generate high voltage and so the solder bond must be domed to avoid arcing and this increases the time required to make the bond. To burn off the enamel coatings used on fine copper wires requires the use of a high temperature and this also increases the copper dissolution rate. Enamel coated transformer wires of 100 µm diameter or less cannot be soldered with lead-free solders as too much copper dissolves resulting in a weak bond and so solders containing lead must be used.
34	Lead in cermet-based trimmer potentiometer elements	Cermet based potentiometers are electronic components used to provide an adjustable electrical resistance. This type of potentiometer is the only type suitable for high current, high humidity or high temperature operation. The device contains a cermet disc with a resistive coating of ruthenium oxide with lead oxide that is applied as a paste which is heated to melt the lead oxide to give a strong, wear-resistant bond. The lead imparts the necessary wear resistance and a stable electrical resistance. Similar coatings of lead with ruthenium oxide are widely used in chip resistors which are generally regarded as being covered by RoHS exemption 7c (lead in electronic ceramic parts) but neither the applicant nor the Commission could determine if the cermet potentiometer application was covered by RoHS exemption 7c or by RoHS exemption 5 (lead in glass of cathode ray tubes, electronic components and fluorescent tubes) and so this exemption has been granted to allow the use of lead in the resistive materials of cermet potentiometers.
35	Mercury used as a cathode sputtering inhibitor in DC plasma displays with a content up to 30 mg per display until 1 July 2010	Most plasma displays on the market, including plasma TVs, are AC types which do not contain mercury. However this exemption applies to DC type plasma displays which contain small amounts of mercury. DC plasma displays that show information (eg numbers) are quite different to AC plasma television displays. Inside the display, DC voltages are applied between anodes and cathodes to generate the plasma. With DC, the charge flows in one direction so that electrons hitting the cathode slowly erode the surface by a process referred to as “sputtering”. Mercury vapour within the plasma display effectively retards sputtering of the cathodes giving the display an acceptable life. No alternative materials have yet been found to replace mercury. The exemption is granted only until 1 July 2010 because research into substitute materials is underway.
36	Lead in the plating layer of high voltage diodes on the basis of a zinc borate glass body	High voltage glass diodes are made with a special type of glass based on zinc borate with ~2.5% lead. The glass composition is designed to match the thermal expansion coefficient of the component’s terminals. The terminals are electroplated with a tin coating and during assembly, small quantities of lead from

		the glass diffuse into the tin coating giving it a composition with up to 0.3% lead. Although the lead in the glass of the diode is covered by exemption No. 5 of the RoHS Annex, the lead that has diffused into the tin coating is not covered by any other existing exemptions.
37	Cadmium and cadmium oxide in thick film pastes used on aluminium bonded beryllium oxide	Hybrid circuits based on alumina substrates are widely used in electronics but for certain specific and demanding applications, beryllium oxide substrates are required. The hybrid circuit consists of a number of layers of insulators, dielectrics and metals that are applied to create the electrical circuit. Semiconductor dies are attached to the circuitry commonly with fine aluminium wires that are bonded to the metal conductors of the hybrid circuit using ultrasonic wire-bonding. The materials of the hybrid circuitry must bond strongly to each other and to the substrate and not de-bond during the thermal processing or when aluminium ultrasonic wire-bonding is carried out. Traditionally, hybrid materials have contained lead and cadmium oxide to form low melting point glasses that melt during processing to create a strong bond. RoHS compliant hybrid materials have been developed that are suitable for the more common alumina substrates but none are yet available that are suitable on beryllium oxide.