



# Apple Regulated Substances Specification

## 069-0135-M

| Revision | ECO #      | Approver                | Date           | Revision Description                      |
|----------|------------|-------------------------|----------------|---|
| M        | 0040069980 | Adrian Liga Gondawijaya | March 21, 2023 | See Section 13 for full revision history. |

## 1. Scope

It's Apple's mission to make sure that anyone who assembles, uses, or recycles an Apple product can do so safely. We have led the industry in removing many harmful substances from our product designs, and we go to great lengths to make sure that they stay that way. We are constantly designing our products to be better for the environment, and for people.

This Regulated Substances Specification describes Apple's global requirements and restrictions on the use of certain chemical substances or materials in Apple products, accessories, manufacturing processes, and packaging used for shipping products to Apple's end-customers. Restrictions are derived from international laws or directives, regulatory agencies, eco-label requirements, environmental standards, and Apple policies. Apple's restrictions may go beyond regulatory requirements in order to protect human health and the environment.

This specification is not an exhaustive list of all chemicals of concern. Apple suppliers should take action to understand the human health and environmental impacts of all chemicals used in the manufacturing process and present in parts and materials supplied to Apple. Suppliers should take action to reduce or eliminate the use of chemicals of concern listed in this specification as a first step, as well as comply with all applicable regulations. Suppliers must demonstrate compliance with this specification and provide required documentation (including required test data, Full Material Disclosure (FMD), and disclosure of reportable substances). Suppliers must notify Apple of any changes in formulation of materials or parts.

We hold our suppliers accountable by conducting factory audits and testing materials and components at certified laboratories for substances of high concern. Apple may verify supplier data and compliance to this specification utilizing our in-house laboratory or external third-party certified laboratories.

**Effective Date:** This specification takes effect on May 15, 2023. Prior to this date, revision L of the Regulated Substances Specification is in effect.

**Questions:** Questions regarding the Apple Regulated Substances Specification should be directed to Apple at [environment@apple.com](mailto:environment@apple.com).

## 2. Definitions

**Alloy:** A metallic material, homogeneous on a macroscopic scale, consisting of two or more elements so combined that they cannot be readily separated by mechanical means.

**Apple Policy:** Apple restrictions that go beyond regulatory requirements, based on best industry practices or toxicological properties.

**Brominated flame retardant:** Brominated organic substance that has an inhibitory effect on the ignition of combustible organic materials.

**CAS:** Chemical Abstracts Service registry numbers that identify unique substances.

**Chemical Safety Disclosure (CSD):** Initiative that requires suppliers to provide information on the chemicals used in Apple manufacturing processes, to report practices in place to ensure compliance with occupational health and safety regulations and Apple requirements, and to support initiatives to advance the adoption of safer, environmentally preferable alternatives. See Section 12 for details.

**Coating:** Product in liquid, paste, or powder form that, when applied to a substrate, forms a layer possessing protective, decorative, and/or other specific properties. Metallic plating layers are exempted from coating requirements.

**Elemental Chlorine Free (ECF):** Process by which packaging material is produced with pulp that has been bleached using a chlorine derivative such as chlorine dioxide (ClO<sub>2</sub>), but without the use of elemental chlorine (Cl).

**Endocrine Disrupting Chemicals (EDCs):** Chemicals that can interfere with the endocrine (hormone) system to cause possible adverse effects in humans and wildlife.

**External Materials:** Materials that are accessible to a customer under reasonable or foreseeable use.

**Final assembly:** Manufacturing process involving assembly of a product that is then directly sold to Apple customers, retail stores, or distribution channels.

**Full Material Disclosure (FMD):** Initiative that requires suppliers to provide the entire chemical composition of the parts and materials used in Apple products to ensure compliance to regulatory requirements, corporate initiatives, and to support assessment of the impact to human and environmental health. See Section 11 for details.

**Homogeneous material:** One material of uniform composition throughout or a material, consisting of a combination of materials, that cannot be disjointed, disaggregated, or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding, and abrasive processes. The definition is consistent with Directive 2011/65/EU on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS 2). Per this document, the following examples illustrate what is and is not a homogeneous material:

- A plastic cover is a homogeneous material if it consists of one type of plastic that is not coated with other materials, or has other materials attached to it.
- A cable that consists of metal wires surrounded by nonmetallic insulation materials isn't a homogeneous material because mechanical processes could separate the different materials. In this case, restrictions apply to each of the separated materials individually.
- A semiconductor package contains many homogeneous materials that include the mold compound, die attach adhesive, die coatings, bonding wires, lead frame, and lead frame platings. Restrictions apply to each individual homogeneous material.
- Printed circuit board laminated materials consist of glass cloth, resins, and copper foil that are each a homogeneous material. Restrictions apply to each individual homogeneous material.

**Incidentally present:** Present as an unavoidable impurity or unintentional trace contaminant.

**Intentionally added:** Substance deliberately used in the formulation of a material or component, where the presence of the substance in the final product provides a specific characteristic, appearance, or quality.

**Mixture:** Solutions composed of two or more substances in which they do not react.

**Nanomaterials:** A natural, incidental, or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate; and where, for 50 percent or more of the particles in the number size distribution, one or more external dimensions are in the 1 nm–100 nm size range. In addition, fullerenes, graphene flakes, and single-wall carbon nanotubes with one or more external dimensions below 1 nm should be considered as nanomaterials.

**No intentional use:** Substance must not be intentionally added. Proof of compliance requires either 1) the substance is not listed in “Section 3 Composition/information on ingredients” of submitted Safety Data Sheet (SDS), which meets Globally Harmonized System (GHS) cutoff value requirement or 2) chemical manufacturer provides self-declaration of no intentional use.

**Non-use:** Substance must not be intentionally or unintentionally present. Apple requires test reports from certified labs as proof of compliance. For all Section 6 restrictions, the substance must be under the method detection level by using Apple specified analytical methods.

**Packaging:** Packaging materials used to enclose or protect Apple products during shipment to the end-customer. Packaging shipped to suppliers or OEMs (e.g., tape and reel, trays), and inter- and intra-factory protective packaging that does not remain in final product are not covered by the RSS.

**Paint:** Coatings containing pigments that, when applied to a substrate, form a dry film with protective, decorative, or special functions.

**Per- and Polyfluoroalkyl Substances (PFAS):** Substances that contain one or more perfluoroalkyl moieties,  $-C_nF_{2n+1}$ .

**Personal protective equipment (PPE):** Equipment for protecting manufacturing employees from exposure to hazardous materials in the workplace specific to the job function.

**ppb:** Parts per billion by weight of a substance; equivalent to 0.001 mg/kg or 0.0000001 percent by weight.

**ppm:** Parts per million by weight of a substance; equivalent to 1 mg/kg or 0.0001 percent by weight.

**Primer:** Surface treatment chemical used to increase adhesion when used in conjunction with a coating or adhesive system.

**Process chemical:** Chemicals, used on their own or in formulations, that are not intentionally incorporated (partly or fully) into the product. Examples of a process chemical: cleaning agent, degreaser, demolder solution, lubricant, metal working fluid, heat transfer fluid, etching solution. Examples of a non-process chemical: paint, coating, ink, adhesive, primer, resin, flux, solder paste.

**Processed Chlorine Free (PCF):** Process by which material is produced with pulp from virgin and/or recycled content that has been bleached without any type of chlorine, or that has not been bleached at all. Recycled content may have originally been bleached with chlorine or chlorine derivatives.

**Test Report Mapping (TRM) Form:** The form used to map test reports to declared materials. The TRM form is created in and exported from the FMD Portal. The TRM form and mapped test reports are collected by Apple manufacturing partners to document compliance of the parts and materials used in Apple products. The information required to create a TRM form for Apple’s manufacturing partners is the foundation of an FMD declaration required by Apple. These processes have been harmonized to eliminate duplicative work and align requirements across the Apple supply chain.

**Textile:** A flexible material made by creating an interlocking network of yarns or threads, which are produced by spinning raw fibers (from either natural or synthetic sources) into long threads.

**Totally Chlorine Free (TCF):** Process by which packaging material is produced with pulp from virgin content that has been bleached without any type of chlorine, or that has not been bleached at all.

**Varnish:** Transparent coating material.

**Wearable products:** Electronics or accessories that can be comfortably worn on the body, such as Apple Watch. These products will occlude the skin.

### 3. Restricted Substances in Products

Restrictions in Section 3 apply to all homogeneous materials used in Apple products, accessories, and packaging. Restrictions also apply to all homogeneous materials applied to or cured onto parts in Apple products, accessories, and packaging. This includes adhesives, inks, coatings, primers, and other wet formulations manufactured by the material manufacturer in addition to the cured materials in the finished good. In certain cases, the scope may be more limited, which is indicated in the table below. Otherwise, if "All materials" is indicated in the scope, the general restriction scope applies. Substances and their respective restrictions are listed in alphabetical order.

| Chemical or Chemical Group       | Substance Identifier or CAS No.  | Threshold Limit   | Scope   | Examples  | References   |
|----------------------------------|--|---|---|---|--|
| Adhesive monomers Group I        | See Appendix O   | No intentional use; 1000 ppm for incidentally present                 | Adhesives in wearable products  | UV-cured adhesives  | Apple Policy   |
| Adhesive monomers Group II       | See Appendix P   | Must pass toxicological review for approval                           | Adhesives in wearable products  | UV-cured adhesives in earphones and headphones  | Apple Policy   |
| Antimony<br>Antimony compounds   | 1309-64-4<br>Several   | 1000 ppm  | All materials   | Flame retardant   | Apple Policy   |
| Arsenic<br>Arsenic compounds     | 7440-38-2<br>Several   | No intentional use<br>2 ppm for incidentally present                  | Wood products   | Pallets   | REACH 1907/2006 and amendments   |
|                                  |  | No intentional use<br>50 ppm for incidentally present                 | All other materials except semiconductors (substrates and dopants) and metal alloys | LCD display glass, camera lens, trackpad glass, display cover glass, antifouling agent  | Apple Policy   |
|                                  |  | No intentional use<br>1000 ppm for incidentally present               | Metals  | Copper alloys   |  |
|                                  |  | Exempt  | Semiconductor substrates and dopants  | GaAs semiconductors   |  |
| Asbestos and compounds           | 1332-21-4<br>12001-28-4<br>12001-29-5<br>12172-73-5<br>77536-66-4<br>77536-67-5<br>77536-68-6<br>132207-32-0 | Non-use   | All materials   | Insulator, filler   | REACH 1907/2006 and amendments   |
| Azo dyes, Arylamines, Anilines   | Appendix A   | 30 ppm total content  | All materials   | Dye or colorant for plastics, textiles, leather   | REACH 1907/2006 and amendments<br>Bedarfsgegenstände<br>Verordnung<br>GB 18401-2010, China<br>GB 20400-2006, China |
| Benzene                          | 71-43-2  | 1000 ppm  | All materials   | Paints, coatings, inks, adhesives, and primers manufactured by the material manufacturer and in the finished good   | Apple Policy   |
| Beryllium<br>Beryllium compounds | 7440-41-7<br>Several   | No intentional use<br>1000 ppm total content for incidentally present | All materials   | Metals, alloys, solder, and ceramic materials in connectors, stiffeners, AC inlets, springs, EMI finger/spring, transceivers, brackets, housing, buttons, and speaker wire. | Apple Policy<br>IEEE 1680.1-2018 criterion 4.1.4.1   |
|                                  |  | Exempt  | Products shipped before September 2014  |   |  |

| Chemical or Chemical Group                                    | Substance Identifier or CAS No.                   | Threshold Limit   | Scope  | Examples  | References  |
|---|---|---|--|---|---|
| Bisphenol A (BPA)   | 80-05-7   | Non-use in thermal paper  | Thermal paper                                    | Thermal paper   | Apple Policy  |
|   |   | Report detectable levels of unpolymerized BPA   | All materials                                    | Adhesives, plastics, epoxy resin  | California Proposition 65<br>Apple Policy   |
|   |   | 1000 ppm  | All other materials, unless preapproved by Apple | Adhesives, plastics, epoxy resin  | REACH 1907/2006 and amendments  |
| Bromine<br>Brominated compounds                               | 7726-95-6<br>Several                              | 900 ppm total content   | All materials                                    | Flame retardant, flux, solder paste   | Apple Policy<br>UL 110, criterion 9.2.3   |
|   |   | 1500 ppm (Cl + Br) total content  |  |   |   |
| Brominated Flame Retardants                                   | See definition                                    | No intentional use  | All materials                                    | Plastics, electronic components   | Apple Policy  |
| Cadmium<br>Cadmium compounds                                  | 7440-43-9<br>Several                              | 20 ppm  | Battery cells and packs                          | Nickel cadmium battery  | 2013/56/EU<br>IEEE 1680.1-2018 criterion 4.1.2.1  |
|   |   | 50 ppm in all other materials   | All other materials                              | Pigment stabilizer, copper alloys   | 2011/65/EU<br>GB/T 26572<br>Taiwan BSMI RoHS  |
| Chlorinated Organic Solvents                                  | Appendix G  | 1000 ppm total content and Cl < 900 ppm   | All materials                                    | Paints, coatings, inks, adhesives, and primers manufactured by the material manufacturer and in the finished good | Apple Policy  |
| Chlorinated Paraffins, Short and Medium Chain (SCCP and MCCP) | Appendix B  | 1000 ppm total content and Cl < 900 ppm   | All materials                                    | Paint, coating, sealant, flame retardant, textiles, lubricants  | REACH 1907/2006 and its amendments<br>EPA, SNUR 2070-AJ73, Dec. 2014<br>IEEE 1680<br>Apple Policy |
| Chlorine<br>Chlorinated compounds                             | 7782-50-5<br>Several                              | Non-use;<br>Must be Elemental Chlorine Free (ECF), Totally Chlorine Free (TCF) or Process Chlorine Free (PCF) | Fiber-based packaging                            | Fiber-based packaging   | IEEE 1680.1-2018 criteria 4.1.5.1 & 4.1.5.2<br>UL 110, criteria 9.2.3 & 12.7.1<br>Apple Policy    |
|   |   | 900 ppm total content in all materials  | All materials                                    | Flame retardant, flux, solder paste   | Apple Policy  |
|   |   | 1500 ppm (Cl + Br) total content in all materials   |  |   |   |
| Dimethylfumarate (DMFu)                                       | 624-49-7  | 0.1 ppm   | All materials                                    | Biocide, desiccant pack   | 2010/153/EC   |
| Formaldehyde  | 50-00-0   | 300 ppm   | All materials                                    | Wood, adhesives, plastics, coatings   | ChemVerbotsV<br>GB 18401-2003/2005, China<br>GB 20400-2006, China                                 |
| Halogenated Diphenyl Methanes                                 | 76253-60-6<br>81161-70-8<br>99688-47-8            | 1000 ppm and Br / Cl < 900 ppm  | All materials                                    | Capacitor, transformer  | REACH 1907/2006 and amendments<br>Apple Policy  |
| Heavy Metals (Cd + Cr (VI) + Hg + Pb)                         | 7440-43-9<br>18540-29-9<br>7439-97-6<br>7439-92-1 | 100 ppm combined total  | Packaging  | Packaging materials   | 94/62/EC  |

| Chemical or Chemical Group  | Substance Identifier or CAS No.                                      | Threshold Limit   | Scope   | Examples  | References   |
|---|--|---|---|---|--|
| Hexabromocyclododecane (HBCDD)  | 25637-99-4<br>3194-55-6<br>134237-50-6<br>134237-51-7<br>134237-52-8 | Non-use or 100 ppm total                                | All materials   | Flame retardant   | 2019/1021/EU   |
| Hexavalent Chromium (Cr (VI), Cr <sup>6+</sup> )<br>Hexavalent Chromium compounds | 18540-29-9<br>Several  | 1 ppm   | All wearable products and accessories   | Watch band materials including leather and textiles   | REACH 1907/2006 Entry 72   |
|   |  | 3 ppm   | Leather in all other applications   | Leather   | REACH 1907/2006 Entry 47<br>Taiwan BSMI RoHS   |
|   |  | 500 ppm   | All other materials   | Metal coating, pigment  | 2011/65/EU, GB/T 26572<br>Taiwan BSMI RoHS   |
| Lacey Act and EU Timber Regulation  | Not Applicable   | Non-use   | All materials   |   | US Lacey Act (16 U.S.C. §§ 3371–3378)<br>EU Timber Regulation                                |
| Lead<br>Lead compounds  | 7439-92-1<br>Several   | No intentional use<br>40 ppm for incidentally present   | Battery cells and packs   | Lead-acid, Zn-Mn, alkaline batteries  | 2013/56/EU   |
|   |  | No intentional use<br>50 ppm for incidentally present   | Plastics, inks, surface coatings, displays (including housing, wiring, and printed circuit board) | Paints, cable jacketing and insulation  | IEEE 1680.1-2018<br>CPSIA, 2008  |
|   |  | No intentional use<br>1000 ppm for incidentally present | All other materials except all exemptions in 2011/65/EU and its amendments                        | Solder, glass, steel, copper alloys, aluminum alloys  | 2011/65/EU<br>GB/T 26572<br>Taiwan BSMI RoHS   |
| Mercury<br>Mercury compounds  | 7439-97-6<br>Several   | No intentional use<br>5 ppm for incidentally present    | Battery cells and packs   | Mercury oxide, zinc-manganese, alkaline manganese batteries   | 2013/56/EU   |
|   |  | No intentional use<br>100 ppm for incidentally present  | All other materials   | CCFL lamps, switches, dyes  | 2011/65/EU, IEEE 1680-1 criterion 4.1.3.1,<br>GB/T 26572, Taiwan BSMI RoHS                   |
| Methyl-phenol compounds   | 95-48-7<br>106-44-5<br>108-39-4<br>1319-77-3                         | 10 ppm total content                                    | All materials   | Cleaning compound, adhesives, resin, coatings at all tiers of the supply chain                                    | Canadian Environmental Protection Act, 1999  |
| Natural rubber, latex   | Latex proteins   | Non-use   | All wearable materials  |   | ASTM D6499 for screening antigens. If positive, use Western Blot / SDS PAGE for confirmation |
| n-Hexane  | 110-54-3   | 1000 ppm  | All materials   | Paints, coatings, inks, adhesives, and primers manufactured by the material manufacturer and in the finished good | Apple Policy   |
| Nickel and its compounds  | 7440-02-0<br>Several   | 0.28 µg/cm <sup>2</sup> /week leach rate                | Parts with direct and prolonged skin contact  | Metal alloys with nickel, plating material, anti-corrosive alloy  | REACH 1907/2006 and amendments   |
| Organotin compounds   | Appendix C   | 1000 ppm total content                                  | All materials   | Glass coatings, antifouling coatings, silicones, polyurethanes, paints, adhesives                                 | REACH 1907/2006 and amendments<br>Apple Policy   |
| Perchlorates  | 7601-89-0<br>7778-74-7<br>7790-98-9<br>7791-03-9<br>10034-81-8       | 0.1 ppm total content                                   | All materials   | Lithium perchlorate coin cell batteries   | CA DTSC<br>Perchlorate Contamination Prevention Act  |

| Chemical or Chemical Group                         | Substance Identifier or CAS No.  | Threshold Limit   | Scope                               | Examples   | References   |
|--|--|---|-------------------------------------|--|--|
| PFBS and related substances                        | Compounds with the formula $C_4F_9SO_3H$ , their salts and any combinations thereof. This includes any substance having a perfluoroalkyl group (linear or branched) $C_4F_9-$ directly attached to a sulfur atom. <b>Including but not limited to the list of compounds on pages 14, 15, 24, and 25 in the reference link.</b>   | 1000 ppm total content  | All materials                       | Flame retardant additive for plastic resins  | <a href="http://www.miljodirektoratet.no/globalassets/publikasjoner/M759/M759.pdf">www.miljodirektoratet.no/globalassets/publikasjoner/M759/M759.pdf</a>   |
| PFCAs (C9-C14), their salts and related substances | Compounds that are perfluoroalkyl carboxylic acids (branched and/or linear) with the formula: $CF_3-(CF_2)_n-$ , $n=8-13$ as a structural element, including their salts. In addition, any related substance (including their salts and polymers) with the above defined linear and/or branched perfluoroalkyl structural elements that can degrade to C9-C14 PFCA. <b>Including but not limited to compounds listed on pages 31, 56, and 198-205 in the reference link.</b> | 25 ppb for the sum of C9-C14 PFCAs and their salts<br>260 ppb for the sum of C9-C14 PFCA-related substances | All materials                       |  | 2021/1297/EU<br><a href="https://echa.europa.eu/documents/10162/2ec5dffd-0e63-0b49-d756-4dc1bae7ec61">echa.europa.eu/documents/10162/2ec5dffd-0e63-0b49-d756-4dc1bae7ec61</a>  |
| PFHxA, its salts and related substances            | See Apple Engineering Requirements Specification: Poly- and Perfluoroalkyl substances (PFAS) and Perfluorohexanoic acid (PFHxA) Definitions and Substance Lists, 099-39076   | 25 ppb for the sum of PFHxA and its salts<br>1000 ppb for the sum of PFHxA-related substances               | All materials                       | Protective and oleophobic coatings   | See Apple Engineering Requirements Specification: PFAS & PFHxA Definition and Reporting, 099-39076   |
| PFHxS, its salts and related substances            | Compounds with the formula $C_6F_{13}SO_3H$ , their salts and any combinations thereof. This includes any substance having a perfluoroalkyl group (linear or branched) $C_6F_{13}-$ directly attached to a sulfur atom. <b>Including but not limited to compounds listed on pages 168-192 in the reference link.</b>   | 25 ppb for the sum of PFHxS and its salts<br>1000 ppb for the sum of PFHxS related substances               | All materials                       |  | <a href="https://echa.europa.eu/documents/10162/a22da803-0749-81d8-bc6d-ef551fc24e19">echa.europa.eu/documents/10162/a22da803-0749-81d8-bc6d-ef551fc24e19</a>  |
| PFOA, its salts and PFOA-related compounds         | PFOA and its salts and compounds that degrade to PFOA, including any substances (including salts and polymers) having a linear or branched perfluoroheptyl group with the moiety $(C_7F_{15})C$ as one of the structural elements. <b>Including but not limited to compounds on pages 79-81 in the reference link.</b>   | < 1 $\mu g/m^2$ coated area   | Textiles and other coated materials | Surfactant, impregnation agent in textiles   | Norway FOR-2004-06-01-922<br>2019/1021/EU<br><a href="https://oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15">oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15</a> |
|  |  | 25 ppb for sum of PFOA and its salts<br>1000 ppb for individual PFOA-related substances                     | All other materials                 |  |  |
| PFOS and its derivatives                           | Compounds with the formula $C_8F_{17}SO_3H$ , their salts and any combinations thereof. This includes any substance having a perfluoroalkyl group (linear or branched) $C_8F_{17}-$ directly attached to a sulfur atom. <b>Including but not limited to compounds on pages 24-44 in reference link.</b>  | $\leq 1 \mu g/m^2$ coated area  | Textiles and other coated materials | Surfactant, impregnation agent in textiles   | 2019/1021/EU<br><a href="https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15">www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15</a>                      |
|  |  | 10 ppm  | Preparations                        |  |  |
|  |  | 1000 ppm total content  | All other materials                 |  |  |
| Phenyl, Isopropylated Phosphate (3:1) or PIP 3:1   | 68937-41-7   | No intentional use  | All materials                       | Plasticizer, flame retardant, or anti-wear additive in plastics, adhesives, lubricants | TSCA Section 6(h)  |
| Phthalates   | Appendix E   | 1000 ppm total content  | All materials                       | Plasticizer  | California Proposition 65<br>REACH 1907/2006 and amendments 2011/65/EU   |



| Chemical or Chemical Group              | Substance Identifier or CAS No.  | Threshold Limit   | Scope                                      | Examples   | References   |
|---|--|---|--|--|--|
| Polybrominated Biphenyls (PBBs)         | 59536-65-1<br>Several  | 1000 ppm and Br < 900 ppm   | All materials                              | Flame retardants   | 2011/65/EU<br>GB/T 26572<br>Apple Policy   |
| Polybrominated Diphenyl Ethers (PBDEs)  | Appendix N   | 10 ppm individually and 500 ppm for sum of total PBDEs  | All materials                              | Flame retardants   | 2011/65/EU<br>GB/T 26572<br>Apple Policy   |
| Polychlorinated Biphenyl (PCB)          | 1336-36-3<br>Several   | Non-detect (< 0.1 ppm)  | All materials                              | Capacitor, transformer, heat transfer fluids, lubricants   | 2019/1021/EU<br>85/467/EEC<br>CRS 001/1983, Brazil   |
| Polychlorinated Naphthalene (PCN)       | 70776-03-3   | 5 ppm   | All materials                              | Lubricant, paint, cable insulation, wood preservatives, lubricants, electroplating masking compounds, feedstock for dye production, dye carriers, capacitor fluids, flame proofing, preservatives, moisture proofing sealant, temporary binders for ceramic component manufacturing, casting material for alloys | Apple Policy   |
| Polychlorinated Terphenyl (PCT)         | 61788-33-8   | 5 ppm   | All materials                              | Capacitor, transformer, heat transfer fluids, lubricants   | 85/467/EEC<br>REACH 1907/2006<br>Apple Policy  |
| Polycyclic Aromatic Hydrocarbons (PAHs) | Appendix F   | 0.5 ppm individually and 10 ppm for sum of total PAHs   | Inks<br>Otherwise, external materials only | Carbon black, plastics, dyes, combustion by-products   | EC/1272/2013<br>Apple Policy   |
| Polyvinyl Chloride (PVC)                | 9002-86-2  | No intentional use<br>900 ppm Cl for incidentally present   | All materials                              | Electrical insulator, wire, tape, tubing, cable enclosure, vibration dampener, films   | Apple Policy   |
|   |  | No intentional use<br>1500 ppm (Cl + Br) for incidentally present   |  |  |  |
| Radioactive substances                  | Several  | Detectable levels of ionized radiation in parts, components, materials, and products above regional background levels. Restrictions under international regulations will apply, if appropriate. Any exceedance above the background levels must be reviewed and preapproved by Apple. | All materials                              | Electrical sensor, phosphorescent ink  | Japanese Laws for the Regulation of Nuclear Source Material, Nuclear Fuel Material, and Reactors, 1986 |
| REACH Annex XVII                        | Check the ECHA website for the individual restrictions at <a href="http://echa.europa.eu/substances-restricted-under-reach">echa.europa.eu/substances-restricted-under-reach</a> | As applicable   | All materials                              | REACH, Annex XVII  | REACH 1907/2006 and amendments   |
| REACH Candidate List of SVHCs           | Check the ECHA website for the updated list at <a href="http://echa.europa.eu/candidate-list-table">http://echa.europa.eu/candidate-list-table</a>                               | 1000 ppm in all materials unless allowed per Apple SVHC disclosures. <b>Must also report to Apple all uses when &gt; 1000 ppm in materials</b>  | All materials                              | REACH, Candidate List  | REACH 1907/2006 and amendments<br>Apple Policy   |
| Tetrabromobisphenyl A (TBBA, TBBPA)     | 79-94-7  | 900 ppm Br  | All materials                              | Flame retardant for electrical insulator, wire, tape, tubing, cable enclosure, vibration dampener  | Apple Policy   |
|   |  | 1500 ppm (Cl + Br)  |  |  |  |
| Toluene                                 | 108-88-3   | 1000 ppm  | All materials                              | Paints, coatings, inks, adhesives, and primers manufactured by the material manufacturer and in the finished good  | Apple policy   |

## 4. Reportable Substances and Future Restrictions in Products

Suppliers are required to report the use of all substances listed in Section 4, regardless of the future restriction timeline, in any homogeneous materials used in Apple products, accessories, and packaging as well as in any homogeneous materials applied to or cured onto parts in Apple products, accessories, and packaging. This includes the wet formulations of adhesives, inks, coatings, primers, and other wet formulations manufactured by the material manufacturer in addition to the cured materials in the finished good. In some cases, reporting is required only if the substances exceed a defined permissible limit. Apple is prioritizing the chemicals it intends to restrict in the future in order to work effectively with its supply chain. Suppliers are required to report via FMD Portal and/or the Test Report Mapping (TRM) form for evaluation and approval for use prior to use in Apple products. Where indicated, Apple expects future restrictions based on regulation or Apple Policy. Some substances will require immediate phase-out; suppliers must start reformulating existing or qualifying new materials that do not intentionally use the substance(s). In some cases, use will be allowed under a specific threshold limit.

| Chemical or Chemical Group                       | Substance Identifier or CAS No.  | Reporting Threshold  | Examples   | Phase-Out & Future Restrictions   | References   |
|--|--|--|--|---|--|
| Per- and Polyfluoroalkyl Substances (PFAS)       | See Apple Engineering Requirements Specification: Poly- and Perfluoroalkyl substances (PFAS) and Perfluorohexanoic acid (PFHxA) Definitions and Substance Lists, 099-39076 | 25 ppb for non-polymeric PFAS<br>50 ppm for polymeric PFAS   | Lubricants, corrosion resistance coatings, top coats, water repellency coatings, plastics  | Begin phase-out immediately. Restriction by October 2025 for all but EU-approved essential use exemptions.  | See Apple Engineering Requirements Specification: PFAS & PFHxA Definitions and Substance Lists, 099-39076; Annex XV Restriction Report   |
| Perfluorohexanoic Acid (PFHxA)                   | See Apple Engineering Requirements Specification: Poly- and Perfluoroalkyl substances (PFAS) and Perfluorohexanoic acid (PFHxA) Definitions and Substance Lists, 099-39076 | 25 ppb for the sum of PFHxA and its salts<br>1000 ppb for the sum of PFHxA-related substances  | Protective coatings, color filter resist coatings  | Restricted (See Section 3)  | See Apple Engineering Requirements Specification: PFAS & PFHxA Definitions and Substance List, 099-39076   |
| REACH Candidate List of SVHCs                    | Check the ECHA website for the updated list at <a href="http://echa.europa.eu/candidate-list-table">http://echa.europa.eu/candidate-list-table</a>                         | 1000 ppm at the material level   |  | Begin phase-out immediately. Expect future restrictions   | REACH Candidate List of SVHCs  |
| Bisphenol Chemicals                              | See Appendix L   | 100 ppm  | Adhesives, plastics, epoxy resin   | Begin phase-out immediately. Expect future restrictions   | Apple Policy   |
| Brominated Organic Solvents                      | See Appendix M   | 100 ppm  |  | Begin phase-out immediately. Expect future restrictions   | Apple Policy   |
| Formaldehyde-releasing substances                | <b>Including but not limited to the compounds in the reference link.</b>   | Formaldehyde released from substance exceeds a concentration of 0.124 mg/m <sup>3</sup> in the air of a test chamber used under the conditions prescribed in EN 717-1. |  | Begin phase-out immediately. Expect future restrictions   | <a href="http://echa.europa.eu/documents/10162/13641/rest_formaldehyde_axvreport_en.pdf">echa.europa.eu/documents/10162/13641/rest_formaldehyde_axvreport_en.pdf</a>                                 |
| Parts/Components utilizing RoHS exemptions       | <a href="http://ec.europa.eu/environment/waste/rohs_eee/index_en.htm">http://ec.europa.eu/environment/waste/rohs_eee/index_en.htm</a>                                      | Individual substance thresholds as per the RoHS directive  |  | Begin phase-out immediately. Expect future restrictions   | 2011/65/EU   |
| Phenyl, Isopropylated Phosphate (3:1) or PIP 3:1 | 68937-41-7   | Any intentional use  | Plasticizer, flame retardant, or anti-wear additive in plastics, adhesives, lubricants   | Restricted (See Section 3)  | TSCA Section 6(h)  |
| Skin sensitizing substances                      | <b>Including but not limited to the compounds in the reference link.</b>   | Various  | Only applicable to leather, textile, hide, and fur articles. Natural leather is exempt.  | Begin phase-out immediately. Expect future restrictions   | <a href="http://echa.europa.eu/de/registry-of-restriction-intentions/-/dislist/details/0b0236e182446136">echa.europa.eu/de/registry-of-restriction-intentions/-/dislist/details/0b0236e182446136</a> |
| Volatile Organic Compounds (VOCs)                | See latest revision of 099-22549 as applicable   | See latest revision of 099-22549 as applicable   | See latest revision of 099-22549 as applicable. Report detectable levels. Vendors must meet all applicable VOC regulations in the areas in which they are operating. | Begin phase-out immediately. Expect future restrictions. Includes VOC content and substance restrictions for paints, coatings, inks, adhesives, primers, and cleaners | Apple Specification 099-22549  |

| Chemical or Chemical Group  | Substance Identifier or CAS No.  | Reporting Threshold  | Examples   | Phase-Out & Future Restrictions | References   |
|---|--|--|--|---------------------------------|--|
| Additive Phosphorous Flame Retardants                                   | Examples include substances in Appendix K  | 1000 ppm   | Plastics, printed circuit boards   | Expect future restrictions      | Sweden Chemical Tax (2016:1067)  |
| Biocides  | Several<br><a href="https://echa.europa.eu/regulations/biocidal-products-regulation/understanding-bpr">echa.europa.eu/regulations/biocidal-products-regulation/understanding-bpr</a> | Detectable levels.<br>Treated articles must use biocides that are approved or under review         | Additive in polymers, leather, other coated materials  | Expect future restrictions      | EU No 528/2012 (BPR)   |
| Cobalt<br>Cobalt Compounds  | 7440-48-4<br>Several   | 1000 ppm   | Moisture indicator, additive in rubber, cobalt alloys  | Expect future restrictions      | REACH 1907/2006 and amendments<br>Apple Policy   |
| Endocrine Disrupting Chemicals (EDCs)                                   | Examples include substances in Appendix J  | Detectable levels  | All materials  | Expect future restrictions      | Apple Policy   |
| IEC 62474 Substances  | <a href="http://std.iec.ch/iec62474">std.iec.ch/iec62474</a>   | Various, as required by standard   | All materials  | Expect future restrictions      | Apple Policy   |
| Indium Phosphide  | 22398-80-7   | Detectable levels in electronic components   | Electronic components  | Expect future restrictions      | Apple Policy   |
| Melamine  | 108-78-1   | 1000 ppm   | Plastics   | Expect future restrictions      | Apple Policy   |
| Nanomaterials   | Several  | Detectable levels  | Silver nanoparticles, carbon nanotubes and graphene, nano-scale cerium dioxide, nano titanium dioxide, nano-scale iron, nanometer-sized copper particles | Expect future restrictions      | France Decree No. 2012-232, Environmental Code Article L. 523-4—<br>Annual declaration of substances in nanoparticle 2011/696/EU |
| N-Ethyl-2-pyrrolidone   | 2687-91-4  | 1000 ppm   | Paints, coatings, inks, adhesives, primers manufactured by the material supplier and in the finished good  | Expect future restrictions      | Apple Policy   |
| Proposition 65 list of chemicals  | All chemicals listed in the following link: <a href="http://oehha.ca.gov/prop65/prop65_list/Newlist.html">http://oehha.ca.gov/prop65/prop65_list/Newlist.html</a>                    | Detectable levels  | All materials  | Expect future restrictions      | California Proposition 65  |
| Washington State's List of Chemicals of High Concern to Children (CHCC) | All chemicals listed in the following link: <a href="http://apps.leg.wa.gov/WAC/default.aspx?cite=173-334-130">http://apps.leg.wa.gov/WAC/default.aspx?cite=173-334-130</a>          | Practical quantification limit (PQL) if added intentionally<br>100 ppm if present as a contaminant | All materials  | Expect future restrictions      | Children's Safe Products Act   |

## 5. Notifying Apple of Chemical Phase Out and Reformulation from Suppliers

Suppliers are required to communicate promptly any change in chemical manufacturing processes, manufacturing site, or any other change that will affect any attribute of the material either in its chemical composition (intentional or residual) or its lead time. For example, if for environmental or other purposes the supplier wishes to modify the goods or the processes, production lines, or site(s) used to manufacture the parts or finished goods, the supplier must provide Apple with the reason (e.g., an internal initiative to a phase out or to reformulate any material/part due to a chemical or any other concern), by contacting the supplier's Apple Global Supply Manager(s) **and** the Apple Environmental Team at [environment@apple.com](mailto:environment@apple.com) prior to any such modification. Apple will review the submission and decide whether, or to what extent, a modification is permitted. For any such modification, the supplier must, at a minimum, provide test reports to meet the requirements of Section 9 and test reports for other substances may also be requested. Subject to the above, suppliers must agree to not modify the goods or the processes used to manufacture the goods in any way after qualification without Apple's prior written consent.

## 6. Restrictions in Manufacturing Processes

Restrictions in Section 6 apply to manufacturing process chemicals used to create components or materials for Apple products and the assembly of Apple products including: direct use during production or indirect use for manufacturing equipment, machines, or tools during maintenance. Restrictions do not apply to laboratory, housekeeping, wastewater treatment plant, or other non-manufacturing processes. Suppliers must comply with threshold limits for the chemicals listed in this section. Test reports are required to demonstrate compliance of non-use. "Non-use" and "no intentional use" are defined in Section 2. Per the Apple Supplier Code of Conduct, suppliers shall identify, evaluate, and manage occupational health and safety hazards through a prioritized process of hazard elimination, engineering controls, and/or administrative controls. Suppliers shall provide their employees with suitable job-related, appropriately maintained personal protective equipment and instruction on its proper use.

| Chemical or Chemical Group      | Substance Identifier or CAS No.                               | Threshold & Scope   | References                            |
|---------------------------------|---|---|---------------------------------------|
| Benzene                         | 71-43-2   | Non-use for cleaning agents, degreasers, and demolder solutions<br>No intentional use for all other manufacturing process chemicals | Apple Policy                          |
| Brominated Organic Solvents     | All Brominated Organic Solvents. See Appendix M for examples  | Non-use for cleaning agents, degreasers, and demolder solutions<br>No intentional use for all other manufacturing process chemicals | Apple Policy                          |
| Chlorinated Organic Solvents    | All Chlorinated Organic Solvents. See Appendix G for examples | Non-use for cleaning agents, degreasers, and demolder solutions<br>No intentional use for all other manufacturing process chemicals | Apple Policy                          |
| Methanol                        | 67-56-1   | No intentional use for cleaning agents, degreasers, and demolder solutions  | Apple Policy                          |
| n-Hexane                        | 110-54-3  | Non-use for cleaning agents, degreasers, and demolder solutions<br>No intentional use for all other manufacturing process chemicals | Apple Policy                          |
| N-Methylpyrrolidone (NMP)       | 872-50-4  | Non-use for cleaning agents, degreasers, demolder solutions   | Apple Policy                          |
| Ozone Depleting Chemicals (ODC) | Appendix H and Appendix I                                     | No intentional use for all manufacturing process chemicals  | Montreal Protocol<br>EC No. 2037/2000 |
| Toluene                         | 108-88-3  | Non-use for cleaning agents, degreasers, demolder solutions   | Apple Policy                          |

## 7. Reportable Substances and Future Restrictions in Manufacturing Processes

Suppliers are required to report the use of substances listed in Section 7 in any manufacturing process used to create components or materials for Apple products regardless of phase out priority. Apple is prioritizing the chemicals it intends to phase out of Apple manufacturing processes in order to work effectively with its supply chain. Suppliers are required to report use through the Chemical Safety Disclosure Portal. Apple may require disclosure of the use of manufacturing process chemicals and their chemical composition as deemed necessary.

| Chemical or Chemical Group | Substance Identifier or CAS No. | Reporting Threshold         | Scope                       | Phase Out & Future Restrictions | References   |
|----------------------------|---------------------------------|-----------------------------|-----------------------------|---------------------------------|--------------|
| Ethylbenzene               | 100-41-4                        | Detectable levels (Content) | All manufacturing processes | Expect future restrictions      | Apple Policy |
| Formaldehyde               | 50-00-0                         | Detectable levels (Content) | All manufacturing processes | Expect future restrictions      | Apple Policy |
| Hydrogen Fluoride (HF)     | 7664-39-3                       | Detectable levels (Content) | All manufacturing processes | Expect future restrictions      | Apple Policy |
| Methanol                   | 67-56-1                         | Detectable levels (Content) | All manufacturing processes | Expect future restrictions      | Apple Policy |
| N-Methylpyrrolidone (NMP)  | 872-50-4                        | Detectable levels (Content) | All manufacturing processes | Expect future restrictions      | Apple Policy |
| Toluene                    | 108-88-3                        | Detectable levels (Content) | All manufacturing processes | Expect future restrictions      | Apple Policy |
| Xylene                     | 1330-20-7                       | Detectable levels (Content) | All manufacturing processes | Expect future restrictions      | Apple Policy |

## 8. Supplementary Specifications

All Apple products must comply with the restrictions listed in this Regulated Substances Specification. In cases when new restrictions are introduced over a transition period, Apple may release supplementary specifications referencing those specific restrictions. Drawings, fabrication notes, and product specifications will reference the supplementary specification as applicable. The supplementary specifications are available to qualified suppliers upon request by contacting Apple at [environment@apple.com](mailto:environment@apple.com).

### 8.1 Apple Environmental Quality Specification, 069-8496

The Apple Environmental Quality Specification sets forth Apple's requirements for final assembly facilities, module suppliers, and component suppliers to maintain an environmental quality control program to ensure the environmental compliance of Apple products. The environmental quality control program for supplier facilities must include a material declaration process, in-process controls, and audits of raw materials and finished goods. All final assembly and module suppliers are required to adhere to these requirements and provide information to Apple in a timely manner.

### 8.2 Apple Regulated Substances Specification for Prolonged Skin Contact Materials, 099-3470

The Apple Regulated Substances Specification for Prolonged Skin Contact Materials applies to materials with direct or indirect prolonged skin contact in both wearable and non-wearable products. Materials with no or incidental skin contact will not need to comply with this specification. All materials, regardless of whether they are in prolonged skin contact, must also comply with the Apple Regulated Substances Specification (069-0135).

### 8.3 Conflict Minerals Restrictions, 069-5202

All suppliers of materials, parts, sub-components, components, or products (Component Goods) that are to be incorporated into an Apple product and containing tantalum, tungsten, tin, gold, or cobalt must comply with the specification on Conflict Minerals Restrictions, 069-5202. Suppliers may only use tin, tantalum, tungsten, gold, or cobalt in Component Goods if the supplier demonstrates that it has exercised due diligence in the sourcing of such materials and reports to Apple on the source and chain of custody of such metals in accordance with the OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas. This will enable a determination as to whether those metals are from the Democratic Republic of the Congo (DRC) or any adjoining country and, if so,

whether those metals directly or indirectly financed or benefited armed groups that are perpetrators of serious human rights abuses in the DRC or an adjoining country. Suppliers may only source tin, tantalum, tungsten, gold, or cobalt through smelters and refiners participating in a verification of their sourcing practices by an independent third-party organization or program recognized by Apple.

Apple expects each supplier to provide complete and accurate reporting of its due diligence efforts for all tin, tantalum, tungsten, gold, or cobalt used in Apple Component Goods. Apple will audit suppliers' Conflict Minerals data submissions to ensure conformity with Apple requirements. If any supplier becomes aware that it has sourced tin, tantalum, tungsten, gold, or cobalt that is from the DRC or any adjoining country and that directly or indirectly financed or benefited armed groups, in any Component Goods incorporated into Apple products, the supplier must immediately notify Apple in writing at [mineralsreporting@apple.com](mailto:mineralsreporting@apple.com).

### 8.4 Apple Volatile Organic Compound (VOC) Specification, 099-22549

This specification sets forth Apple's requirements for compliance with all restrictions, regulations, and reporting requirements for VOC (Volatile Organic Compound)-containing materials applicable to Apple products and packaging, and related manufacturing processes. Compliance is applicable to the following stakeholders: all contract manufacturing partners, suppliers, and vendors, including all component, module, or system-level assembly facilities applying VOC-containing materials. Apple expects these stakeholders to ensure that materials under the scope of this specification used by their suppliers also comply with restrictions, regulations, and reporting requirements defined in this specification.

### 8.5 Engineering Requirements Specification: PFAS and PFHxA Definitions and Substances Lists, 099-39076

This document is the material specification defining chemicals that may be considered "Poly- or perfluoro alkyls substances" or PFAS and "Perfluorohexanoic acid and its related compounds", the most comprehensive (though non-exhaustive) list of PFAS and PFHxA chemicals, and information that helps material vendors provide information to Apple in order to satisfy Apple RSS reporting requirements for PFAS.

## 9. Demonstrating Compliance

In addition to requiring test reports for the substances below, Apple may request analytical test reports demonstrating compliance for **any of the substances listed in this specification**, at the supplier's expense. Besides the prescribed test methods below, other test methods may be acceptable by Apple if preapproved.

Apple requires test reports from certified labs as proof of compliance for the following substances in homogeneous materials:

| Chemical or Chemical Group  | Test Results Required for:   | Test Method  |
|---|--|--|
| Arsenic (As)  | Glass  | Total acid digestion followed by ICP-MS, ICP-OES, ICP-AES  |
| Beryllium   | Metal alloys that contain copper and beryllia ceramics<br>For metals and alloys that contain copper and solder, it is acceptable to submit a Certified Mill Test Report (also known as a Mill Test Certificate) in lieu of a test report as defined later in this section, if it provides full composition information | US EPA 3050B<br>US EPA 3052<br>ICP-AES in addition to ICP-MS<br>ICP-OES in addition to ICP-MS  |
| Bis(2-ethylhexyl) phthalate (DEHP)<br>Butyl benzyl phthalate (BBP)<br>Cadmium (Cd)<br>Dibutyl phthalate (DBP)<br>Diisobutyl phthalate (DIBP)<br>Hexavalent Chromium (Cr <sup>6+</sup> )<br>Lead (Pb)<br>Mercury (Hg)<br>Polybrominated biphenyl (PBB)<br>Polybrominated diphenyl ether (PBDE) | All materials.<br>Test reports are not required for PBB, PBDE, DEHP, BBP, DBP, and DiBP in metals, glass, or ceramic   | Methods described or referenced in IEC 62321<br>ISO17075-2 for Hexavalent Chromium (Cr <sup>6+</sup> ) in leather<br>EN 14372 followed by GC-MS for Phthalates |
| Bromine (Br)<br>Chlorine (Cl)<br>Fluorine (F)   | All materials except metals and ceramics   | EN 14582<br>US EPA SW-846 5050/9056<br>ASTM D 7359-14a, DIN 53474:2017-12, or IEC62321-3-2, followed by IC testing   |
| PFOA<br>PFOS  | Inks, leather, coated textiles, lubricants, coatings (e.g., primers, varnishes, paints, CVDs, photoresist, solder resist; see Definitions section), fluoropolymer materials  | DIN CEN/TS 15968<br>LC-MS-MS methods that can achieve an MDL of 25 ppb   |
| Any other substance listed in this specification  | Any material if requested by Apple   | As required  |

Apple requires test reports from certified labs as proof of non-use for the following manufacturing process chemicals:

| Chemical or Chemical Group   | Test Results Required for:                      | Test Method   |
|------------------------------|---|---|
| Benzene                      | Cleaning agents, degreasers, demolder solutions | Solvent extraction, analyzed by GC-MS or HPLC-MS<br>5 ppm Minimum Detection Limit                                       |
| Brominated Organic Solvents  | Cleaning agents, degreasers, demolder solutions | EN 14582 for total bromine or US EPA SW-846 5050/9056<br>50 ppm Minimum Detection Limit<br>Others preapproved by Apple  |
| Chlorinated Organic Solvents | Cleaning agents, degreasers, demolder solutions | EN 14582 for total chlorine or US EPA SW-846 5050/9056<br>50 ppm Minimum Detection Limit<br>Others preapproved by Apple |
| n-Hexane                     | Cleaning agents, degreasers, demolder solutions | Solvent extraction, analyzed by GC-MS or HPLC-MS<br>5 ppm Minimum Detection Limit                                       |
| N-Methylpyrrolidone (NMP)    | Cleaning agents, degreasers, demolder solutions | Solvent extraction, analyzed by GC-MS or HPLC-MS<br>5 ppm Minimum Detection Limit                                       |
| Toluene                      | Cleaning agents, degreasers, demolder solutions | Solvent extraction, analyzed by GC-MS or HPLC-MS<br>5 ppm Minimum Detection Limit                                       |

All test reports must meet the following requirements:

- Test reports must be no more than two years old from the date submitted to Apple or Apple's manufacturing partners. Material test reports are required for each use of that material in a new product design. Suppliers are obligated to maintain appropriate processes and systems to manage test reports so that the valid reports can be submitted to Apple in a timely manner. Materials tested must be homogeneous.  
Test reports that are not at a homogeneous material level are not acceptable (e.g., modules made up of several homogeneous materials tested after grinding the entire subassembly).
- Apple requires unaltered test reports of homogeneous materials from certified labs as proof of compliance for the substances listed in Section 9. Digital test reports must be in the form of original, unaltered PDF files containing text and images as provided by the certified lab(s). Scanned, photographed, modified, and/or image-only PDF files are prohibited without Apple's prior approval, and will be rejected at Apple's discretion.
- A nationally or internationally certified laboratory must issue the test report. Supplier-owned laboratories are acceptable if they are independently certified and evidence of certification is submitted to [environment@apple.com](mailto:environment@apple.com) for approval. One example of international certification is ISO 17025.
- Test reports based on X-ray Fluorescence Spectroscopy (XRF) are not acceptable forms of compliance documentation.
- Testing must be conducted on the material in the form present in the final Apple product, accessory, or retail packaging item (i.e., "dry" or "cured").
- When conducting test method (EN14582) for halogens (Br, Cl, F), supplier must ensure with test laboratory that the method is validated for different halogens using certified reference materials.
- Test reports submitted to Apple must be issued in English or include English if a multilingual report.
- It is the supplier's responsibility to provide test reports at the supplier's expense.
- Redacted test reports will not be accepted by Apple. They may, however, satisfy contract manufacturer requirements. Contact the Apple Environmental Quality Team for guidance as required. (Source: Current version of Apple Environmental Quality Specification [069-8496] on Section 4.1 General Requirement).

Apple or Apple's manufacturing partners may request test reports on a case-by-case basis, at the supplier's expense, if there are concerns regarding the validity of the test data or compliance of the parts.

All compliance documentation (e.g., test reports and declarations) must be retained by the supplier for a minimum of 10 years as part of the supplier's record-keeping process. Digital formats are acceptable unless otherwise noted. Suppliers are also expected to have compliance assurance processes and systems to control and maintain compliance. Refer to the Apple Environmental Quality Specification (069-8496) for additional information on supplier's internal environmental quality assurance requirements. Questions relating to test requirements may be directed to Apple Global Supply Managers (GSM), or emailed to Apple at [environment@apple.com](mailto:environment@apple.com).

For substances that are restricted or regulated and have been replaced with an alternative substance, the supplier is required to ensure the alternative substance is an environmentally responsible substitution. Substitutions should be selected based on minimizing unintended consequences that might occur in phasing out a potentially hazardous substance. Suppliers shall conduct alternative assessments or obtain these assessments from their raw materials suppliers prior to making a replacement. Contact Apple at [environment@apple.com](mailto:environment@apple.com) for more information on conducting alternative assessments.



## 10. Waiver Process

Any instances of materials exceeding the thresholds in this specification must immediately be reported to Apple. Suppliers that are seeking a temporary waiver of restrictions in the Apple Regulated Substances Specification must make the request to Apple in writing. Apple will review the request and provide its decision via email to the requester. Contact Apple at [environment@apple.com](mailto:environment@apple.com) for more information on this process.

## 11. Full Material Disclosure (FMD)

Apple has implemented the Full Material Disclosure (FMD) initiative that requires suppliers to provide the entire chemical composition of the parts and materials used in Apple products. Implementation of FMD requires suppliers to disclose the complete, accurate, and precise identity of the parts and materials used in Apple products. Apple's Full Material Disclosure (FMD) requirements are documented in the FMD Data Requirements for Part Suppliers (080-00316) and the FMD Data Requirements for Material Suppliers (080-01462) specifications. The use of the FMD data collected from suppliers is governed by the Apple FMD Data Use Policy (080-00967), which restricts access to and use of the FMD data submitted to Apple.

Apple will audit supplier FMD data submissions to ensure conformity with the requirements. Apple will conduct analyses to ensure submissions accurately reflect the composition of the parts and materials provided. The analyses will include comparison of FMD data to supplier-provided test reports and may include comparison to Apple test reports. Please contact [FMD\\_Support@apple.com](mailto:FMD_Support@apple.com) for more information.

## 12. Chemical Safety Disclosure (CSD)

Suppliers must submit the required information in Apple SupplierCare System to enable Apple to evaluate conformity with the requirements in Section 6 and Section 7 of this specification. Please contact [CSD@group.apple.com](mailto:CSD@group.apple.com) for more information.

## 13. Revision History

| Revision | Date              | Revision Description   |
|----------|-------------------|--|
| M        | March 21, 2023    | <b>Section 2:</b> Added definitions for Brominated flame retardant and intentionally added. <b>Section 3:</b> Updated Adhesive monomers Group I to include adhesives in wearable products within the scope. Updated Mercury, Lead, Arsenic, Brominated flame retardants, PVC, and Beryllium to indicate “No intentional use” under the threshold limit. Removed Benzenamine, N-phenyl-, reaction products with styrene and 2,4,4-trimethylpentene (BNST). Added Brominated flame retardants restriction. Added PFHxA, its salts, and related substances restriction. Added Phenyl, Isopropylated Phosphate (3:1), or PIP 3:1 restriction. Added “1000 ppm in all materials unless allowed per Apple SVHC disclosures. Must also report to Apple all use when > 1000 ppm in materials” for REACH SVHC restriction. Added Toluene restriction. <b>Section 4:</b> Updated the threshold section of PFAS section to include 50 ppm for polymeric PFAS, 25 ppb for non-polymeric PFAS, and a link to pre-published draft Annex XV report. Added Perfluorohexanoic Acid (PFHxA). Added REACH Candidate List of SVHCs. Added Phenyl, Isopropylated Phosphate (3:1), or PIP 3:1. Removed Aminoethyl ethanolamine and Diphenylamines, Substituted (SDPA) (including Appendix H). Regulation references updated for POP, PFOA, and PFCAs. <b>Section 8:</b> Added Engineering Requirements Specification: PFAS and PFHxA Definitions and Substances (099-39076) <b>Section 9:</b> Added the following test methods for Beryllium “ICP-AES in addition to ICP-MS and ICP-OES in addition to ICP-MS”. Added Fluorine. Added “LC-MS-MS methods that can achieve an MDL of 25 ppb” test method for PFOA and PFOS. Included language for conducting test method EN14582. <b>Section 14:</b> Updated POP regulation to 2019/1021/EC. <b>Section 15:</b> Updated substances in Appendix O and P.  |
| L        | March 15, 2021    | <b>Multiple Sections:</b> Updated Section 3, Section 4, and Section 6 introductions to include a clarified scope. Added a larger list of Brominated Organic Solvents that expands on “n-Propyl bromide” in Section 4, Section 6, and Section 9. <b>Section 2:</b> Added definitions for Alloys, Chemical Safety Disclosure (CSD), Coating, Mixture, No intentional use, Paint, ppb, Primer, Process chemical, Textile, Varnish, and Wearable products. <b>Section 3:</b> Added restriction for Adhesive monomers Group I & II. Broadened restriction of Antimony to all Antimony compounds. Added restrictions for Benzene, Chlorinated Organic Solvents, and n-Hexane. Updated scope and restriction thresholds for Hexavalent Chromium and its compounds. Updated restriction scope of Lead compounds to include “No intentional use” in all other materials besides those exempted by the EU. Lowered restriction threshold for Mercury and its compounds. Added Natural rubber, latex restriction. Added restrictions for PFCAs (C9-C14), their salts and related substances, and PFHxS, its salts and related substances. Updated restriction thresholds for PFOA and updated restriction group to include “its salts, and PFOA-related compounds.” Updated restriction for PFOS to include “and its derivatives.” Updated list of restricted Polybrominated Diphenyl Ethers (PBDEs). Updated restriction threshold for Polycyclic Aromatic Hydrocarbons (PAHs). <b>Section 4:</b> Changed Section 4 column “Phase Out Priority” to “Phase-Out & Future Restrictions,” and clarified what is meant by “phase-out.” Changed all “Priority 1” substances to “Begin phase-out immediately. Expect future restrictions.” Changed all “Reportable” substances to “Expect future restrictions.” Added Adhesive monomers Group I, Per- and Polyfluoroalkyl Substance (PFAS), PFBS and related substances, PFHxA, its salts, and related substances, and Toluene to Section 4 with explicit timelines for phase-out. Expanded the list of reportable Bisphenol Chemicals. Added Formaldehyde-releasing substances. Changed the phase-out and future restriction for Parts/Components utilizing RoHS exemptions from just reportable to “Begin phase-out immediately. Expect future restrictions.” Added Skin sensitizing substances. Added reference to the Apple VOC Specification for Volatile Organic Compounds (VOCs). Added Melamine and N-Ethyl-2-pyrrolidone to “Expect future restrictions.” <b>Section 6:</b> Increased scope of Benzene, Brominated Organic Solvents, n-Hexane, and Chlorinated Organic Solvents to include “No intentional use for all other manufacturing process chemicals.” Added Methanol restriction for “No intentional use for cleaning agents, degreasers, and demolder solutions.” <b>Section 7:</b> Added Ethyl Benzene, Formaldehyde, Hydrogen Fluoride (HF), Methanol, and Xylene. Changed instances of “Reportable” to “Expect future restrictions.” <b>Section 8:</b> Added Apple Volatile Organic Compound (VOC) Specification, 099-22549, and Safeguarding Substances Specification, 080-03584. Updated text for Apple Regulated Substances Specification for Prolonged Skin Contact Materials, 099-3470, and Conflict Minerals Restrictions, 069-5202. <b>Section 9:</b> Updated scope of materials in “Test results required for” for Beryllium and PFOS, PFOA. Added “Any other substance listed in this specification” in which test results are required for “Any material if requested by Apple.” Updated test report requirements. <b>Other Sections:</b> Updated description of Waiver Process (Section 10), Full Material Disclosure (FMD; Section 11), and Chemical Safety Disclosure (CSD; Section 12). Modified Appendix D. Removed SF <sub>6</sub> from Appendix I. Created Appendices M, N, O, P, and Q. |
| K        | March 30, 2018    | Updated Scope to include supplier requirements. Updated restriction on BPA. Split PFOA and PFOS into separate listings and updated PFOA restriction. Added restriction on REACH Candidate List of SVHCs, HBCDD. Moved listing for Radioactive Substances from reportable to restricted. Updated restrictions for Cadmium, Chlorine, Bromine, Hexavalent Chromium, Lead, and Mercury to include “compounds.” Created separate restriction listing for Heavy Metals in packaging. Updated scope for restriction on PAHs to External Materials. Updated threshold for reportable listings Benzene, Chlorinated Organic Solvents, and Toluene to reference wet formulation. Changed Parts/Components utilizing RoHS exemptions from priority phase-out 3 to 2. Added reportable listings, priority 2 phase-out listings Bisphenol F/Bisphenol S and VOCs. Added reportable listings for EDCs, Additive Phosphorous Flame Retardants, IEC 62474 substances, Indium Phosphide, PFAS, and Biocides. Changed the priority phase out for several listings to “Reportable.” Added Section “Notifying Apple of Chemical Phase Out and Reformulation from Suppliers.” Added restriction on nPB in manufacturing process. Created new section “Reportable Substances and Future Restrictions in Manufacturing Processes.” Changed Beryllium test results required for Metals and Ceramics. Added requirement for test results for DEHP, BBP, DBP, and DIBP. Added test report requirement for PFOA/PFOS for leather, textiles, and coatings. Added manufacturing chemical test report requirements for nPB. Removed test reports being valid for the life of the component. Added additional requirements for test reports. Updated Appendices D, E, F, and I with additional substances. Created Appendices K, L, and M.   |
| J        | March 21, 2016    | Folded the following specifications into 069-0135-J: Apple RoHS Compliance Specification (069-1111), Apple Specification on Restriction of Beryllium (099-3471), and Apple Specification on the Restriction of Bromine and Chlorine (069-1857). Added additional asbestos compounds. Updated Azo dyes, Arylamines, and Anilines into Appendix A. Updated formaldehyde content restrictions. Updated restrictions for lead. Additional CAS numbers added for Perchlorates. Added Appendix B for Chlorinated Paraffins. Added Appendix C for Organotin compounds, Appendix D for Perfluorinated compounds, Appendix E for Phthalates. Lowered the thresholds for PAHs. Lowered the threshold for PCBs. Added reporting requirements for benzene, toluene, and chlorinated solvents, proposition 65 list, Washington State’s List of Chemicals of High Concern, and substances allowed due to RoHS exemptions in Section 4. Phase out priorities added to all the items in reportable Section 4. Added Manufacturing Process restrictions for NMP and Toluene in Section 5. Updated content restriction values for Benzene, Chlorinated Organic Solvents, n-Hexane, and Toluene in Section 5. Updated Supplementary Specifications. Updated Section 7, Demonstrating Compliance. Added testing requirements for manufacturing process chemicals. Added Section 9 relating to Full Material Disclosure (FMD).  |
| H        | June 20, 2014     | Updated definition of Homogeneous Material, Separated Reportable Substances into new section; updated requirements for azo dyes, beryllium, BPA, cadmium, halogenated biphenyl methanes, Lacey Act, lead, organic tin, PFOS, PFOA, phthalates, PVC, REACH SVHCs, TBPA, benzene, n-Hexane, chlorinated solvents, nPB in ODC, conflict minerals; removed Halogens; addition of Soft Goods Regulated Substances and Beryllium Restriction Specifications in Section 6 for Supplementary Specifications; addition of alternative assessment verbiage and testing requirements for cleaning agents and degreasers in Section 7 for Demonstrating Compliance.  |
| G        | April 11, 2013    | Updated REACH SVHCs, arsenic, asbestos, beryllium requirements, new nickel standard. Added REACH 1907/2006 and amendments, reference to RoHS Recast (RoHS 2), CEPA substances, perchlorate, new phthalates, lead in surface coating, PFOA, BPA reporting, benzotriazole, new PAHs, Lacey Act, and EU Timber Regulation, additional ODCs, benzene and n-Hexane restrictions in manufacturing. Removed polystyrene, gallium. Added reference to 069-8496 for supplier QA. Updated Conflict Minerals reference. Added PFOA/PFOS testing requirement for ink and paints.   |
| F        | January 6, 2010   | Added restrictions on DMF, PAH, PFOS, organic tin compounds, formaldehyde in textiles, and certain phthalates. Added notification requirements and restrictions for substances regulated by REACH. Adjusted arsenic limit and added test report requirement for arsenic in glass. Added reference to Conflict Minerals Restriction specification.  |
| E        | October 9, 2007   | Updated format; introduced restrictions on Br, Cl, TBBA, red phosphorus, gallium; updated limits on As, Pb, Cd, Hg, Cr(VI), asbestos, chlorinated paraffins, formaldehyde, diphenyl methanes, nickel, organic Sn, PCB, PCN, PCT, PVC, radioactive substances; added Be to watch list; limited scope restrictions on Chlorinated Organic Solvents.  |
| D        | October 26, 2004  | Updated plastics Pb limit; merged plastics and cables section; added appendix for guidance on Pb restrictions; added appendix with summary table of permissible limits.  |
| C        | August 18, 2004   | Changed format, new substances added, included permissible limits.   |
| B        | February 12, 2003 | Initial release  |
| A        | December 10, 2002 | Initial release  |

## 14. Referenced Documents

**069-5202:** Conflict Minerals Restriction, Apple Inc.

**069-8496:** Apple Environmental Quality Specification, Apple Inc.

**080-00316:** Apple FMD Data Requirements for Part Suppliers, Apple Inc.

**080-00967:** Apple FMD Data Use Policy, Apple Inc.

**080-01462:** Apple FMD Data Requirements for Material Suppliers, Apple Inc.

**099-3470:** Apple Regulated Substances Specification; Prolonged Skin Contact Materials

**099-39076:** Engineering Requirements Specification: PFAS and PFHxA Definitions and Substances

**94/62/EC:** Directive of the European Parliament and of the Council on Packaging and Packaging waste, 94/62/EC, December 1994.

**2019/1021/EU:** European Parliament and the Council of the European Union recasted a Regulation on persistent organic pollutants (2019/1021/EC) amended the regulation (2004/850/EC) in July 2019

**2009/425/EC:** Commission Decision 2009/425/EC of 28 May 2009 amending Council Directive 76/769/EEC: As regards restrictions on the marketing and use of organostannic compounds for the purpose of adapting its Annex I to technical progress.

**2010/153/EU:** Prolonging the validity of Decision 2009/251/EC requiring Member States to ensure that products containing the biocide dimethylfumarate are not placed or made available on the market.

**2011/65/EU:** The restriction of the use of certain hazardous substances in electrical and electronic equipment ("RoHS Recast"). This directive replaces the directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

**2011/696/EU:** Commission recommendation of 18 October 2011 on the definition of nanomaterial.

**2013/56/EU:** 2013/56/EU Directive amended 2006/66/EC Directive of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators, and repealing Directive 91/157/EEC.

**ACGIH:** American Conference of Governmental Industrial Hygienist (ACGIH), Guide to Occupational Exposure Values, 2013.

**AIHA TWA:** The AIHA Guideline Foundation Workplace Environmental Exposure Levels® (WEELs®) provide guidance for protecting most workers from adverse health effects related to occupational chemical exposures expressed as time-weighted average (TWA).

**Apple Supplier Code of Conduct and Supplier Responsibility Standards:** See supplier requirements at [www.apple.com/supplier-responsibility](http://www.apple.com/supplier-responsibility).

**ASTM D6499:** Standard Test Method for Immunological Measurement of Antigenic Protein in Hevea Natural Rubber (HNR) and its Products.

**ASTM D7359 - 14a:** Standard Test Method for Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures by Oxidative Pyrohydrolytic Combustion followed by Ion Chromatography Detection (Combustion Ion Chromatography-CIC).

**Bedarfsgegenstände Verordnung:** German National Law (consumer article regulation).

**CA DTSC:** California Department of Toxic Substances Control; Perchlorate Contamination Prevention Act of 2003, AB 826.

**Cal OSHA:** California Department of Public Health, Occupational Health Branch, PELs, Title 8, section 5155/AC-1.

**California Prop 65:** The Safe Drinking Water and Toxic Enforcement Act of 1986, California Health and Safety Code, Division 20, Chapter 6.5, sections 25249.5 through 25249.13.

**Canadian Environmental Protection Act, 1999 (CEPA 1999):** Chemicals Management Plan, Section 71.

**ChemVerbotsV:** Chemical Prohibition Ordinance, Germany.

**Children's Safe Products Act (CSPA):** Washington State's Children's Safe Products Act reporting List of Chemicals of High Concern to Children (CHCC), US.

**China RoHS:** Administration methods for use of hazardous substance in electrical and electronic products, Ministry of Industry and Information Technology of People's Republic of China, Order#32, January 21, 2016.

**CLP Regulation (EC) No. 1272/2008:** Classification, Labeling and Packaging complements Dangerous Substances Directive (67/548/EEC) and the Dangerous Preparations Directive (1999/45/EC) replaced by EU REACH Directive.

**CPSIA, 2008:** Consumer Product Safety Improvement Act of 2008—Public Law 110-314; US.

**CRS 001/1983:** Executive Directive CRS 001/1983 Regulates Procedures for the Handling, Storage, and Transport of PCB-Contaminated Equipment in Brazil.

**DIN 53474:2017-12:** Testing of plastics, rubber and elastomers - Determination of the chlorine content.

**DIN CEN/TS 15968:** Determination of extractable perfluorooctane sulfonates (PFOS) in coated and impregnated solid articles, liquids, and fire fighting foams.

**DIN EN ISO 17075:** Leather—Chemical Tests—Determination of chromium(VI) content

**EC No. 2037/2000:** Regulation (EC) No. 2037/2000 of the European Parliament and of the Council of 29 June 2000 on substances that deplete the ozone layer.

**EC/757/2010:** Commission Regulation (EU) No. 757/2010 amending Regulation (EC) No. 850/2004 of the European Parliament and of the Council on persistent organic pollutants (perfluorooctane sulfonates) as regards Annexes IV and V.

**ECHA/NA/15/29:** SEAC (Committee for Socio Economic Analysis) concludes on Bisphenol A, DecaBDE, and PFOA restrictions and finalizes two opinions for authorization, September 2015.

**EN 14372:2004:** Child use and care articles. Cutlery and feeding utensils. Safety requirements and tests.

**EN 1811:2011+A1:2015:** Reference test method for release of nickel from all post assemblies that are articles intended to come into direct and prolonged contact with the skin. Replaces BS EN 1811:2011

**EN 14582:2016:** Characterization of waste. Halogen and sulfur content. Oxygen combustion in closed systems and determination methods. British Standards Institute, 2016.

**EPA SW-846 5050/9056:** Bomb preparation method for solid waste; Method 9056: Determination of inorganic anions by ion chromatography. EPA, 1994.

**EU/1272/2013:** Commission Regulation (EU) No. 1272/2013 to amend Entry 50 of Annex XVII to REACH Regulation (EC) No. 1907/2006 on the restrictions of polycyclic aromatic hydrocarbons (PAH).

**EU 2017/1000:** Commission Regulation (EU) 2017/1000 of 13 June 2017 amending Annex XVII to Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) as regards perfluorooctanoic acid (PFOA), its salts and PFOA-related substances.

**EU No. 528/2012 (BPR):** Regulation (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products.

**EU Timber Regulation:** Regulation laying down the obligations of operators who place timber and timber products on the market: (EU) No. 995/2010.

**France Decree No. 2012-232, Environmental Code Article L. 523-4:** Annual declaration of nanoparticles in substances.

**GB 18401:** Chinese National General Safety Technical Code for Textile Products:  
GB 18401–2010.

**GB 20400:** Limit of Harmful Matters in Leather and Fur, 2006 (Chinese mandatory standard).

**GB/T 26572:** Chinese Standards on the Requirements of Concentration Limits for Certain Restricted Substances in Electrical and Electronic Products, 2011.

**GBZ 2.1-2007:** Occupational exposure limits for hazardous agents in the workplace  
in China, 1 November 2007.

**IEC 62321:** Determination of certain substances in electrotechnical products. IEC, 2008. Updates in 2013 and 2015.

**IEC 62474:** Material Declaration for Products of and for the Electrotechnical Industry.

**IEEE 1680.1-2018:** IEEE Standard for Environmental and Social Responsibility Assessment of Computers and Displays, IEEE, 2018.

**ISO17075-2:2017:** Leather — Chemical determination of chromium(VI) content in leather — Part 2: Chromatographic method, 2017.

**Japan Chemical Substances Control Law (CSCL):** Japanese Chemical Substances Control Law (CSCL) and amendments, 2011.

**Japanese Laws:** Japanese Laws for the Regulation of Nuclear Source Material, Nuclear Fuel Material, and Reactors, 1986.

**Lacey Act (16 U.S.C. §§ 3371–3378):** Amended in the Food, Conservation, and Energy Act of 2008 (Pub. L. 110-234, H.R. 2419, 122 Stat. 923, enacted May 22, 2008), expanded its protection to a broader range of plants and plant products (Section 8204. Prevention of Illegal Logging Practices).

**Montreal Protocol:** Montreal Protocol on Substances that Deplete the Ozone Layer, September 1987.

**NIOSH:** National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards, Center for Disease Control and Prevention (CDC), 2014.

**Norway FOR-2004-06-01-922:** Regulations relating to restrictions on the use of health-hazardous chemicals and other products (Product Regulations).

**REACH:** Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

**REACH 1907/2006 and amendments:** Annex XVII of Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). This Annex replaces the following directives:

- **76/769/EEC** (Azocolorants, Arsenic)
- **85/467/EEC** (PCB/PCT)
- **91/659/EEC** (Asbestos)
- **94/27/EC** (Nickel)
- **2002/45/EEC** (Short-Chain Chlorinated Paraffins)
- **2002/61/EC** (Azocolorants)
- **2003/3/EC** (Blue Azocolorants)
- **2009/425/EC** (Organotin Compounds)

**REACH, Article 59 (10):** Candidate List of substances of very high concern for Authorisation under REACH regulation.

**Sweden Chemical Tax (2016:1067):** Tax enacted on July 1, 2017, levied on chemicals in certain electronics.

**SZJG 54-2017:** Technical Specification for Low Volatile Organic Compound Content Paint.

**Taiwan BSMI RoHS:** CNS 15663 is the technique standards of Taiwan BSMI RoHS.

**UL 110:** UL Standard 110, Edition 2, UL 110 Standard for Sustainability for Mobile Phones, UL, 2017.

**US EPA 3050B:** EPA method describing acid digestion of sediments, sludges, and soils.

**US EPA 3052:** EPA method describing microwave assisted acid digestion of siliceous and organically based matrices.

**US EPA 5021A:** Method to determine volatile organic compounds in soils and other solid matrices using equilibrium headspace analysis.

**US EPA, SNUR 2070-AJ73:** EPA's significant new use rule for short-chain chlorinated paraffins, under TSCA Section 5(a)(2), December 2014.



## 15. Appendices

### Appendix A: Azo Dyes, Arylamines, and Anilines

| Azo Dyes, Arylamines, and Anilines [24 items] | CAS No.  |
|---|----------|
| 4-Aminoazobenzene                             | 60-09-3  |
| o-Aminoazotoluene                             | 97-56-3  |
| 2-Amino-4-nitrotoluene                        | 99-55-8  |
| o-Anisidine                                   | 90-04-0  |
| Benzidine                                     | 92-87-5  |
| 2,2'-dichloro-4,4'-methylenedianiline (MOCA)  | 101-14-4 |
| 4-Biphenylamine                               | 92-67-1  |
| 4-Chloroaniline                               | 106-47-8 |
| 4-Chloro-2-toluidine                          | 95-69-2  |
| p-Cresidine                                   | 120-71-8 |
| 2,4-Diaminoanisole                            | 615-05-4 |
| 4,4'-Diaminodiphenylmethane                   | 101-77-9 |
| 2,4-Diaminotoluene                            | 95-80-7  |
| 3,3'-Dichlorobenzidine                        | 91-94-1  |
| 3,3'-Dimethoxybenzidine                       | 119-90-4 |
| 3,3'-Dimethylbenzidine                        | 119-93-7 |
| 3,3'-Dimethyl-4,4'-diaminodiphenylmethane     | 838-88-0 |
| 2-Naphthylamine                               | 91-59-8  |
| 4,4'-Oxydianiline                             | 101-80-4 |
| 4,4'-Thiodianiline                            | 139-65-1 |
| o-Toluidine                                   | 95-53-4  |
| 2,4,5-Trimethylaniline                        | 137-17-7 |
| 2,4-Xylidine                                  | 95-68-1  |
| 2,6-Xylidine                                  | 87-62-7  |

### Appendix B: Chlorinated Paraffins (SCCP and MCCP)

| Chlorinated Paraffins (SCCP and MCCP)   | CAS No.    |
|---|------------|
| Short-Chain Chlorinated Paraffins (SCCPs) $C_xH_{2x+2-y}Cl_y$ , where $x=10-13$ and $y=1-13$ [4+ items] | Examples   |
| Alkanes, C10-13, chloro   | 85535-84-8 |
| Alkanes, C10-21, chloro   | 84082-38-2 |
| Alkanes, C12-13, chloro   | 71011-12-6 |
| Alkanes, C12-14, chloro   | 85536-22-7 |
| Medium-Chain Chlorinated Paraffins (MCCPs) $C_xH_{2x+2-y}Cl_y$ , where $x=14-17$ and $y=1-17$ [1 item]  | Example    |
| Alkanes, C14-17, chloro   | 85535-85-9 |

### Appendix C: Organotin Compounds

| Organotin Compounds [9 items]     | CAS No.  |
|-----------------------------------|----------|
| Dibutyltin (DBT) Compounds        | Multiple |
| Diocetyltn (DOT) Compounds        | Multiple |
| Monobutyltin (MBT) Compounds      | Multiple |
| Monocetyltn (MOT) Compounds       | Multiple |
| Tetrabutyltin (TeBT)              | Multiple |
| Tetraocetyltn (TeOT)              | Multiple |
| Tributyltin (TBT) Compounds       | Multiple |
| Tricyclohexyltin (TCyT) Compounds | Multiple |
| Triphenyltin (TPhT) Compounds     | Multiple |

## Appendix D: PFAS Compounds

| PFAS Compounds [7 items]  | Chemical Group Definition and CAS No.[s]   |
|---|--|
| PFAS compounds  | Compounds containing at least one perfluoroalkyl moiety, $-C_nF_{2n-}$ . <b>Including but not limited to compounds on pages 45-78 in:</b> <a href="http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15">www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15</a>   |
| Perfluorooctanoic Acid (PFOA), its salts and PFOA-related compounds           | PFOA and its salts and compounds that degrade to PFOA, including any substances (including salts and polymers) having a linear or branched perfluoroheptyl group with the moiety $(C_7F_{15})C$ as one of the structural elements. <b>Including but not limited to compounds on pages 79-81 in:</b> <a href="http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15">www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15</a>   |
| Perfluorooctane Sulfonate (PFOS) and its derivatives                          | Compounds with the formula $C_8F_{17}SO_3H$ , their salts and any combinations thereof. This includes any substance having a perfluoroalkyl group (linear or branched) $C_8F_{17}-$ directly attached to a sulfur atom. <b>Including but not limited to compounds on pages 24-44 in:</b> <a href="http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15">http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?doclanguage=en&amp;cote=env/jm/mono(2006)15</a>   |
| Perfluorobutane Sulfonate (PFBS), its salts and related substances            | Compounds with the formula $C_4F_9SO_3H$ , their salts and any combinations thereof. This includes any substance having a perfluoroalkyl group (linear or branched) $C_4F_9-$ directly attached to a sulfur atom. <b>Including but not limited to the list of compounds on pages 14, 15, 24, and 25 in:</b> <a href="http://www.miljodirektoratet.no/globalassets/publikasjoner/M759/M759.pdf">www.miljodirektoratet.no/globalassets/publikasjoner/M759/M759.pdf</a>   |
| Perfluorocarboxylic Acids (PFCAs; C9-C14), their salts and related substances | Compounds that are perfluoroalkyl carboxylic acids (branched and/or linear) with the formula: $CF_3-(CF_2)_n-$ , $n=8-13$ as a structural element, including their salts. In addition, any related substance (including its salts and polymers) with the above defined linear and/or branched perfluoroalkyl structural elements that can degrade to C9-C14 PFCA. <b>Including but not limited to compounds listed on pages 31, 56, and 198-205 in:</b> <a href="http://echa.europa.eu/documents/10162/2ec5dfdd-0e63-0b49-d756-4dc1bae7ec61">echa.europa.eu/documents/10162/2ec5dfdd-0e63-0b49-d756-4dc1bae7ec61</a> |
| Perfluorohexanoic Acid (PFHxA), its salts and related substances              | Compounds (including salts and polymers) having a linear or branched perfluoropentyl group with the formula $C_5F_{11}-$ directly attached to another carbon atom. <b>Including but not limited to compounds listed in:</b> <a href="http://echa.europa.eu/documents/10162/7da473c1-7f27-df34-9e6a-46152ef10d4b">echa.europa.eu/documents/10162/7da473c1-7f27-df34-9e6a-46152ef10d4b</a>   |
| Perfluorohexane Sulfonate (PFHxS), its salts and related substances           | Compounds with the formula $C_6F_{13}SO_3H$ , their salts and any combinations thereof. This includes any substance having a perfluoroalkyl group (linear or branched) $C_6F_{13}-$ directly attached to a sulfur atom. <b>Including but not limited to compounds listed on pages 168-192 in:</b> <a href="http://echa.europa.eu/documents/10162/a22da803-0749-81d8-bc6d-ef551fc24e19">echa.europa.eu/documents/10162/a22da803-0749-81d8-bc6d-ef551fc24e19</a>   |

## Appendix E: Phthalates

| Phthalates [21 items]  | CAS No.                  |
|--|--------------------------|
| 1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7-rich (DIHP)  | 71888-89-6               |
| 1,2-Benzenedicarboxylic acid, di-C6-10-alkyl esters; 1,2-Benzenedicarboxylic acid, mixed decyl and hexyl and octyl diesters with ≥ 0.3% of dihexyl phthalate | 68515-51-5<br>68648-93-1 |
| 1,2-Benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters (DHNUP)  | 68515-42-4               |
| 1,2-Benzenedicarboxylic acid, dipentylester, branched and linear (DPP)   | 84777-06-0               |
| Bis-(2-methoxyethyl) phthalate (DMEP)  | 117-82-8                 |
| Butylbenzyl phthalate (BBP)  | 85-68-7                  |
| Dibutyl phthalate (DBP)  | 84-74-2                  |
| Diethyl phthalate (DEP)  | 84-66-2                  |
| Diethylhexyl phthalate (DEHP)  | 117-81-7                 |
| Diisobutyl phthalate (DIBP)  | 84-69-5                  |
| Diisodecyl phthalate (DIDP)  | 26761-40-0<br>68515-49-1 |
| Diisononyl phthalate (DINP)  | 28553-12-0<br>68515-48-0 |
| Di-iso-pentyl phthalate (DIPP)   | 605-50-5                 |
| Dimethyl phthalate (DMP)   | 131-11-3                 |
| Di-n-hexyl phthalate (DnHP)  | 84-75-3                  |
| Di-n-Octyl phthalate (DNOP)  | 117-84-0                 |
| Di-n-pentyl phthalate (DnPP)   | 131-18-0                 |
| n-Pentyl-isopentyl phthalate (nPIPP)   | 776297-69-9              |
| Diundecyl phthalate (DuDP)   | 3648-20-2                |
| Dicyclohexyl phthalate (DCHP)  | 84-61-7                  |
| Diisohexyl phthalate (DiHP)  | 68515-50-4               |

## Appendix F: Polycyclic Aromatic Hydrocarbons (PAHs)

| Polycyclic Aromatic Hydrocarbons (PAHs) [27 items] | CAS No.              |
|--|----------------------|
| Acenaphthene                                       | 83-32-9              |
| Acenaphthylene                                     | 208-96-8             |
| Anthracene   | 120-12-7             |
| Benzo(a)anthracene                                 | 56-55-3; 1718-53-2   |
| Benzo(a)phenanthrene (chrysene)                    | 218-01-9             |
| Benzo(a)pyrene                                     | 50-32-8              |
| Benzo(b)fluoranthene                               | 205-99-2             |
| Benzo(e)pyrene                                     | 192-97-2             |
| Benzo(g,h,i)perylene                               | 191-24-2             |
| Benzo(j)fluoranthene                               | 205-82-3             |
| Benzo(k)fluoranthene                               | 207-08-9             |
| Benzo(j,k)fluorene (Fluoranthene)                  | 206-44-0; 93951-69-0 |
| Benzo(r,s,t)pentaphene                             | 189-55-9             |
| Dibenz(a,h)acridine                                | 226-36-8             |
| Dibenz(a,j)acridine                                | 224-42-0             |
| Dibenzo(a,h)anthracene                             | 53-70-3              |
| Dibenzo(a,e)fluoranthene                           | 5385-75-1            |
| Dibenzo(a,e)pyrene                                 | 192-65-4             |
| Dibenzo(a,h)pyrene                                 | 189-64-0             |
| Dibenzo(a,l)pyrene                                 | 191-30-0             |
| 7H-Dibenzo(c,g)carbazole                           | 194-59-2             |
| Fluorene   | 86-73-7              |
| Indeno(1,2,3-cd)pyrene                             | 193-39-5             |
| 5-Methylchrysene                                   | 3697-24-3            |
| Naphthalene  | 91-20-3              |
| Phenanthrene                                       | 85-01-8              |
| Pyrene   | 129-00-0; 1718-52-1  |

## Appendix G: Chlorinated Organic Solvents

| Chlorinated Organic Solvents    | CAS No.  |
|---------------------------------|----------|
| Chlorinated Methanes [6 items]  |          |
| Bromodichloromethane            | 75-27-4  |
| Carbon tetrachloride            | 56-23-5  |
| Chloroform                      | 67-66-3  |
| Dibromochloromethane            | 124-48-1 |
| Methylene chloride              | 75-09-2  |
| Methyl chloride                 | 74-87-3  |
| Chlorinated Ethanes [9 items]   |          |
| Chloroethane                    | 75-00-3  |
| 1,1-Dichloroethane              | 75-34-3  |
| 1,2-Dichloroethane              | 107-06-2 |
| Hexachloroethane                | 67-72-1  |
| Pentachloroethane               | 76-01-7  |
| 1,1,1,2-Tetrachloroethane       | 630-20-6 |
| 1,1,2,2-Tetrachloroethane       | 79-34-5  |
| 1,1,1-Trichloroethane           | 71-55-6  |
| 1,1,2-Trichloroethane           | 79-00-5  |
| Chlorinated Ethylenes [5 items] |          |
| 1,1-Dichloroethylene            | 75-35-4  |
| cis-1,2-Dichloroethylene        | 156-59-2 |
| trans-1,2-Dichloroethylene      | 156-60-5 |
| Tetrachloroethylene             | 127-18-4 |
| Trichloroethylene               | 79-01-6  |

## Appendix H: Ozone Depleting Chemicals

| Ozone Depleting Chemicals [62 items]  | CAS No.                                     |
|---|---|
| 1,1,1-Trichloroethane (methyl chloroform) and its isomers except 1,1,2-trichloroethane  | 71-55-6                                     |
| 1,1,2-Trichloro-1,2,2 trifluoroethane (CFC-113)<br>1,1,1-Trichloro-2,2,2 trifluoroethane (CFC-113a)   | 76-13-1<br>354-58-5                         |
| 1,1,2,2-Tetrachloro-1,2-difluoroethane (CFC-112)<br>1,1,1,2-Tetrachloro-2,2-difluoroethane (CFC-112a)   | 76-12-0<br>76-11-9                          |
| 1,2,2-Trichloropentafluoropropane (CFC-215aa)<br>1,2,3-Trichloropentafluoropropane (CFC-215ba)<br>1,1,2-Trichloropentafluoropropane (CFC-215bb)<br>1,1,3-Trichloropentafluoropropane (CFC-215ca)<br>1,1,1-Trichloropentafluoropropane (CFC-215cb) | 1599-41-3<br>76-17-5<br>–<br>–<br>4259-43-2 |
| Bromochlorodifluoromethane (Halon 1211)   | 353-59-3                                    |
| Bromochloromethane  | 74-97-5                                     |
| Bromodifluoroethane   | 420-47-3, 357188-74-0                       |
| Bromodifluoromethane  | 1511-62-2                                   |
| Bromodifluoropropane  | –   |
| Bromoethane (ethyl bromide)   | 74-96-4                                     |
| Bromofluoroethane   | 762-49-2                                    |
| Bromofluoromethane  | 373-52-4                                    |
| Bromofluoropropane  | 1871-72-3                                   |
| Bromohexafluoropropane  | 2252-78-0                                   |
| Bromomethane (methyl bromide)   | 74-83-9                                     |
| Bromopentafluoropropane   | 460-88-8                                    |
| Bromotetrafluoroethane  | 124-72-1                                    |
| Bromotetrafluoropropane   | 679-84-5                                    |
| Bromotrifluoroethane  | 421-06-7                                    |
| Bromotrifluoromethane (Halon 1301)  | 75-63-8                                     |
| Bromotrifluoropropane   | 421-46-5                                    |
| Chloromethane (methyl chloride)   | 74-87-3                                     |
| Chlorotrifluoromethane (CFC-13)   | 75-72-9                                     |
| Dibromodifluoroethane   | 75-82-1                                     |
| Dibromodifluoromethane (Halon 1202)   | 75-61-6                                     |
| Dibromodifluoropropane  | 460-25-3                                    |
| Dibromofluoroethane   | 358-97-4                                    |
| Dibromofluoromethane  | 1868-53-7                                   |
| Dibromofluoropropane  | 51584-26-0                                  |

| Ozone Depleting Chemicals   | CAS No.                             |
|---|-------------------------------------|
| Dibromopentafluoropropane   | 431-78-7                            |
| Dibromotetrafluoroethane (Halon 2402)   | 124-73-2                            |
| Dibromotetrafluoropropane   | –                                   |
| Dibromotrifluoroethane  | 354-04-1                            |
| Dibromotrifluoropropane   | 431-21-0                            |
| Dichlorodifluoromethane (CFC-12)  | 75-71-8                             |
| Dichlorohexafluoropropane (CFC-216)   | 661-97-2                            |
| Dichlorotetrafluoroethane (CFC-114)   | 76-14-2                             |
| Heptachlorofluoropropane (CFC-211)<br>1,1,1,2,2,3,3-Heptachloro-3-fluoropropane (CFC-211aa)<br>1,1,1,2,3,3,3-Heptachloro-2-fluoropropane (CFC-211ba)                | 135401-87-5<br>422-78-6<br>422-81-1 |
| Hexabromofluoropropane  | –                                   |
| Hexachlorodifluoropropane (CFC-212)   | 3182-26-1                           |
| Monochloroheptafluoropropane (CFC-217)  | 422-86-6, 76-18-6                   |
| Monochloropentafluoroethane (CFC-115)   | 76-15-3                             |
| Pentabromodifluoropropane   | –                                   |
| Pentabromofluoropropane   | –                                   |
| Pentachlorofluoroethane (CFC-111)   | 354-56-3                            |
| Pentachlorotrifluoropropane (CFC-213)   | 2354-06-5; 134237-31-3              |
| Tetrabromodifluoropropane   | –                                   |
| Tetrabromofluoroethane  | 306-80-9                            |
| Tetrabromofluoropropane   | –                                   |
| Tetrabromotrifluoropropane  | –                                   |
| Tetrachloromethane (carbon tetrachloride)   | 56-23-5                             |
| Tetrachlorotetrafluoropropane (CFC-214)<br>1,2,2,3-Tetrachloro-1,1,3,3-tetrafluoropropane (CFC-214aa)<br>1,1,1,3-Tetrachloro-2,2,3,3-tetrafluoropropane (CFC-214cb) | 29255-31-0<br>2268-46-4<br>–        |
| Tribromodifluoroethane  | –                                   |
| Tribromodifluoropropane   | 70192-80-2                          |
| Tribromofluoroethane  | –                                   |
| Tribromofluoropropane   | 75372-14-4                          |
| Tribromotetrafluoropropane  | –                                   |
| Tribromotrifluoropropane  | –                                   |
| Trichlorofluoromethane (CFC-11)   | 75-69-4                             |
| Trifluoriodomethane (trifluoromethyl iodide)  | 2314-97-8                           |

## Appendix I: Ozone Depleting Chemicals—Hydrochlorofluorocarbons

| Hydrochlorofluorocarbons [34 items]            | CAS No.    |
|--|------------|
| 1,1,2,2-Tetrachloro-1-fluoroethane (HCFC-121)  | 354-11-0   |
| 1,1,1,2-Tetrachloro-2-fluoroethane (HCFC-121a) | 354-14-3   |
| Chlorodifluoroethane (HCFC-142)                | 25497-29-4 |
| 2-Chloro-1,1-difluoroethane (HCFC-142)         | 338-65-8   |
| 1-Chloro-1,1-difluoroethane (HCFC-142b)        | 75-68-3    |
| 1-Chloro-1,2-difluoroethane (HCFC-142a)        | 338-64-7   |
| Chlorodifluoromethane (HCFC-22)                | 75-45-6    |
| Chlorofluoromethane (HCFC-31)                  | 593-70-4   |
| Chlorotetrafluoroethane (HCFC-124)             | 63938-10-3 |
| 2-chloro-1,1,1,2-tetrafluoroethane             | 2837-89-0  |
| 1-chloro-1,1,2,2-tetrafluoroethane (HCFC-124a) | 354-25-6   |
| Chlorotrifluoroethane (HCFC-133)               | 431-07-2   |
| 1-Chloro-1,2,2-trifluoroethane (HCFC-133)      | 1330-45-6  |
| 2-Chloro-1,1,1-trifluoroethane (HCFC-133a)     | 75-88-7    |
| 1-Chloro-1,1,2-trifluoroethane (HCFC-133b)     | 421-04-5   |
| Dichlorodifluoroethane (HCFC-132)              | 25915-78-0 |
| 1,2-Dichloro-1,2-difluoroethane (HCFC-132)     | 431-06-1   |
| 1,1-Dichloro-2,2-difluoroethane (HCFC-132a)    | 471-43-2   |
| 1,2-Dichloro-1,1-difluoroethane (HCFC-132b)    | 1649-08-7  |
| 1,1-Dichloro-1,2-difluoroethane (HCFC-132c)    | 1842-05-3  |
| Dichlorofluoroethane (HCFC-141)                | 25167-88-8 |
| 1,2-Dichloro-1-fluoroethane (HCFC-141)         | 430-57-9   |
| 1,1-Dichloro-2-fluoroethane (HCFC-141a)        | 430-53-5   |
| 1,1-Dichloro-1-fluoroethane (HCFC-141b)        | 1717-00-6  |
| Dichlorofluoromethane (HCFC-21)                | 75-43-4    |
| Dichlorotrifluoroethane (HCFC-123)             | 34077-87-7 |
| Dichloro-1,1,2-trifluoroethane                 | 90454-18-5 |
| 2,2-dichloro-1,1,1-trifluoroethane             | 306-83-2   |
| 1,2-dichloro-1,1,2-trifluoroethane (HCFC-123a) | 354-23-4   |
| 1,1-dichloro-1,2,2-trifluoroethane (HCFC-123b) | 812-04-4   |
| Trichlorodifluoroethane (HCFC-122)             | 41834-16-6 |
| 1,2,2-Trichloro-1,1-difluoroethane (HCFC-122)  | 354-21-2   |
| 1,1,2-Trichloro-1,2-difluoroethane (HCFC-122a) | 354-15-4   |
| 1,1,1-Trichloro-2,2-difluoroethane (HCFC-122b) | 354-12-1   |
| Trichlorofluoroethane (HCFC-131)               | 27154-33-2 |
| 1-Fluoro-1,2,2-trichloroethan                  | 359-28-4   |
| 1,1,2-Trichloro-1-fluoroethane (HCFC-131a)     | 811-95-0   |
| 1,1,1-trichloro-2-fluoroethane (HCFC-131b)     | 2366-36-1  |

| Hydrochlorofluorocarbons                                | CAS No.                 |
|---|-------------------------|
| Chlorofluoroethane (HCFC-151)                           | 110587-14-9             |
| 1-Chloro-2-fluoroethane (HCFC-151)                      | 762-50-5                |
| 1-Chloro-1-fluoroethane (HCFC-151a)                     | 1615-75-4               |
| Chlorohexafluoropropane (HCFC-226)                      | 134308-72-8             |
| 2-Chloro-1,1,1,3,3,3-hexafluoro-propane (HCFC-226da)    | 431-87-8                |
| Chloropentafluoropropane (HCFC-235)                     | 134237-41-5             |
| 1-Chloro-1,1,3,3,3-pentafluoropropane (HCFC-235fa)      | 460-92-4                |
| Dichloropentafluoropropane (HCFC-225)                   | 127564-92-5             |
| 2,2-Dichloro-1,1,1,3,3-pentafluoropropane (HCFC-225aa)  | 128903-21-9             |
| 2,3-Dichloro-1,1,1,2,3-pentafluoropropane (HCFC-225ba)  | 422-48-0                |
| 1,2-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC-225bb)  | 422-44-6                |
| 3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)  | 422-56-0                |
| 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)  | 507-55-1                |
| 1,1-Dichloro-1,2,2,3,3-pentafluoropropane (HCFC-225cc)  | 13474-88-9              |
| 1,2-Dichloro-1,1,3,3,3-pentafluoropropane (HCFC-225da)  | 431-86-7                |
| 1,3-Dichloro-1,1,2,3,3-pentafluoropropane (HCFC-225ea)  | 136013-79-1             |
| 1,1-Dichloro-1,2,3,3,3-pentafluoropropane (HCFC-225eb)  | 111512-56-2             |
| Dichlorotetrafluoropropane (HCFC-234)                   | 127564-83-4             |
| 1,2-Dichloro-1,2,3,3-tetrafluoropropane (HCFC-234db)    | 425-94-5                |
| Hexachlorofluoropropane (HCFC-221)                      | 134237-35-7, 29470-94-8 |
| 1,1,1,2,2,3-Hexachloro-3-fluoropropane (HCFC-221ab)     | 422-26-4                |
| Pentachlorodifluoropropane (HCFC-222)                   | 134237-36-8             |
| 1,1,1,3,3-pentachloro-2,2-difluoropropane (HCFC-222ca)  | 422-49-1                |
| 1,2,2,3,3-pentachloro-1,1-difluoropropane (HCFC-222aa)  | 422-30-0                |
| Pentachlorofluoropropane (HCFC-231)                     | 134190-48-0             |
| 1,1,1,2,3-pentachloro-2-fluoro-propane (HCFC-231bb)     | 421-94-3                |
| Tetrachlorodifluoropropane (HCFC-232)                   | 134237-39-1             |
| 1,1,1,3-Tetrachloro-3,3-difluoropropane (HCFC-232fc)    | 460-89-9                |
| Tetrachlorofluoropropane (HCFC-241)                     | 134190-49-1             |
| 1,1,2,3-Tetrachloro-1-fluoropropane (HCFC-241db)        | 666-27-3                |
| Tetrachlorotrifluoropropane (HCFC-223)                  | 134237-37-9             |
| 1,1,3,3-Tetrachloro-1,2,2-trifluoropropane (HCFC-223ca) | 422-52-6                |
| 1,1,1,3-Tetrachloro-2,2,3-trifluoropropane (HCFC-223cb) | 422-50-4                |
| Trichlorotetrafluoropropane (HCFC-224)                  | 134237-38-0             |
| 1,3,3-Trichloro-1,1,2,2-tetrafluoropropane (HCFC-224ca) | 422-54-8                |
| 1,1,3-Trichloro-1,2,2,3-tetrafluoropropane (HCFC-224cb) | 422-53-7                |
| 1,1,1-Trichloro-2,2,3,3-tetrafluoropropane (HCFC-224cc) | 422-51-5                |
| Trichlorotrifluoropropane (HCFC-233)                    | 134237-40-4             |
| 1,1,1-Trichloro-3,3,3-trifluoropropane (HCFC-233fb)     | 7125-84-0               |
|   | 7125-83-9               |

## Appendix I: Ozone Depleting Chemicals—Hydrochlorofluorocarbons continued

| Hydrochlorofluorocarbons  | CAS No.  |
|---|--|
| Chlorodifluoropropane (HCFC-262)<br>1-Chloro-2,2-difluoropropane (HCFC-262ca)<br>2-Chloro-1,3-difluoropropane (HCFC-262da)<br>1-Chloro-1,1-difluoropropane (HCFC-262fc) | 134190-53-7<br>420-99-5<br>102738-79-4<br>421-02-3 |
| Chlorofluoropropane (HCFC-271)<br>2-Chloro-2-fluoropropane (HCFC-271ba)<br>1-Chloro-1-fluoropropane (HCFC-271fb)  | 134190-54-8<br>420-44-0<br>430-55-7                |
| Chlorotetrafluoropropane (HCFC-244)<br>3-Chloro-1,1,2,2-tetrafluoropropane (HCFC-244ca)<br>1-Chloro-1,1,2,2-tetrafluoropropane (HCFC-244cc)                             | 134190-50-4<br>679-85-6<br>421-75-0                |
| Chlorotrifluoropropane (HCFC-253)<br>3-chloro-1,1,1-trifluoropropane (HCFC-253fb)   | 134237-44-8<br>460-35-5                            |
| Dichlorodifluoropropane (HCFC-252)<br>1,3-Dichloro-1,1-difluoropropane (HCFC-252fb)   | 134190-52-6<br>819-00-1                            |
| Dichlorofluoropropane (HCFC-261)<br>1,1-Dichloro-1-fluoropropane (HCFC-261fc)<br>1,2-Dichloro-2-fluoro-propane (HCFC-261ba)   | 134237-45-9<br>7799-56-6<br>420-97-3               |
| Dichlorotrifluoropropane (HCFC-243)<br>1,1-dichloro-1,2,2-trifluoropropane<br>2,3-dichloro-1,1,1-trifluoropropane<br>3,3-dichloro-1,1,1-trifluoropropane                | 134237-43-7<br>7125-99-7<br>338-75-0<br>460-69-5   |
| Trichlorodifluoropropane (HCFC-242)<br>1,3,3,Trichloro-1,1-difluoropropane (HCFC-242fa)   | 134237-42-6<br>460-63-9                            |
| Trichlorofluoropropane (HCFC-251)<br>1,1,3-Trichloro-1-fluoropropane (HCFC-251fb)<br>1,1,2-Trichloro-1-fluoropropane (HCFC-251dc)                                       | 134190-51-5<br>818-99-5<br>421-41-0                |

## Appendix J: Endocrine Disruptors

| Endocrine Disruptors [11 items] | CAS No.    |
|---------------------------------|------------|
| 3-Benzylidene camphor 3-BC      | 15087-24-8 |
| 4-nitrophenol                   | 100-02-7   |
| 4,4'-Dihydroxybenzophenone      | 611-99-4   |
| Butylated hydroxytoluene        | 128-37-0   |
| Metam sodium                    | 137-42-8   |
| Resorcinol                      | 108-46-3   |
| Tert-butylhydroxyanisole (BHA)  | 25013-16-5 |
| Thiram                          | 137-26-8   |
| Triphenyl phosphate (TPHP)      | 115-86-6   |
| Zineb                           | 12122-67-7 |
| Ziram                           | 137-30-4   |

## Appendix K: Additive Phosphorous Flame Retardants

| Additive Phosphorus Flame Retardants [27 items]        | CAS No.                |
|--|------------------------|
| 2-Ethylhexyl diphenyl phosphate                        | 1241-94-7              |
| Aluminum diethylphosphinate                            | 225789-38-8            |
| Cetyl diphenyl phosphate                               | 56827-92-0             |
| Diethyl ethanephosphonate                              | 78-38-6                |
| Diethyl N,N'-bis(2-hydroxyethyl)aminomethylphosphonate | 2781-11-5              |
| Diphenyl cresyl phosphate                              | 26444-49-5             |
| Diphenyl octyl phosphate                               | 115-88-8               |
| Dodecyl diphenyl phosphate                             | 27460-02-2             |
| Isopropylated triphenyl phosphate                      | 26967-76-0, 72668-27-0 |
| Resorcinol bis(diphenyl phosphate)                     | 57583-54-7             |
| Tri-n-butyl phosphate                                  | 126-73-8               |
| Tricresyl phosphate                                    | 1330-78-5              |
| Triphenyl phosphate                                    | 115-86-6               |
| Trixylyl phosphate                                     | 25155-23-1             |
| Zinc diethylphosphinate                                | 284685-45-6            |

## Appendix K: Additive Phosphorous Flame Retardants continued

| Additive Phosphorus Flame Retardants        | CAS No.    |
|---|------------|
| Isodecyl diphenyl phosphate                 | 29761-21-5 |
| Melamine phosphate                          | 41583-09-9 |
| Piperazine pyrophosphate                    | 66034-17-1 |
| Red phosphorous                             | 7723-14-0  |
| Tetrakis(hydroxymethyl)phosphonium sulphate | 55566-30-8 |
| Tri-m-cresyl phosphate                      | 563-04-2   |
| Tri-o-cresyl phosphate                      | 78-30-8    |
| Tri-p-cresyl phosphate                      | 78-32-0    |
| Triethyl phosphate                          | 78-40-0    |
| Tris(2-butoxyethyl) phosphate               | 78-51-3    |
| Tris(2-ethylhexyl) phosphate                | 78-42-2    |
| Tris(4-tert-butylphenyl) phosphate          | 78-33-1    |

## Appendix M: Brominated Organic Solvents

| Brominated Organic Solvents [7 items] | CAS No.  |
|---------------------------------------|----------|
| 1-Bromobutane                         | 109-65-9 |
| 1-Bromopropane                        | 106-94-5 |
| 2-Bromopropane                        | 75-26-3  |
| Bromodichloromethane                  | 75-27-4  |
| Bromoethane                           | 74-96-4  |
| Bromomethane                          | 74-83-9  |
| Dibromochloromethane                  | 124-48-1 |

## Appendix L: Bisphenol Chemicals

| Bisphenol Chemicals [20 items]                                      | CAS No.    |
|---|------------|
| 2,2-bis(2-hydroxy-5-biphenyl)propane [BPBP]                         | 24038-68-4 |
| 4,4'-(1-methylpropylidene)bisphenol [BPB]                           | 77-40-7    |
| 4,4'-(1-Phenylethylidene)bisphenol [BPAP]                           | 1571-75-1  |
| 4,4'-(1,3-phenylene-bis(1-methylethylidene))bisphenol [BPM]         | 13595-25-0 |
| 4,4'-(1,4-Phenylenediisopropylidene)bisphenol [BPP]                 | 2167-51-3  |
| 4,4'-(dichlorovinylidene)diphenol [BPC12]                           | 14868-03-2 |
| 4,4'-[2,2,2-trifluoro-1-(trifluoromethyl)ethylidene]diphenol [BPAF] | 1478-61-1  |
| 4,4'-cyclohexylidenebisphenol [BPZ]                                 | 843-55-0   |
| 4,4'-i-hydroxytetraphenylmethane [BPPH]                             | 1844-01-5  |
| 4,4'-isopropylidenedi-o-cresol [BPC]                                | 79-97-0    |
| 4,4'-isopropylidenediphenol [BPA]                                   | 80-05-7    |
| 4,4'-methylenediphenol [BPF]  | 620-92-8   |
| 4,4'-sulphonyldiphenol [BPS]  | 80-09-1    |
| 4,4'-Ethylidenebisphenol [BPE]                                      | 2081-08-5  |
| 9,9-Bis(4-hydroxyphenyl)fluorene [BPFL]                             | 3236-71-3  |
| Biphenyl-4,4'-diol [BP4,4']   | 92-88-6    |
| Bis(2-hydroxyphenyl)methane [BIS2]                                  | 2467-02-9  |
| p,p'-oxybisphenol [DHDPE]   | 1965-09-9  |



## Appendix N: Polybrominated Diphenyl Ethers (PBDEs)

| Polybrominated Diphenyl Ethers (PBDEs) [10 items] | CAS No.     |
|---|-------------|
| 2,2',3,4,4'-Pentabromodiphenyl ether              | 182346-21-0 |
| 2,2',3,4,4',5'-Hexabromodiphenyl ether            | 182677-30-1 |
| 2,3',4,4'-Tetrabromodiphenyl ether                | 189084-61-5 |
| 2,3',4,4',6-Pentabromodiphenyl ether              | 189084-66-0 |
| 2,4,4',6-Tetrabromodiphenyl ether                 | 189084-63-7 |
| Bis(pentabromophenyl) ether                       | 1163-19-5   |
| Diphenyl ether, heptabromo derivative             | 68928-80-3  |
| Diphenyl ether, hexabromo derivative              | 36483-60-0  |
| Diphenyl ether, pentabromo derivative             | 32534-81-9  |
| Diphenyl ether, tetrabromo derivative             | 40088-47-9  |

## Appendix O: Adhesive monomers Group I

| Adhesive monomers Group I [10+ items]           | CAS No.    |
|---|------------|
| Butanediol diacrylate                           | 1070-70-8  |
| Tetrahydrofurfuryl acrylate                     | 2399-48-6  |
| 4-tert-Butylcyclohexyl acrylate (TBCHA)         | 84100-23-2 |
| 2-Acryloyloxyethyl butylcarbamate               | 63225-53-6 |
| Isobornyl acrylate                              | 5888-33-5  |
| 1,6-Hexanediol diacrylate                       | 13048-33-4 |
| 2-(2-Ethoxyethoxy)ethyl acrylate                | 7328-17-8  |
| Trimethylolpropane triacrylate                  | 15625-89-5 |
| 2-Phenoxyethyl acrylate (PHEA)                  | 48145-04-6 |
| Tripropylene glycol diacrylate                  | 42978-66-5 |
| Other adhesive monomers with similar properties | Multiple   |

## Appendix P: Adhesive monomers Group II

| Adhesive monomers Group II [19+ items]            | CAS No.    |
|---|------------|
| Cyclic trimethylol-propane formal acrylate (CTFA) | 66492-51-1 |
| 2-hydroxyethyl acrylate (HEA)                     | 818-61-1   |
| Tricyclododecane dimethanol diacrylate (TCDDMDA)  | 42594-17-2 |
| Benzyl acrylate (BZA)                             | 2495-35-4  |
| Methyl phenylglyoxalate                           | 15206-55-0 |
| 3,3,5-Trimethylcyclohexyl acrylate (TMCHA)        | 86178-38-3 |
| 4-Acryloylmorpholine (ACMO)                       | 5117-12-4  |
| Butyl acrylate                                    | 141-32-2   |
| tert-Butyl acrylate                               | 1663-39-4  |
| Isobutyl acrylate                                 | 106-63-8   |
| Acrylic acid                                      | 79-10-7    |
| Isodecyl acrylate                                 | 1330-61-6  |
| Ethyl trimethylbenzoyl phenylphosphinate          | 84434-11-7 |
| 2-Ethylhexyl acrylate                             | 103-11-7   |
| Methyl acrylate                                   | 96-33-3    |
| N,N-Dimethylacrylamide                            | 2680-03-7  |
| Isobutyl methacrylate                             | 97-86-9    |
| Ethyl acrylate                                    | 140-88-5   |
| Isobornyl methacrylate                            | 7534-94-3  |
| Other adhesive monomers with similar properties   | Multiple   |