

# IEEE Standard for Environmental Assessment of Imaging Equipment

IEEE Computer Society

Sponsored by the  
Environmental Assessment Standards Committee

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USA

**IEEE Std 1680.2™-2012**

19 October 2012



# IEEE Standard for Environmental Assessment of Imaging Equipment

Sponsor

**Environmental Assessment Standards Committee**  
of the  
**IEEE Computer Society**

Approved 30 August 2012

**IEEE-SA Standards Board**

**Abstract:** A clear and consistent set of environmental performance criteria for the design of imaging equipment products is established, providing an opportunity to secure market recognition for efforts to reduce the environmental impact of electronic products. This standard is also intended to provide a tool for government, institutional, corporate, and consumer purchasers to identify products that demonstrate environmental leadership. The intent is that the standard will be updated and revised on a periodic basis to continue to set a higher performance standard for leadership products.

**Keywords:** copiers, digital duplicators, electronic product, electronic product design, environment, environmental impact, environmental leadership, environmental performance, facsimile machines, fax machines, IEEE 1680.2, imaging equipment, multifunction devices, printers, mailing machines, scanners

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## Introduction

This introduction is not part of IEEE Std 1680.2-2012, IEEE Standard for Environmental Assessment of Imaging Equipment.

IEEE Std 1680.2-2012 was developed due to a growing demand by purchasers for an easy-to-use evaluation tool that allows the comparison and selection of electronic products based on environmental performance.

This standard is intended to be used by government, institutional, corporate, and consumer purchasers in the selection of electronics products based on environmental performance, and by product designers and manufacturers who wish to sell products that meet environmental performance standards.

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# IEEE Standard for Environmental Assessment of Imaging Equipment

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## 1. Overview

### 1.1 Scope

This standard defines environmental performance standards for imaging equipment (as defined by the U.S. ENERGY STAR<sup>®</sup> Imaging Equipment Specification<sup>1</sup>) including copiers, digital duplicators, facsimile machines, multifunction devices, printers, mailing machines, and scanners, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, life-cycle extension, energy conservation, end-of-life management, corporate performance, packaging, consumables, and indoor air quality.

### 1.2 Purpose

This standard for imaging equipment is part of the IEEE 1680<sup>™</sup> family of standards that provides a clear and consistent set of performance criteria for the design of electronic products, and provides an opportunity to secure market recognition for efforts to reduce the environmental impact of electronic products. This *imaging equipment standard* is intended to provide a tool for government, institutional, corporate, and consumer purchasers. Product manufacturers may use this tool to earn recognition in these markets, recognizing that certain criteria may not be applicable to all types of purchasers.

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<sup>1</sup> ENERGY STAR is a registered trademark of U.S. Environmental Protection Agency.

The environmental performance criteria of this standard are intended to define a measure of environmental leadership in the design and manufacture of imaging equipment, the delivery of specified services that are associated with the sale of the product, and in associated corporate performance characteristics. This standard is defined with the intention that the criteria are technically feasible to achieve, but that only products demonstrating the leading environmental performance currently available in the marketplace would meet them at the time of their adoption. As the environmental performance of products that are available in the marketplace improves, it is intended that the criteria will be updated and revised to set a higher performance standard for leadership products.

### 1.3 Application

The environmental performance criteria in Clause 4 apply to imaging equipment (as defined by the ENERGY STAR Imaging Equipment Specification) including copiers, digital duplicators, facsimile machines, multifunction devices, printers, mailing machines, and scanners.<sup>2</sup> Within this standard, consumables are not considered part of the product and are addressed in a separate performance category within the standard. The principles and procedures identified in the base standard (IEEE Std 1680) apply to imaging equipment.

The manufacturer shall declare if its product is an *institutional product* as defined in 3.2.

### 1.4 Conformance with this standard

See IEEE Std 1680.

### 1.5 Product Registration Entity and Market Surveillance Entity

See IEEE Std 1680.

In addition to provisions of IEEE Std 1680, a Product Registration Entity (PRE) may be authorized to qualify an Electronics Take-Back Standard for use in conforming with applicable criteria in this standard if it determines that a particular standard meets all of the requirements listed in 4.6.2.1 of this standard. The PRE shall utilize the processes defined below in qualifying standards.

A Market Surveillance Entity (MSE) shall develop and operate a system by which PREs can be authorized to qualify electronics take-back standards. Assessments for qualification of a standard shall be conducted by PREs that are independent of any business or financial relationships with electronics take-back service providers and subscribers. Any Standard Assessors (SAs) who conduct the assessments and qualifications shall disclose any potential conflicts of interest and shall possess the requisite technical competency to perform these activities. Qualified standards shall be listed on an MSE Registry.

Authorized PREs shall maintain the following:

- a) A publicly available listing of Electronics Take-Back Standard Assessors who have been trained and qualified to conduct such assessments.
- b) A Qualification Panel consisting of experts who have been trained and qualified to qualify standards.

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<sup>2</sup> Information on references can be found in Clause 2.

PREs shall establish and maintain a qualification process, defined as follows, by which entities can propose an Electronics Take-Back Standard to be assessed for qualification for use in this end-of-life criterion:

- The process is initiated when an authorized PRE is contacted by an interested party with a request to have a standard be qualified. The request shall specify the countries/regions in which the standard is applicable and shall be qualified for use.
- The applicant shall engage one or more SAs to assess the standard according to the requirements of 4.6.2.1, and for its applicability to be used in the countries/regions being requested. For qualification, all requirements in the Electronics Take-Back Standard shall be fully implementable in the applicable countries/regions.
- The SA shall generate a recommendation for either qualification or rejection of the application, which is provided to the PRE.
- The PRE shall submit the recommendation to the Qualification Panel, which will make the final judgment regarding qualification of the standard and define the country(s)/region(s) in which the standard is applicable.
- The PRE shall provide information to an MSE on Qualified Standards for listing on an MSE Registry. All records of assessment and qualification shall be made publically available.
- Qualified Standards shall be listed on a Registry prior to any subscriber claiming they are being met when declaring to 4.6.2.1.

## 1.6 Verification of conformance with this standard

See IEEE Std 1680.

## 1.7 Qualified Verifier

See IEEE Std 1680.

## 2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

In the case of EU Directives, which contain an adoption date in their title, when the EU repeals a directive and replaces it with a new directive, or otherwise edits and updates a directive, the new directive will apply as the referenced directive upon its enforcement date, unless otherwise explicitly stated in the normative reference.

ASTM D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.<sup>3</sup>

ASTM D6400, Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities.

ASTM D6868, Standard Specification for Labeling of End Items that Incorporate Plastics and Polymers as Coatings or Additives with Paper and Other Substrates Designed to be Aerobically Composted in Municipal or Industrial Facilities.

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<sup>3</sup> ASTM publications are available from the American Society for Testing and Materials (<http://www.astm.org/>).

Blue Angel RAL-UZ 122, Office Equipment with Printing Function (Printers, Copiers, Multifunction Devices), May 2009.<sup>4</sup>

EN 13432, Requirements for packaging recoverable through composting and biodegradation—Test scheme and evaluation criteria for the final acceptance of packaging.<sup>5</sup>

ENERGY STAR Imaging Equipment Specification.<sup>6</sup>

European Union, Eco-Management and Audit Scheme (EMAS).<sup>7</sup>

European Union Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

European Union, European Commission Directive 2002/96/EC of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE).<sup>8</sup>

European Union, European Commission Directive 2006/66/EC of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC.

European Union, European Council former Directive 2002/95/EC as amended by 2005/618/EC and 2011/65/EU of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

European Union Regulation (EC) No. 1907/2006, Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).<sup>9</sup>

Greenhouse Gas (GHG) Protocol, Product Life Cycle Accounting and Reporting Standard.<sup>10</sup>

IEC 60950-1, Information technology equipment—Safety—Part 1: General requirements.<sup>11</sup>

IEC 62301, Household electrical appliances—Measurement of standby power.

IEC 62474, Material declaration for products of and for the electrotechnical industry.

IEEE Std 1680<sup>TM</sup>, IEEE Standard for Environmental Assessment of Electronic Products.<sup>12, 13</sup>

ISO 179, Plastics—Determination of Charpy impact properties.<sup>14</sup>

ISO 180, Plastics—Determination of Izod impact strength.

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<sup>4</sup> Available at [http://www.blauer-engel.de/en/products\\_brands/vergabegrundlage.php?id=147](http://www.blauer-engel.de/en/products_brands/vergabegrundlage.php?id=147).

<sup>5</sup> Available at <http://www.en-standard.eu/>.

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<sup>7</sup> EMAS publications of the European Union are available at [http://ec.europa.eu/environment/emas/index\\_en.htm](http://ec.europa.eu/environment/emas/index_en.htm).

<sup>8</sup> European Union Directives are available at <http://europa.eu>.

<sup>9</sup> REACH regulations and information are available from the European Union at [http://ec.europa.eu/environment/chemicals/reach/reach\\_intro.htm](http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm).

<sup>10</sup> Available at <http://www.ghgprotocol.org/about-ghgp>.

<sup>11</sup> IEC publications are available from the International Electrotechnical Commission (<http://www.iec.ch/>). IEC publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

<sup>12</sup> IEEE publications are available from The Institute of Electrical and Electronics Engineers (<http://standards.ieee.org/>).

<sup>13</sup> The IEEE standards or products referred to in this clause are trademarks of The Institute of Electrical and Electronics Engineers, Inc.

<sup>14</sup> ISO publications are available from the ISO Central Secretariat (<http://www.iso.org/>). ISO publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).



ISO 1043, Plastics—Symbols and Abbreviated Terms.

ISO 11469, Plastics—Generic identification and marking of plastics products.

ISO 14001, Environmental management systems—Requirements with guidance for use.

ISO 14025, Environmental labels and declarations—Type III environmental declarations—Principles and procedures.

ISO 14040, Environmental management—Life cycle assessment—Principles and framework.

ISO 14044, Environmental management—Life cycle assessment—Requirements and guidelines.

ISO 14064, Greenhouse gases—Specifications with guidance.

ISO 14065, Greenhouse gases—Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition.

ISO 14067, Carbon Footprint of Products—Requirements and Guidelines for Quantification and Communication.

ISO 17088, Specifications for Compostable Plastics.

ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories.<sup>15</sup>

ISO/IEC 28360, Information technology—Office equipment—Determination of chemical emission rates from electronic equipment.

Joint Industry Guide 101 (JIG-101 Ed. 4.0), Material Composition Declaration for Electrotechnical Products.<sup>16</sup>

PAS 2050:2011, Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.<sup>17</sup>

UL 60950-1, Information Technology Equipment—Safety—Part 1: General Requirements.<sup>18</sup>

United Nations Protocol on Pollutant Release and Transfer Registers (PRTR).<sup>19</sup>

U.S. EPA Toxics Release Inventory.<sup>20</sup>

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<sup>15</sup> ISO/IEC publications are available from the ISO Central Secretariat (<http://www.iso.org/>). ISO publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

<sup>16</sup> Available at [http://www.ecaus.org/engineering/JIG\\_101\\_Ed\\_4%200.pdf](http://www.ecaus.org/engineering/JIG_101_Ed_4%200.pdf).

<sup>17</sup> Available at <http://www.bsigroup.com/upload/Standards%20&%20Publications/Energy/PAS2050.pdf>.

<sup>18</sup> UL standards are available from Global Engineering Documents (<http://www.global.ihs.com/>)

<sup>19</sup> Available at [http://www.unece.org/env/pp/prtr/Protocol%20texts/PRTR\\_Protocol\\_e.pdf](http://www.unece.org/env/pp/prtr/Protocol%20texts/PRTR_Protocol_e.pdf).

<sup>20</sup> Available at <http://www.epa.gov/TRI/>.

### 3. Definitions, special terms, acronyms, and abbreviations

#### 3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.<sup>21</sup>

**automatic duplexing:** The capability of a copier, fax machine, multifunction device (MFD), or printer to automatically place images on both sides of an output sheet, without manual manipulation of output as an intermediate step.

**biobased:** A material that is composed of biological materials, including renewable agricultural (plant, animal, and/or marine) and/or forestry materials.

**biobased plastic material content:** A percentage calculated by dividing the weight of biobased plastic material by the full weight of the plastic material in the part or product.

**cartridge:** A customer replaceable module with printing-related functionality that includes integrated components or moving parts integral to the imaging product's function beyond holding the toner/ink and fitting onto/into the product.

NOTE—Examples of cartridges are toner, drum, and print-head cartridges. Moving parts in a toner cartridge may include, e.g., transport roller, charging unit, or photoconductor drum.<sup>22</sup>

**chassis:** A rigid framework onto which electronic and/or mechanical components may be mounted. The framework may also support the product case.

**chlorine free paper:** Paper that is classified as either “totally chlorine-free” (TCF) or “elementally chlorine-free” (ECF) for non-recycled paper or “processed-chlorine-free” (PCF) for paper with recycled content. TCF paper is produced with pulp that has been bleached without any type of chlorine, or that has not been bleached at all. ECF papers are produced from pulp that has been bleached with a chlorine derivative such as chlorine dioxide (ClO<sub>2</sub>), but without elemental chlorine (Cl). PCF papers are produced with no chlorine or chlorine derivatives, but papers that were originally bleached with chlorine or chlorine derivatives may have been used as feedstock for recycled content.

NOTE—Source: CalRecycle.<sup>23</sup>

**commodity materials:** Materials derived from primary resources (mined or extracted from virgin raw materials) or from secondary raw materials that need no further processing (such as smelting), cleaning, separation, or recycling in order to be either sold directly on the retail market as new consumer products, or used as a direct feedstock in primary manufacturing processes.

**connectors:** An electrical or mechanical coupling device employed to connect one element with those of another element.

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<sup>21</sup> *IEEE Standards Dictionary Online* subscription is available at [http://www.ieee.org/portal/innovate/products/standard/standards\\_dictionary.html](http://www.ieee.org/portal/innovate/products/standard/standards_dictionary.html).

<sup>22</sup> Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

<sup>23</sup> Available at <http://www.calrecycle.ca.gov/paper/chlorinefree/default.htm>.

**consumable:** A product integral to the functioning of the imaging equipment product with the intent, when depleted or worn, to be replaced or replenished by the user during the normal usage and life span of the imaging equipment product.

NOTE—Consumables may include: toner, toner containers, toner bottles, toner cartridges, waste toner cartridges, ink cartridges, ink heads, ink sticks, ribbon ink, thermal paper, copy paper, imaging units, transfer belts, transfer roller, fusers, drum maintenance units, and other associated items. Items not intended to be replaced or replenished by the user would be not be considered consumable supplies, but rather “spare parts.”

**container:** A customer replaceable module that holds toner or ink and that fit onto/into or emptied into the imaging product.

NOTE—Containers may be constructed of plastic or recycled plastic composite and do not contain integrated components or moving parts integral to the imaging product’s function. Examples of such containers are toner cylinders, toner containers, toner bottles, ink tanks, and solid ink modules.

**disposal:** Final disposition (not including reuse or recycling) that includes incineration (with and without energy recovery), landfill, and any other placement of electronic equipment, components, or materials into or on land, water, and air.

**disposal facility:** Facilities that are licensed and permitted to provide final disposal for the specific wastes they accept, including incineration (with and without energy recovery) and landfill.

**electronic components:** An individual part or combination of parts that, when together, perform a design function(s) and are typically directly attached to a printed circuit board.

NOTE—Examples include cables, connectors, sockets, discrete printed circuit board components, and integrated circuits.

**electronic products:** Products that are dependent on electric currents or electromagnetic fields in order to work properly.

**electromagnetic interference (EMI) components:** Components designed to mitigate or manage the effects of conducted or radiated electromagnetic energy that may interfere, interrupt, obstruct, or otherwise degrade or limit the performance of telecommunication or other electrical and electronic products.

**electrostatic discharge (ESD) components:** Components designed to mitigate or manage the effects of electrical discharges of static electricity that may build up on personnel or equipment, generated by interaction of dissimilar materials.

**environmental management system:** Part of an organization’s management system used to develop and implement its environmental policy and manage its environmental aspects.

**external enclosure:** The external housing that protects the internal parts from environmental effects and prevents the user from coming into contact with moving, radiating, or current-carrying components.

**external plastic casings:** Components of a product’s external enclosure composed of plastic, exclusive of cabling.

**final disposition:** The last point in the recycling chain where materials have been converted into a commodity or properly treated in a disposal facility.

**firmware:** Software resident in the electronic product required for the product to operate as specified by the manufacturer.

**general office paper:** Uncoated, cut sheet paper intended for use in imaging equipment with a basis weight of 64 gsm to 100 gsm.

**hazardous characteristics:** The potential adverse environmental and health effects attributable to a specific environmental agent, the mechanisms by which agents exert their toxic effects, and the associated dose, route, duration, and timing of exposure.

**imaging equipment:** Includes the following products:

- *Copier*—A commercially available imaging product whose sole function is the production of hard copy duplicates from graphic hard copy originals. The unit is capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as copiers or upgradeable digital copiers (UDCs).
- *Digital duplicator*—A commercially available imaging product that is sold in the market as a fully automated duplicator system through the method of stencil duplicating with digital reproduction functionality. The unit is capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as digital duplicators.
- *Facsimile machine (fax machine)*—A commercially available imaging product whose primary functions are scanning hard copy originals for electronic transmission to remote units and receiving similar electronic transmissions to produce hard copy output. Electronic transmission is primarily over a public telephone system, but also may be via computer network or the Internet. The product also may be capable of producing hard copy duplicates. The unit is capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as fax machines.
- *Mailing machine*—A commercially available imaging product that serves to print postage onto mail pieces. The unit is capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as mailing machines.
- *Multifunction device (MFD)*—A commercially available imaging product, which is a physically integrated device or a combination of functionally integrated components, that performs two or more of the core functions of copying, printing, scanning, or faxing. The copy functionality as addressed in this definition is considered to be distinct from single-sheet convenience copying offered by fax machines. The unit is capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as MFDs or multifunction products (MFPs).
- *Printer*—A commercially available imaging product that serves as a hard copy output device, and is capable of receiving information from single-user or networked computers, or other input devices (e.g., digital cameras). The unit is capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as printers, including printers that can be upgraded into MFDs in the field.
- *Scanner*—A commercially available imaging product that functions as an electro-optical device for converting information into electronic images that can be stored, edited, converted, or transmitted, primarily in a personal computing environment. The unit is capable of being powered from a wall outlet or from a data or network connection. This definition is intended to cover products that are marketed as scanners.

NOTE—*Imaging equipment* as defined by the ENERGY STAR Imaging Equipment Specification.

**incineration:** A disposal method that involves combustion of waste material converting it into heat, gas, steam, and ash, but not including smelting.

**labels:** Piece of paper, plastic, metal, or other material affixed to a component or product, on which is printed specific information.

**light source:** A device to supply radiant energy capable of exciting a phototube or photocell.

**materials of concern:** A generic term to encompass hazardous, toxic, and potentially hazardous materials that are defined by individual take-back standards, regardless of what the individual standard may refer to them as (e.g., *restricted materials*, *focus materials*, *hazardous wastes*, *toxics* or *toxic materials*, *designated materials*).

**non-manufacturer cartridge:** A cartridge not sold by the registering manufacturer and that is remanufactured and/or refilled.

**non-manufacturer container:** A toner or ink container not sold by the registering manufacturer and that is remanufactured and/or refilled.

**optical components:** An individual part or combination of parts that are used in the creation, transmission, manipulation, or detection of light.

NOTE—Examples include lasers, light sources, optoelectronics, fiber optics, lenses, polarizers, mirrors, beam splitters, windows, and prisms.

**packaging:** All goods made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of products, from raw materials to processed goods, from the producer to the user or the consumer.

NOTE—For the purpose of this standard, *packaging* is limited to (a) sales packaging or primary packaging, i.e., packaging conceived so as to constitute a sales unit to the final user or consumer at the point of purchase; (b) grouped packaging or secondary packaging, i.e., packaging conceived so as to constitute at the point of purchase a grouping of a certain number of sales units whether the latter is sold as such to the final user or consumer or whether it serves only as a means to replenish the shelves at the point of sale; it can be removed from the product without affecting its characteristics.

**packaging component:** Any individual assembled part of a package such as, but not limited to, (a) any interior or exterior blocking, bracing, cushioning, weatherproofing, exterior strapping, coatings, closures, inks and labels; (b) tin-plated steel that meets the American Society for Testing and Materials (ASTM) specification A-623; (c) electro-galvanized coated steel and hot dipped coated galvanized steel that meets ASTM A-525 and A-879.

**postconsumer:** A material or finished product that has served its intended use and has been discarded for disposal or recovery, having completed its life as a consumer item; part of the broader category of “recovered” items.

**printed circuit boards:** A circuit board onto which the pattern of copper traces connecting the components has been etched or printed.

**printing function:** The ability of a product to generate hard copy images from either electric or hardcopy input. The following imaging equipment product types have a printing function by definition: copier, digital duplicator, facsimile machine, mailing machine, multifunction device (MFD), and printer.

**product:** A marketing model and chassis type including all its included peripherals or options but not including consumables.

**recovered:** Waste materials and byproducts that have been recovered or diverted from solid waste, but does not include materials and byproducts generated from, and commonly reused within, an original manufacturing process.

**recovered fiber:** Postconsumer fiber such as paper, paperboard, and fibrous materials from retail stores, office buildings, homes, and so forth, after they have passed through their end-usage as a consumer item, including used corrugated boxes, old newspapers and magazines, mixed waste paper, tabulating cards, and used cordage; and all paper, paperboard, and fibrous materials that enter and are collected from municipal solid waste, and manufacturing wastes such as dry paper and paperboard waste generated after completion

of the papermaking process (that is, those manufacturing operations up to and including the cutting and trimming of the paper machine reel into smaller rolls or rough sheets) including, envelope cuttings, bindery trimmings, and other paper and paperboard waste resulting from printing, cutting, forming, and other converting operations; bag, box, and carton manufacturing wastes; and butt rolls, mill wrappers, and rejected unused stock; and repulped finished paper and paperboard from obsolete inventories of paper and paperboard manufacturers, merchants, wholesalers, dealers, printers, converters, or others. *Mill broke* means any paper waste generated in a paper mill prior to completion of the papermaking process. It is usually returned directly to the pulping process. Mill broke is excluded from the definition of *recovered fiber*.

**recyclable:** Materials or components that can be removed or recovered from the whole product or package and put back into productive use as a material, not including energy recovery, using standard technologies, or as otherwise demonstrated.

**recyclable plastic stream:** A group of identifiable plastics that, mixed together, can be processed back into productive use as a material, not including energy recovery.

**recycled content:** A percentage calculated by dividing the weight of recycled material of the type of material being measured by the full weight of the material in the part or product.

**recycling:** A process by which materials or components are processed to be put back into productive use as a material or component, not including waste to energy.

**refurbishment:** The process by which electronic products or components are restored to a defined condition in function and form that is comparable to, or better than, a new unit. The unit's composition and design is not changed significantly, as in *remanufacturing*.

**remanufacturing:** All actions necessary to build up as-new products using components taken from previously used electronic equipment as well as new components, if applicable. Depending on the components used, this process may significantly change the unit's composition and design.

**renewable:** Material considered to be an agricultural product, both fiber and animal, that takes 10 years or less to grow or raise, and harvest.

**repair:** The process by which the faults in a unit preventing its specified operation are corrected. The unit's composition and design is not changed significantly.

**reusable:** Components or systems of components that can be removed or recovered from the whole product or package and put back into productive use as a component or system of components, not including energy recovery, using standard technologies, or as otherwise demonstrated.

**reuse:** Using an object again, for its original purpose or as repurposed, without significantly altering the physical form of the object although the object may be cleaned, repaired, or refurbished between uses.

**special handling needs materials:** Materials with hazardous characteristics; components having an adverse impact on or posing a hazard to recycling workers' safety; or components that need to be removed before shredding due to hazardous characteristics.

**standard size media:** Media with widths between 210 mm and 406 mm.

**subassembly:** Two or more basic parts that form a portion of an assembly of a unit, replaceable as a whole, but having a part or parts that are individually replaceable.

**take-back:** Any collection service provided by or caused to be provided by the manufacturer, by which either the product, packaging, or designated items produced by or recommended by the manufacturer for use in or with the product, can be returned to the manufacturer or their collection service for reuse, repair, refurbishment, remanufacturing, and/or recycling. This collection occurs at the end of customer use or when the product or designated item is damaged beyond repair.

**toxic chemical release/toxics released:** Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of any hazardous substance, pollutant, or contaminant.

**waste to energy:** The heat treatment of material in which the heat produced is used to produce electricity or steam or reduce the energy already required in a process.

### 3.2 Special terms

**commercial customers:** Customers that purchase institutional products.

**commonly available tools:** Widely used, commercially available tools.

**competent authority:** A governmental authority designated by a country to be responsible for receiving notification of a transboundary movement of hazardous wastes or other wastes, and any information related to it, and for responding to such notification.

**conformance assurance system:** A process to ensure conformity to a design requirement where the key consideration is control of the supply chain of components, materials, packaging and/or services, and can also include recyclers, test laboratories, and even internal designers. A conformance assurance system will include elements addressing the following elements: Plan (i.e., a description of the requirement to the supplier), Do (i.e., the collection of documents that show conformity), Check (i.e., demonstration of how conformance is assured), and Act (i.e., corrective action).

**consumer:** Individual and/or household purchasers of products.

**consumer product:** All products that are not declared as institutional products.

**contractual agent:** Repair/refurbishment operations with whom a manufacturer has contracted and closely controls to accomplish the repair or refurbishment of taken back products, under manufacturer specifications and policies, that are intended to be returned to a customer under an manufacturer program, such as warranty, off-lease, or trade-in programs.

**harnessed replaceable entities:** A collection of one or more parts considered as a single part for the purpose of replacement and repair due to physical constraints of the unit under test.

**homogeneous material:** One material of uniform composition throughout or a material, consisting of a combination of materials, that cannot be disjointed or separated into different materials by mechanical actions such as unscrewing, cutting, crushing, grinding, and abrasive processes.

NOTE—Examples of *homogeneous material* are individual types of: plastics, ceramics, glass, metals, alloys, paper, board, resins, and coatings.

**incidental presence:** The presence of a substance as an unintended or undesired ingredient of the product or aspect of the product applicable to a criterion.

**independent certification bodies:** Organizations that conduct conformity assessments and third-party certification of organizations against designated management system standards in accordance with the requirements of ISO/IEC 17021, as confirmed and accredited by a national accreditation body, which is a member of the International Accreditation Forum (IAF) [B12]. Audits are impartial, and conducted by competent, professional auditors, meeting international guidelines for management systems auditing as specified in ISO 19011.

**initial service providers:** Companies who contract directly with manufacturers to provide one or more take-back services. Initial service providers perform recycling and/or refurbishment services for product/equipment/components.

**institutional product:** Products declared as institutional product are as follows:

- Only available through authorized dealers or resellers
- If sold directly, are marketed primarily as a product for “business” or “enterprise” or equivalent

**intentionally added:** The act of deliberately utilizing a substance in the formation of a product, component, package, or packaging component where its continued presence is desired in the final product, component, package, or packaging component to provide a specific characteristic, appearance, or quality. The use of recycled material as feedstock in the manufacture of a product, component, or package, where some portion of the recycled material may contain residual amounts of a restricted substance, is not considered intentionally added, unless the restricted substance in the recycled material is used for the express purpose of imparting a specific characteristic, appearance, or quality to the final product.

**key functions:** All the essential functions an electronic product was designed to perform.

**on average:** The term as used in this standard means that the desired material (e.g., recycled or biobased plastic) is present at the designated percentage in the total weight of like material (e.g., all plastic) within each unit for each product declared to the criterion.

**manufacturer’s environmental packaging requirement:** Specifications for packaging suppliers that denote the respective environmental attributes required in the packaging. Each manufacturer sets different requirements.

**nationwide:** Across the entire nation or country, including those outside of major population centers.

**region:** Countries and territories whose independence is not recognized by all countries (e.g., Taiwan).

**spare parts:** A component of a product that is kept in reserve for possible use to replace a similar or identical component in the product.

**take-back service providers:** Companies who provide one or more take-back services (e.g., recycling, reuse, repair, refurbishment, or remanufacturing).

**technically required:** A characteristic of a design element that is essential to the function of the product and for which an alternative that would meet the requirements of the standard is not available.

**weighted average:** An average that takes into account the proportional relevance of each component, rather than treating each component equally.

**working properly:** Electronic equipment or components are *working properly* when they are tested and proven capable of performing the key functions they were designed (or modified) to perform.



**written management plan:** A document that addresses the special treatments necessary to properly manage “materials of concern” (or equivalent term that describes toxic or hazardous materials) to protect human health and the environment.

### 3.3 Acronyms and abbreviations

|       |  |
|-------|--|
| ASTM  | American Society of Testing and Materials                            |
| BFRs  | brominated flame retardants  |
| CAS   | Chemical Abstracts Service   |
| CFRs  | chlorinated flame retardants   |
| DfE   | design for the environment   |
| DIN   | Deutsches Institut für Normung (German Institute of Standardization) |
| ECHA  | European Chemicals Agency  |
| EMAS  | Eco-Management and Audit Scheme                                      |
| EMI   | electromagnetic interference   |
| EMS   | environmental management system                                      |
| ESD   | electrostatic discharge  |
| EU    | European Union   |
| F-GHG | fluorinated greenhouse gas   |
| GHG   | greenhouse gas   |
| GRI   | Global Reporting Initiative  |
| GSCP  | Global Social Compliance Program                                     |
| GSM   | grams per square meter   |
| IEEE  | Institute of Electrical and Electronics Engineers, Inc.              |
| ISO   | International Organization for Standardization                       |
| ISRI  | Institute of Scrap Recycling Industries                              |
| JIG   | Joint Industry Guide   |
| LCA   | life-cycle assessment  |
| LCACP | Life Cycle Assessment Certified Professionals                        |
| LCD   | liquid crystal display   |
| LCI   | life-cycle inventory   |
| MSE   | Market Surveillance Entity   |
| OECD  | Organisation for Economic Co-operation and Development               |

|          |   |
|----------|---|
| PRE      | Product Registration Entity   |
| PRTR     | Pollutant Release and Transfer Register   |
| PVC      | polyvinyl chloride  |
| REACH    | European Union Regulation (EC) No 1907/2006   |
| RoHS     | European Union, European Council former Directive 2002/95/EC as amended by 2005/618/EC and 2011/65/EU |
| SVHC     | substances of very high concern   |
| TRI      | Toxics Release Inventory  |
| TVOC     | total volatile organic compounds  |
| U.S. EPA | United States Environmental Protection Agency   |
| WBCSD    | World Business Council for Sustainable Development  |
| WEEE     | waste electrical and electronic equipment   |
| WRI      | World Resources Institute   |

## 4. Environmental performance criteria for imaging equipment

### 4.1 Reduction/elimination of environmentally sensitive material

#### 4.1.1 Reduction of use of hazardous substances

##### 4.1.1.1 Required—Compliance with provisions of European Union RoHS Directive

**Product criterion:** All products shall comply with the requirements of the European Union (EU) RoHS Directive in effect at the time of product registration.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to the EU RoHS requirements through effective control of the supply chain

**References and details:** The EU RoHS Directive, formerly known as Directive 2002/95/EC, stipulates maximum concentration values (MCVs) by weight for the presence of each substance within homogeneous materials.

Elements of a conformance assurance system are outlined in the United Kingdom (UK) RoHS Enforcement Guidance document [B27].<sup>24</sup>

#### 4.1.2 Cadmium

##### 4.1.2.1 Optional—Further reduction of the use of EU RoHS Directive hazardous substances (cadmium)

**Product criterion:** Products shall not use exempted cadmium applications; excluding those with a sunset date within one year, under the EU RoHS Directive in effect at the time of product registration.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain

**References and details:** The EU RoHS Directive, formerly known as Directive 2002/95/EC, stipulates allowable thresholds for the presence of each regulated substance within homogeneous materials.

#### 4.1.3 Mercury

##### 4.1.3.1 Required—Reporting on amount of mercury content in light sources

**Product criterion:** Manufacturer shall report the number of mercury containing light sources in the product and the mercury content per light source. Data may be reported in accordance with the ranges of the following list:

- 0 mg (less than lower limit of detection)
- > 0 mg to ≤ 5 mg
- > 5 mg to ≤ 10 mg
- > 10 mg to ≤ 50 mg
- > 50 mg to ≤ 100 mg
- > 100 mg to ≤ 1 g
- Greater than 1 g

For products that do not contain light sources, the manufacturer may declare “Not applicable” on the MSE Registry.

**Applies to:** All covered products.

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<sup>24</sup> The numbers in brackets correspond to those of the bibliography in Annex A.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation showing mercury content per light source or access to a representative aggregated mercury content report

**References and details:** IEC 62554 ed 1.0 [B11] may be used in preparing samples for subsequent measurement of mercury content of lamps.

**4.1.3.2 Optional—Use of non-mercury containing light sources**

**Product criterion:** No intentionally added mercury in light sources. Light source employs a technology that is documented not to require the presence of mercury.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain or declaration of demonstrated use of non-mercury containing technology

**References and details:** None available.

**4.1.4 REACH**

**4.1.4.1 Optional—Reduction of substances on the EU REACH Candidate List of SVHCs**

**Product criterion:** A product shall not contain substances included in the Candidate List of Substances of Very High Concern (SVHC) and REACH Annex XIV (List of Substances Subject to Authorization) above the 0.1% weight by weight threshold as described by the current European Chemicals Agency “Guidance on Articles” document or the REACH regulation. The manufacturer shall demonstrate absence (less than 0.1% weight by weight in the product) of substances on the Candidate List of SVHC that have a Date of Inclusion on the candidate list of one year or more prior to the date the product in question is first registered. External attachments and associated accessories that ship with the product being registered shall also not contain SVHCs above 0.1% weight by weight of the individual attachment or accessory.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain

**References and details:** EU Regulation (EC) No 1907/2006.

The Candidate List of SVHCs is maintained at the European Chemicals Agency (ECHA) Website.<sup>25</sup> The criteria used to classify SVHCs can be found in Article 57 of the REACH regulation.

REACH Guidance on Articles is available on the ECHA Website.<sup>26</sup>

#### 4.1.5 Batteries

##### 4.1.5.1 Required—Compliance with provisions of EU Battery Directive

**Product criterion:** Batteries shall comply with the material content limits of EU Directive 2006/66/EC (Battery Directive) in effect when the product is registered.

For products that do not contain batteries, the manufacturer may declare not applicable on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain

**References and details:** European Commission Directive 2006/66/EC of 6 September 2006.

This criterion only applies to those substances for which the Battery Directive establishes threshold limits on the amount of the substance in batteries. This criterion does not apply to those substances only subject to the Battery Directive labeling requirements.

#### 4.1.6 Organohalogens

##### 4.1.6.1 Required—Reducing BFR/CFR/PVC content of external plastic casings

**Product criterion:** External plastic casings greater than 25 g shall contain no more than 0.1% weight (1000 ppm) bromine and 0.1% weight (1000 ppm) chlorine attributable to brominated flame retardants (BFRs), chlorinated flame retardants (CFRs), and polyvinyl chloride (PVC) with the following exceptions:

- Parts containing 25% or more postconsumer recycled content are permitted up to 0.3% weight (3000 ppm) bromine and 0.3% weight (3000 ppm) chlorine.
- Uses of brominated or chlorinated substances that are not classified as BFRs, CFRs, or PVC are allowed, but their use shall be documented if the bromine or chlorine content exceeds the applicable threshold.
- External plastic casings for external power supplies.

For products that do not have plastic casings weighing >25 g, manufacturer may declare “Not applicable” on the MSE Registry.

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<sup>25</sup> Available at [http://www.echa.europa.eu/home\\_en.asp](http://www.echa.europa.eu/home_en.asp).

<sup>26</sup> Available at [http://guidance.echa.europa.eu/docs/guidance\\_document/articles\\_en.htm](http://guidance.echa.europa.eu/docs/guidance_document/articles_en.htm).

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain
- c) If the bromine or chlorine content exceeds the applicable threshold, documentation that demonstrates that the source of the bromine or chlorine is not from BFRs, CFRs, or PVC

**References and details:** None available.

**4.1.6.2 Optional—Eliminating or reducing BFR/CFR content of printed circuit board laminates**

**Product criterion:** All printed circuit board laminates included in the product excluding components soldered or affixed to the printed circuit board laminates shall contain no more than 0.1% weight (1000 ppm) bromine and 0.1% weight (1000 ppm) chlorine attributable to BFRs and CFRs, with the following exception:

- Uses of brominated or chlorinated substances that are not classified as BFRs or CFRs are allowed, but their use shall be documented if the bromine or chlorine content exceeds the applicable threshold.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration by manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain
- c) If the bromine or chlorine content exceeds the applicable threshold, documentation that demonstrates that the source of the bromine or chlorine is not from BFRs or CFRs

**References and details:** IEC 61249-2-21 [B9] establishes limits on elemental bromine (900 ppm) and chlorine (900 ppm), and a combined limit of (1500 ppm). Demonstration of conformance with the threshold limits established in IEC 61249-2-21 meets the requirements of this criterion.

**4.1.6.3 Optional—Eliminating or reducing BFR/CFR/PVC content of product**

**Product criterion:** All plastic materials within the product shall contain no more than 0.1% weight (1000 ppm) bromine and 0.1% weight (1000 ppm) chlorine attributable to BFRs, CFRs, and PVC with the following exceptions:

- Parts containing 25% or more postconsumer recycled content are permitted up to 0.3% weight (3000 ppm) bromine and 0.3% weight (3000 ppm) chlorine.
- Uses of brominated or chlorinated substances that are not classified as BFRs, CFRs, or PVC are allowed but their use shall be documented if the bromine or chlorine content exceeds the applicable threshold.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration by manufacturer
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain
- c) If the bromine or chlorine content exceeds the applicable threshold, documentation that demonstrates that the source of the bromine or chlorine is not from BFRs, CFRs, or PVC

**References and details:** None available.

#### 4.1.7 Manufacturing chemicals

##### 4.1.7.1 Optional—Reduce fluorinated gas emissions resulting from flat panel display manufacturing

**Product criterion:** The manufacturer shall declare that the supplier of flat panel displays used in products declared to conform to this criterion has installed, operated, and maintained control technology designed specifically to recover or destroy fluorinated greenhouse gases (F-GHGs) used in the production of flat panel displays. The intent of this criterion is to enable recovery, destruction, or removal of at least 90% of the F-GHG used across all flat panel display manufacturing facilities. This declaration shall be supported with a letter provided by the flat panel display supplier. F-GHGs include CF<sub>4</sub>, C<sub>2</sub>F<sub>6</sub>, C<sub>3</sub>F<sub>8</sub>, C-C<sub>4</sub>F<sub>8</sub>, C<sub>4</sub>F<sub>8</sub>O, CHF<sub>3</sub>, NF<sub>3</sub>, and SF<sub>6</sub>.

The letter shall assure the following:

- That the supplier has installed control technology covering at least 90% of the equipment used in each and every type of operation that uses F-GHGs in the production of flat panel displays. This includes equipment used in all manufacturing and ancillary operations related to flat panel displays, such as dry etching and chamber cleaning.
- That the supplier installs, operates, and maintains the control technology in accordance with the control technology supplier's specifications.

Manufacturers shall declare “Not applicable” for this criterion on the MSE Registry for products that do not contain flat panel displays manufactured with F-GHGs.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter that includes baseline and conformance assurance information, specifically the following:
  - 1) Declaration that control technologies designed specifically for F-GHG emission control cover at least 90% of the equipment used in each and every type of operation that uses F-GHGs in the production of flat panel displays

- 2) Declaration that the control technologies are designed specifically to recover or destroy F-GHGs, and are installed, operated, and maintained in accordance with the control technology supplier's specifications
- 3) Declaration that the control technology supplier and the flat panel display supplier have created a maintenance plan that ensures that the specifications are being met

**References and details:** IPCC Guidelines for National Greenhouse Gas Inventories [B13].

U.S. EPA Protocol for Measuring Destruction or Removal Efficiency (DRE) of Fluorinated Greenhouse Gas Abatement Equipment in Electronics Manufacturing [B23].

For example, if a supplier were to use F-GHGs in 20 dry etching lines and the cleaning of 10 chambers, at a minimum, the supplier would need control technology installed for 18 of the dry etching lines and for 9 of the chambers. Installation for 17 dry etching lines and 10 chambers would not qualify. Similarly, installation for 20 lines and 7 chambers would not satisfy this criterion. If the supplier were to have an additional type of operation that uses F-GHGs for flat panel display production, this criterion would require control technology to be installed for at least 90% of that equipment as well.

Suppliers may determine success in recovery, destruction, or removal of 90% of the F-GHGs by using the U.S. EPA Protocol for Measuring Destruction or Removal Efficiency (DRE) of Fluorinated Greenhouse Gas Abatement Equipment in Electronics Manufacturing [B23] or another nationally acceptable method that has been demonstrated to produce results equivalent to or exceeding the accuracy and precision of EPA's DRE Protocol, where the relative error of true fraction emitted does not exceed 5%. Where suppliers are using other abatement systems, such as centralized abatement systems, measurements can be performed using a nationally acceptable method that has been demonstrated to produce results where the relative error of true fraction emitted does not exceed 5%.

#### 4.1.8 Safer alternatives

##### 4.1.8.1 Optional—Inventory of intentionally added chemicals residing in the product

**Product criterion:** Manufacturer has documented the presence of the Joint Industry Guide 101 (JIG-101) or IEC 62474 declarable substance lists in concentrations above the thresholds noted in the latest published revision of the JIG-101 or IEC 62474 available at time of product registration.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration by manufacturer.
- b) Documentation of a conformance assurance system that demonstrates conformity to this criterion through effective control of the supply chain.

**References and details:** JIG-101 and IEC 62474 declarable substances lists.

The criterion does not require public disclosure, but only internal documentation.



## 4.2 Materials selection

### 4.2.1 Postconsumer recycled plastic content

#### 4.2.1.1 Required—Declaration of postconsumer recycled plastic content

**Product criterion:** Manufacturer declares minimum percentage of postconsumer recycled plastic content, calculated as a percentage of total plastic (by weight) in each product.

The following may be excluded from the calculation of percentage: printed circuit boards, labels, cables, connectors, electronic components, optical components, electrostatic discharge (ESD) components, electromagnetic interference (EMI) components, and biobased plastic material.

Products that do not contain plastics can declare “Not applicable” for this criterion on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter stating minimum percentage of postconsumer recycled plastic content in material supplied to manufacturer or to manufacturer’s part supplier
- c) Documentation of calculation

**References and details:** If filler materials or additives are used in recycled plastics, the calculation of the recycled plastic content is made by dividing the weight of the recycled plastic by the full weight of the plastic material, including additives and fillers, in the part or product. Additives or fillers are not considered recycled plastic, except in the case where the additives or fillers are derived from a recycled feedstock.

#### 4.2.1.2 Required—Minimum content of postconsumer recycled plastic

**Product criterion:** Any product containing plastic parts whose combined weight exceeds 100 g shall contain at least 5 g of postconsumer recycled plastic.

The following may be excluded from the combined weight total: printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, EMI components, and biobased plastic material.

Product registration to this standard shall not be withdrawn if failure to meet this criterion is caused by temporary circumstances beyond the subscriber’s control including, but not limited to, fire, flood, earthquakes, acts of war, government action, accident, labor difficulties or shortage, inability to obtain materials, equipment, or transportation.

For products that contain less than 100 g of plastic after the exclusions are removed, the manufacturer may declare “Not applicable” on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter stating minimum percentage of postconsumer recycled plastic content in material supplied to manufacturer or to manufacturer's part supplier
- c) Documentation of the following: plastic component part name(s) or other part identifier that contains the postconsumer recycled plastic content, weight (g) of postconsumer recycled plastic in the component part, and postconsumer recycled plastic resin type. If the part identifier is not descriptive, a description of the type of part shall be provided.
- d) If supply was temporarily disrupted since the product was declared on the MSE Registry, documentation of the occurrence, including the dates in which the postconsumer recycled plastic supply was disrupted and reinstated and the reason for the interruption. If the interruption was caused by the postconsumer recycled plastic supplier, this documentation shall include a supplier letter stating the cause and dates of the interruption in supply.

**References and details:** A supply disruption greater than 6 months duration, or repeated disruptions occurring at intervals of less than 6 months, would require justification to be considered temporary.

Additives or fillers are not considered recycled plastic, except in the case where the additives or fillers are derived from a recycled feedstock.

**4.2.1.3 Optional—Minimum 5% to 10% content of postconsumer recycled plastic**

**Product criterion:** Product containing 5 kg of plastic or less shall contain on average a minimum of 10% postconsumer recycled plastic. Product containing more than 5 kg of plastic shall contain on average a minimum of 5% postconsumer recycled plastic. Postconsumer recycled plastic content shall be calculated as a percentage of total plastic (by weight) in the product.

In addition, manufacturers shall declare the minimum percentage of postconsumer recycled content derived from waste electrical and electronic equipment (WEEE) calculated as a percentage of total plastic (by weight) in the product.

The following may be excluded from the calculation of percentage: printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, EMI components, and biobased plastic material.

Manufacturer shall not be deemed non-conformant if failure to meet this criterion is caused by temporary circumstances beyond the subscriber's control including, but not limited to, fire, flood, earthquakes, acts of war, government action, accident, labor difficulties or shortage, inability to obtain materials, equipment, or transportation.

Products that do not contain plastics can declare "Not applicable" for this criterion on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter stating minimum percentage of postconsumer recycled plastic content in material supplied to manufacturer or to manufacturer's part supplier

- c) Documentation of calculation
- d) If supply was temporarily disrupted since the product was declared on the MSE Registry, documentation of the occurrence, including the dates in which the postconsumer recycled plastic supply was disrupted and reinstated and the reason for the interruption. If the interruption was caused by the postconsumer recycled plastic supplier, this documentation shall include a supplier letter stating the cause and dates of the interruption in supply.

**References and details:** A supply disruption greater than 6 months duration, or repeated disruptions occurring at intervals of less than 6 months, would require justification to be considered temporary.

WEEE shall be defined to include all types of products included in the EU WEEE Directive 2002/96/EC.

If filler materials or additives are used in recycled plastics, the calculation of the recycled plastic content is made by dividing the weight of the recycled plastic by the full weight of the plastic material, including additives and fillers, in the part or product. Additives or fillers are not considered recycled plastic, except in the case where the additives or fillers are derived from a recycled feedstock.

#### 4.2.1.4 Optional—Minimum 25% content of postconsumer recycled plastic

**Product criterion:** Product shall contain on average a minimum of 25% postconsumer recycled plastic, calculated as a percentage of total plastic (by weight) in the product.

The following may be excluded from the calculation of percentage: printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, EMI components, and biobased plastic material.

Manufacturer shall not be deemed non-conformant if failure to meet this criterion is caused by temporary circumstances beyond the subscriber's control including, but not limited to, fire, flood, earthquakes, acts of war, government action, accident, labor difficulties or shortage, inability to obtain materials, equipment, or transportation.

Products that do not contain plastics can declare "Not applicable" for this criterion on the MSE Registry.

**Applies to:** All covered products.

#### **Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter stating minimum percentage of postconsumer recycled plastic content in material supplied to manufacturer or to manufacturer's part supplier
- c) Documentation of calculation
- d) If supply was temporarily disrupted since the product was declared on the MSE Registry, documentation of the occurrence, including the dates in which the postconsumer recycled plastic supply was disrupted and reinstated and the reason for the interruption. If the interruption was caused by the postconsumer recycled plastic supplier, this documentation shall include a supplier letter stating the cause and dates of the interruption in supply.

**References and details:** A supply disruption greater than 6 months duration, or repeated disruptions occurring at intervals of less than 6 months, would require justification to be considered temporary.

If filler materials or additives are used in recycled plastics, the calculation of the recycled plastic content is made by dividing the weight of the recycled plastic by the full weight of the plastic material, including

additives and fillers, in the part or product. Additives or fillers are not considered recycled plastic, except in the case where the additives or fillers are derived from a recycled feedstock.

#### 4.2.2 Biobased plastic material content

##### 4.2.2.1 Required—Declaration of biobased plastic materials content

**Product criterion:** The manufacturer shall declare the percentage of the combined weight of biobased plastic materials, calculated as a percentage of total plastic (by weight) in each product.

The following may be excluded from the calculation of percentage: printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, EMI components, and postconsumer recycled plastic.

Products that do not contain plastics can declare “Not applicable” for this criterion on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter
- c) Documentation of calculation

**References and details:** ASTM D6866 [B1] may be used to determine if the carbon isotope ratios measured for the plastic materials in the product are consistent with the declared weight percentages of biobased plastic materials.

A declaration of 0% biobased plastic material content is acceptable if there is no biobased plastic material in the product or if the manufacturer does not have the required verification documentation. If 0% biobased plastic material content is declared, the manufacturer does not need to provide verification documentation.

If filler materials or additives are used in biobased plastic materials, the calculation of the biobased plastic material content is made by dividing the weight of the biobased plastic material in the part or product by the full weight of the plastic material, including additives, fillers, and other plastics, in the part or product.

##### 4.2.2.2 Optional—Minimum content of biobased plastic material

**Product criterion:** Product containing 5 kg of plastic or less shall contain on average a minimum of 10% biobased plastic materials. Product containing more than 5 kg of plastic shall contain on average a minimum of 5% biobased plastic materials. Plastic content shall be calculated as a percentage of total plastic (by weight) in the product.

The following may be excluded from the calculation of percentage: printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, EMI components, and postconsumer recycled plastic.

Manufacturer shall declare the minimum percentage of biobased plastic materials in the product derived from sources that do not compete with the human food supply.

Products that do not contain plastics can declare “Not applicable” for this criterion on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter, including identification of the source used to make the biobased plastic material
- c) Documentation of calculation

**References and details:** ASTM D6866 [B1] may be used to determine if the carbon isotope ratios measured for the plastic materials in the product are consistent with the declared weight percentages of biobased plastic materials.

Examples of materials that do not compete with the human food supply would include crop materials that are not typically used for human food production.

If filler materials or additives are used in biobased plastic materials, the calculation of the biobased plastic material content is made by dividing the weight of the biobased plastic material in the part or product by the full weight of the plastic material, including additives, fillers, and other plastics, in the part or product.

#### 4.2.3 Weight declaration

##### 4.2.3.1 Required—Declaration of product weight

**Product criterion:** Manufacturer shall declare the product weight in kilograms.

**Applies to:** All covered products.

**Verification requirements:**

- Declaration from manufacturer

**References and details:** None available.

#### 4.3 Design for end of life

##### 4.3.1 Ability to disassemble product

###### 4.3.1.1 Required—Ease of disassembly of product

**Product criterion:** Products declared as institutional products shall be designed to provide ease of access to the following: (a) materials with special handling needs at end of life that should be removable for handling at the component or part level, e.g., before mechanical processing; (b) material, components and subassemblies that could potentially be reused; and (c) components and subassemblies that may need removal for repair or replacement. Ease of access shall include the following:

- External enclosures, chassis, and electronic subassemblies shall be removable with commonly available tools or by hand. This shall include:
  - Product shall utilize commonly used fasteners for joining components, subassemblies, chassis and enclosures; an exception shall be provided for special fasteners needed for safety and/or anti-theft reasons.
  - All disassembly for recycling purposes can be done exclusively with commonly available tools or by hand.
  - Access to points of connection and clearance shall be adequate for ease of dismantling of enclosures, chassis, and electronic subassemblies.
- Non-separable connections (e.g., glued, welded) between different materials shall be avoided unless they are technically or legally required or utilized for safety purposes or in an anti-theft application.
- Electrical and communication wiring and cables that connect to external devices or sources of power or data shall be removable from all products by hand or with commonly available tools (such as a screwdriver) in such a way as to be removed without being cut or in any way rendered unusable, unless required for technical or safety reasons.
- Whole external power supplies shall be removeable with commonly available tools or by hand but are not required to be further able to be disassembled.

Products declared as consumer products shall be designed to provide ease of access to materials with special handling needs at end of life that should be removed before mechanical processing. Ease of access shall include the following:

- Enclosures shall be removable by one person with commonly available tools.
- Electrical and communication wiring and cables that connect to external devices or sources of power or data shall be removable from all products by hand or with commonly available tools (such as a screwdriver) in such a way as to be removed without being cut or in any way rendered unusable, unless they are technically required.
- Materials that require special handling shall be easy to find and remove.
- Whole external power supplies shall be removeable with commonly available tools or by hand but are not required to be further able to be disassembled.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration by manufacturer
- b) Supporting documentation that demonstrates that all elements of criterion are met in the product design
  - 1) Description of disassembly process that identifies how each of the disassembly requirements is met, including a description and justification for any exceptions to the requirements that are required for technical, legal, or anti-theft reasons, *or*
  - 2) A statement from a minimum of three recyclers individually, or at least one recycler working under an independent entity with electronics recycling expertise that is not a trade organization, confirming that the product design meets the requirements of this criterion.
- c) The justification for the exemption of safety shall demonstrate how the relevant design features are necessary to meet the elements of safety as defined in any one of the following, based on applicable safety requirements for the product:

- 1) EU Directive 2006/95/EC, Annex I
- 2) IEC 60950-1
- 3) UL 60950-1

**References and details:** Materials exhibiting hazardous characteristics or those requiring special handling are those materials defined under Annex II of the EU WEEE Directive 2002/96/EC and subsequent updates.

The elements of safety that can justify an exemption from the requirements of this criterion are defined in any one of the following sources based on applicable safety requirements for the product:

- EU Directive 2006/95/EC
- IEC 60950-1
- UL 60950-1

#### 4.3.1.2 Optional—Ease of disassembly of consumer products

**Product criterion:** Manufacturers shall meet the following requirements for consumer products.

All such products shall be designed to provide ease of access to the following: (a) materials with special handling needs that should be removed before mechanical processing; (b) material, components and subassemblies that are able to be reused; and (c) components and subassemblies that may need removal for repair or replacement. Ease of access shall include the following:

- External enclosures, chassis, and electronic subassemblies shall be removable by one person with commonly available tools or by hand. This shall include:
  - Product shall utilize commonly used fasteners for joining components, subassemblies, chassis, and enclosures, an exception shall be provided for special fasteners needed for safety and anti-theft reasons.
  - All disassembly for recycling purposes can be done exclusively with commonly available tools or by hand.
  - Access to points of connection and clearance shall be adequate for ease of dismantling of enclosures, chassis, and electronic subassemblies.
  - Non-separable connections (e.g., glued, welded) between different materials shall be avoided unless they are technically or legally required or utilized for safety purposes or in an anti-theft application.
- Electrical and communication wiring and cables that connect to external devices or sources of power or data shall be removable without tools from all products unless they are technically required.

**Applies to:** All covered consumer products.

#### Verification requirements:

- a) Declaration by manufacturer
- b) Supporting documentation that demonstrates that all elements of criterion are met in the product design

- 1) Description of disassembly process that identifies how each of the disassembly requirements is met, including a description and justification for any exceptions to the requirements that are required for technical, legal, or anti-theft reasons, or
- 2) A statement from a minimum of three recyclers individually, or at least one recycler working under an independent entity with electronics recycling expertise that is not a trade organization, confirming that the product design meets the requirements of this criterion.
- c) The justification for the exemption of safety shall demonstrate how the relevant design features are necessary to meet the elements of safety as defined in any one of the following, based on applicable safety requirements for the product:
  - 1) EU Directive 2006/95/EC, Annex I
  - 2) IEC 60950-1
  - 3) UL 60950-1

**References and details:** Materials exhibiting hazardous characteristics or those requiring special handling are those materials defined under Annex II of the EU WEEE Directive 2002/96/EC and subsequent updates.

The elements of safety that can justify an exemption from the requirements of this criterion are defined in any one of the following sources based on applicable safety requirements for the product:

- EU Directive 2006/95/EC
- IEC 60950-1
- UL 60950-1

### 4.3.2 Recyclability of plastics

#### 4.3.2.1 Required—Use of single recyclable plastic type per plastic part

**Product criterion:** Each plastic part >100 g shall consist of only one recyclable plastic type. Printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, EMI components, and hoses/tubes for transporting fluid within the unit are excluded from this requirement.

For products that do not contain plastic parts weighing >100 g, manufacturers may declare “Not applicable” on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation stating part number or name, part weight, and plastic type of each applicable plastic part >100 g

**References and details:** A blend of plastics that is recyclable as a blend shall be considered a single plastic type for the purpose of this criterion.

This criterion applies only to resins and plastic parts. Non-plastic surface coatings, inks or pigments applied to or incorporated into the resin would not alter the plastic type.

ISO 14021:1999 [B14] may be referred to for information on evaluation methods for recyclable.



#### 4.3.2.2 Required—Restriction on materials not compatible with reuse and recycling

**Product criterion:** Plastic parts >100 g shall not contain adhesives, coatings, paints, finishes, or pigments associated with surface coatings that are not compatible with reuse and recycling. Printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, and EMI components are excluded from this requirement. Adhesives, coatings, paints, finishes, or pigments associated with surface coatings required for safety, legal, or technical requirements are exempt from this requirement.

For products that do not contain plastic parts weighing >100 g, manufacturers may declare “Not applicable” on the MSE Registry.

**Applies to:** All covered products.

##### Verification requirements:

- a) Declaration from manufacturer
- b) Documentation stating part number or name, part weight, and confirmation of compatibility with reuse and recycling for each plastic part >100 g that contain adhesives, coatings, paints, finishes, or pigments associated with surface coatings
- c) Demonstration of compatibility with reuse and recycling
- d) Documentation stating part number or name, part weight and list of non-compatible adhesives, coatings, paints, finishes, or pigments associated with surface coatings used on each plastic part > 100 g, if exemption for these materials is taken due to safety, legal, or technical requirements. Documentation shall include a description or citation of the applicable safety, legal, or technical requirement.

**References and details:** “Significant impact” is defined as no more than a 25% reduction in the notched Izod impact at room temperature, as measured using ASTM D256, ISO 180, or ISO 179.

Compatibility of adhesives, coatings, paints, finishes, or pigments associated with surface coatings with reuse shall be demonstrated through the following:

- Evaluation by the manufacturer that these materials individually or combined do not alter the original functional and/or physical properties per design drawing specifications.

Compatibility of adhesives, coatings, paints, finishes or pigments associated with surface coatings with recycling shall be demonstrated through the following:

- Test results showing that these materials individually or combined do not significantly impact the physical/mechanical properties of the recycled plastic; *or*
- Peer reviewed published literature concluding that these materials individually or combined do not significantly impact the physical/mechanical properties of the recycled plastic; *or*
- A statement from a minimum of three plastics recyclers individually, or at least one plastics recycler working under an independent entity with electronics recycling expertise that is not a trade organization, confirming these materials individually or combined do not significantly impact the physical/mechanical properties of the recycled plastic.

#### 4.3.2.3 Required—Manual separation and marking of plastics

**Product criterion:** Plastic parts >100 g shall be manually separable into recyclable plastic streams with commonly available tools. Plastic parts >100 g shall be marked with a material code in accordance with the

identification and marking requirements of ISO 11469. Plastic parts on which the only sufficiently sized marking surface is also a necessary functional surface (e.g., a button face), parts with less than 200 mm<sup>2</sup> of plane surface, printed circuit boards, labels, cables, connectors, electronic components, optical components, ESD components, and EMI components are excluded from this requirement.

For products that do not contain plastic parts weighing >100 g, manufacturers may declare “Not applicable” on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Manufacturer record of visual inspection confirming applicable plastic markings, or supplier verification of applicable plastic markings
- c) One of the following items shall be provided:
  - 1) Demonstration that the product meets the mandatory requirements specified in Annex 2 of Blue Angel RAL-UZ 122, May 2009, *or*
  - 2) Documentation that applicable plastic parts are manually separable into recyclable plastic streams with commonly available tools. Examples of documentation include the following:
    - i) A list of the commonly available tools required to separate the applicable plastic parts; *and*
    - ii) Instructions for disassembly that show how the applicable plastic parts can be manually separated into individual plastic streams; *or*
    - iii) A statement from a minimum of three recyclers individually, or at least one recycler working under an independent entity with electronics recycling expertise that is not a trade organization, confirming that the applicable plastic parts are manually separable into recyclable plastic streams with commonly available tools.

**References and details:** ISO 11469.

A blend of plastics that is recyclable as a blend shall be considered a single plastic type for the purpose of this criterion.

The mandatory requirements specified in Annex 2 of Blue Angel RAL-UZ 122, May 2009, are inclusive of the requirements in this criterion, but include other requirements.

### 4.3.3 Materials with special handling needs

#### 4.3.3.1 Required—Notification regarding the identification of both materials and components that have hazardous characteristics or special handling needs

**Product criterion:** Manufacturer shall (a) within one year after the equipment is put on the market make available to reuse and recycling facilities information identifying the presence and location of all materials and components exhibiting hazardous characteristics or requiring special handling, and (b) ensure that such materials and components are safely and easily identifiable. Manufacturers shall provide such information to a central information source that makes such information available to recyclers (if such central information source is referred to them by the PRE) or to a Website making information available to recyclers. If the manufacturer does not provide information to a central information source, but rather

provides such information on another Website, the manufacturer shall declare the URL where the information regarding the declared product is located.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation as to how information is provided to reuse and recycling facilities, including, but not limited to, the URL of the Website and how reuse/recycling facilities gain access to the information
- c) Documentation that identifies the presence and location of all materials and components demonstrating hazardous characteristics or requiring special handling and confirming that the applicable components are safely and easily identifiable

**References and details:** Materials exhibiting hazardous characteristics or those requiring special handling are those materials defined under Annex II of the EU WEEE Directive 2002/96/EC and subsequent updates.

For further information see: Blue Angel RAL-UZ 122; NIOSH Pocket Guide [B18]; U.S. EPA IRIS Glossary [B21].

#### 4.3.4 Product end-of-life analysis and planning

##### 4.3.4.1 Required—Preparation of product end-of-life characterization report

**Product criterion:** Manufacturer shall prepare and make available to reuse and recycling facilities, and upon request to other institutions and organizations, for each registered product, an end-of-life characterization report that provides guidance for the effective processing of the materials identified in EU WEEE Directive 2002/96/EC, Annex II, within one year after the equipment is put on the market.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration by manufacturer
- b) The end-of-life characterization report
- c) Documentation as to how information is provided to reuse and recycling facilities
- d) Identification of a point of contact for institutions and organizations to request the end-of-life report

**References and details:** A WEEE disassembly report, adapted to report on any additional elements from criteria from this standard that are declared to, shall meet the requirements of this criterion.

Products whose designs are the same relative to the end-of-life processes may utilize a report in common, which shall list the applicable product names.

#### 4.3.4.2 Required—Minimum reusable/recyclable rate based on requirements of EU WEEE Directive

**Product criterion:** The rate of reusability of components and recyclability of materials and components by weight in the product, utilizing the current infrastructure and using demonstrated technologies, shall meet or exceed the rate specified in the EU WEEE Directive 2002/96/EC for the applicable product category.

**Applies to:** All covered products.

##### Verification requirements:

- a) Declaration from manufacturer
- b) Description of demonstrated recycling technologies
- c) Demonstration that material is normally recyclable or that the components are reusable, or if not, that there exists a market/use
- d) Documentation of calculation of the rate of reusability and recyclability

**References and details:** Declaration by manufacturer of the material and components and how they can be recycled or reused within the existing infrastructure and demonstrated technologies.

For further explanation of when a product can be claimed to be *reusable* or *recyclable*, see definitions in 3.1.

The definition of *reusability* and *recyclability* is in accord with Article 7 of the EU WEEE Directive 2002/96/EC in that it includes component, material and substance reuse but excludes reuse of whole products in calculating the reusable/recyclable rate. Unless the Directive incorporates whole product reuse in the recycling/recovery targets of Article 7, this exclusion will apply. Though the Directive applies these rates to the rate of “component, material and substance reuse and recycling” within a country, applied to a given type of product, the targets are defined as  $x\%$  “by an average weight per appliance.” This criterion translates these targets into a reusable/recyclable rate per each appliance (e.g., product).

#### 4.3.4.3 Optional—Minimum 90% reusable/recyclable

**Product criterion:** 90% or greater by weight of materials and components shall be recyclable or reusable within the current infrastructure and using demonstrated technologies.

**Applies to:** All covered products.

##### Verification requirements:

- a) Declaration from manufacturer
- b) Description of demonstrated recycling technologies
- c) Demonstration that material is normally recyclable or that the components are reusable, or if not, that there exists a market/use
- d) Documentation of calculation of the rate of reusability and recyclability

**References and details:** Declaration by manufacturer of the material and components and how they can be recycled or reused within the existing infrastructure and demonstrated technologies.

The definition of reusable and recyclable is in accord with Article 7 of the EU WEEE Directive 2002/96/EC in that it includes component, material and substance reuse but excludes reuse of whole

products in calculating the reusable/recyclable rate. Unless the Directive incorporates whole product reuse in the recycling/recovery targets of Article 7, this exclusion will apply. Though the Directive applies these rates to the rate of “component, material and substance reuse and recycling” within a country, applied to a given type of product, the targets are defined as  $x\%$  “by an average weight per appliance.” This criterion translates these targets into a reusable/recyclable rate per each appliance (e.g., product).

## 4.4 Product longevity/life-cycle extension

### 4.4.1 Minimum product life

#### 4.4.1.1 Required—Early failure process

**Product criterion:** Manufacturer shall make available to the customer procedures as to how the manufacturer or its designee shall troubleshoot, repair, or replace a product that fails prior to 3 years after date of sale for institutional products and 1 year after date of sale for consumer products. These procedures shall be easily accessible to customers on the manufacturer’s Website or in the documentation that accompanies the product at the point of sale.

**Applies to:** All covered products.

#### Verification requirements:

- a) Declaration from manufacturer
- b) Documentation of procedures as to how the manufacturer or its designee shall troubleshoot, repair, or replace a product that fails prior to 3 years after date of sale for institutional products and 1 year after date of sale for consumer products<sup>27</sup>
- c) Documentation that these procedures are easily accessible to customers on the manufacturer’s Website or in the documentation that accompanies the product at the point of sale

**References and details:** Note that the information that the manufacturer makes available are the procedures that customers should follow in order to access the troubleshooting, repair, or replacement services as identified in the criterion..

### 4.4.2 Modular design

#### 4.4.2.1 Optional—Product upgradeability

**Product criterion:** Products declared as *institutional* products shall have upgradeability by offering two or more upgrade modules.

Products declared as *consumer* products shall have upgradeability by offering two or more upgrade modules, or at least one upgrade module, if the product already incorporates any two of the types of modules listed as follows at the time of registration:

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<sup>27</sup> Note that availability of warranty or service contract would meet this verification requirement.

- Media handling modules such as duplexers and additional paper trays; *or*
- Processing modules such as memory, disk drives; *or*
- Connectivity modules such as networking, wireless and print servers; *or*
- Software/firmware modules such as print drivers or operating system upgrades.

Information on how to obtain upgrade modules shall be provided in sales and marketing materials, or in product-specific documentation available hardcopy, or on the manufacturer Website.

**Applies to:** All covered institutional and consumer products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Manufacturer documentation such as Web-based information, user guide, or spec sheet showing additional upgrade modules available for the product, and for consumer products, if applicable, two of the types of modules listed above already incorporated at the time of registration

**References and details:** Examples of upgrade modules may include but are not limited to: media handling modules such as duplexers and additional paper trays; processing modules such as memory, disk drives; connectivity modules such as networking, wireless, and print servers; or software/firmware modules such as operating system print driver upgrades.

#### 4.4.3 Product life extension

##### 4.4.3.1 Required—Spare parts

**Product criterion:** Manufacturer shall declare if spare parts are available, and if available, the length of time that spare parts are available after the end of production. The following information shall be provided to purchasers:

- a) If spare parts are available, and if available the length of time that they are planned to be available after the end of production.
- b) If spare parts are available, how to obtain spare parts (or, at the manufacturer's option, compatible spare parts from a different supplier).

**Applies to:** All covered products.

**Verification requirements:**

- 1) Declaration from manufacturer
- 2) Declaration stating whether spare parts are available, and if available, the length of time spare parts are planned to be available after the end of production, and documentation of how that information is provided to purchasers.
- 3) If spare parts are available, description about how to obtain spare parts and documentation of how that information is provided to purchasers. For example, the manufacturer can provide the link to the Website where customers can obtain these spare parts.

**References and details:** *Spare parts* referred to in the criterion in this subclause are those parts that typically have the potential to fail during the normal use of the product. In contrast, those parts whose life cycle usually exceeds the usual life of the product need not be provisioned as spare parts.

## 4.5 Energy conservation

### 4.5.1 Power management system

#### 4.5.1.1 Required—ENERGY STAR

**Product criterion:** Product shall qualify to or comply with the eligibility criteria of the ENERGY STAR program requirements for the declared product at the time of declaration to this standard. If ENERGY STAR eligibility criteria are modified such that the eligibility criteria version is changed during the time that the product is declared to this standard, the product shall conform to the new eligibility criteria of the ENERGY STAR program requirements to remain in conformance with this criterion.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Demonstration of ENERGY STAR qualification or documentation showing compliance with all applicable eligibility criteria of the ENERGY STAR program requirements

**References and details:** “Qualified to” or “qualification” is ENERGY STAR’s term for products that are listed or compliant with ENERGY STAR as meeting all of ENERGY STAR’s “program requirements,” including all partner commitments for labeling, marketing, etc., and all eligibility criteria.

“Compliant with the eligibility criteria of the ENERGY STAR program requirements” relative to IEEE Std 1680.2-2012 means the product meets the technical specifications for energy efficiency (including relevant test procedures) as listed in the “eligibility requirements” provided by the ENERGY STAR program, but the product is not necessarily listed at the ENERGY STAR Website as a qualified product with the ENERGY STAR program.<sup>28</sup>

Conformance to this criterion does not allow manufacturers the ability to market products conformant to this criterion as ENERGY STAR Qualified. Only products whose qualification to performance or testing data has been substantiated according to the ENERGY STAR program rules for participation in the country for which the product claim is being made are able to be marketed as ENERGY STAR Qualified.

### 4.5.2 Product specific greenhouse gas emissions

#### 4.5.2.1 Optional—Product specific greenhouse gas emissions—life-cycle assessment

**Product criterion:** Manufacturers shall conduct an assessment of the complete cradle-to-grave life-cycle greenhouse gas (GHG) emissions of the product from raw material extraction through final disposal or end use by the consumer (i.e., the complete product carbon footprint) using PAS 2050:2008, the GHG Protocol, ISO 14067, or ISO 14040/14044.

**Applies to:** All covered products.

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<sup>28</sup> Available at [www.energystar.gov](http://www.energystar.gov) or [www.eu-energystar.org](http://www.eu-energystar.org).

**Verification requirements:**

- a) Declaration by manufacturer
- b) Identification of standard utilized

**References and details:** None available.

**4.5.2.2 Optional—Product specific greenhouse gas emissions—third-party verification or making LCA assessment publicly available**

**Product criterion:** Within 2 months of product registration, manufacturers shall either:

- Third-party verify results of the criterion in 4.5.2.1, *or*
- Make the summary of results of the LCA assessments (i.e., the total GHG emissions for each major life-cycle stage of the product) conducted under 4.5.2.1 both publicly available and submitted into a national database to improve lifecycle data quality

Manufacturers shall declare whether they conducted third-party verification or made the summary of results of the LCA assessment publicly available.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration by manufacturer
- b) Documentation of the assessment
- c) If third-party verification was conducted, a document confirming that the process used to determine results of LCA assessment conducted under 4.5.2.1 were verified by an independent third party in conformance with ISO 14064 and ISO 14065 carbon accounting and verification standards, or another method referenced in one of the standards referenced in 4.5.2.1 (PAS 2050:2011, the GHG Protocol, ISO 14067, ISO14040/14044, or ISO 14025). The document shall include credentials and contact information of third-party verifier.

*Or,*

- d) If the summary of results of the LCA assessment were made publicly available and results submitted into a national database:
  - 1) Documentation of where the summary of results is publicly available. Examples of where companies should disclose the summary of results of the LCA assessment include, but are not limited to: company Website, company annual sustainability report, industry sustainability index database if one is developed, public disclosure initiatives, and/or programs that publicly track and reduce GHG emissions specific to products.
  - 2) Listing of the credentials and name for responsible party for submitting into the LCA/LCI database (e.g., the LCACP name or registration number).

**References and details:** ISO 14025, ISO 14064, ISO 14065, ISO 14067, ISO14040/14044, PAS 2050:2011, GHG Protocol.



### 4.5.3 Lowest power level

#### 4.5.3.1 Required—Standby power level $\leq 1$ W and disclosure

**Product criterion:** In standby, the product shall have a load of  $\leq 1$  W as measured in accordance with IEC 62301 or ENERGY STAR relevant test method. The manufacturer shall provide information in the product documentation detailing how the standby power level is achieved.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Test report in accordance with IEC 62301 or ENERGY STAR relevant test method
- c) Available documentation demonstrating conformance in product documentation

**References and details:** For imaging equipment products addressed by this specification, the standby power level, usually occurs in *off* mode, but can occur in *ready* or *sleep*.

#### 4.5.3.2 Optional—Auto standby capability

**Product criterion:** The product shall automatically power down to a standby power level of  $\leq 1$  W. The auto standby function shall be enabled at product shipment.

For products where an auto standby function is inappropriate for the product's intended use, the capability to automatically enter a standby power of  $\leq 1$  W is included as an option that may be accessed by the user, but need not be enabled at shipment.

The manufacturer shall provide information in the publicly available product documentation detailing how the auto standby power function operates.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Publicly available product documentation detailing how the auto standby power level function operates
- c) Evidence that auto standby power level function is:
  - 1) Enabled at product shipment, or
  - 2) For products where an auto standby power level mode is inappropriate for the product's intended use, the capability is included as an option that may be accessed by the user. Documentation shall be provided demonstrating that a 1 W or less standby power level is inappropriate for the product's intended use.

**References and details:** For imaging equipment products addressed by this specification, the standby power level, usually occurs in *off* mode, but can occur in *ready* or *sleep*.

## 4.5.4 Duplexing

### 4.5.4.1 Optional—Default to automatic duplex printing

**Product criterion:** A product shall, when installed according to the manufacturer’s instructions, using the default *print drivers*, and using the default standard size media type and size settings, default to automatic duplexing for its printing mode. The manufacturer shall make publicly available and provide in the product documentation information demonstrating compliance with the criterion.

Products that do not have automatic duplex printing capability can declare “Not applicable” in the MSE Registry for this criterion.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration by manufacturer
- b) Evidence that the default to automatic duplex function is operational
- c) Publicly available and product documentation information demonstrating conformance

**References and details:** None available.

## 4.6 End-of-life management

### 4.6.1 Product take-back

#### 4.6.1.1 Required—Provision of product take-back service

**Annual Corporate Declaration Criterion:** Manufacturers shall provide a nationwide take-back service for reuse, refurbishment, and/or recycling for registered products and formerly registered products. The reuse, recycling and refurbishment programs should consider the hierarchy of management of used and end-of-life electronic equipment and components based on reuse, refurbishment, and/or materials recovery first, before considering energy recovery and/or disposal.

The manufacturer shall take responsibility for the provision of the take-back service. Manufacturer shall declare if there will be any direct costs to the consumer at the point of service for their consumer take-back service that conforms to this standard.

In jurisdictions where there are existing laws and/or regulations specifically to collect and recycle registered and formerly registered products, demonstration of compliance with those legal requirements will fulfill this requirement.

Notification of the take-back service, including how to utilize the service, shall be available to the purchaser through written or online documentation.

This criterion is applicable only in those countries or regions for which the product is declared on the MSE Registry.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation that take-back service for reuse, refurbishment and recycling services is offered nationwide in countries where the product is registered
- c) Documentation of notification to the purchaser of availability of take-back services, that includes how to utilize the take-back service (if applicable)
- d) Declaration stating if there will be any direct costs to the consumer at the point of service for manufacturer's consumer take-back service that conforms to this standard
- e) Documentation of compliance for areas of the country where the product is registered where laws and/or regulations establish a system for collecting and recycling registered and formerly registered products (if applicable)

**References and details:** Purchaser is not obligated to contract with manufacturer for take-back management services. Take-back management services may be provided via contracts or leases for commercial customers.

**4.6.1.2 Optional—Provision of take-back service for broader scope of products**

**Annual Corporate Declaration Criterion:** Manufacturers providing national take-back services, pursuant to 4.6.1.1, offer such national take-back service not only for products declared to conform IEEE Std 1680.2-2012, but also for all consumer electronics (defined as follows) that the company manufactures or manufactured, under all the brand names owned by the manufacturer. Further, the manufacturer provides annual disclosure on the company's Website of annual volumes collected by weight under this program, with the following data elements for each country in which the manufacturer is registering products:

- a) Volume of products collected in jurisdictions with local or federally mandated collection programs
- b) Volume of products collected voluntarily (efforts beyond required collection under local or federally mandated programs)
- c) Total volume of products collected

NOTE—If manufacturers collect in cooperative schemes with other manufacturers, reporting specifics herein should only reflect the reporting manufacturer's portion of the total collected, and not include totals that can be "claimed" by other manufacturers in their reports.

This criterion is applicable only in those countries or regions for which the product is declared on the MSE Registry.

**Applies to:** All types of products that the company manufactures or manufactured, under all the brand names owned by the manufacturer.

**Verification requirements:**

- 1) Declaration from manufacturer
- 2) Evidence of disclosure of the required volumes per the criterion, on the subscriber's Website

- 3) Evidence of the annual nature of the disclosure
  - Evidence of history of at least the disclosure from two consecutive years, including the disclosures, *or*
  - One annual disclosure and procedure/policy committing to the annual disclosure if only a single disclosure is available

**References and details:** *Consumer electronics* means electronic equipment, including, but not limited to, TVs, VCRs/DVDs/DVRs, home theater, handheld and software-based games, computers, printers, and Internet appliances.

## 4.6.2 Service provider standards

### 4.6.2.1 Required—End-of-life processing requirements

**Annual Corporate Declaration Criterion:** In jurisdictions where the manufacturer has control over the choice of initial service providers, manufacturer shall ensure that all equipment collected pursuant to 4.6.1.1 is managed by initial service providers that are certified on an ongoing basis to a qualified recycling standard<sup>29</sup> by independent certification bodies. These certification bodies shall be accredited by an IAF member accreditation body to certify to the specific qualified recycling standard. The take-back service providers that shall be certified are the initial service providers.

The following programs operated by the manufacturer (or their contractual agent) are exempt from this requirement:

- Management of leased products where the manufacturer (or their contractual agent) retains legal ownership.
- Trade-in/exchange programs where the customer surrenders the product to the manufacturer (or their contractual agent) in return for compensation or replacement product.
- Product servicing and/or warranty programs, operated by the manufacturer or their contractual agent, where a product (or similar product) is returned to a customer.

For the preceding exempted programs the manufacturer shall provide documentation that addresses the manufacturer's compliance with the legal requirements of importing, exporting and transit countries for transboundary trade to the point of repair or refurbishment.

In addition, manufacturers shall ensure that any residual equipment and components (including unrepairable equipment/components or equipment/components with no reuse value or market), scrap, and materials derived from equipment that result from these exempt programs are processed by a recycler certified to a qualified recycling standard and that any transboundary trade to the certified recycler meets the legal requirements of importing, exporting and transit countries.

The manufacturer may choose not to exercise these exemptions and instead shall certify these programs and the related contractual agent to a qualified recycling standard.

Qualified recycling standards shall meet the following requirements: A qualified recycling standard is any electronics recycling standard that is applicable in the country (or region) being declared to, that has an accredited certification program associated with it and required by it as of July 1, 2010. For any standard that does not meet these requirements, that standard shall meet the following:

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<sup>29</sup> The qualification process is defined in 1.5 of this standard. Prior to a subscriber claiming to meet any electronics recycling standard, that standard is first approved by the PRE and listed on an MSE website.

- a) The standard is applicable in the country (or region) being declared to.
- b) The standard states that if a requirement of the standard conflicts with applicable legal requirements, the initial service provider shall adhere to the legal requirements.
- c) The standard includes definitions of (1) covered equipment and (2) “materials of concern” (or analogous term identifying materials with toxic or hazardous characteristics) and requires initial service providers to have a written management plan for these materials that protects human health and the environment.
- d) The standard requires that initial service providers shall develop, document, fully implement, review annually, and update, as needed an environmental, health and safety management system.
- e) The standard only allows hazardous waste as defined by the importing country(s) or used and new electrical and electronic equipment and components or materials derived from them going for recycling, reuse, repair, refurbishment, remanufacturing and/or disposal, to be exported by any vendor in the recycling chain to countries that legally accept them, as determined by the competent authority of the importing countries.
- f) The standard requires that equipment/components going for reuse, repair or refurbishment shall be tested to confirm that key functions of the equipment/components are working properly, prior to export by any vendor in the recycling chain in conformance with the laws of the importing country, as determined by their competent authority.
- g) The standard disallows the initial service provider from utilizing the following:
  - 1) Incineration and waste-to-energy facilities for materials that contain mercury, halogenated compounds, and beryllium, at a minimum.
  - 2) Non-hazardous disposal facilities for disposing of equipment, components, or materials derived from them, which contain “materials of concern”, except as required by law.
- h) The standard requires that initial service providers shall control, document and track the material flow of all covered equipment, components and materials that pass through its facilities.
- i) The standard requires initial service providers to track all “materials of concern” (as defined by the specific standard) to final disposition, and to ensure that the downstream take-back service providers that process “materials of concern” are meeting the requirements of item c) through item i).

In countries where there are no initial service providers certified by accredited certification bodies to a qualified recycling standard, manufacturers shall have 18 months to utilize only initial service providers that meet all the preceding requirements. The grace period begins from the time the manufacturer first registers in the country where products are being registered. During the 18-month grace period, manufacturers shall only utilize initial service providers whose ongoing conformance to a qualified recycling standard has been confirmed through second- or third-party audits. Following the 18-month period, manufacturers shall provide take-back services that meet the requirements in 4.6.2.1.

Manufacturers are required to show ongoing conformance by providing evidence of certification to the qualified recycling standard(s) utilized by their initial service providers except as previously noted.

This criterion is applicable only in those regions or countries for which the product is declared on the MSE Registry.

**Applies to:** All products that are declared to conform to this standard.

**Verification requirements:**

- 1) Declaration from manufacturer
- 2) Complete list of subscriber’s initial service providers for the declared country/region

- 3) Declaration of which standard(s) in each country is being met by each initial service provider in each country
- 4) Evidence that the initial service providers utilized are performing take-back services to the declared qualified recycling standard
  - Copies/evidence of current certifications to the declared qualified recycling standard(s) utilized by all of their initial service providers, or
  - For use only during the 18-month grace period, copies of second- or third-party audit reports of their initial service providers indicating conformance to the declared qualified recycling standard(s)
- 5) For programs exempt from this criterion's requirements for certification to a qualified recycling standard, the manufacturer shall provide documentation of certification to qualified recycling standard, or documentation that addresses the manufacturer's compliance with the legal requirements of importing, exporting, and transit countries for transboundary trade to the point of repair or refurbishment
- 6) For programs exempt from this criterion's requirements for certification to a qualified recycling standard, the manufacturer shall provide evidence that residual equipment and components, scrap, and materials derived from equipment from these programs are processed by a recycler certified to a qualified recycling standard; and documentation that addresses the manufacturer's compliance with the legal requirements of importing, exporting, and transit countries for transboundary trade to the certified recycler

**References and details:** None available.

#### **4.6.2.2 Optional—Certification of programs exempt from end-of-life processing requirements**

**Annual Corporate Declaration Criterion:** All programs, operated by the manufacturer or a contractual agent that are exempt from the criterion in 4.6.2.1 are certified to a qualified recycling standard as outlined in 4.6.2.1.

This criterion is applicable only in those countries or regions for which the product is declared on the MSE Registry.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

#### **Verification requirements:**

- a) Declaration from manufacturer
- b) Declaration of which standard(s) is being met by each facility operated by the manufacturer or contractual agents for programs on the exempt list in 4.6.2.1
- c) Evidence that the facilities are certified to a qualified recycling standard
  - 1) Copies/evidence of current certifications to the declared qualified standard(s) for all facilities operated by the manufacturer or contractual agents for programs on the exempt list in criterion 4.6.2.1, or
  - 2) For use only during the 18-month grace period, copies of second- or third-party audit reports of the facilities indicating conformance to the declared qualified recycling standard(s)

**References and details:** None available.

## 4.7 Corporate performance

### 4.7.1 Environmental management system

#### 4.7.1.1 Required—Self-declared environmental management system for design and manufacturing organizations

**Annual Corporate Declaration Criterion:** Manufacturer shall have self-declared that the manufacturer-owned organizations that have significant responsibility for the design and manufacture of the declared product have an operational environmental management system (EMS) that meets either requirements of ISO 14001 or EU EMAS.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of self-declaration to ISO 14001 or EU EMAS

**References and details:** ISO 14001 and EU EMAS, or GSCP Environmental Module [B8].

#### 4.7.1.2 Optional—Third-party certified environmental management system for design and manufacturing organizations

**Annual Corporate Declaration Criterion:** Manufacturer shall certify that manufacturer-owned organizations that have significant responsibility for the design and manufacture of the declared product have registered ISO 14001 or EU EMAS EMSs.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation of registration to ISO 14001 or EU EMAS for all owned facilities

**References and details:** ISO 14001, EU EMAS, GSCP Environmental Module [B8].

### 4.7.2 Corporate reporting and public disclosure

#### 4.7.2.1 Required—Public disclosure of key environmental aspects

**Annual Corporate Declaration Criterion:** The manufacturer, either at the level of the whole enterprise or for those parts of the enterprise having significant or complete responsibility for the design and manufacture of the declared product, shall determine and make an annual public disclosure of the following key environmental aspects that are affected by the company's operations:

- a) *GHG emissions*: Total Scope 1 and 2 annual GHG emissions using an internationally agreed upon protocol or standard approach, such as the WRI/WBCSD GHG Protocol [B29] or other internationally recognized applicable standards.
- b) *Water*: Total water withdrawal by source, percentage and total volume of water recycled and reused, and total water discharge by quality and destination.
- c) *Waste*: All solid waste generated and any discards that have been reduced (from a defined base year), reused, or recycled, each element of the disclosure being expressed in units of metric ton. The disclosure will specify the amount of solid waste that is landfilled, sent to waste-to-energy, incineration, or other disposal facilities, as applicable.
- d) *Toxics*: All toxic chemical releases to land, water, and air from the company owned manufacturing, assembly facilities and office operations. Toxic chemicals listed on the U.S. EPA Toxics Release Inventory (TRI) when threshold quantities are met, or United Nations Protocol on Pollutant Release and Transfer Register lists shall at a minimum be determined *or* use of national reporting system for the country *or* default to the national reporting requirement of the country in which the manufacturer's headquarters is located.

Disclosure of each of the key environmental aspects shall be supported by documentation summarizing the manufacturer's performance in relation to that aspect as described by the following:

- Plan with goals, targets and objectives; last year's goals, targets and objectives and the actual performance against them; *and*
- A brief report on progress made in meeting the manufacturer's environmental performance commitments.

Additionally, the manufacturer shall provide a Web page where existing reports are available at the time of initial declaration, or public Website hyperlink(s) to a widely used repository(ies) where GHG, water, recycling activities, and toxics are reported and publicly available. At least two consecutive annual public disclosures shall be available, except that for the first 2 years of registration of products to this standard; if manufacturer does not have 2 years of annual public disclosures, the manufacturer shall operate a program to collect and disclose the required data on an annual basis.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

**Verification requirements:**

- 1) Declaration by the manufacturer
- 2) Documentation of the determination of the key environmental aspects
- 3) Summary and annual public disclosures to reside on manufacturer's public Website or hyperlink(s) to public repository(ies) where disclosures are available on the manufacturer's Website
- 4) Copy of previous two annual public disclosures or if the manufacturer does not have 2 years of annual public disclosures, documentation demonstrating the existence and operation of a program to collect and disclose the required data on an annual basis

**References and details:** ISO 14001 and EMAS, or GHG emissions: for example, see WRI/WBCSD GHG Protocol [B29].

Water: for example, see indicators EN8, EN10, and EN21 of GRI [B7].

Waste: for example, see indicators EN22 of GRI [B7].



Toxics: U.S EPA Toxics Release Inventory.

United Nations Protocol on Pollutant Release and Transfer Register.

#### 4.7.2.2 Optional—Public disclosure of supply chain toxics

**Annual Corporate Declaration Criterion:** Manufacturers shall obtain and publicly disclose for at least one registered product, the toxics release data of chemicals, listed on the TRI, United Nations Protocol on Pollutant Release and Transfer Register, or the applicable country's Protocol on Pollutant Release and Transfer Register of at least three major suppliers for three of the six following listed parts/component suppliers. The toxics release data obtained by the individual suppliers can reflect the whole enterprise or the individual organization(s) that has manufacturing responsibility of the following parts/components:

- 1) Display
- 2) External power supply (EPS)
- 3) Unpopulated printed circuit board
- 4) Lamp
- 5) Motor
- 6) Integrated circuit/semiconductor

The manufacturer shall provide a Web page where information is available at the time of initial declaration, or public Website hyperlink(s) to a widely used repository.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

#### Verification requirements:

- a) Declaration by the manufacturer
- b) Documentation of the determination of toxics
- c) Copy of previous two annual public disclosures *or* copy of most recent annual public disclosure and the policy establishing the annual nature of the public disclosure
- d) Link to annual public disclosure or hyperlink available on the manufacturer's Website

**References and details:** U.S. EPA Toxics Release Inventory; United Nations Protocol on Pollutant Release and Transfer Register.

#### 4.7.3 Life-cycle assessment

##### 4.7.3.1 Optional—Product life-cycle assessment and public disclosure of analyses

**Annual Corporate Declaration Criterion:** Manufacturers shall conduct a complete life-cycle assessment on any one product covered under the scope of this standard. The life-cycle assessment shall cover from raw material extraction through final disposal in accordance with ISO 14044. The manufacturer shall make the results publicly available by the following:

- a) Submitting the LCA for use in a national database (such as the U.S. LCI Database [B25], the European LCA Platform Database [B4], or the LCA Society of Japan Database [B16]), or other public disclosure system; *or*
- b) Publishing in a peer reviewed LCA journal or through an Environmental Product Declaration (EPD) Type III label that is in accordance with ISO 14025.

Manufacturers may enter into voluntary agreements with the databases and public disclosure systems referenced above to keep proprietary information confidential.

Secondary data sources used in the LCA shall be made publicly available via the company Website, company annual sustainability report, industry sustainability index database if one is developed, other relevant databases, or public disclosure systems.

**Applies to:** All manufacturers with products declared to conform to this standard.

**Verification requirements:**

- 1) Declaration by manufacturer
- 2) Documentation of data contribution by the relevant database operator, or
- 3) Documentation of publication of LCA in peer-reviewed LCA journal or *environmental product declaration* (EPD) label in accordance with ISO 14025

**References and details:** None available.

## 4.8 Packaging

### 4.8.1 Constituents in packaging

#### 4.8.1.1 Required—Elimination of intentionally added heavy metals in packaging

**Product criterion:** Heavy metals—lead, cadmium, mercury, and hexavalent chromium—shall not be intentionally added to any package or packaging component. For incidental presence, the sum of the concentrations of lead, cadmium, mercury, and hexavalent chromium present in any packaging component shall not exceed 100 ppm by weight, with the exception of packaging components that qualify for the recycled content exemption cited in References and details.

**Applies to:** Packaging of products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Supplier letter(s) for each packaging component that certifies to:
  - 1) No intentional addition of the specified heavy metals in any package or packaging component; *and*
  - 2) That the sum of the concentration of the four metals present in any packaging component does not exceed 100 ppm by weight, or 200 ppm by weight for recycled content materials, *or*
- c) Documentation of a conformance assurance system that demonstrate conformity to this criterion through effective control of the supply chain.

**References and details:** This criterion is drawn from the Model Toxics in Packaging Legislation [B17], which is available online through the Toxics in Packaging Clearinghouse.

“Recycled content exemption” is specified in the Model Toxics in Packaging Legislation as the following: packaging components that would not exceed the maximum contaminant levels, i.e., the sum of the concentration levels of lead, cadmium, mercury, and hexavalent chromium present in any packaging component shall not exceed 100 ppm by weight but for the addition of recycled materials; and provided that none of the four regulated metals in the packaging components has been recovered and/or separated from other materials for use as a metal or metallic compound; and provided that the packaging components do not exceed a maximum concentration limit of 200 ppm by weight for the sum of the four regulated metals.

Analytical testing is not required for verification to this criterion. However if testing is undertaken, the selected test methods should be appropriate for measuring total concentration of the restricted metals in the substrate. For example, energy dispersive X-ray fluorescence spectrometry can be used with limitation to quantitatively determine the amount of heavy metals in polymeric materials (lead, cadmium, mercury, and total chromium) by following ASTM F 2617-08. This method does not determine hexavalent chromium. Materials that exceed 100 ppm chromium with this method should be further analyzed using destructive wet testing methods. Laboratory analysis for total metals in polymeric and other materials can be performed using procedures such as EPA SW-846 Method 3052 [B24] and IEC 62321:2008 [B10].

#### **4.8.1.2 Required—Elimination of elemental chlorine as a bleaching agent in packaging material**

**Product criterion:** Manufacturer shall state in the manufacturer’s environmental packaging requirement that elemental chlorine shall not be used as a bleaching agent to bleach virgin or recovered content fibers used in product packaging.

**Applies to:** Packaging of products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Copy of manufacturer’s environmental packaging requirement

**References and details:** None available.

#### **4.8.2 Recyclable packaging materials**

##### **4.8.2.1 Required—Separable packaging materials**

**Product criterion:** All dissimilar packaging materials shall be separable without the use of tools (e.g., foam shall not be permanently adhered to any other type of packaging material). Exceptions include the following:

- a) Plastic bags (or wrap) affixed with paper labels that meet either of the following criteria:
  - 1) Combined weight of single bag (or wrap) and label is less than 25 g
  - 2) Surface area of label is less than 50 cm<sup>2</sup>

- b) Pallets or pallet assemblies that are part of the primary package.
- c) Tape, glue, or staples used to construct or close a fiber-based container.

**Applies to:** Packaging of products that are declared to conform to this standard.

**Verification requirements:**

- 1) Declaration from manufacturer
- 2) Documentation demonstrating feasibility of disassembly of dissimilar packaging materials without tools and identifies permissible exemptions. Includes one of the following:
  - Manufacturer's packaging part or assembly drawing
  - Manufacturer's disassembly instructions
  - Trial packaging disassembly report
  - Statement from a minimum of three recyclers individually, or at least one recycler working under an independent entity that is not a trade organization, confirming that the packaging design meets the requirements of this criterion

**References and details:** None available.

#### 4.8.2.2 Optional—Packaging 90% compostable/recyclable

**Product criterion:** At least 90% of packaging (by weight) shall consist of materials that are compostable, fiber based or recyclable as determined herein.

- 1) Materials considered compostable shall meet one of the following:
  - ASTM D6400
  - ASTM D6868
  - EN 13432
  - ISO 17088
- 2) Materials considered to be fiber-based shall be fully derived from natural fiber such as wood, hemp, kenaf, palm, bamboo, and bagasse.
- 3) Materials considered recyclable shall meet one of the following in the country in which the product is declared to this standard:
  - Material is recycled at a national rate of at least 15% by weight.
  - At least 65% of the country's population has local access to drop-off or collection services for the material in its converted form.
  - The packaging material is covered by a nationally mandated packaging recycling scheme in which the manufacturer participates and has a minimum recycling goal of 15% by weight.

Pallets that are part of the primary package, including integrated pallets, are included in the weight calculation. This criterion is dependent on the region or country and may be declared by a manufacturer differently in different regions or countries.

**Applies to:** Packaging of products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) List of all packaging materials with designation of whether material is compostable, fiber-based, or recyclable
- c) Documentation of calculation showing total weight of non-recyclable or non-compostable material is less than 10% of total package weight
- d) Documentation supporting claim for materials, excluding fiber-based materials, considered compostable and/or recyclable
  - 1) For a compostable material, provide one of the following indicating that the material meets ASTM D6400, ASTM D6868, EN 13432, or ISO 17088: data sheet, supplier letter with reference to specification met, or test results from an accredited laboratory
  - 2) For a recyclable material, provide documentation that is applicable to the country in which the product is declared, from a governmental or non-governmental organization, but not a material trade association, that:
    - i) the material is recycled at a national rate of at least 15% by weight; *or*
    - ii) 65% of the country's population has local access to drop-off or collection services for the material in its converted form; *or*
    - iii) manufacturer participates in a nationally mandated packaging recycling scheme that includes collection of the material with a minimum recycling goal of 15% by weight.

**References and details:** The following resources provide information on material collection rates and/or collection accesses data. This list may not be comprehensive and in no way shall it be interpreted to limit options for supporting recyclable claims.

European Organization for Packaging and the Environment [B6].

Japan, Ministry of the Environment [B15].

United Kingdom, WRAP and British Retail Consortium [B28].

United States, U.S. EPA [B22].

**4.8.2.3 Required—Plastics marked in packaging materials**

**Product criterion:** All plastics shall be marked by material type (ISO 11469 referring ISO 1043, SPI resin identification code, DIN, or country specific). Marking requirement does not apply to plastic parts weighing less than 25 g or with surface area less than 50 cm<sup>2</sup>; tape; plastic protective and stretch wraps and labels; or plastic pieces when due to shape marking is not possible.

For products with packaging that does not contain any plastics, manufacturers may declare “Not applicable” on the MSE Registry.

**Applies to:** Packaging of products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Photographs, physical evidence, or engineering specifications of the plastic components

**References and details:** None available.

### 4.8.3 Recovered content in packaging materials

#### 4.8.3.1 Required—Recovered content in select fiber-based packaging materials

**Product criterion:** The following packaging materials—paperboard, corrugated fiberboard, solid fiberboard, and spiral wound tubes—shall meet or exceed the minimum total recovered fiber content specified in the table below. In the manufacturer’s environmental packaging requirement, the manufacturer shall state a preference for the use of postconsumer content in packaging.

For products with packaging that does not contain any of the materials identified, manufacturers may declare “Not applicable” on the MSE Registry.

**Table 1—Minimum total recovered fiber content**

| Category                           | Comments / examples                                    | Total recovered fiber content <sup>a</sup> |
|------------------------------------|--|--|
| Paperboard                         | Boxboard<br>Chipboard<br>Barrier board<br>Carton board | 80%  |
| Corrugated fiberboard <sup>b</sup> | Container board<br>Linerboard<br>Corrugated medium     | 25%  |
| Solid fiberboard                   | —  | 40%  |
| Spiral wound tubes                 | Comprised of paper only                                | 90%  |

<sup>b</sup> Required content based on weighted average (by weight) of all components in packaging part (e.g., liners and mediums in corrugated).

<sup>a</sup> Calculated as percent of total packaging part weight over the course of a year using a weighted average.

**Applies to:** Packaging of products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) List of applicable packaging materials with corresponding category as specified
- c) Supplier letter(s) from first tier suppliers of each applicable material that:
  - 1) Names the manufacturer to which the material is being supplied; *and*
  - 2) Specifies the material and attests that it has a recovered fiber content of at least *x*% (as specified in the table in the criterion) by weight over the course of a year using a weighted average, or as a minimum percentage.
- d) Copy of manufacturer’s environmental packaging requirement

**References and details:** None available.

#### 4.8.4 Take-back option for packaging materials

##### 4.8.4.1 Optional—Provision of take-back service for packaging

**Annual Corporate Declaration Criterion:** Manufacturer shall offer a take-back service for all packaging materials that are *not* fiber-based. Manufacturer shall declare if there will be any direct costs to commercial customers for this packaging take-back service. Packaging materials requiring take-back shall be collected/returned to the manufacturer or its designee for reuse or recycling. The manufacturer shall give consideration to the end use (reuse or recycling) with the higher environmental benefit. Manufacturer shall notify purchaser of the availability of the take-back service.

This criterion is dependent on the region or country and may be declared by a manufacturer differently in different regions or countries.

Manufacturers that do not sell products to institutions shall declare “Not applicable” for this criterion on the MSE Registry.

**Applies to:** All manufacturers with products declared to conform to this standard that are marketed and sold directly to institutions, regardless of whether the product is classified as commercial or consumer.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation indicating that the manufacturer gave consideration to reuse options
- c) Documentation of take-back service available at the time of service for all packaging that are not fiber-based, which can include evidence of the manufacturer’s bona fide participation in a region or country-specific packaging take-back scheme
- d) Declaration stating if there will be any direct costs to commercial customers for this packaging take-back service
- e) Documentation of notification to purchaser of take-back service
- f) Documentation that packaging materials collected through the take-back service are delivered to a processor for reuse or recycling

**References and details:** Region or country-specific take-back schemes shall provide an infrastructure for recycling or reuse in the specific country (ies) being declared to in the product declaration.

#### 4.9 Consumables

##### 4.9.1 General office paper

###### 4.9.1.1 Required—Allow use of general office paper with renewable content, recycled content, and that is chlorine free

**Product criterion:** The product allows the use of general office paper with renewable content, and paper with pre/postconsumer recycled content, and paper that is chlorine free. Documentation that the product allows the use of these types of paper is readily available or has been provided to the purchaser. For example, documentation types may include the following:

- a) An owner's manual, set-up instructions, label or other information provided with the product, *or*
- b) Warranty and/or service contract provided with the product, *or*
- c) Information on the manufacturer's Website, such as included in product specification or as a policy statement, etc.

The manufacturer may require that paper shall meet standard paper quality requirements such as EN 12281:2002 [B5].

Products that do not have a paper printing function can declare "Not applicable" for this criterion on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- 1) Declaration from manufacturer
- 2) Documentation that the product allows use of general office paper with renewable content, and paper with pre/postconsumer recycled content, and paper that is chlorine free, is readily available, or has been provided to the purchaser

**References and details:** None available.

#### **4.9.2 Allow use of non-manufacturer cartridges and non-manufacturer containers**

##### **4.9.2.1 Required—Documentation that product does not prevent the use of non-manufacturer cartridges and non-manufacturer containers**

**Product criterion:** Manufacturer shall make documentation readily available and available upon request to the purchaser stating that the machine is not designed to prevent the use of a non-manufacturer cartridge or non-manufacturer container.

Examples of documentation that will satisfy the requirements of this criterion and should be readily available and available upon request to the purchaser include, but are not limited to, an owner's manual; set-up instructions, label or other information provided with the product; or information on the manufacturer's Website, such as a product specification or a policy statement.

Products that do not use a cartridge or container as part of the paper printing function can declare "Not applicable" for this criterion on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation that the required information is readily available and available upon request to the purchaser
- c) Documentation that the information from item b) meets the requirements of the criterion

**References and details:** Lack of availability of remanufactured or refilled cartridges and containers in the marketplace is not adequate evidence of non-conformance. Customer demand and size of printer-installed base will drive non-manufacturer investment in cartridges or containers.



Imaging equipment product performance related to the use of the cartridge and container is the responsibility of that cartridge or container brand owner.

### 4.9.3 End-of-life management for cartridges and containers

#### 4.9.3.1 Required—Provision of take-back and end-of-life management for cartridges and containers

**Annual Corporate Declaration Criterion:** Manufacturer provides a take-back service for toner and ink cartridges and containers for end-of-life management for at least registered and formerly registered products. In the case of containers, the manufacturer can advocate local recycling of toner and ink containers but offers take-back for such items if a local recycling option is not identified by the end user.

Landfill disposal and incineration are not used as part of the manufacturer take-back program for registered and formerly registered products. Waste-to-energy conversion may be used as an acceptable, but not preferable, disposition process when necessary for some materials. Secondary or residual materials resulting from waste-to-energy processes are exempt from this requirement.

Additionally, on an annual basis, manufacturer shall provide on its Website the end-of-life management methods for all cartridges and containers that are collected through its take-back program. Manufacturers shall report the following:

- a) Total tonnage of cartridges and containers collected annually (in metric tons)
- b) Total tonnage of materials sent to each of the following end-of-life management methods as a proportion of total collected weight of cartridges and containers
  - Reuse of components
  - Materials recycling
  - Waste-to-energy
  - Material in storage, pending processing
  - Incineration (incineration cannot be used for registered or formerly registered products)
  - Landfill (landfill cannot be used for registered or formerly registered products)

Manufacturers shall declare the Website location of the preceding required information. Reporting shall be done at the global level and/or at the region or country level and shall be for all cartridges and containers collected through its take-back program for that geographic region.

The take-back requirement is applicable only in those regions or countries for which the manufacturer has products declared on the MSE Registry. Cartridges or containers not manufactured under the registered trademark of the manufacturer provider of the imaging equipment are exempt from this requirement.

Manufacturers that do not have any products on the Registry that use toner cartridges or containers can declare “Not applicable” for this criterion on the Registry.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

**Verification requirements:**

- 1) Declaration from manufacturer
- 2) Documentation that a take-back service for cartridges and containers is available to the end user
- 3) Declaration of the Website location documenting end-of-life management methods
- 4) Documentation that landfill disposal and incineration are not used as part of the take-back program for registered and formerly registered products

**References and details:** Manufacturer can advocate local recycling of toner and ink containers in order to reduce possible environmental footprint from collection transportation associated with these products. Advocacy can take the form of information on manufacturer's Website, product packaging or user manuals, etc.

**4.9.3.2 Optional—Manufacturer recycles or reuses toner material collected through its cartridge and container take-back program**

**Annual Corporate Declaration Criterion:** In accordance with the priorities of the waste hierarchy, manufacturer ensures that toner material collected through its cartridge and container take-back program for at least registered and formerly registered products is reused or recycled and that none is disposed of through a landfill or incineration option. Disposal through waste to energy of up to 25% of the total weight of toner material collected through this program is allowed. More than 25% may be sent to waste to energy where applicable local, national, or regional regulations dictate that toner material, regardless of composition, shall be sent to waste to energy. The manufacturer shall provide on its Website information confirming conformance with this requirement.

The requirement is applicable only in those regions or countries for which the manufacturer has products declared on the MSE Registry. Cartridges or containers not manufactured under the registered trademark of the manufacturer provider of the imaging equipment are exempt from this requirement.

Manufacturers that do not have any products on the Registry that use toner cartridges or containers can declare "Not applicable" for this criterion on the Registry.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation that the required information is readily available on the manufacturer's Website

**References and details:** The percentage of disposal through waste to energy is calculated as weight of toner sent to waste to energy divided by the total toner collected (by weight).

**4.9.3.3 Optional—Manufacturer recycles or reuses plastics collected through its cartridge and container take-back program**

**Annual Corporate Declaration Criterion:** In accordance with the priorities of the waste hierarchy, manufacturer ensures that plastic collected through its cartridge and container take-back program for at least registered and formerly registered products is reused or recycled and that none is disposed of through a landfill or incineration option. Disposal through waste to energy of up to 25% of the total weight of plastic collected through this program is allowed. More than 25% may be sent to waste to energy where applicable local, national, or regional regulations dictate that plastic, regardless of composition, shall be

sent to waste to energy. The manufacturer shall provide on its Website information confirming conformance with this requirement.

The requirement is applicable only in those regions or countries for which the manufacturer has products declared on the MSE Registry. Cartridges or containers not manufactured under the registered trademark of the manufacturer provider of the imaging equipment are exempt from this requirement.

Manufacturers that do not have any products on the Registry that use cartridges or containers can declare “Not applicable” for this criterion on the Registry.

**Applies to:** All manufacturers with products that are declared to conform to this standard.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Documentation that the required information is readily available on the manufacturer’s Website

**References and details:** The percentage of disposal through waste to energy is calculated as the weight of plastic sent to waste to energy divided by the total plastic collected (by weight).

#### **4.9.4 Not inhibiting reuse and recycling of cartridges or containers**

##### **4.9.4.1 Required—Documentation that the cartridge or container is not designed to prevent its reuse and recycling**

**Product criterion:** Manufacturer shall provide documentation that is readily available and provided to the purchaser stating that any cartridge or container produced by or recommended by the manufacturer for use in the product is not designed to prevent its reuse and recycling.

Examples of documentation that will satisfy the requirements of this criterion and should be readily available and provided to the purchaser include, but are not limited to, an owner’s manual; set-up instructions; or information on the manufacturer’s Website, whereby a purchaser received a URL or hard/electronic copy of a product specification or a policy statement that is available on the manufacturer’s Website.

Products that do not use a cartridge or container as part of the printing function can declare “Not applicable” for this criterion on the MSE Registry.

**Applies to:** All covered products.

**Verification requirements:**

- a) Declaration from manufacturer
- b) Demonstration that the documentation meets the requirements of this criterion
- c) Documentation that the required information is readily available and provided to the purchaser

**References and details:** None available.

## 4.10 Indoor air quality

### 4.10.1 Indoor air quality emissions

#### 4.10.1.1 Required—Indoor air quality emission requirements

**Product criterion:** Manufacturers shall declare if the product is either:

- a) A standard format black-and-white device that outputs a hard copy with print speeds up to 65 images per minute (ipm) *or*
- b) A standard format color device that outputs a hard copy with print speeds up to 50 ipm

Products that do not meet either of the above conditions have no additional requirements. This criterion does not apply to imaging devices whose sole print function is a date stamp, postage, or document counter. For products that meet either of these conditions, manufacturers may declare “Not applicable” on the MSE Registry.

*And,*

Products that do meet either of the preceding conditions shall not exceed the emission rate of any of the substances listed in Table 2 when using the manufacturer specified or provided cartridge and when tested in accordance with ISO/IEC 28360 in force at the time testing was performed, using the Blue Angel RAL-UZ 122 options for emission calculation methods.

**Table 2—Emission rates**

| Substance | Emission rate—print phase (mg/h)               |   |
|-----------|--|---|
|           | Color printing<br>total in ready + print phase | Monochrome printing<br>total in ready + print phase |
| TVOC      | 18   | 10  |
| Benzene   | <0.05  | <0.05   |
| Styrene   | 1.8  | 1.0   |
| Ozone     | 3.0  | 1.5   |
| Dust      | 4.0  | 4.0   |

**Applies to:** All covered products.

**Verification requirements:**

- 1) Declaration from manufacturer
- 2) Documentation of emission rates for each of the five substance categories, including a statement that the emission rates have been determined according to ISO/IEC 28360 in force at the time testing was performed, using the Blue Angel RAL-UZ 122 option for emission calculation methods
- 3) Upon request from the PRE, the manufacturer will provide a full test report or evidence of product certification from a laboratory accredited to ISO 17025 with the ISO/IEC 28360 and RAL-UZ 122 standards within the scope of accreditation and that participates in a qualified round-robin testing program. The PRE may allow additional time for providing this evidence.

**References and details:** An example of a qualified independent round robin testing program is one conducted by BAM (Federal Institute for Materials Research and Testing).

If two devices of identical design differ in their maximum print speed, the product printing at higher speed shall be tested. The result is considered as transferable to those products of identical design whose print speed falls short of the maximum print speed by not more than 20%. When there are three or more devices of identical design printing at different speeds the product printing at highest speed and another one featuring a lower print speed shall be tested.

Provided that the emission rate determined also meets the limit values for monochrome printing when printing the color test page no additional testing of color equipment will be required for monochrome printing.

For the definition of *standard format*, see the ENERGY STAR Imaging Equipment Specification.

## Annex A

(informative)

### Bibliography

Bibliographical references are resources that provide additional or helpful material but do not need to be understood or used to implement this standard. Reference to these resources is made for informational use only.

[B1] ASTM D6866, Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis.<sup>30</sup>

[B2] ASTM F2617-08.

[B3] European Chemicals Agency.<sup>31</sup>

[B4] European LCA Platform Database.<sup>32</sup>

[B5] EN 12281:2002, Printing and Business Paper.<sup>33</sup>

[B6] European Organization for Packaging and the Environment—European—Official EU-27 plus Iceland, Liechtenstein and Norway Packaging and Packaging Waste Statistics.<sup>34</sup>

[B7] Global Reporting Initiative (GRI), Sustainability Reporting Guidelines.<sup>35</sup>

[B8] GSCP Environmental Module.<sup>36</sup>

[B9] IEC 61249-2-21 ed. 1.0, Materials for printed boards and other interconnecting structures—Part 2-21: Reinforced base materials, clad and unclad—Non-halogenated epoxide woven E-glass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad, published 2003-11-12.<sup>37</sup>

[B10] IEC 62321:2008 ed. 1.0, Electrotechnical products—Determination of levels of six regulated substances (lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, polybrominated diphenyl ethers).

[B11] IEC 62554 ed. 1.0, Sample preparation for measurement of mercury level in fluorescent lamps, published 2011-08-19.

[B12] International Accreditation Forum (IAF).<sup>38</sup>

[B13] IPCC Guidelines for National Greenhouse Gas Inventories, 2006, Volume 3 Chapter 6, pp. 6.20.<sup>39</sup>

[B14] ISO 14021:1999, Environmental labels and declarations—Self-declared environmental claims (Type II environmental labelling).<sup>40</sup>

[B15] Japan, Ministry of the Environment—Implementation Status of Sorted Collection and Recycling by Municipalities; State of Sorted Collection and Recycling of Used Containers and Packaging.<sup>41</sup>

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<sup>30</sup> ASTM publications are available from the American Society for Testing and Materials (<http://www.astm.org/>).

<sup>31</sup> Available at [www.echa.europa.eu/home\\_en.asp](http://www.echa.europa.eu/home_en.asp).

<sup>32</sup> Available online at <http://lca.jrc.ec.europa.eu/lcainfohub/index.vm>.

<sup>33</sup> Available at <http://www.en-standard.eu/>.

<sup>34</sup> Available at <http://www.europen.be/?action=onderdeel&onderdeel=3&titel=Key+Topics&categorie=2&item=19>.

<sup>35</sup> GRI guidelines are available at <http://www.globalreporting.org/Home>.

<sup>36</sup> Available online at <http://gscpnet.com/working-plan/environmental-module.html>.

<sup>37</sup> IEC publications are available from the International Electrotechnical Commission (<http://www.iec.ch/>). IEC publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

<sup>38</sup> Information available at <http://www.iaf.nu/>

<sup>39</sup> Available online at <http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html>.

<sup>40</sup> ISO publications are available from the ISO Central Secretariat (<http://www.iso.org/>). ISO publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

<sup>41</sup> Available at <http://www.env.go.jp/en/recycle/>.

- [B16] LCA Society of Japan (JLCA) Database.<sup>42</sup>
- [B17] Model Toxics in Packaging Legislation [compilation was developed by CONEG and is administered by the Toxics in Packaging Clearinghouse (TPCH)].<sup>43</sup>
- [B18] NIOSH Pocket Guide.<sup>44</sup>
- [B19] Office of Management and Budget Circular 119.<sup>45</sup>
- [B20] U.S. Consumer Product Safety Commission Test Method CPSC-CH-E1002-08.<sup>46</sup>
- [B21] U.S. EPA IRIS Glossary.<sup>47</sup>
- [B22] U.S. EPA Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Detailed Tables and Figures.<sup>48</sup>
- [B23] U.S. EPA Protocol for Measuring Destruction or Removal Efficiency (DRE) of Fluorinated Greenhouse Gas Abatement Equipment in Electronics Manufacturing, Version 1, March 2010.<sup>49</sup>
- [B24] U.S. EPA SW-846 Method 3052.<sup>50</sup>
- [B25] U.S. LCI Database.<sup>51</sup>
- [B26] U.S. National Institute of Standards and Technology BEES Program.<sup>52</sup>
- [B27] United Kingdom, RoHS Enforcement Guidance.<sup>53</sup>
- [B28] United Kingdom, WRAP and British Retail Consortium. On-pack recycling label.<sup>54</sup>
- [B29] WRI/WBCSD GHG Protocol for Corporate GHG Emissions Reporting.<sup>55</sup>

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<sup>42</sup> Available at <http://lca-forum.org/english/>.

<sup>43</sup> Available at <http://www.toxicsinpackaging.org/>.

<sup>44</sup> Available at <http://www.cdc.gov/niosh/npg/>.

<sup>45</sup> Available at [www.whitehouse.gov/omb/circulars\\_a119](http://www.whitehouse.gov/omb/circulars_a119)

<sup>46</sup> Available at <http://www.cpsc.gov/about/cpsia/CPSC-CH-E1002-08.pdf>.

<sup>47</sup> Available at <http://www.epa.gov/iris/>.

<sup>48</sup> Available at <http://www.epa.gov/epawaste/nonhaz/municipal/msw99.htm>.

<sup>49</sup> Available at [http://www.epa.gov/semiconductor-pfc/documents/dre\\_protocol.pdf](http://www.epa.gov/semiconductor-pfc/documents/dre_protocol.pdf).

<sup>50</sup> Available at <http://www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/3052.pdf>.

<sup>51</sup> Available at <http://www.nrel.gov/lci/>.

<sup>52</sup> Available at <http://www.nist.gov/el/economics/BEESSoftware.cfm>.

<sup>53</sup> Available at <http://www.bis.gov.uk/nmo/enforcement/rohs-home/duo-diligence>.

<sup>54</sup> Available at <http://www.onpackrecyclinglabel.org.uk>.

<sup>55</sup> Available at <http://www.ghgprotocol.org/>.