

HAZARDOUS WASTE IDENTIFICATION GUIDE

ANNEX 4-2

CLASSIFICATION OF WEEE

Normal use of electrical and electronic equipment ('EEE') does not pose a risk to human health or the environment as 'a significant proportion of hazardous substances are in solid, non-dispersible form'. However, when EEE becomes waste, these hazardous substances may be released into the environment through recycling or other treatment of WEEE.

The most common components of EEE containing hazardous substances are:

- transponder boards;
- mercury-containing components;
- plastic housings, cables;
- insulating foam;
- cooling agents;
- flame retardants¹;
- activated glass;
- cathode ray television picture tubes;
- capacitors;
- Ni-Cd batteries.

Considering the composition of EEE and the waste codes assigned to certain WEEE in both Great Britain and Lithuania², the list of WEEE and waste codes assigned to WEEE has been drawn up, including the aspects affecting the classification of waste as hazardous (see Table 1).

Table 1. Waste codes assigned to certain WEEE.

Type of waste	Waste properties	List of waste code	
		Household EEE	Non-household EEE
Temperature exchange equipment			
Components such as transponder boards containing nickel, engines and pumps containing oil, coolants and any plastic parts that may contain hazardous chemicals. Coolants and foams are also dangerous. Typically, there is not enough POP to classify the item as POP waste.			
freezing equipment containing freon (refrigerators, freezers, air conditioning equipment, automatic dispensers of frozen products, etc.), i.e. this equipment contains ozone depleting substances such as coolants, foaming/blowing agents.	Hazardous	20 01 23*	16 02 11*
Freezing equipment without freon (refrigerators, freezers, etc., air conditioning, other equipment that uses hazardous liquids to exchange temperature); Radiators containing oil and other equipment for exchanging temperature using hazardous liquids to exchange	Hazardous	20 01 35*	16 02 13*

¹A chemical agent that improves the firing resistance of an installation or part of an installation.

² Recommendations on the classification of equipment as EEE and its individual categories prepared by the Environment Agency (2012).

Type of waste	Waste properties	List of waste code	
		Household EEE	Non-household EEE
temperature.			
EEE without hazardous components (electric radiators using water or other non-hazardous liquid to exchange temperature; electric fans, steam extraction equipment, dehumidifying (drying) equipment, heat pumps, air conditioning equipment without hazardous fluids)	Non-hazardous	20 01 36	16 02 14
screens, monitors, and equipment containing screens with a surface greater than 100 cm² WEEE may include hazardous components: activated glass, cathode ray tubes (CRT), fluorescent lighting, transponder boards (containing nickel), capacitors, Ni-Cd batteries for portable devices.			
Cathode ray tubes (CRT), LCD screens (for laptops and notebooks, photo frames, televisions, and computer monitors), etc.	Hazardous	20 01 35*	16 02 13*
Plasma screens, LED screens (for laptops and notebooks, televisions, and computer monitors, etc.)	Non-hazardous	20 01 36	-
Lamps			
Straight fluorescent lamps, compact fluorescent lamps, fluorescent lamp bulbs, energy efficient lamps, high intensity discharge lamps, including pressure sodium lamps, metal halide lamps and low-pressure sodium lamps.	Hazardous	20 01 21*	16 02 13*
LED, halogen, and incandescent lamps, not containing dangerous components	Non-hazardous	20 01 36	16 02 14
Large equipment (any external dimension greater than 50 cm) Components such as transponder boards, motors or any plastic parts may contain hazardous chemical substances.			
Large EEE (printing, copying equipment, etc.)	Hazardous	20 01 35*	16 02 13*
Large EEE (any external dimension greater than 50 cm) without dangerous components (e.g. washing machines, dryers, dishwasher cooking appliances, electric cookers, electric cookers, lights, sound or image reproduction equipment, musical equipment (excluding church	Non-hazardous	20 01 36	16 02 14

Type of waste	Waste properties	List of waste code	
		Household EEE	Non-household EEE
organs), knitting and weaving equipment, universal kits (server kits), microwave ovens, water heaters, photovoltaic boards, etc.)			
Large EEE (large coin-operated apparatus, large medical devices (excluding implanted and infected products), large monitoring and control devices, large automatic product, and money dispensers)	Non-hazardous	-	16 02 14
<p>Small EEE (no external dimension greater than 50 cm)</p> <p>This includes small household-type electrical and electronic equipment assembled from residents or businesses.</p> <p>Components such as screens, boards, batteries, or any plastic parts may contain hazardous chemical substances.</p>			
Small EEE (none of the external dimensions exceeding 50 cm) containing hazardous waste (e.g. ionisation smoke detectors, portable DVD players with LCD screens, power sources (UPS), etc.)	Hazardous	20 01 35*	-
Small EEE (none of the external dimensions exceeding 50 cm) not containing hazardous components (e.g. vacuum cleaners, carpet sweepers, appliances for sewing, luminaires, microwaves, coffee machines, electric grills, ventilation equipment, irons, toasters, electric knives, electric kettles, clocks and watches, electric shavers, scales, appliances for hair and body care, calculators, radio sets, video cameras, video recorders, hi-fi equipment, musical instruments, equipment reproducing sound or images, electrical and electronic toys, sports equipment, computers for biking, diving, running, rowing, etc., photoelectric smoke detectors, heating regulators, thermostats, small electrical and electronic tools, small medical devices (except for implanted and infected products), small monitoring and control instruments, small appliances which automatically deliver products, small equipment with integrated photovoltaic panels. etc.)	Non-hazardous	20 01 36	-

Type of waste	Waste properties	List of waste code	
		Household EEE	Non-household EEE
Small IT and telecommunications equipment (no external dimension greater than 50 cm). This is WEEE not listed above and is separated from small mixed WEEE. Hazardous components may include transponder boards, motors, pumps, some batteries, lamps and bulbs, displays, capacitors, ink or toner cartridges, asbestos, mercury switches, or components may contain POPs.			
EEE with hazardous components (e.g. old mobile phones, PCs, printers, etc.)	Hazardous	20 01 35*	16 02 13*
EEE without hazardous components (e.g. smart mobile phones, cordless phones, telephones, calculators, routers, GPS systems)	Non-hazardous	20 01 36	16 02 14

Sources of information: <https://www.gov.uk/how-to-classify-different-types-of-waste/electronic-and-electrical-equipment>; <https://www.theukrules.co.uk/rules/legal/environment/waste/classification/electronic-and-electrical-equipment.html>; <https://docplayer.se/5453124-Nej-tonerkassetter-tips-och-rad-tonerkassetter-blackpatroner-toner-och-black-i-flaskor.html>.

Table 1 shows some WEEE that can be assigned a specific waste code at once. Since the composition of each EEE cannot be assessed, the waste holder or the waste manager must further verify that the waste classified as non-hazardous WEEE in Table 1 does not contain hazardous components. Main hazardous substances that are EEE: lead, mercury, cadmium, zinc, yttrium, chromium, beryllium, nickel, brominated flame retardants, antimony trioxide, halogenated flame retardants, tin, polyvinyl chloride (PVC) and phthalates³.

To facilitate the identification of hazardous WEEE, a list of substances that may be present in certain WEEE components is provided. This list is based on the information provided in Solving the E-Waste Problem (Step) Green Paper (2015): E-waste Prevention, Take-back System Design and Policy Approaches⁴ (see Table 2).

Table 2. Hazardous substances contained in some EEE components

Chemical substances	EEE component
Antimony	Cathode ray tube (CRT), transponder boards, etc.
Arsenic	Used transistor
Barium	Tube (CTR) glass
Beryllium	Computer motherboards
Cadmium	Chip resistors and semiconductors
Chlorofluorocarbons (CFCs)	Older refrigerators and freezers
Cobalt	Rechargeable batteries and hard disk covers
Copper	Used as conductor
Gallium	Chips, optical electronics, etc.
Hexavalent chromium	Used for corrosion protection or for coating steel surfaces of crude and galvanised steel plates
Indium	LCD screens
Lead	Transponder boards, glass panels for computer monitors
Lithium	Rechargeable batteries

³ <http://www.diva-portal.org/smash/get/diva2:702629/FULLTEXT01.pdf>.

⁴ https://www.step-initiative.org/files/documents/green_papers/Step%20Green%20Paper_Prevention%26Take-back%20System.pdf.

Chemical substances	EEE component
Mercury	Relays, switches, and transponder boards
Nickel	Rechargeable batteries
Perfluorooctane sulfonyl fluoride (PFOS-F)	Non-reflective coating
Phthalates	Used for softening of plastics
Polybrominated diphenyl ethers (PBDEs) and brominated flame retardant (HBCDD)	Used for protection against ignition of plastic EEE housings and transponder boards
Silver	Wires for EEE boards
Thallium	Batteries, semiconductors, etc.
Tin	Lead-free solder

Source: Smith, Sonnenfeld & Naguib Pellow, 2006 and BAN, 2011. Quoted Lundgren K., 2012, The global impact of e-waste: addressing the challenge. International Labour Office, Programme on Safety and Health at Work and the Environment (SafeWork), Sectoral Activities Department (SECTOR) – Geneva: ILO, 2012.

The E-waste Statistics: Guidelines on Classifications, Reporting and Indicators prepared by the United Nations University in 2018⁵ also states that WEEE containing hazardous components referred to in Annex VIII to the Basel Convention under code A1180, and having the characteristics listed in Annex III to the Basel Convention may be considered as hazardous WEEE unless it is demonstrated that the WEEE does not contain these components⁶. The main components are⁷:

- a) Lead containing glass from cathode-ray tubes (CRT) and video lenses, as specified in Annex VIII, entries A1180 or A2010, 'Waste electronic tube glass and other activated glass'. This waste is also included into group Y31 in Annex I 'Lead; lead compounds' and may display hazardous properties H6.1, H11, H12 and H13 in accordance with Annex III to the Basel Convention;
- b) Nickel-cadmium batteries and mercury-containing batteries included in entry A1170 of Annex VIII, 'Unsorted waste batteries...'. This waste is also included into group Y26 in Annex I, 'Cadmium; cadmium compounds' or Y29 'Mercury; mercury compounds' and may display hazardous properties H6.1, H11, H12 and H13;
- c) Selenium coated copying machine drum that is assigned to entry A1020 'Selenium; selenium compounds' in Annex VIII. This waste is also included into group Y25 in Annex I 'Selenium; selenium compounds' and may display hazardous properties H6.1, H11, H12 and H13;
- d) Transponder boards falling under Annex VIII, entry A1180 in 'Waste electrical and electronic assemblies...' and entry A1020 'Antimony; antimony compounds' and 'Beryllium; beryllium compounds'. These assemblies contain brominated compounds and antimony oxides as flame retardants, lead solder and beryllium copper alloy compounds. They are also included in Annex I, groups Y31 'Lead; lead compounds', Y20 'Beryllium; beryllium compounds', Y27 'Antimony; antimony compounds' and Y45 'Organohalogen compounds other than substances referred to elsewhere in Annex I'. They are likely to have hazardous properties H6.1, H11, H12 and H13;
- e) Fluorescent lamps and backlight lamps from liquid crystal displays (LCD) containing mercury and assigned to entry A1030 'Mercury; mercury compounds' in Annex VIII. This waste is also included into group Y29 in Annex I 'Mercury; mercury compounds' and may display hazardous properties H6.1, H11, H12, and H13;
- f) Plastic components containing brominated flame retardants (BFR), in particular BFR that are persistent organic pollutants within the meaning of the Stockholm Convention that may be classified under entry A3180 of Annex VIII 'Wastes, substances and articles containing, consisting of or contaminated with polychlorinated biphenyl (PCB), polychlorinated terphenyl (PCT), polychlorinated naphthalene (PCN) or polybrominated biphenyl (PBB), or any other polybrominated analogues of these compounds, at a concentration level of 50 mg/kg or more'. This

⁵ <https://globalewaste.org/publications/#page=2>.

⁶ E-waste Statistics: Guidelines on Classifications, Reporting and Indicators, second edition, (Bonn: United Nations University, 2018).

⁷ The examples in this list of components or parts are not exhaustive.

- waste is also included into group Y45 in Annex I 'Other chloro-organic compounds' and may display hazardous properties H6.1, H11, H12, and H13;
- g) Other components containing or contaminated with mercury, such as mercury switches, contacts, and thermometers, are assigned to entries A1010, A1030 or A1180 in Annex VIII. This waste is also included into group Y29 in Annex I 'Mercury; mercury compounds' and may display hazardous properties H6.1, H11, H12, and H13;
 - h) Waste oils and/or liquids covered by entry A4060 of Annex VIII ('Waste oils/water, hydrocarbons/water mixtures, emulsions'). The waste is included into group Y8 of Annex I 'Waste mineral oils unfit for their originally intended use' of group Y9 'Waste oils/water, hydrocarbons/water mixtures, emulsions' and may display hazardous properties H3, H11, H12, and H13.
 - i) Components containing asbestos, such as wires, cookers, and heaters, are included in entry A2050 of Annex VIII. The waste is included into group Y36 'Asbestos (dust and fibres)' of Annex I and may display a hazardous property H11;
 - j) Waste metal cables coated or insulated with plastics under A1190 'Waste metal cables coated or insulated with plastics containing or contaminated with coal tar, PCB⁸, cadmium, other organohalogen compounds or other Annex I constituents to an extent that they exhibit Annex III characteristics'.

Examples of hazardous components (waste) that are most frequently contained in WEEE are given in Table 3.

Table 3. Codes for the hazardous components that are most frequently separated from WEEE.

Component separated from EEE	List of waste code
Asbestos containing products/components	16 02 16*
Beryllium containing products/components	16 02 15*
Lead batteries	16 06 01*
Crushed glass (from CRT monitors)	16 02 15*
Chlorofluorocarbons (HCFCs) from refrigerating installations	14 06 01*
CFC/refrigerant (gas)	14 06 01*
Chlorofluorocarbons from foams contained in refrigerating equipment	14 06 01*
Components containing beryllium (BeO)	16 02 15*
Transformers and capacitors containing PCBs	16 02 09*
Plastics containing brominated flame retardants	16 02 15*
Transponder boards/contacts with precious metals	16 02 15*
Unspecified refrigerants from refrigeration equipment	14 06 03*
Mercury-containing batteries	16 06 03*
Mercury-containing components	16 02 15*
LCD screens	16 02 13*
Fluorescent tubes containing mercury	20 01 21*
Light sources containing mercury, such as energy efficient light bulbs	20 01 21*
Fluorescent lamps disassembled from composite articles	20 01 21*
Toner cartridges	08 01 11*
Ni-Cd batteries	16 06 02*
Insulating or heat transmission oils containing PCBs	13 03 01*
Mineral-based non-chlorinated insulating and heat transmission oils	13 03 07*
Oil mixture from compressors, etc.	13 02 06*
Oil-contaminated components	16 02 15*
Selenium-containing components	19 12 11*
Sulphur hexafluoride (SF6) systems and components	16 02 09*
Monitors (CRT)	16 02 15*

⁸ PCBs are at concentration level of 50 mg/kg or more.

Data source: Guidance on the identification and declaration of hazardous waste, commissioned by the Norwegian Environmental Protection Agency, published in 2015⁹.

In assessing the hazardousness of WEEE, it should be considered that Article 4(1) of Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) states that Member States shall ensure that EEE placed on the market, including cables and spare parts for its repair, its reuse, updating of its functionalities or upgrading of its capacity, does not contain the substances listed in Annex II (see Table 4).

Table 4. Regulated substances in accordance with Directive 2011/65/EU, RoHS.

Substance	Cut-off value, % according to Directive 2011/65/EU
Lead	0.1
Mercury	0.1
Cadmium	0.1
Hexavalent chromium	0.1
Polybrominated biphenyls (PBBs)	0.1
Polybrominated diphenyl ethers (PBDEs)	0.1
Bis (2-ethylhexyl)phthalate (DEHP)	0.1
Benzyl butyl phthalate (BBP)	0.1
Dibutyl phthalate (DBP)	0.1
Diisobutyl phthalate (DIBF)	0.1

Exemptions:

The restriction on the use of DEHPs, BBPs, DBPs and DIBPs applies as of 22 July 2021 for medical devices, including *in vitro* medical devices, and monitoring and control devices, including industrial monitoring and control devices.

The restriction on the use of DEHPs, BBPs, DBPs and DIBPs does not apply to cables or spare parts for the repair, re-use, functional improvement or enhancement of EEE placed on the market before 22 July 2019 and medical devices, including *in vitro* medical devices, and monitoring and control devices, including industrial monitoring and control devices placed on the market before 22 July 2021.

The restriction on the use of DEHPs, BBPs and DBPs does not apply to toys already subject to the restriction on the use of DEHPs, BBPs and DBPs set out in entry 51 of Annex XVII to Regulation (EC) No 1907/2006.

Table 4 Those restrictions apply to medical devices and monitoring and control devices placed on the market from 22 July 2014, in devices used for *in vitro* diagnosis placed on the market from 22 July 2016, industrial monitoring and control devices placed on the market from 22 July 2017, and any other EEE not falling within the scope of Directive 2002/95/EC and placed on the market from 22 July 2019, with the exception of those listed below the table.

In the light of the above, the algorithm is presented in Figure 8 of Chapter 2.4.2 of the Guide, showing which WEEE is absolutely hazardous, and which WEEE is subject to the assessment of hazardous properties due to the hazardous components contained therein according to Stage III of the Guide or it shall be determined, or the cases where the hazardousness of WEEE should be determined according to the information listed in Table 1 hereof. Please note that the threshold values based on hazard statement codes refer to the state of the waste as it is when the classification of the waste is undertaken (i.e. the state in which WEEE is usually transferred to the waste manager). For the case of EEE this might imply that if whole appliances are to be classified, the weight of the appliance must be considered as basis for the applied concentration limits of hazardous substance. If separated fractions must be classified (e.g. after selective treatment) the weight of the separated fractions are to be considered as basis for the applied concentration limits.

For information on the main hazardous components contained in WEEE, see Table 3.

Additional examples¹⁰ of hazardous components that can be contained in WEEE are provided, including the instruction of their separation.

⁹ https://www.energinorge.no/faqomrader/hms_tema/hms-verktoykasse/veiledere-farlig-avfall/veiledere-farlig-avfall/.

Hazardous liquids are typically present in heating and cooling appliances, such as refrigerators and freezers (coolant circuit) and oil filled radiators. The WEEE Directive requires all fluids to be removed from WEEE. Liquids must be safely disposed of before the waste is crushed. Cooling appliances containing refrigerants (refrigerators and freezers) – most refrigerators entering the waste stream are 10–15 years old and may therefore contain ozone depleting substances (e.g. CFCs and HCFCs). Refrigeration equipment manufactured after 1994 is unlikely to contain CFCs.

Capacitors containing polychlorinated biphenyls (PCBs) – historically, PCBs have been widely used in electrical equipment such as capacitors and transformers. However, in 1972, their use in the open environment was widely banned and they were not used from in the manufacture of new equipment 1986 onwards. Equipment installed before 1986 was allowed to be operated until the end of life. Consequently, capacitors manufactured before 1976 should be considered to contain PCBs. However, it is highly unlikely to contain PCB-containing capacitors unless the device is more than 20 years old. Any use of PCBs should have been phased out by 2000.

Mercury-containing components, such as switches or lamps. Mercury is used in fluorescent lamps, medical equipment, data transmission, telecommunications, and mobile phone manufacturing. Its use in electrical and electronic equipment has decreased significantly in recent years. In addition to batteries, transponder boards are likely to contain other mercury-containing elements. Therefore, when a transponder board is removed, most mercury-containing elements such as switches must be removed too.

Non-CRT flat screens (such as LCDs) are increasingly becoming WEEE from laptops and desktop monitors, and plasma displays. One of the key problems related to the post-operational treatment of flat screens is mercury-containing fluorescent backlighting required to illuminate LCD, laptop, and desktop displays (note: plasma displays do not pose such a risk. They are not illuminated from backlight and do not contain liquid crystals, and the image is generated by excitation of fluorescent coatings in plasma. They are typically easy to recognize because of their glossy display and are much thicker and heavier than other flat screen types). Manufacturers report an average of 3.5 mg mercury per backlight and an average 37-inch television can have up to 18 lamps, but studies show that these levels are often higher.

Asbestos waste and components containing asbestos – asbestos has been used in older appliances such as toasters and irons. Asbestos was also a constituent of some electric heaters. Modern appliances do not contain asbestos. However, devices older than 20 years may contain asbestos and should be carefully inspected and treated accordingly.

Lead and other substances, including CRT containing phosphorus pentachloride – lead and other health-threatening substances such as phosphorus pentachloride, may be released during glass treatment when fluorescent coating is removed.

Solar cells are non-toxic, and their waste is non-hazardous. However, like other electrical appliances, they contain substances that should not be released into the environment. The key problem is the small proportion of lead present in electrical contacts. Some solar cells also contain traces of cadmium. These materials are firmly bonded and not washed during operation¹¹.

¹⁰ <https://www.360environmental.co.uk/documents/smw-qq.pdf>.

¹¹ <https://www.br.de/nachrichten/wissen/photovoltaik-wie-umweltschaedlich-sind-solarzellen,Sjw7cLN>.