

GUIDANCE DOCUMENT

ENVIRONMENTALLY SOUND RECYCLING OF ELECTRONICS

This Guidance Document was developed to serve as an educational document to inform interested parties about the environmental, legal, health and safety hazards associated with recycling end-of-life electronics (EOLE) to allow recyclers to develop environmentally sound recycling processes and to allow environmental auditor with a knowledge based for conducting assessments of electronics recyclers.

DISCLAIMER: This document is intended for information purposes only and is not intended to constitute or to provide legal advice. It does not address all of the legal, environmental, health, safety or scientific aspects of end of life electronics (EOLE) recycling and may not address new technologies that are available. Any application of this information must be in accordance with applicable legal and regulatory requirements. Processors of EOLE must exercise due diligence in ensuring that they remain up-to-date on applicable laws and regulatory requirements as well as scientific and technological advancements and industry best practices.

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MATERIAL SEPARATION

Recycling of electronics includes disassembly and processing to recover raw materials such as metals, glass and plastics. Ferrous and non-ferrous materials, including steel, aluminium, copper, wires and cables are often sold to smelters for the production of raw materials. Leaded glass from CRTs can be processed and sold to CRT manufacturers for use in new CRTs or can be sent to lead smelters for lead recovery. The market for recycling plastics used in electronics is slowly developing as a result of design for the environment initiatives and advancements in plastic recycling technology. Alternately, plastics are sometimes used in non-IT applications, often incinerated with waste to energy recovery or used as a coal fuel substitute in the smelting process with adequate emissions controls to remove dioxins and furans, or disposed in landfills.

Prior to being processed to recover raw materials, end-of-life electronics (EOLE) must often be dismantled manually or by a combination of manual and mechanical dismantling process. Manual dismantling and separation involves the use of hand tools (not heating or shredding), in conjunction with adequate engineering controls and personal protective equipment (PPE), such as safety glasses and ergonomic workstations, while mechanical means of dismantling and separation include shredding, heating and grinding.

Facilities engaged in electronics dismantling and processing should track, on a shipment specific basis, the fate of materials that are received. Transactions that involve the transboundary shipment (export) of materials resulting from electronics processing should be conducted in accordance with applicable legislation, including international conventions such as the Basel convention.

The following components should be removed from EOLE prior to mechanical processing and managed separately:

- Mercury containing components such as lamps and switches (e.g. light bulbs found in scanners & laptops);
- All batteries, including coin cell batteries on motherboards;
- Toner cartridges, liquid and pasty, as well as colour toner and ink cartridges, and.
- Other materials specified by the processor that may pose environmental, safety, or mechanical risks.

Mechanical dismantling and separation processes as well as improper manual techniques can result in the release of hazardous substances, such as lead and beryllium in dust. As a result, appropriate controls preventing worker exposure and environmental releases must be implemented and maintained. At a minimum, personnel should have adequate knowledge with regards to material and equipment handling, hazard exposure and control, control of releases, and safety and emergency procedures.

Any dismantling or separation operations, as well as storage areas for components that may contain a hazardous substance, must be located in an indoor area equipped with adequate containment systems such as impervious floors. Storage areas should be adequate to hold all processed and unprocessed inventory.

A financial instrument should be maintained to assure that sufficient funds are available in the event of major pollutant releases, gross mismanagement, or closure of the facility. The facility itself should conduct regular audits and/or inspections of its environmental compliance.

SUBSTANCES OF CONCERN

Nearly all of the substances of concern in EOLE are no cause for concern for human exposure or release into the environment during ordinary use and handling. None of these substances will be released through normal contact, including transportation and manual disassembly. However, human health and environmental concerns may arise if EOLE are improperly handled, landfilled, incinerated, shredded, ground, or melted. All of

these exposures can be mitigated through appropriate work practices and engineering controls, such as combustion and air emission control systems.

Circuit Boards

Substances of concern (note this is not an exhaustive list)

- **Antimony:** Contained in some lead solder
- **Beryllium:** Small amount in the form of a copper-beryllium alloy (typically 98% copper, 2% beryllium) is used for connectors.
- **Cadmium:** Small amounts in plated contacts and switches
- **Chlorine and/or Bromine:** Brominated and inorganic flame retardants may be present in the plastic in printed circuit boards.
- **Corrosive liquids:** Contained in solid state capacitors present on some circuit boards
- **Lead:** Contained in solder and some board components,
- **PCBs:** Known to be used in some capacitors on old main frames and printers.

Printed circuit board may contain lead in solder and board components that can be released as a fine particulate if shredded or as a fume if heated to remove components. To protect worker safety, shredding processes should be equipped with dust collection systems and workers may need to be provided personal protection equipment to reduce exposure dependant on air monitoring results. Most Canadian jurisdictions require employers to implement a control programs to limit worker exposure to certain substances such as lead. Printed circuit boards may also contain small amounts of antimony and beryllium which can be released as a fine particulate from shredding, which can cause respiratory ailments such as berylliosis

Heating of plastics on circuit boards to recover components can cause the halogens (chlorine and bromine) to be released in the form of dioxins and furans, so adequate ventilation to remove toxins is required in processes that involve heating of circuit board.

Capacitors may also be present on the circuit boards and are solid state devices. Small electrolyte capacitors may contain corrosive liquids and may be classified as hazardous waste. Although their historic use in personal computers is not clear, it is known that PCB capacitors have been used in larger computer equipment such as mainframes and large printers.

Batteries

Substances of concern

- **Cadmium:** Contained in nickel cadmium (Ni-Cd) batteries,
- **Lead:** Contained in sealed lead acid batteries
- **Lithium:** Contained in coin cell and lithium ion batteries.
- **Mercury:** Small amounts contained with several battery chemistries.

Motherboards contain a small lithium cell battery often referred to as a coin cell battery. When lithium coin cells are sheared in the presence of oxygen and moisture heat is generated which may cause a fire, therefore they should be removed from the motherboard prior to shredding. Once separated, coin cells should not be accumulated in quantity without physical separation from each other so that uncontrolled electrical discharge will not occur. Separation can be achieved by using insulating tape on the contacts. Coin cells may be thermally processed with appropriate combustion and emission controls. Lithium can be recovered, after it has been fully discharged to eliminate potential reactivity, by shredding and gravity separation.

Nickel cadmium (Ni-Cd), nickel metal hydride (NiMeH), lithium ion and lead acid batteries should be removed before shredding and sorted by type. All battery cells should be managed to avoid inadvertent external short circuits and current flows, and large inventories of batteries should be avoided. Some Canadian jurisdictions

restrict storage of hazardous wastes for long periods, therefore it is recommended to contact the Provincial environment department to determine maximum storage volumes and timeframes. Batteries can be recycled to recover the metal content. Lithium ion batteries do not have the fire hazard problem associated with lithium metal coin cell batteries because the lithium is in the stable form of lithium hydroxide. Care should be taken by workers if lithium ion batteries are opened or broken, as lithium hydroxide is somewhat corrosive. The lithium contained in these batteries can be recycled.

Cathode Ray Tube (CRT), Leaded Plasma Display Glass, and Other Leaded Glass

Substances of concern

- **Antimony:** May be present in the screen and/or cone glass of CRTs.
- **Barium Oxide:** May be contained in the getter plate of the electron gun and deposited on the interior surface.
- **Cadmium Sulfide:** Has been used in phosphors in some older CRTs.
- **Lead:** Contained in the CRT glass in the form of lead oxide (PbO).
- **Phosphors:** A phosphor coating, typically zinc sulfide and rare earth metals, are used on the interior panel glass of a CRT screen.

The leaded glass in a CRT can be recovered in new CRT manufacture when all non-glass components are removed. These steps require aeration (release of the vacuum) and breaking of the bare CRT and careful separation of the glass parts, i.e., the faceplate, funnel and neck. Workers involved with the breaking of CRTs should be protected from inhalation of dust that may contain lead, barium oxide and phosphors.

The lead in a CRT and other leaded glass can also be recovered as lead by a lead smelter. The glass also serves as a silicate flux in the lead smelting process, and is a substitute for silicate which the smelter would otherwise acquire and use. The leaded glass can also be used as a silicate flux by a copper smelter, again as a substitute for silicate which the copper smelter would otherwise acquire and use. The copper smelter may also have a subsequent procedure in which the by-products from copper smelting and electrorefining are treated for lead recovery.

Practices that would be considered as non-environmentally sound include the use of leaded glass in construction materials (as a substitute for sand) and its use as blasting grit or other abrasive material. Some regions consider the use of leaded glass in making tiles and other ceramics as non-environmentally sound. The contamination of other glass which does normally not contain lead, especially container glass, should be avoided. Non-leaded glass could be used in building products.

Lamps, Bulbs and Switches

Substances of concern

- **Mercury:** Mercury may be present in lighting devices and switches.

Many products use fluorescent bulbs that contain mercury. These bulbs are used for backlighting of LCD panels or the optical scanner of photocopiers, scanners and fax machines. Although the mercury in fluorescent lamps is in vapour form, to create the light arc, mercury adheres to the phosphor powder contained within the lamps. Mercury is also present in the UHP lamps used in data projectors and rear projection televisions and is contained within a small bulb within the lamp. The amount of mercury per bulb can range from 2.2mg in a fluorescent lamp to more than 30mg in a UHP lamp. Mercury switches are also used in several electronic products. The mercury contained in lamps, bulbs and switches can be released during shredding and therefore should be removed prior mechanical processing of EOLE and sent to a specialised mercury recovery facility for treatment, such as metal recovery operations or thermal treatment at an environmentally sound and appropriately authorised incinerator with modern flue gas cleaning systems. If processing of EOLE involves breaking of mercury vapour bulbs, the system should be equipped with a negative pressure dust evacuation system to prevent work exposure, a dust filtration system to remove

mercury contaminated phosphor powder, and an activated charcoal filter to remove any other trace elements of mercury. Consideration should also be given to mercury contamination of other materials being processed along with mercury bulbs as well as the equipment used.

Insulated Wire

Substances of concern

- **Cadmium:** Very small amounts in some stabilizers for PVC wire insulation
- **Polyvinylchloride (PVC):** Insulation on wires and cables

The substance of concern is PVC, because of its chlorine content. In the past, the insulation was removed by burning, sometimes in uncontrolled combustion. This is not considered environmentally sound, because the burning may be incomplete, emitting a variety of particles of incomplete combustion, and chlorinated dibenzofurans and dibenzodioxins may form in the exhaust emissions. Insulated electrical wire should be separated if the wire is accessible during dismantling then shredded or chopped (or both) to a relatively small size (typically between one to ten centimetres in length). It can then be burned under controlled combustion and at specific temperatures with an air emission control system designed to prevent formation of chlorinated dibenzofurans and dibenzodioxins. Shredded or chopped wire can also be granulated to separate the insulation from the copper. The resulting mixed material can be separated by a variety of physical means, using water or air. The entire process, when properly executed, will produce clean copper and a plastic fraction which is suitable for plastic recycling.

Plastics

Substances of concern

- **Cadmium:** Very small amounts in some stabilizers for PVC plastic.
- **Chlorine and/or Bromine:** Brominated and inorganic flame retardants may be present in the plastic in plastic housings and circuit boards.

Plastic is one category of material components for which recycling opportunities are currently quite limited. This is because of the numerous resin types used in electronic equipment; some manufacturers' plastic parts are not always labelled accurately according to their type; cannot be sorted and cleaned economically, and the presence of chlorine and bromine compounds, especially in flame retardant plastic resins. A wide variety of brominated flame retardants have been used as additives to some plastic components, or chlorine in PVC insulation, may recombine with carbon and hydrogen in various disposal or recovery processes that involve heat, such as combustion or plastics extrusion, to form other halogenated organic compounds such as dibenzodioxins and furans.

The small amount of cadmium in some plastics may be released in the form of cadmium oxide dust if the plastic is burned prior to or in the course of metal reclamation. When hard plastic components containing brominated flame retardants are shredded, workers can be exposed to dust containing these chemicals. Therefore, measures are required for the protection of human health and the environment in operations where these plastics are shredded or heated. Shredding operation should be equipped with dust collection system and, if air monitoring shows the need, provide workers with personal protection equipment. Thus, opportunities for recycling need to regard not only the particular resin types of the various parts, but also the types of flame retardants that are present in the plastics, as the safety of the worker may be affected

HEALTH, SAFETY AND OCCUPATIONAL HYGIENE

The facility should have an occupational hygiene program to identify, assess and control any potential hazards, as well as procedures for monitoring, reporting and responding to actual hazards, pollutant releases and other emergencies, such as fires.

Key elements of the occupational hygiene program should include:

- Risk Assessment
- Sampling, Monitoring and Evaluation
- Engineering Controls
- Administrative Controls
- Personal Protective Equipment (PPE)
- Personal Hygiene
- Emergency Response
- Program Review and Evaluation

Risk Assessment

A risk assessment is a systematic process to identify hazards and evaluate the potential risks associated with them. The risk assessment should consider physical, chemical and ergonomic hazards under both normal and abnormal conditions. When evaluating risks, the facility should consider the probability, potential severity and frequency of the hazard. The documented results of any risk assessments should be used to determine the appropriate level of control necessary to eliminate or effectively control the hazard.

Examples of hazards associated with the processing of EOLE include:

- Physical – equipment noise and vibration; sharp or rough surfaces of materials and tools
- Chemical – dust and fume from shredding or grinding; toxic substances such as lead and mercury
- Ergonomic – awkward work posture, heavy lifting, repetitive tasks, excessive force

Sampling, Monitoring and Evaluation

Where occupational exposure limits are regulated or the results of a risk assessment indicate an opportunity for exposure, workplace sampling such as air or noise monitoring may be required.

To identify exposure levels, a qualified individual, such as an industrial hygienist, should conduct the necessary sampling of the affected areas and the results of the sampling activities should be evaluated against recognized industrial hygiene standards and regulatory limits. This evaluation should identify areas where control measures to reduce or eliminate exposure may be required to maintain levels within the permissible limits. In addition, the facility should consider this information as well as regulatory requirements to determine if regular sampling is required, and if so, for establishing the sampling schedule.

Additionally, the facility should maintain a process to consider the potential impact of any process or workplace changes prior to initiation, and should assess actual exposure levels following any significant changes, such as equipment modifications or changes in processing rates.

The results of any sampling, monitoring and evaluations should be used to determine the appropriate types and levels of controls necessary to eliminate or effectively control any hazards.

Control of Risks:

Engineering Controls

Where possible, it is optimal to eliminate hazards altogether at the source. This can be accomplished through process design changes or by substituting hazardous materials or processes with less hazardous alternatives.

If eliminating a hazard is not practical, consideration should be given to isolating the hazard from workers, or removing the hazard from the work area. One of the most effective means to isolate physical hazards is

through the use of physical barriers, such as walls, mechanical guards, or acoustic panels, while airborne contamination may be removed from the work area by means of ventilation.

All mechanical controls should be suitably rated or tested to ensure adequate protection from the hazard. Physical barriers must be designed to withstand any process related forces as well as external forces such as those applied by a worker. Ventilation systems must be equipped to remove the intended contaminants and must maintain adequate flow rates.

Wherever mechanical controls are used, suitable preventive maintenance programs should be implemented to monitor performance of the equipment and ensure proper functioning to the approved specifications. Preventive maintenance programs should be developed based upon manufacturer's suggested tasks and frequencies. Specifically for ventilation systems, preventive maintenance tasks should include airflow testing, ductwork inspections and filter replacements.

At minimum, the facility should ensure that all mechanical processes are safeguarded to prevent access to hazardous areas, and adequate ventilation is provided to remove air contaminants and maintain acceptable air quality levels.

Administrative Controls

Where the use of mechanical controls is not practical or if following the implementation of the mechanical controls it is determined that a potential hazard still exists, administrative controls such as safe work procedures and training should be implemented.

Safe work procedures are documented processes that clearly outline the potential hazards associated with performing a task, the approved steps for completing the task to prevent the occurrence of a hazard, as well as appropriate emergency response information in the event of an operational or procedural failure. Safe work procedures should be communicated to all applicable workers and made available for reference at the point of use.

In addition to safe work procedures, workers should be provided with various training to identify and prevent workplace hazards, as is applicable to their responsibilities. Typical examples of training include Workplace Hazardous Materials Information System (WHMIS), Transportation of Dangerous Goods (TDG), as well as process and equipment specific training.

The facility should maintain a process to identify training needs by job function and should maintain records of all training completed. Where appropriate, the facility should implement a process to assess the effectiveness of the training programs, including knowledge retention. Training assessments may include written tests, task observation and worker performance reviews. The results of these activities should be used to establish a training schedule for refresher and upgrade training requirements.

In addition to safe work procedures and training programs, the facility should employ appropriate signs and labels to clearly identify significant items such as the following: restricted or hazardous areas, equipment hazards, hazardous materials, and areas requiring personal protective equipment.

Personal Protection Equipment (PPE)

Where it is determined that engineering and/or administrative controls may not be sufficient to prevent worker exposure to a hazard, the use of personal protective equipment (PPE) is required. PPE may include the use of safety glasses or face shields where there is a danger of flying parts or debris; hearing protection in areas of elevated noise; gloves for handling sharp or hazardous materials; smocks, uniforms or other specialized clothing for protection from dusts and debris; and respiratory protection where airborne contaminants are present. The facility should use the results of risk assessments and workplace sampling to determine the appropriate type of PPE as well as degree of protection required.

The facility must provide workers with PPE and enforce its use where required. Any workers required to use PPE must be trained in the proper use of and care for the equipment. Where specialized or custom fit PPE

such as respirators, prescription safety glasses, or custom hearing protection are used, workers should be periodically re-assessed for proper fit and function.

Any areas requiring the use of PPE should be appropriately identified, and where regulated, exposure levels should be posted, such as noise levels exceeding permissible limits.

Personal Hygiene

Any facility where EOLE processing occurs should provide workers with an enclosed environment, separate from processing areas where food consumption is permitted. This area should be independently ventilated from any processing areas, including fresh air makeup, and should be equipped with separate facilities for the removal of contaminated clothing and hand washing prior to entering.

Additionally, the facility should maintain a personal hygiene program that requires the removal of contaminated clothing and hand washing prior to entering this or other clean areas, and further preventing workers from consuming food outside of the designated area. This procedure should also address the need for the removal of contaminated clothing prior to leaving the premises.

Emergency Response

Notwithstanding the overall occupational hygiene program and hazard controls, the facility should maintain adequate procedures for responding to emergency situations. Emergency situations may be identified through the risk assessment process, and may include but are not limited to worker injury and fire.

The facility should maintain a stock of the necessary first aid supplies and ensure an appropriate number of individuals trained in the administration of first aid are available on site. The plan should also provide information on transportation to the nearest hospital or other location for external medical support.

All facilities should be equipped with an emergency notification system, such as pull stations, horns, or bells, to notify workers in the event of an emergency, and where appropriate, facilities should additionally be equipped with a fire suppression system and/or fire extinguishers.

In areas where workers may be exposed to eye injuries from contact with dust, debris or chemical splashes, emergency eye wash stations should be provided. Safety showers should also be provided where workers may be exposed to skin hazards from exposure to toxic or other irritating substances.

All emergency response plans should provide details on when and how to contact external emergency response assistance such as fire or ambulance if required.

Program Review and Evaluation

In order to ensure that the occupational hygiene program effectively controls workplace hazards and prevents worker exposure, the facility should periodically review and evaluate its suitability.

Program reviews should consider at a minimum:

- Information collected through risk assessments
- Results of workplace sampling
- Changes in processes or the workplace
- Root causes and outcomes of any emergency situations or near-miss incidents
- Changes to regulatory requirements or industry best practices

The review should determine if the occupational hygiene program is suitable for the facility based on its ability to control workplace hazards, and furthermore should provide direction for addressing opportunities for improvement.

The following resources may be consulted for more information on health, safety and industrial hygiene:
www.ccohs.ca www.iapa.ca www.acgih.org www.cdc.gov/niosh

TRANSPORTATION and EXPORT

Transportation

The transportation of materials classified as “dangerous goods” is regulated under the federal Transportation of Dangerous Goods Act, 1992 (TDGA), which has been adopted by all provinces and territories and establishes the safety requirements for the transportation of these materials.

Components of EOLE and/or the materials resulting from the processing of EOLE could possess toxic or corrosive characteristics that would classify them as dangerous goods and the requirements of TDGA would apply

Materials classified as “Environmental Hazardous Substances” are regulated under TDGA, which is determined through a Toxicity Characteristic Leaching Procedure (TCLP) leachate test and comparing the results to the criteria on TDGA schedules.

Section 5 of the TDGA states:

No person shall handle, offer for transport, transport or import any dangerous goods unless

- (a) the person complies with all applicable prescribed safety requirements;
- (b) the goods are accompanied by all applicable prescribed documents; and
- (c) the means of containment and transport comply with all applicable prescribed safety standards and display all applicable prescribed safety marks.

Materials that contain lead or mercury could be classified environmental hazardous substances and batteries could be classified as corrosive. It is advised that the facility review their operations and the materials they transport to ensure that they are compliant with the requirements of TDGA. More information on TDGA is available at the following website:

<http://www.tc.gc.ca/acts-regulations/GENERAL/t/tdg/act/tdg.htm#0.2.JZ0KIZ.K1D72S.JJEJED.C5>

Export

The export and import of wastes or recyclable materials that fall under the requirements of TDGA are regulated through the federal Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulation, 2005 (EIHWRMR) of the Canadian Environmental Protection Act. It is the responsibility of the importer or exporter to ensure the proper classification of their hazardous waste.

The EIHWRMR was created to transpose Canada’s obligation from ratification of the Basel Convention, which is intended to prevent developed nations from dumping hazardous wastes in developing nations. EOLE, components, and some materials generated from processing EOLE may be considered environmentally hazardous and/or leachable toxic wastes and are regulated under EIHWRMR. Thus, controls are normally applied to the export of hazardous wastes to foreign destinations which involve a “prior informed consent” regime, which requires notification and consent from the recipient government prior to export. In addition to these controls, some countries, such as China, have implemented an import prohibition for certain types of electronic wastes. These prohibitions must be respected when exporting these materials.

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EIHWHRMR does exclude certain low-risk recyclable materials from the definition of “hazardous recyclable material”, including electronic scrap, “such as circuit boards, electronic components and wires that are suitable for base or precious metal recovery.” This exclusion ONLY applies if the listed material is exported to an OECD country AND is destined for recycling at an authorized facility, even if it fails a TCLP test for leachability. If these conditions are not met, the requirements of EIHWHRMR apply.

The low risk exemption does not apply to EOLE components such as CRT leaded glass and batteries, which must be exported in accordance with the EIHWHRMR control.

Although the United States is an OECD member country, it has not ratified the Basel convention so special consideration should be made to EOLE shipment to the USA. If the USA is used as transit of material to other destinations, the full requirements of EIHWHRMR may apply.

In order to export EOLE materials that are defined as hazardous waste or hazardous recyclable material, such as CRTs, batteries or materials that do not meet the low risk material recycling exemption, the following steps must be taken:

1. Complete the notification information requirements set out under the EIHWHRMR. The notification requirements include such information as:
 - 1.1. The nature and quantity of hazardous waste or hazardous recyclable material involved;
 - 1.2. The addresses and the sites of the exporter, the importer, and the carrier(s);
 - 1.3. The proposed disposal or recycling of the waste or material;
 - 1.4. Proof of written contracts between exporters and importers;
 - 1.5. Proof of insurance coverage; and
2. Have a signed written contract between the generator and receiver of the hazardous waste or hazardous recyclable material as required by the EIHWHRMR (exports and imports only) and ensure that the Canadian importer or Canadian exporter (as the case may be), and all carriers have valid insurance coverage (all movements) required under the EIHWHRMR.
3. The notification requirements and insurance must be submitted to Environment Canada’s Transboundary Movement Branch for review and approval.
4. Obtain a PERMIT issued by the Minister of the Environment for the export, import or transit of hazardous wastes or hazardous recyclable materials **before** proceeding with any shipments. The valid dates set out in the PERMIT.
5. Use an authorized carrier and authorized recycling/disposal facility set out in the PERMIT to accept the hazardous waste or hazardous recyclable material. Ensure that the volume in the shipment does not exceed the quantity provided and approved in the PERMIT.
6. Ensure that the Movement Document is correctly completed, signed and accompanies each approved shipment of hazardous waste and hazardous recyclable material entering or exiting Canada.
7. Comply with all requirements of the Transportation of Dangerous Goods Regulations (TDGR) during the movement of the hazardous waste or hazardous recyclable material, where applicable.
8. Ensure that a copy of the Movement Document as well as a copy of the Permit is provided to the carrier(s) and both are dropped off at the point of entry/exit to a Canadian Border Services Agency agent.
9. Submit copies of the completed Movement Document and certificate of recycling/disposal to Environment Canada to fulfil your obligations under the EIHWHRMR.
10. Retain the Movement Documents at your place of business in Canada for 3 years following the completion of the movement.

Detailed information on how to complete a notice and meet the requirements of the EIHWHRMR are outlined further in the User Guide to Classification and Implementation, which is available at http://www.ec.gc.ca/tmb/eng/guides_e.html.

In addition to these requirements, some producers or owners of EOLE may impose requirements that exceed those listed above, such as only allowing export if the recipient of the EOLE material is compliant with applicable local waste handling, storage, and disposal regulations.

SMELTING, ENERGY RECOVERY AND DISPOSAL

Smelting is the process often used to recover precious and other metals from end-of-life electronics. Smelting operations require proper furnace combustion conditions and furnace emission control systems, such as acid gas scrubbers and particulate controls. The facility permit regarding air emission controls should specifically authorize the processing of electronic scrap. The presence of halogens (chlorine and bromine) in plastics which will be burned during metal recovery raises concerns which differ from those most commonly associated with copper ores and attention must be given to the possible creation of dibenzofurans and dioxins in the burning processes. Complete thermal destruction of hydrocarbons will substantially reduce the possibility of formation of dibenzofurans and dioxins in the furnace emission stream. Halogens will be converted to acids, and then to salts in an acid gas scrubber. Likewise, the presence of beryllium and mercury can lead to serious emissions of these metals in vapour form, endangering workers and the local environment. Care must be taken to monitor and reduce such emissions to a minimum. Lead smelters processing leaded glass do not usually have pollution control systems suitable for burning of plastic, so all plastic material should be removed from CRTs prior to smelting. A copper smelter may also have a pollution control system which permits it to burn plastic.

Materials should be recovered wherever possible, however, it is likely that some components cannot be recycled or recovered, such as plastics or resins with halogenated flame retardants or slag from smelting operations. However, recent technology has become available which more appropriately removes halogens from the plastics prior to further material recovery. Efforts should be made to implement these technologies in order to avoid contaminating secondary materials. Non-recoverable materials will need to be disposed of in an environmentally sound manner; preferably combustible fractions would be used for energy recovery, as this method is higher in the waste management hierarchy than burning without energy recovery or landfilling. The lead in silicate slag resulting from copper smelting of CRT glass is immobilized and may be disposed of in an environmentally sound and appropriately authorised landfill.

The incinerator or other combustion unit (with or without energy recovery) should be operated to minimise the formation of furans and dioxins, as well as be equipped with state-of-the-art flue gas cleaning systems. Combustion ash, as well as materials from the processing of materials that cannot be recycled, should be disposed of in an environmentally sound and appropriately authorised landfill.

ENVIRONMENTAL MANAGEMENT SYSTEM

An effective environmental management system is an optimal tool to allow EOLE recyclers to safeguard the environment and worker health & safety while ensuring compliance to legal requirements and the Electronic Product Stewardship Canada (EPSC) Electronics Recycling Standard.

Ideally the facility will have an internationally recognized environmental management system that is assessed and approved through a third party, such as an ISO 14001 or EMAS system. If a system of this nature is not in place the facility should demonstrate that it has implemented elements of an environmental management system that allow it to effectively control the facility's operations on the environment. Elements of an environmental management system include:

Process Flow

To assist in identifying risks and regulatory requirements of the recycling process, a process flow chart should be established that outlines all the incoming materials, the processes used, and the outgoing materials through the entire recycling process. The material flow should outline the flow of materials through downstream vendors to the point of final recycling, destruction, or disposal.

Regulatory Assessment, Permits and Certification

Regulatory permits or certification may be required for accepting, transferring, transporting, processing, or disposing of EOLE waste. Additionally, processing permits or certification may be required for air exhausts, water discharges or waste generation. Recyclers must identify and track all applicable regulatory requirements and provide evidence of compliance. Where exemptions to regulations exist, confirmation of the exemption from the regulating authority must be maintained. The facility must also maintain a process to identify changes in regulations, and to re-evaluate regulatory applicability based on changes in operations.

Process Controls

Controls should be implemented on processes that are environmentally sensitive or, if done incorrectly, could lead to a negative impact on the environment or worker health and safety. This can include work instructions on how to perform tasks or handle materials, preventative maintenance, or recycling programs for non-core materials such as packaging and administrative waste.

Hazardous Waste Management

The facility should implement programs to identify and manage hazardous waste generated from processing EOLE, such as batteries, mercury bulbs, ink, toner, phosphors and leaded glass. The program should be compliant to regulatory requirements, including the requirements for handling, storage, labelling, transportation, export, processing, and disposal.

Training

The facility should identify areas of training requirements where their absence could lead to a breach in regulatory requirements, damage to worker health & safety, or environmental impairment. Training could include how to handle materials, operate equipment, use personal protection equipment, or maintain equipment. The facility should identify training requirements and provide records of completed training.

Self-Assessments and Corrective Actions

The facility should implement a process to periodically assess conformance of the facility's operating policies and procedures, regulatory and other requirements, such as the EPSC Electronics Recycling Standard.

Any non-conformances identified through the self-assessment process or other means, such as audits, external communications must be addressed through a corrective action process to correct and prevent reoccurrences.

Change Control

A process should be implemented that allows the facility to evaluate changes in processing or other activities and assess potential impact on the environment, worker health and safety, and regulatory requirements.

Insurance Coverage

Evidence of sufficient amount of general liability and worker compensation insurance coverage is required. This can be in the form of an insurance certificate from the facility's insurance company or broker as well as confirmation of participation in provincial worker compensation plans, or equivalent.

MATERIAL PROCESSING AND END USE ACCEPTABILITY TABLE

The following table outlines which EOLE recycling processing, end-use, or method of disposal are considered acceptable by the members of EPSC.

Product / Material	Minimum Acceptable Application	Acceptable Process	Not Acceptable
End of Life Electronics	Material recovery Metals recovery	Manual dismantling and sorting into major material categories Mechanical processing for dismantling and/or material separation with required dust collection & operator protection	Landfill Dismantling using prison labour Exporting to non-OECD countries for the purpose of recycling and/or disposal.
CRT Tubes, Leaded Plasma Display Glass, and Other Leaded Glass	Glass product manufacturing Lead recovery	Mechanical cutting and crushing with required dust collection & operator protection. Manual cutting and crushing	Landfill Manual processing using prison labour Exporting to non-OECD countries for the purpose of recycling and/or disposal.
Circuit Boards	Metal recovery Smelting	Manual processing Mechanical processing with dust collection and operator protection. Smelting complete boards	Landfill Manual processing using prison labour Exporting to non-OECD countries for the purpose of recycling and/or disposal.
Cable and Wires	Metal recovery Smelting	Manual or mechanical processing Smelting	Landfill Export to non OECD countries
Batteries	Metal recovery	Manual or mechanical processing Smelting	Landfill Export to non OECD countries
Mercury Containing Lamps and Switches	Mercury recovery	Mechanical processing Mercury distillation	Landfill Export to non OECD countries
Ink and Toner Cartridges	Remanufacture Plastic recovery Hazardous waste incineration / landfill	Manual or mechanical processing Incineration or landfill through sites approved for hazardous waste	Export to non OECD countries
Plastics	Plastic recovery Energy Recovery Landfill Depolymerization Pelletizing	Manual or mechanical processing Waste to energy incineration	Use in food or toy applications if containing BFR Open incineration without proper controls to ensure acceptable temperature and combustion.
Ferrous and Non-ferrous Metals	Metal recovery	Manual or mechanical processing Foundry	Landfill

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The information contained in the “Material Separation”, “Substances of Concern”, and “Smelting, Energy Recovery” sections is largely based on the “Technical Guidance Document for the Environmentally Sound Management of Specific Waste Streams: Used and Scrap Personal Computers (ENV/EPOC/WGWPR(2001)3/FINAL)” that was published by the OECD Working Group on Waste Prevention and Recycling.

The information contained in the “Transportation” section is largely based on information obtained from the Transport Canada website for transportation of dangerous goods (www.tc.gc.ca).

The information contained in the “Export” section is largely based on information obtained from the Environment Canada website for transboundary movement branch (www.ec.gc.ca).