

# **Printed circuit board [EDP 2005-108(0)]**

## **1. General**

### **1.1. Scope and definition**

This requirement specifies technical considerations, declaration format and communication necessary for developing and issuing Environmental Declaration of Products(EDP).

- Common rules: It is general requirements for applying to the all of products
- Product-specific rules: It consists of reflecting the characteristics of each product

### **2.2. Terms and definitions**

2.2.1. Functional unit: quantified performance of a product system for use as a reference unit in a life cycle assessment study

2.2.2. Elementary flow: material or energy entering the system being studied, which has been drawn from the environment without previous human transformation. Material or energy leaving the system being studied, which is discarded into the environment without subsequent human transformation.

2.2.3. Reference flow: measure of the needed outputs from processes in a given product system required to fulfill the function expressed by the functional unit

2.2.4. Unit process: smallest portion of a product system for which data are collected when performing a life cycle assessment.

2.2.5. Data quality: characteristic of data that bears on their ability to satisfy stated requirements

2.2.6. Ancillary input: material input that is used by the unit process producing the product, but does not constitute a part of the product

2.2.7. Co-products: any of two or more products from the same unit process

2.2.8. Output: material or energy which leaves a unit process

2.2.9. System boundary: interface between a product system and the environment or other product systems

2.2.10. Impact category: class representing environmental issues of concern to which LCI results may be assigned

2.2.11. Raw material: primary or secondary material that is used to produce a product

2.2.12. Life cycle: consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to the final disposal

2.2.13. Life cycle inventory analysis: phase of life cycle assessment involving the compilation and quantification of inputs and outputs, for a given product system throughout its life cycle

2.2.14. Life cycle impact assessment: phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts of a product system

2.2.15. Life cycle assessment (LCA): compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle

2.2.16. Life cycle interpretation: phase of life cycle assessment in which the findings of either the inventory analysis or the impact assessment, or both, are combined consistent with the defined goal and scope in order to reach conclusions and recommendations

2.2.17. Product: any goods or service

2.2.18. Product system: collection of materially and energetically connected unit processes which performs one or more defined functions

2.2.19. Intermediate product: input to or output from a unit process which requires further transformation

2.2.20. Final product: product which requires no additional transformation prior to its use

2.2.21. Input: material or energy which enters a unit process

2.2.22. Characterization factor: factor derived from a characterization model which is applied to convert the assigned LCI results to the common unit of the category indicator

2.2.23. Waste: any output from the product system which is disposed of

## **2. Common rules**

## **2.1. Scope**

The name and scope of a product to be studied shall be clearly described; if any components of the product are included in or excluded from the scope, they shall also be documented.

## **2.2. Function and functional unit**

The function and functional unit of the product to be studied shall be defined to show its characteristics. If the functional unit does not sufficiently represent the function of the product, additional information on the characteristics of the product shall be described to complement the functional unit.

## **2.3. System boundaries**

2.3.1. In principle, a product system should include all of the life cycle stages of a product, including raw material acquisition, production, use and disposal. However, some part of the life cycle stages may be excluded depending on the characteristics of the product. A process flow diagram for the stages included shall be drawn.

2.3.2. Inputs into and outputs from a unit process included within system boundaries should be elementary flows.

2.3.3. When defining system boundaries, any capital goods (e.g. subsidiaries, buildings, etc.) that are not directly associated with the production may be excepted.

2.3.4. System boundaries shall be classified as follows, and a process flow diagram shall be drawn for unit processes (including transportation) determined.

2.3.4.1. Raw materials acquisition and preparation phase

- This phase includes acquisition of raw materials for the product and production of intermediate products put into the manufacturing phase.

2.3.4.2. Manufacturing phase

- This phase includes the relevant processes for manufacturing the product, including the processes directly related to manufacturing of the product, the ancillary processes (utilities), the emissions treatment processes, etc.

- The processes related to manufacturing phase should be subdivided into appropriate unit processes.

#### 2.3.4.3. Use phase

- This phase includes the use of the product by customers and its distribution. However, the items associated with its maintenance may be excluded.

- A use scenario shall be developed and applied, taking into account the characteristics, life, and use methods of the product.

#### 2.3.4.4. End-of-life phase

- This phase is classified into recycling, incineration and landfill, depending on the materials and disposal method of the product.

- Use site-specific data on waste treatment whenever they are available, and the data shall be reported.

- Use proved statistical data on disposal of specific products and materials.

- If neither 3.3.4.4.2. nor 3.3.4.4.3. is applicable, a disposal scenario shall be developed and applied.

2.3.5. If the wastes resulted from the manufacturing or end-of-life phase are recycled into other product systems, i.e. an open loop recycling system, it shall be excluded from the system boundaries.

2.3.6. When the materials recycled through the open loop recycling system are used as inputs into any process, the recycling process shall be included within the system boundaries.

2.3.7. The incineration process shall be included within the system boundaries. When recovered heat is used for the system, it shall be deducted from the total environmental impact.

## **2.4. Cut-off rules**

2.4.1. Mass, energy and environmental relevance shall be taken into account in order to apply cut-off rules for inputs.

2.4.2. Omitted components or materials should be documented and recorded.

## **2.5. Data categories**

2.5.1. Data categories for inputs should include the materials (both raw and ancillary materials), water and energy that are used throughout the product life cycle.

2.5.2. Data categories for outputs shall include the products, co-products and environmental emissions (emissions to air, emissions to water, wastes, etc.).

2.5.3. Data categories for environmental emissions shall include those that are defined in the Clean Air Conservation Act, Water Quality Preservation Act and Waste Management Act and the site-specific items that are independently defined by the site. The wastes are classified into recyclable wastes, wastes to be landfilled and wastes to be incinerated.

2.5.4. In addition to the air emissions defined in the Clean Air Conservation Act, other relevant emissions, such as carbon dioxide, shall also be included.

2.5.5. The name of environmental emissions from which data should be collected shall be reported.

2.5.6. The name of the materials should be International Union of Pure and Applied Chemistry (IUPAC) or usual name.

## **2.6. Data quality requirements**

2.6.1. In principle, site-specific data (measured, calculated, etc.) should be used. If site-specific data are not available, data on similar products or processes may be used.

2.6.2. The site-specific data shall be the average data cumulated for the latest 1 year within 3 years after the day when the certification was applied for. However, for a new product manufactured less than 1 year, cumulative average data of the period ranging from the time of the beginning of manufacturing to the time of data collection can be used.

2.6.3. Technology coverage, e.g. technology and method used for production or data measuring, shall be determined by the technical level and methods in the site.

2.6.4. If it is difficult to use site-specific data, generic data obtained from published sources, e.g. Life Cycle Inventory Analysis Database (hereafter referred to as 'National LCI Database') developed by the government, should be used.

2.6.5. When generic data is used, priority should be given in the order of geographical coverage, time-related coverage, and technology coverage.

2.6.6. When data on similar products or processes or generic data are used, or there are data gaps, its reasons and validity should be reviewed and documented.

## **2.7. Data collection and calculation**

2.7.1. Data collection should include the items specified in the data categories and those below. When any data items are difficult to measure, they should be calculated by an appropriate method, and its justification should also be documented.

- Data sources and data collection techniques
- Data (including gaps) processing procedures
- Assumptions
- Data processing techniques and results

2.7.2 The data collection and calculation for each life cycle stage shall be made in accordance with the procedures below:

2.7.2.1. Raw materials acquisition and preparation phase

- Depending on the data quality requirements, either site-specific or generic data may be used. Generic data shall be applied in the order of:

- 1) National LCI database of the country
- 2) Average data of the relevant industries, e.g. APME, IISI, etc.
- 3) Generic data, e.g. software-contained data, etc.

-When inputs are supplied by multiple suppliers, data collection should in principle be conducted for all of the suppliers. However, when validity is proved, representative data may be used, and the criteria for selecting the representative data shall be justified.

2.7.2.2. Manufacturing phase

- For the manufacturing phase, site-specific data should in principle be collected. The validity of data on inputs into and outputs from each unit process should be verified using material or energy balances.

- If the quantity of carbon dioxide emissions is not measured in site, calculate it using the emissions factors given by Intergovernmental Panel on Climatic Change (IPCC).
- In principle, site-specific data should be collected for the incineration and wastewater treatment processes. If it is difficult to collect site-specific data, generic data may be used. When general wastes and specific wastes are separated and incinerated individually, data on general wastes and specific data should be used; when wastes are separated according to materials and incinerated individually, data on each material should be applied.
- Data Collection Form for Unit Process provided in Annex 2 (Instructions for Life Cycle Assessment Report) shall be used for site-specific data on the unit processes defined in the manufacturing phase.
- Data shall be collected from each unit process. If necessary, unit processes may be further subdivided.
- If the product is manufactured in multiple production lines, data should in principle be collected from all of the lines. However, when the characteristics of the production lines are similar, data may be collected from a representative production line; the validity of criteria for selecting the representative production line should be justified.
- When inputs are supplied by multiple suppliers, data should in principle be collected from all of the suppliers. However, when validity is proved, data from a representative supplier may be used, and the criteria for selecting the representative supplier should be justified.

#### 2.7.2.3. Use and End-of-life phase

- Data shall be collected and calculated according to 2.3.4.

2.7.2.4. For the transportation, actual data, e.g. tonnage and distance transported for each transportation mode, shall be collected. When the products are delivered by multiple transportation modes, a representative transportation mode may be defined and data may be collected from it; the validity of selecting the representative transportation mode should be justified. Empty return is not taken into account.

## 2.8. Allocation rules

2.8.1. Basis for allocation in the manufacturing phase shall be made in accordance with the allocation procedures defined in ISO 14041 (Environmental management - Life cycle assessment - Goal and scope definition and inventory analysis).

2.8.2. For the ancillary processes and wastewater/waste treatment processes, allocation should be made on the basis of production, i.e. weight or number of the products.

2.8.3. For the combined heat and power generation, allocation should be made on the basis of energy.

2.8.4. For the plastic molding processes (injection molding etc), allocation should be made on the basis of the weight of molded product.

2.8.5. For the painting and plating processes, allocation should be made on the basis of surface area of the surface-treated product.

## **2.9. LCI results**

2.9.1. When there is an upstream process for a unit process, site-specific data collected from the unit process shall be linked to the upstream process. The data shall be quantified in terms of the functional unit so as to be used to produce life cycle inventory analysis results.

2.9.2. In the inventory analysis, inputs and outputs shall be separately described as follows:

- Inputs shall include natural resources, water and energy. When any upstream flow that is relevant to the inputs is not traced, the inputs should be expressed as 'untraceable inputs.'

- Outputs shall include products, co-products and environmental emissions (e.g. emissions to air, emissions to water, wastes, etc.). When any downstream flow that is relevant to the outputs is not traced, the outputs should be represented as 'untraceable outputs.'

## **2.10. LCIA characterization factors**

2.10.1. Resource depletion: Guinee, 2001 with modification for crude oil, natural gas, hard coal and soft coal. Reserve basis, Sb-equivalents



2.10.2. Global warming potential: IPCC (1994-95, direct effect), the Time horizon 100 years, CO<sub>2</sub>-equivalents

2.10.3. Ozone depletion potential: WMO (World Metrological Organization 1999), CFC11-equivalents

2.10.4. Acidification potential: Heijungs et al, 1992 (updated with Hauschild & Wenzel, 1998), SO<sub>2</sub>-equivalents. For SO<sub>x</sub> and NO<sub>x</sub>, the characterization factors for SO<sub>2</sub> and NO<sub>2</sub> are used, respectively.

2.10.5. Eutrophication potential: Heijungs et al, 1992(with some modifications), PO<sub>4</sub>-3-equivalents

2.10.6. Photochemical ozone creation potential: Derwent et al, 1998 (updated in Jenkin & Hayman, 1999; included inorganic substances Derwent et al, 1996), in high NO<sub>x</sub>, C<sub>2</sub>H<sub>2</sub>-equivalents. For VOCs and non-methane VOCs, Heijungs et al., 1992 shall be referred to.

### **3. Product-specific rules**

#### **3.1 Scope**

This criteria shall apply to the rigid printed circuit board and flexible printed circuit board products (hereinafter, refer to as "PCB") including packaging materials.

#### **3.2 Function and functional unit**

3.2.1. Function: Connecting electrically between components or signals by making mounted electronic components on the plugboard.

3.2.2. Functional unit: 1 m<sup>2</sup> PCB production (product production unit)

\* Product specification: Number of layers (section, both side, multiple layer), dimension(width×length×height), weight, number of produced product per 1 m<sup>2</sup>, loss area per 1 m<sup>2</sup>, product materials information, plating area, etc.

#### **3.3. System boundaries**

3.3.1. Regarding to the system boundaries, it shall be accordance with the common rules and the following:

3.3.1.1. Raw materials acquisition and preparation phase: It is including the manufacturing process of the intermediate product which is delivered to the

product manufacturing phase, and the extracting process of raw materials those are comprising the product.

3.3.1.2 Manufacturing phase: It is including the component manufacturing and product manufacturing process. Production related process includes the production process that is directly relevant to the product production, and support process utility, treatment process of released emission and waste. If the processes included in the product manufacturing stage are changed, it shall be reflected to the phase.

3.3.1.2.1. Main component-manufacturing processes:

- Main component-manufacturing processes refer to the manufacturing process of the essential components those perform the main function of the PCB product and comprise the product.

- Main component-manufacturing processes are including the component manufacturing process and its detail process defined in the following table.

- In case the processes defined in the following table are changed, it should be reflected and included within the system boundaries.

Process	Description
Cutting & drilling	- Including processes cutting CCL, bonding sheet, and coverlay etc, and drilling insulated board, and removing residues attached in the hole during the drilling process
Plating treatment	- Including plating process to make the continuity possible of the non conductive components in the hole of the insulated board
Circuit formation	- Including processes attaching the photosensitive film to the insulated board to form the circuit, etching, and adhering bonding sheet, coverlay, stiffener with the insulated board
Pressure & printing	- Flexible printed circuit board: Including the process attaching bonding sheet, coverlay, stiffener to the circuit board by adding heat and pressure - Rigid printed circuit board: Including the process printing on the circuit board to protect the circuits
Surface treatment	- Including the surface treatment process necessary for using on the exposed circuit board by attaching the processed coverlay
Processing &	- Including the process of checking, inspecting and packaging

packaging	for the finished product processed in accordance with the standards
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### 3.3.2. Transportation

3.3.2.1. The transportation is not considered within the raw materials acquisition and preparation phase.

3.3.2.2. The transportation is not considered from the raw materials acquisition and preparation phase to the product manufacturing phase.

3.3.2.3. The transportation in the product manufacturing phase refers to the transportation between the components manufacturing processes and the product manufacturing processes, and its own unit processes. In this case, the transportation of major components selected in the product manufacturing phase in the system boundaries shall be included, and only considered when the transportation is occurred between the production company and the business site.

### 3.4. Cut-off rules

3.4.1. Cut-off rules shall be in accordance with the common rules.

3.4.2. It shall be set out in such a way that the quantity of input into the manufacturing phase should be more than 99 %, based on the cumulative mass contribution.

### 3.5. Data categories

3.5.1. Data categories shall be in accordance with the common rules.

### 3.6. Data quality requirements

3.6.1. Data quality requirements shall be in accordance with the common rules.

3.6.2. In the product manufacturing phase, site-specific data should be collected for the main component manufacturing processes and the product manufacturing processes.

### 3.7. Data collection and calculation

3.7.1. Data collection and calculation shall be in accordance with the common rules and the following.

### 3.7.2. Product manufacturing phase

3.7.2.1. Even if some processes among defined unit processes in the product manufacturing phase are placed outside of the business site, the site-specific data should be collected.

3.7.2.2. Among the wastes from the processes in the manufacturing phase, recyclable and landfill-capable wastes should be recorded as only the quantity of wastes collected.

### 3.7.3. Transportation

3.7.3.1. It shall be in accordance with the common rules, and Article 3, Clause (2).

3.7.3.2. It shall be complied with the common rules, and specify the reason for selecting the representative supplier and the means of transportation.

## **3.8. Allocation rules**

3.8.1. Basis for allocation shall be in accordance with the common rules, and the following.

3.8.2. In cases of recycling at the manufacturing phase after used to the other product system, they shall not be considered from the system boundaries.

3.8.3. The basis for allocation for each production line shall be determined by operating facilities, etc.

3.8.4. The basis for allocation for each product shall be determined by the number of manufactured products and their characteristics.

3.8.5. In case the plant does not equipped with the waste water treatment facility, allocate the collected site-specific data results from the waste water(collaboration) treatment facility based on the distribution of the waste water treatment cost.

3.8.6. In case the plant does not equipped with the waste treatment facility such as incinerator, allocate the collected site-specific data results from the collaborated treatment facility based on the distribution of the treatment cost.