Product Category Rules (PCR)

for preparing an Environmental Product Declaration (EPD) for

Robotic Vacuum Cleaner

PCR 2011:1.0

Matsutek Enterprises Co., Ltd.

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1. General Information

This document is to be used as the product category rules (PCR) for the global production and manufacturing of Robotic Vacuum Cleaners. The requirements specified in this PCR are intended to be used for EPDs certified in accordance with ISO 14025 standard. This document shall be valid until March 31, 2014.

This PCR was prepared by Matsutek Enterprises Co., Ltd. Representatives from major Taiwanese manufacturers of similar products and stakeholders were invited by the Taiwan Electrical and Electronic Manufacturers Association (TEEMA) to the open consultation meeting on February 15, 2011, to participate in the discussion and review of this PCR. Environment and Development Foundation (EDF) then reviewed and approved this PCR.

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2. Company and product description

The EPD shall include information about the manufacturing company/organization. The information may include manufacturing process related information, and environmental related information, such as the environmental management system information. The information may also include special issues which the company/organization would like to emphasize, such as the products meeting certain environmental criteria, or environmental safety and health related information.

This PCR is applicable to the robotic vacuum cleaner products. When certification of product environmental impacts is conducted, the product accessories and packaging shall also be included in the certification scope.

2.1 Product function

The robotic vacuum cleaner is an electronic product designed to automatically remove solid debris (such as dust and fibers), and are often capable of cordless operation

(battery operated) and obstacle sensing functions. Other special features may also include anti-dropping and automatic return for recharging etc.

2.2 Product components

A robotic vacuum cleaner consists of main components, accessories, packaging and other components described as follows:

Main Components:

- ☐ Casing assembly
- DC fan assembly (include motor)
- Gear assembly (include motor, gear)
- Dust container
- Printed circuit board assembly (PCBA)
- Sensor
- Battery
- Power supply

Accessories and packaging materials: charging dock, packaging box and packaging material.

Other components: e.g., remote control, brush, etc.

The data quality requirements for the main components are described in Section 9 on calculation rules and data quality requirements. The EPD shall also include the other components of the product, but their data quality requirements are different from those of the main components.

2.3 Product technical description

The product technical description part of the EPD shall include the following information:

- Noise (dB): measured sound power level
- Power supply's type and specifications
- Power consumption: description of power consumption
- Battery specification
- Cleaning method: describe how to remove dust
- Product design service life span

3. List of parts and banned substances

The contents of the following parts and substances in the product shall be declared:

- All parts with weight ratio (part weight/product weight) ≥ 1%;
- All banned substances regulated by legal, customer and environmental requirements;

- The following materials in the main components: flame retardants, lead content in solder, lead and flame retardant content in solder masking agent, and substances regulated by EU's RoHS Directive (the latest version).

The declaration of halogen-free flame retardants, lead-free solders and no RoHS-regulated substances may only be made when appropriate evidences are available (for example, test reports from accredited laboratories/testing facilities). The following organizations may provide accreditation for testing facilities: Taiwan Accreditation Foundation (TAF), (Asia Pacific Laboratory Accreditation Cooperation (APLAC), International Laboratory Accreditation Cooperation (ILAC) or ILAC Mutual Recognition Arrangement (ILAC MRA). For definitions of testing methodology and confirmations of regulated hazardous substances based on the accredited laboratories' product testing methods, please refer to IEC 62321 Standard.

4. Declared unit

The declared unit is one "unit" of robotic vacuum cleaner, as the robotic vacuum cleaners are marketed and sold in such a unit.

5. System boundaries

The main system boundaries for the declared product system are presented as follows:

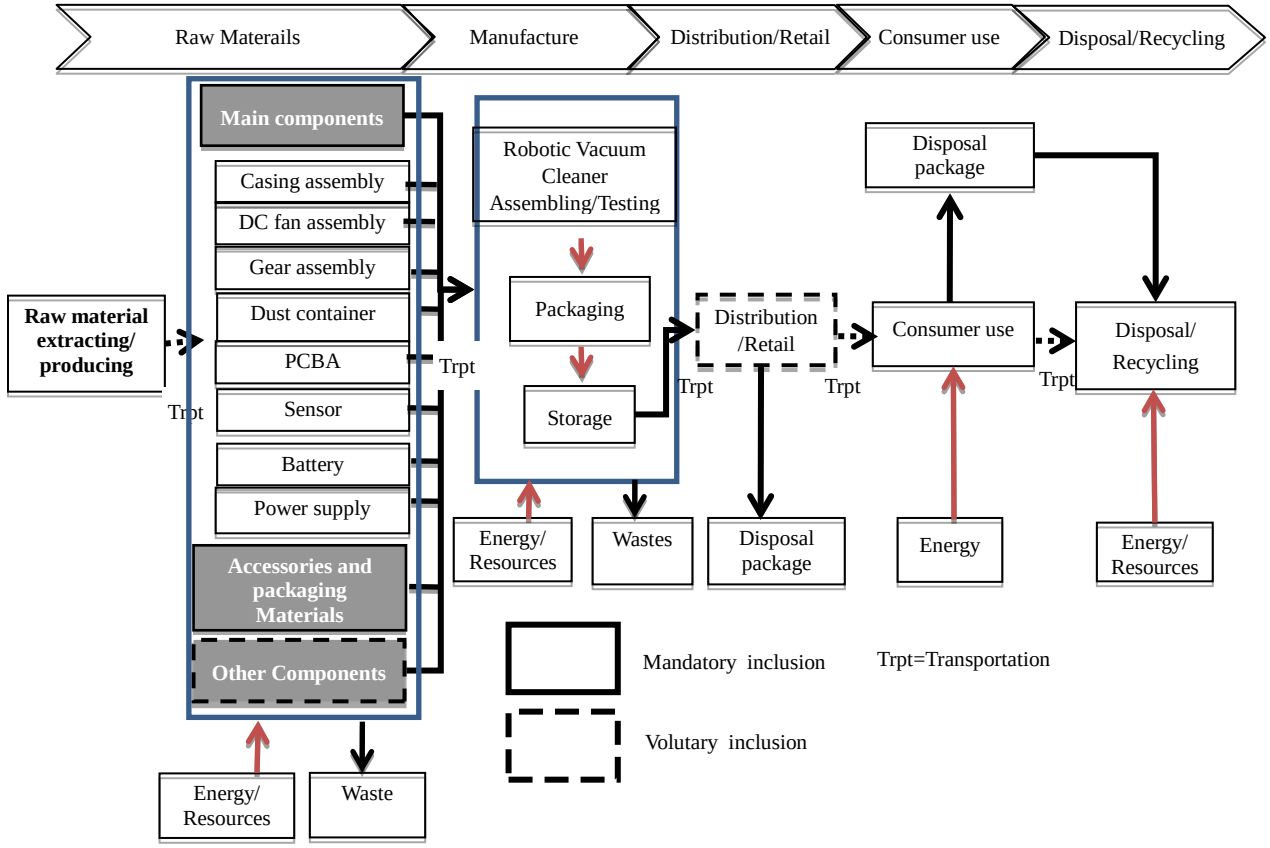

Figure 1 System boundary of the main product system

As noted in Figure 1 above, the life cycle of a robotic vacuum cleaner product only includes the raw material acquisition, product manufacturing, use and waste disposal phases.

Raw Materials Acquisition and Manufacturing Phase

The LCA shall include information for the following unit processes:

— Material extraction and manufacturing of main components and other components;

— Manufacturing of main components and other components;

— Product assembly;
— Transportation of main components to product manufacturing site;
— Transportation of other components to product manufacturing site.

The inclusion in the LCA the information on the forming and refining of raw materials and the manufacturing of smaller parts is of voluntary reporting nature. When voluntarily reported information is included, they shall be explained in the EPD.

Distribution and Marketing Phase

- Transportation of products to the distribution sites or customer designated locations;
- The inventory and reporting of energy/resource input and waste generation during the marketing process is voluntary (optional);
- The inventory and reporting of transportation from sales/distribution sites to users is voluntary (optional).

Use Phase

- The basis for the product's annual time of use data is based on the EU ErP Directive's Lot 17 Study Report on Vacuum Cleaners.
- The test procedure for energy efficiency or power consumption is based on the EU ErP Directive's Lot 17 Study Report or other relevant international standards.
- The main power source measurement for the vacuum cleaner use shall be based on the main power source of the region where the product is marketed.
- The design service life span for the product is three years.
- The total energy consumption during the product lifetime is calculated based on the Typical Energy Consumption (TEC) equation.

The assumed product energy consumption scenarios are as follows:

- Standby mode:
  - The state in which the product is fully charged, can work normally and has not entered into OFF mode;
  - If the product is equipped with a hard switch, it should be switched to ON position;
  - Based on the EU ErP Directive's Lot 17 Study Report on vacuum cleaners, a typical vacuum cleaner spends 7891 hours per year in standby mode.
- Off mode
  - The state in which the product is turned off, but the power supply is still connect to the main power source and the product;
  - If the product is equipped with a hard switch, it should be switched to OFF position;

- Based on the EU ErP Directive's Lot 17 Study Report on vacuum cleaners, a typical vacuum cleaner spends 47 hours per year in off mode.
- If there are other energy usage scenarios or definitions, they should be described along with the actual usage scenario or reference to other international standards.

- Equation for calculating the total energy consumption (unit: MJ) during the robotic vacuum cleaner's design service lifetime:

$$\mathbf{E_{TEC} = [(8760/1000) \times (P_{standby} \times T_{standby} + P_{off} \times T_{off}) \times 3.6] \times product\ lifetime}$$

Note: All Px are power values in watts; All Tx are Time values in % of year.

－ Based on the product standby mode and off mode time data from EU ErP Directive' s Lot 17 Study Report on vacuum cleaners, the TEC for a typical vacuum cleaner can be calculated as follows:

Mode Weighting for Robotic Vacuum Cleaner:

Annual time in standby mode: 7891 hours ∴ $T_{standby}$= (7891/8760) = 90.1%-year

Annual time in off mode: 47 hours； ∴ T_{off}= (47/8760) = 0.5%-year

$$\mathbf{E_{TEC} = ((8760/1000) \times (P_{standby} \times 0.091 + P_{off} \times 0.005)) \times 3.6}$$

Sample Calculations

Measurement of robotic vacuum cleaner's standby/off mode power consumption:

a) Off mode: 1W

b) Standby mode: 2 W

c) Design product lifetime: 3 years

Typical Energy Consumption of robotic vacuum cleaner:

$$E_{TEC} = ((8760/1000) \times (1 \times 0.091 + 2 \times 0.005)) \times 3.6 = 41.21\ (MJ/Year)$$

Lifetime energy consumption of robotic vacuum cleaner = 41.21× 3 = 123.6 (MJ/ 3 Years)

Recycling/end of life

The reporting of recycling information (such as recycling and dis-assembly report and

information on recycling channels) is mandatory in the EPD.

5.1 Specification of different boundary settings

Boundary in time

The validity period for the LCA results presented in the LCA report shall be defined.

Boundary towards nature

If the manufacturing processes are located within Taiwan, the solid waste categories as defined in Taiwan's Waste Disposal Act shall be adopted. If the processes are located in other countries, equivalent legal requirements shall be considered.

The natural boundary of the system shall describe the boundary where the materials and energy resources flow from nature into the system, and where the water and air emissions and waste are released out of the system.

Only the waste which is required to be disposed of needs to be considered; landfilling process does not need to be included. If the waste will be treated through water treatment or incineration, these processes need to be included.

Boundaries in the life cycle

The boundaries in the product life cycle are described in Figure 1. The construction of the site and infrastructure, as well as the production of manufacturing equipment and activities of the workers, does not need to be included.

Boundaries towards other technical systems

Boundaries towards other technical systems describe the inputs of material and other components towards other systems, as well as outputs of materials towards other systems. For the inputs of recycled materials and energy towards the product manufacturing phase, the transportation between the recycling process and use of recycled materials shall be included in the data set. For the production of recyclable products during the manufacturing phase, the transportation towards the recycling process shall be included.

(Note: Further explanations are provided in Section 7 on open-loop recycling)

Boundaries regarding geographical coverage

The manufacturing phase may cover manufacturing processes located on any sites

around the world. For processes located in a specific region, the data used should be representative of the region. The data for the main components shall be the specific regional data for the region where the process takes place (see Section 9). For ease of comparison, no matter where the emissions are generated, the same parameters should be used for life cycle impact assessment (see Section 10).

6. Cut-off rules

For any impact category, if the sum of various impacts from a specific process/activity is less than 1% of the impact equivalent in that category, such a process/activity may be neglected during the inventory analysis. Nonetheless, the accumulated impact of neglected process/activity may not exceed 5%. Components and materials omitted from the LCA shall be documented.

(Note: This judgment for this “1% Rule” is based on the environment relevance assessment of material input to the system, and does not consider special and exceptional environmental impacts.)

7. Allocation rules

The main allocation rules shall be valid for the entire product system. For other secondary processes, other allocation rules may be defined; however, the use of these rules should be justified. Product-specific information should be preferentially collected in order to avoid the need for allocation. While selecting allocation rules, the following principles are recommended.

- Multi-output: The allocations are based on the changes in the resource consumption and pollutant emissions (for example, adopted quantity allocation for some main component, or surface allocation for some components), following the changes in the studied system’s output product or function or economical relationship.
- Multi-input: The allocation is based on actual relationship. For example, the manufacturing process’s emissions may be affected by the change in waste flow input.
- Open loop recycling: For the input of recycled materials or energy during the manufacturing phase of the product system, the transportation between the

recycling process and the recycling to material use shall be included in the dataset. For the product which shall be recycled during the manufacturing phase, the transportation towards the recycling process shall be included.

Notes:

- Allocation may be avoided through avoidance of dividing processes, for example as described in Section 6.3 of ISO/TR 14049; or through expansion of system boundary (for example as described in Section 6.4), so that the amended system shares the same product exchanges as the original system.

8. Units

The base units and derived units of the International System of Units (SI, Système International d'unités) shall be used preferentially.

Power & energy units:

- power unit: W
- energy unit: J

Specification units:

- length unit: m
- capacity unit: m^3
- area unit: m^2
- weight unit: kg

If necessary, prefixes may be used before the SI units.

10^9 = giga, symbol “G”
10^6 = mega, symbol “M”
10^3 = kilo, symbol “k”
10^{-2} = centi, symbol “c”
10^{-3} = milli, symbol “m”
10^{-6} = micro, symbol “µ”
10^{-9} = nano, symbol “n”

9. Calculation rules and data quality requirements

Date quality requirements for raw material acquisition phase and manufacturing

phase

- Generic data may be used for the acquisition, production, forming and refining of raw materials used for the components of the robotic vacuum cleaners. Please refer to Appendix I for the common sources of generic data. The date of the generic data used can not be older than 1990.

- Site specific data (for example, specific factory data or transportation data for a specific manufacturing process) shall be used for the manufacturing of components and assembly of the robotic vacuum cleaners. If other types of information are used, description of the information and rationale for using the information shall be provided.

- Generic data may be used for the manufacturing process for the packaging material and optionally included components of the robotic vacuum cleaners. Please refer to Appendix I for the common sources of generic data.
- When generic data are used, the equivalence between the chemical and/or physical process of referred systems shall be considered. The system referred in the generic data should have equivalent technology and system boundaries with the declared product system.

- Generic data may also be used when suppliers refuse to provide specific data, or when even if generic data are used in place of specific data, there is only minor impact to the results. The general rule is that if generic data are used in place of specific data, their combined contribution for all life cycle phases shall not be greater than 20% of total impacts for each impact category. But there may be certain exception to specific products.
- The data shall be representative for the average of a specific year.

- The electricity mix for the manufacturing phase should be site specific data. If site specific data cannot be obtained, the official electricity mix for the country where the site is located may be used as approximate value. The electricity mix should be documented.

- For the definition of hazardous waste, the definition as defined in Taiwan's Waste Disposal Act shall be used for sites located in Taiwan. For sites located outside Taiwan, legal requirements for the host country shall be observed.

- For the transportation of main components to the assembly plant, the actual transportation modes used and distance traveled shall be considered.

Date quality requirements for the distribution and marketing phase

- For the transportation of product to the distribution sites or retailer sites, the actual mode of transportation and distance traveled shall be considered.
- The energy and resource consumption as well as waste generation for the distribution and marketing phase shall be considered.

Date quality requirements for the use phase

- The product electricity consumption during the use phase shall be confirmed in accordance with the corresponding testing method for the region where the product is being use.
- For the electricity mix of the use phase, the generic data for the official electricity mix for the country/region where the product is being use may be used as approximate value. Please refer to Appendix I for the common sources of generic data used internationally. The date of the generic data used can not be older than 1990.

Date quality requirements for the waste disposal phase

- Generic data may be used when site-specific data from the waste disposal and recycling system can not be obtained due to specific reason. Please refer to Appendix I for the common sources of generic data used internationally. The date of the generic data used can not be older than 1990.

10. Parameters to be declared in the EPD

The following parameters shall be declared in the EPD:

1. Energy use

- The energy consumption during each phase shall be declared, especially the electricity consumption during the use phase when the product is being used by the end user.
- The following units shall be used preferentially:
  kW or W for power; J or MJ for energy.

2. Resource use

The resource input during each phase shall be declared.

3. Impact equivalents expressed as potential environmental impacts

-Global warming	kg CO_2 equivalent
-Acidification	kg SO_2 equivalent
-Photochemical oxidant formation	kg C_2H_4 equivalent
-Eutrophication	kg PO_4^{3-} equivalent
-Ozone depletion	kg CFC-11 equivalent

Note: For characterization factors of each impact category, please refer to *EPD Supporting Annexes*, Version 1.0 (2008-02-29), The International EPD Cooperation, downloadable from www.environdec.com.

4. Additional information

- - Recyclable materials (optional)
- - Information on secondary materials (optional)
- - Waste (classification):
  - Hazardous waste as defined in Taiwan's Waste Disposal Act. Follow host countries' laws for sites outside Taiwan.
  - Other waste.

- Plastic parts marking

Where technologically feasible, the plastic parts of the robotic vacuum cleaner weighing ≧ 25 g are marked in accordance with the ISO 11469 and ISO 1043 Part 1/2/3/4, SPI or other international standard label to facilitate their identification and recovery at the end of life.

- Plastic packaging materials marking

The Plastic packaging materials must be labeled on the parts with SPI or other international standards for ease of sorting.

11. Recycling information

The recycling information shall include information such as dis-assembly instructions, which parts/components are suitable for recycling (such as metal casing) or not suitable for recycling. The information which the EU WEEE Directive requires the end product manufacturer to provide may also be included in the product declaration information for robotic vacuum cleaners.

If feasible, information for the parts which can not be recycled and therefore should

be disposed of properly during the end-of-life phase may also be included.

12. Other environmental information (Optional)

The EPD may cover information including technology adopted, site of product manufacturing and assembly, as well as information on other working environment, health and risk-related aspects.

If this PCR is to be used for product carbon footprint declaration purpose, in the declaration, information regarding commitment on GHG reduction shall be included and shall ensure that the commitment is measurable, reportable and verifiable. The organization may also list environmental and energy management related information, such as awards, commendations and system certifications (e.g., ISO 14001, ISO 14064-1, IECQ HSPM) etc.

13. Information about the certification

The information on PCR review, EPD verification and verification organization shall be included.

EPD Certification is valid until 20XX-__-__ According to the Requirements for the international EPD system. General Programme Instructions, Version 1 (2008) – www.environdec.com The PCR review for _____ (PCR 201X:) was administered by the Environment and Development Foundation and carried out by an LCA expert panel chaired by Dr. Ning Yu (ningyu@edf.org.tw). Independent verification of the declaration, according to ISO 14025:2006 □ Internal ■ External
Third party verifier: Environment and Development Foundation in Taiwan. Accredited by : Name: Title: Organization: Signature:_____ Name: Title: Organization: Signature:_____ Name: Title: Organization: Signature:_____
Environmental declarations from different programmes may not be comparable.

14. References

The EPD shall make reference to the following documents:

- EPD General Program Instructions, Version 1.0 (2008-02-29), The International EPD Cooperation, downloadable from http://www.environdec.com/;
- Relevant PCR documents;
- The underlying LCA report.

When available, the following documents shall also be referenced:

- Other documents and recycling instructions which verify and complement the EPD.

Appendix I – Generic Data Sources to Refer to

For processes located within Taiwan, Taiwan generic data or the data published by the commercial, industrial and energy competent authorities of the Republic of China (ROC) government, may be used. However, for other regions (such as EU), if there are more relevant generic data available, these data should be used instead.

When data from the following generic databases are used, the most current and updated data should be used:

Material	Database	Published
Aluminum	EAA (European Aluminum Association)	2000
Copper	ICA (International Copper Association)	1998
Copper semi products	ICA (International Copper Association) + IME (Institut für Metallhüttenwesen und Elektrometallurgi, Aachen)	1998 1995
Electricity	ETH (Eidgenössische Technische Hochschule) Data combined with IEA (International Energy Agency) statistics 1998	1996
Electronic components	EIME (Environmental Information and Management Explorer) EcoBilan	1998-2000
Energy	Boustead model 5.0	2007
Energy	ETH ESU 96	2004
Industrial processes	Ecoinvent 2nd edition	2007
LCA Database in Taiwan	DoITPro	2010
Packaging materials, transport, waste treatments	BUwAL 250, 2nd edition	2004
Plastics (and some chemicals)	APME (Association of Plastics Manufacturers in Europe)	1993-1998
Steel	IISI (International Iron and Steel Institute)	1998

Appendix II – Reporting Format for the EPD

This appendix provides guidance information for the titles of sections, types of data and required information to be reported in the mandatory reporting part of the EPD. As a generic reporting template, the following titles and sub-titles are recommended:

(Refer to the PCR manual for the section numbering, the information in Italics are the recommended data/information for inclusion)

Introductory part

Each EPD should have an introduction part on the top part of the EPD which includes the following information:

- *Company/organization name*
- *Product name*
- *EPD registration number*

Description of the company/organization and product/service

Company/Organization

- *Description of company/organization*
- *Description of overall working environment, existing quality system and environmental management system*

Product and services (see Section 2)

- *Product's main applications*
- *Description of product specification, manufacturing process, manufacturing sites (if there are several sites)*
- *For product's environmental performance aspects, characteristics which may improve the usefulness of product*
- *Other types of relevant information, for example, special manufacturing processes with special advantages to the environment*

List of materials and chemical substances

- *Content declaration (see Section 3)*

Presentation of the environmental performance

- *Outline of the LCA methodology, for example, period of LCA, declared units, system boundaries (graphical presentation), cut-off and allocation rules, and data sources.*

Manufacturing phase *(see Section 10)*

Use phase *(see Section 10)*

-Geographical region for product delivery
-Transportation data
-End-of-life information

Information about Company and Certification Organization

Recycling information *(see Section 11)*

Other environmental information *(see Section 12)*

Information regarding certification

- Names of certification and verification organizations

- Validity of certification certificates

- Compliance with legal and relevant requirements

References *(see Section 13)*

- relevant PCR documents

- EPD General Program Instructions, Version 1.0 (2008-02-29)

- underlying LCA study

- other supporting documents for LCA information

- other relevant documents regarding company/organization's environmental activities

Appendix III Abbreviations

Acronyms	Common Name
ACPI	Advanced Configuration & Power Interface
APLAC	Asia Laboratory Accreditation Cooperation
CFP	Carbon Footprint of Product
EPD	Environmental Product Declaration
ErP	Energy Related Product
ILAC	International Laboratory Accreditation Cooperation
ILAC MAR	International Laboratory Accreditation Cooperation Mutual Recognition Arrangement
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
PCR	Product Category Rule
RoHS	The Restriction of the use of certain Hazardous Substances in electrical and electronic equipment
SPI	Society of the Plastics Industry
TAF	Taiwan Accreditation Foundation
TEC	Typical Energy Consumption
Trpt	Transportation
WEEE	The Waste Electrical and Electronic Equipment Directive