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PEP ecopassport® PROGRAM

PSR

SPECIFIC RULES FOR THERMAL SOLAR COLLECTORS

PSR-0017-ed1-EN-2019 04 01

According to PSR-model-ed1-EN-2015 03 20

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1. Introduction

This reference document complements and explains the Product Category Rules (PCR) defined by the PEP ecopassport® program (PEP-PCR ed.3-EN-2015 04 02), available at www.pep-ecopassport.org).

It defines the additional requirements applicable to thermal solar collectors. Compliance with these requirements is necessary to:

- Qualify the environmental performance of these products on an objective and consistent basis,
- Publish PEPs compliant with the PEP ecopassport® program and international reference standards.[1]

This reference document was drawn up in compliance with the open, transparent rules of the PEP ecopassport® program with the support of stakeholders and professionals of the thermal solar collector market and the interested parties.

	www.pep-ecopassport.org
PSR reference	PSR-0017-ed1-EN-2019 03 14
Critical review	The third-party Critical review was carried out by Julie ORGELET- DDemain. The declaration of conformity published on 05/02/2019 can be found in the Appendices.
Availability	The Critical review report is available on request from the P.E.P. Association contact@pep-ecopassport.org
Scope of validity	The critical review report and the declaration of conformity remain valid within 5 years or until the PEP Drafting Rules, or the normative reference texts to which they refer, are modified.

1 ISO 14025, ISO 14040 and ISO 14044 standards

2. Scope

In accordance with the General Instructions of the PEP ecopassport® program (PEP-General Instructions-ed-4.1-EN-2017 10 17) and additional to the PCR, “Product Category Rules” of the PEP ecopassport® eco-declaration program (PEP-PCR-ed3 -EN-2015 04 02) , this document sets out the specific rules for the thermal solar collector and defines the product specifications to be adopted by manufacturers in the development of their PRODUCT ENVIRONMENTAL PROFILES (PEPs) particularly with regard to:

- the technology and its type of application,
- the reference life time (RLT) taken into account for the products Life Cycle Assessment (LCA),
- the conventional use scenarios to be adopted during the product use phase.

The main purpose of those specific rules is to provide a shared basis to manufacturers when developing life cycle assessments for their products. The various thermal solar collector technologies available are presented. Thermal solar collector are technical subsystems that can be used, for example, by systems dedicated to the exclusive production of hot water defined by the PSR-0004-ed3.0-EN-2018 02 09.

Are excluded from the scope:

- Photovoltaic collectors
- Parabolic or cylindro-parabolic collectors (collectors used for the process or the production of electricity from the steam produced by the collectors)
- Hybrid collectors (thermal and photovoltaic)

2.1. Definition of the covered product families

The covered product family is designated by the following terminology: "THERMAL SOLAR COLLECTOR" which is a "device for absorbing solar radiation and transmitting the heat thus produced to a coolant[1]".

This family includes at the writing day of this PSR two categories of products presented below.

2.1.1. Liquid flow collector

These are solar collectors in which the coolant is a liquid. This family includes:

- Glazed flat plate solar collectors
- Unglazed flat plate solar collectors
- Vacuum glass tube solar collectors
- Vacuum glass tube solar collectors with optical concentration system of solar flux

2.1.2. Air flow collector

These are solar collectors in which the coolant is air. This family includes:

- Glazed flat plate solar collectors with a closed circuit

- Glazed flat plate solar collectors with outside fresh air in collector's input
- Unglazed flat plate solar collectors (unglazed plan placed between the solar flux and the collector's absorber) with a closed circuit
- Unglazed flat plate solar collectors (plan without glazing placed between the solar flux and the absorber of the collector) with fresh air outside the collector's inlet

2.2. Considerations of technical developments

The specific rules to thermal solar collectors will take into account any technological advance, as long as it is the subject of a request for inclusion in the specific rules to thermal solar collectors to the P.E.P. Association, which will decide according to the presentation of the new technology and the justification of the claimed performances.

3. Product life cycle assessment

3.1. Functional unit and reference flow description

These specific rules are additional to section "Functional unit and reference flow description" of the current PCR (PEP-PCR-ed3-FR- 2015 04 02).

3.1.1. Functional unit

The functional unit is:

« Absorb the solar radiation and transmit 1 kW of heat to the coolant, according to the reference use scenario over a period of 50 years »

The power of the collector taken into account is the one defined in the conditions of use of the ISO 9806 standard with an overall irradiation of 1000 W/m² for a DeltaT of 40 K. It should be noted that this power takes into account the energy efficiency of the collector. This power corresponds to the output power of the collector.

3.1.2. Reference product and reference flow description

The study is realized:

- on a solar thermal collector with its packaging and the installation elements delivered with the product,
- for a reference lifetime of 50 years,

- then the impacts are reported to the functional unit according to the method described in paragraph 3.10.

The reference lifetime of solar thermal collectors is 50 years. This duration corresponds to the reference lifetime of a building when carrying out building LCA studies. Manufacturers involved in the development of this PSR believe that solar thermal collectors are structural equipment of the building which are not subject to any renewal.

In the case of a declaration for an homogeneous product family, the environmental statement and the associated study will relate to a reference product with the following characteristics:

- A solar thermal collector with an area of 2 m² or on the closest surface product. This surface is judged as the most used surface. The choice of the latter will facilitate the comparison between the PEP documents.

An extrapolation rule to other products, in accordance with section 3.6, will apply and will be documented in the LCA report and the PEP document.

3.2. System boundaries

These specific rules are additional to section « System boundaries », of the current PCR (PEP-PCR-ed3-FR-2015 04 02).

3.2.1. Manufacturing stage

All the components delivered with the product and allowing its proper functioning must be included in the scope of the study.

In the case of solar thermal collectors, the elements to include are the panel and its mounting bracket.
The items to be excluded from the scope of study are the fluid and the elements outside the collector such as the primary flexible pipes and the circulation pump. These elements are to be considered at the system level using the thermal collector.

3.2.2. Distribution stage

For this step, the rules defined in the current PCR (PEP-PCR-ed3-EN-2015 04 02) apply.

3.2.3. Installation stage

Conventionally, the solar thermal collectors installation involves:

- The manufacturing and processing of the components necessary for the collector installation that are integrated only at the installation time.

- The processes and energies that are implemented at the installation time.

The flows related to the installation process, when necessary for the proper functioning of the equipment at its place of implementation, may be:

  - The lifting equipment on site-transport
  - The energy consumed during a on-site test phase

- The treatment of packaging waste. In fact, the packaging waste generated during the installation stage is supposed to be eliminated by the installer once the equipment is installed.

Are not considered:

- The connection of the collector to the other elements of the building heat transfer system such as coolant, primary flexible pipes, circulation pump. These components are excluded from the scope of the study and are to be considered at the system level using the solar thermal collector. These elements may be the subject of a specific declaration.
- Energy flows associated with the use of portable hand tools to install solar thermal collectors may be neglected.
- Any modification of the frame and / or addition of elements not foreseen by the manufacturer. The actual impact of these operations is to be calculated by the user of the declaration if he wishes according to the installation elements used during the construction phase.

3.2.4. Use stage

The use stage of the solar thermal collector involves once the element is installed:

- A solar energy consumption measured, justified and dependent on the reference use scenario
- An heat production measured, justified and dependent on the reference use scenario

A solar thermal collector requires no maintenance for the following reasons:

- In normal use conditions, a solar thermal collector does not require any maintenance operation as servicing or replacement of parts.
- Maintenance of other components of the building heat transfer system (such as coolant, primary flexible pipes, circulation pump) is not considered. These maintenance operations are to be considered at the system level using the solar thermal collector.
- Due to the difficulty of allocating the impacts of control visits between the solar thermal collector and the system using the collector, it is considered that control visits are to be considered at the system level using the solar thermal collector.
- At the building level, maintenance or renovation work on the roof can be carried out. Depending on the types of installations (especially on the roof and terrace), these interventions can lead to a removal and reassembly of the collectors. Energy flows related to the use of portable hand tools may be neglected.

3.2.5. End of life stage

For this step, the rules defined in the current PCR apply.

3.3. Cut-off criteria

The rules specified in the paragraph "Cut-off rules" of the current PCR (PEP-PCR-ed3-EN-2015 04 02) apply.

3.4. Specific allocation rules

These specific rules supplement the paragraph "Rules for allocation between co-products" of the current PCR (PEP-PCR-ed3-EN-2015 04 02).

In the case where primary data is shared with products other than those covered by these specific rules, the calculation of impacts is made in proportion to the mass of equipment manufactured.

3.5. Development of scenarios (default scenarios)

3.5.1. Manufacturing stage

A solar thermal collector consists of components supplied by the manufacturer:

- directly shaped by the manufacturer,
- or ready to be assembled.

The rules defined in section 3.8 "Primary and secondary data collection requirements" of these specific rules apply.

3.5.1.1. Wastes from the manufacturing stage

The manufacturing of wastes and their treatment are included in the manufacturing phase.

Manufacturers can eliminate manufacturing wastes themselves, or under their responsibility. The LCA report precise how the manufacturer, or any person working on his behalf, fulfill those steps by distinguishing hazardous from non-hazardous manufacturing wastes, and by providing proof of those allegations.
When they are known, treatment processes (incineration with energy recovery, landfill, and incineration without energy recovery) must be presented and justified in the LCA report, and the related environmental impacts must be taken into account as defined in the section “End-of-life treatment scenarios” of the current PCR.
The waste treatment processes justification must be defined, in the LCA report, by detailing the treatment sector and the valorization ratio selected for each waste (e.g. via an annual report on the end-of-life processing of equipment by an eco-organisation).

Without more precise and justified information, the following values must be used by default:

- Product weight X 0,30 = 50% incinerated without energy recovery and 50% landfill

Where applicable, as this is a default penalty value, no energy recovery shall be taken into account.

As a sectorial convention, the waste collection transport is accounted with a 100km truck transport.

3.5.2. Distribution stage

The distribution stage must be analyzed in accordance with the section "System boundaries / Distribution stage" of the current PCR.

3.5.3. Installation stage

3.5.3.1. Type of installation

A solar thermal collector can be installed according to 3 types of installation: roof, terrace or integrated. The choice of the type of installation chosen should be justified in the LCA report and indicated in the PEP document.

3.5.3.2. Waste from the installation stage

Packaging wastes from a solar thermal collector generated during the installation stage fall into the category of non-hazardous waste and are, in principle, removed by the installer once the solar thermal collector is installed.

Their treatment is calculated by default as follow:

On the packaging mass	Cardboard, wood, corn starch, cellulose	Plastics and other products as non-hazardous waste
Percentage of packaging recycled at end of life	89%	21%
Percentage of packaging incinerated with energy recovery at end of life	8%	32%
Percentage of packaging incinerated without energy recovery (50%) and landfilled (50%) at end of life	3%	47%

Plastic film, straps, packing notes, labels or any other paper on or inside the package of the solar thermal collector are considered to be insignificant and will not be included in the life cycle assessment for packaging waste.

By sector-based agreement, the transport stage for this waste shall be taken into account, assuming that it is trucked over a distance of 100 km.

3.5.4. Use stage

The use stage of the solar thermal collector involves, once the element installed, no consumption of energy except solar energy.

3.5.4.1. Reference use scenario

The reference use scenario of a solar thermal collector is:

"The solar thermal collector absorbs solar radiation and transmits a power P kW of heat according to an annual solar irradiation of 1848 kWh/m² corresponding to the sunshine of the city of Strasbourg for 50 years. The conditions of use are those defined in the ISO 9806 standard with an overall irradiation of 1000 W/m² for a DeltaT of 40 K. The collector is exposed to the South with a 45° inclination."

With P, collector power as defined in paragraph 3.1.1

3.5.4.2. Solar energy consumption

The following formula allows calculating the amount of solar energy absorbed by the solar thermal collector over its reference lifetime, denoted E_{solar} and expressed in Wh:

$$E_{solar} = I * S* \eta*50$$

With:

- I : annual solar irradiation for the city of Strasbourg, 1848 kWh/m².an
- S : solar collector area (in m²)
- η : collector efficiency $\eta = \eta0 – (a1*DT/G) - a2*DT²/G$

With:

- G : overall average irradiance of 1000 W/m² (southern exposure, inclination at 45°)
- DT : temperature difference between the average temperature of the solar collector and the outside temperature. The value of DT is set to DT = 40K.
- η0 : optical performance of the collector
- a_1 : first order coefficient, representing constant percentage losses (in W/m².K)
- a_2 : first order coefficient, representing losses at constant percentage (in W/m².K²)

The solar energy consumption is to be modeled with the elementary flow ELCD "Elementary flow / Resources / Resources from air / Renewable energy resources from air / primary energy from solar energy".

It should be noted that this flow will be accounted for in the energy flows but will have no influence on the environmental impact indicators. It allows to complement the indicators:

- Total use of primary energy
- Use of renewable primary energy, excluding renewable primary energy resources used as raw materials

3.5.4.3. Heat production

The amount of heat produced by the solar thermal collector must not be declared in the LCA software. In fact, the indicator "Exported energy" refers only to energy from the incineration of waste and landfills.

3.5.5. Maintenance stage

The use stage of the solar thermal collector involves, once the element installed, no particular maintenance. Maintenance is to be considered at the system level.

3.5.6. End-of-life stage

Nowadays, there is no specific treatment system for the solar thermal collector. In addition, the working group leading this PSR has no specific information on the recycling of products, since the solar thermal collectors currently on the market have not reached their end of life.
For the realization of a PEP document, it is assumed that the solar thermal collectors are dismantled during the deconstruction of the building. The materials used in the manufacturing of solar thermal collectors are eliminated and/or recovered depending on the waste stream. The deconstruction operations of solar thermal collectors are considered negligible.

With regard to recovery processes, the study will cover all stages until stock constitution before reuse.

Their transport stage is to be taken into account, considering a transport hypothesis of 100 km return trip in a light truck.

In the absence of additional information, the recyclability potential to be considered is as follows:

Type of waste	Type of treatment	Treated part
Metals	Declaration of the waste stock for recycling	95%
	Landfill of scrap metal	5%
Glasses	Landfill of glass-type inert waste	100%
Plastics	Landfill of plastic waste	100%
Other	Landfill of waste Note: Landfill classification has to be justified according to the nature of the waste	100%

Any other end-of-life treatment scenario of the product must be justified in the LCA report and mentioned in the PEP.

3.6. Rules for extrapolation to an homogeneous family

These rules are additional to section "Rule(s) for extrapolation to an environmental homogeneous family" of the PCR (PEP-PCR-ed3-FR- 2015 04 02).

It is accepted that the PEP covers products other than those that constitute the reference product. These other products, different from the reference product, may be named (commercial references) in the PEP oand in the LCA report, provided that they belong to the same homogeneous environmental family as the reference product. An homogeneous environmental family means a group of products satisfying the following characteristics:

- Same function
- Same product standard
- Similar manufacturing technology: identical type of materials and identical manufacturing processes

As part of the development of a PEP valid for a range of solar thermal collectors whose technical data, material balances or environmental impacts, are different from those of the reference product, extrapolation rules to estimate the data associated with the other products in the range must be used for each stage of the life cycle. These extrapolation rules must be documented and justified in the LCA report and mentioned in the PEP document.

3.7. Rules applying to joint environmental declaration

These rules are complementary to the sections "Rules applying to joint environmental declarations" of the PCR (PEP-PCR-ed3-EN-2015 04 02).
For a joint environmental declaration, the study must cover a typical product with a reference area of 2 m², or, if not available, any other closest area to it. This area is judged as the most used one. It will facilitate the comparison between the PEP documents.

3.8. Requirements concerning the collection of primary and secondary data

These rules are additional to the sections "Requirements for the collection of primary data" and "Requirements for secondary data" of the PCR (PEP-PCR-ed3-EN- 2015 04 02).

As far as possible, the primary data (i.e. all the data associated with the manufacturing stage of the reference product and specific to an organization) is to be preferred and shall be justified in the LCA report, specifying:

1) primary data in case of a single supplier,

2) in case of procurement from several suppliers, the primary data to be taken into account is the data provided by major suppliers representing at least 50% of the procurement by volume (with respect to the total quantity bought). For example, for 10 suppliers each providing 10 % of the procurement volume, at least 5 suppliers shall be considered in order to obtain an overall view of the primary information provided. Any other distribution rule should be mentioned in the LCA report and in the PEP.

If primary data are shared with products other than those referred to in these specific rules, the calculation of impacts will be done in proportion to the mass of the products manufactured.

This information is not always available to manufacturers of solar thermal collectors: for lack of primary data, secondary data, i.e. data obtained from the life cycle assessment software database shall be used. PCR explains how to select the LCI modules. If the transportation information is not available, the data defined in the section "Transport scenarios" of the current PCR will be used.

The proportion of primary and secondary data used in the life cycle assessments of solar thermal collectors must be indicated in the LCA report and may be included in the PEP, in the section describing the environmental impacts, in addition to the information required in the section 2.12 - Environmental Impacts - of the PCR. This proportion is determined in relation to the product mass.

3.9. Data quality evaluation

The specific rules specified in section "Data quality evaluation" in the current PCR (PEP-PCR-ed3-EN- 2015 04 02) apply.

3.10. Calculation of environmental impact

3.10.1. Calculation of environmental impact at functional unit level (FU)

To ensure consistency of the results of environmental impacts between the functional unit and the reference product, the PEP shall show the environmental impacts of the manufacturing, distribution, installation, use (including maintenance) and end-of-life stages as follows:

Environmental impacts from the PEP (for 1 kW) =
Environmental impacts of the reference product / Power of the reference product (in kW)

With:
Power of the reference product = power of the collector defined in the conditions of use of the ISO 9806 standard with an overall irradiation of 1000 W/m² for a DeltaT of 40 K.

3.10.2. Calculation of environmental impact at product level (declared unit)

The results of the environmental impacts generated by the life cycle of the reference product at the declared unit scale can be declared in the PEP document as additional environmental information. The expression of the declared unit and the method of calculation to be applied are detailed in section 4.3.

4. Drafting of the Product Environmental Profile

4.1. General information

These rules supplement the "General Information" section of the current PCR (PEP-PCR-ed3-EN-2015 04 02).

In addition to the information required by the PCR, the PEP must include:

- Family and type of collector according to paragraph 2.1
- The elements that make up the solar thermal collector. The following statement will appear: "The coolant and the elements outside the collector such as the primary flexible pipes and the circulation pump are excluded. These elements have to be included in the environmental declaration of the system using the solar thermal collector. "
- The collector area expressed in m²
- The collector energy efficiency
- The reference power in kW
- The type of installation considered (roof, terrace or integrated)
- The baseline usage scenario as defined in section 3.5.4.1
- The reference usage(s) type(s) provided by the manufacturer
- The absence of maintenance operations considered at the level of the solar thermal collector. The following statement will appear: "Maintenance operations, such as control visits and fluid changes, are to be considered in the environmental declaration of the system using the solar thermal collector."
- In the case of extrapolation rules declaration, the area, energy efficiency and power considered for each thermal solar collector covered by the PEP for the product range

4.2. Constituent materials

The rules specified in section "Constituent materials" of the current PCR (PEP-PCR-ed3-EN- 2015 04 02) apply.

4.3. Additional environmental information

These specific rules are additional to section "Additional environmental information" of the PCR (PEP-PCR-ed3-EN- 2015 04 02).

In the context of performing Life Cycle Assessments at building level, the environmental impacts of the equipment must be considered at product level and the impacts related to energy consumption in the use stage must be treated separately.

To facilitate the use of the PEP results for LCA of buildings, the PEP may include:

- The table of the environmental impacts of the reference product expressed at the level of the declared unit (here the m²) in addition to the table at the level of the functional unit. The values should then be given in numerical values, expressed in the appropriate units with three significant digits (and, optionally, as a percentage) for each stage of the life cycle, and the total for each indicator of the complete life cycle assessment.
  The details below should then be indicated in the PEP, in order to guarantee clarity and transparency for the user:
  - For the environmental impacts expressed by functional unit, the following statement will appear: "per kW corresponding to the functional unit". In order to lighten the reading, the mention can be reduced to "per kW" or "per UF".
  - For environmental impacts expressed per declared product, the following statement will appear: "per m²".
- The declared unit corresponds to: "1 m² of solar thermal collector operating according to the reference use scenario over a period of 50 years".
- The calculation of the environmental impact at the product level (declared unit) is as follows:
  Environmental impacts reported in the PEP (for 1 m²) =
  Environmental impacts of the reference product / Reference product area (in m²)
  The results of the environmental impacts in the use stage according to a breakdown of Module B (B1 to B7) in compliance with standards EN 15978 and EN 15804.
- In the case of solar thermal collectors, the module B6 includes the solar energy absorbed by the collector. The values of the other modules are zero.

PEP ecopassport®	Manufacturing stage (Section 3.5.1)			Distribution stage (Section 3.5.2)	Installation stage (Section 3.5.3)	Use stage (Sections 3.5.4 and 3.5.5)							End-of-life stage (Section 3.5.7)				Benefits
EN 15978 / 15804	Production stage			Construction stage		Use stage							End-of-life stage				Benefits
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Supply of raw materials	Transport	Manufacture	Transport	Installation process	Use	Maintenance	Repair	Replacement	Rehabilitation	Energy use during use if building	Water use during use if building	Demolition/Deconstruction	Transport	Waste treatment	Disposal	Benefits beyond the system boundaries

Table 1 – Lookup table showing breakdown of life cycle by stage or by module

- The extrapolation rules at the level of the declared product.

4.4. Environmental impacts

To meet the requirements of the current PCR (PEP-PCR-ed3-EN April 02 2015), the results presented in the table of environmental impacts are related to the implementation of the functional unit, namely the provision of 1 kW of power by a thermal collector over a period of 50 years.

To know the impact of the product over its lifecycle, the PEP user must multiply the results to the functional unit by total kW of installed collector as defined in section 3.10.2.

The following clarification should be completed and presented in the PEP, in order to guarantee clarity and transparency for the user:
In order to develop the PEP, the impacts were reported to provide 1 kW of heat. The impact of the life cycle stages of the installed product is to be calculated by the user of the declaration by multiplying the impact considered by the total energy output of the product. The maintenance step of the solar thermal collector is not included. For the LCA of building, the maintenance operations of the system must be considered separately (module B2 according to EN 15978).

The results of this PEP document cannot be compared directly with the results of another PEP document. The results take into account the energy efficiency and performance of the collectors.

In the case of a PEP covering a family of products, the extrapolation rules must be mentioned and the clarification below must be entered in the PEP document:
The extrapolation factors are given for the environmental impact of the functional unit namely the supply of 1 kW of heat. For each stage of the life cycle, the environmental impacts of the product under consideration are calculated by multiplying the impacts of the declaration corresponding to the reference product by the extrapolation factor. The "Total" column is to be calculated by adding the environmental impacts of each stage of the life cycle.

5. Appendices

5.1. Glossary

LCA	Life Cycle Assessment
EC	European Community
IEC	International Electrotechnical Commission
CEM	Electromagnetic compatibility
CENELEC	European Committee for Electromagnetic Standardization
ES	European standards
EEE	Electrical and Electronic Equipment
EU	European Union (Union Européenne)
LCI	Life Cycle Inventory
Kg	Kilogram

5.2. References

Chapter	Subject	Sources
2.1	Definition of a solar thermal collector.	NF EN ISO 9488 January 2000 "Solar energy - Vocabulary"

5.3. Declaration of conformity

PROGRAMME PEP ECOPASSPORT®

Certificate of critical review for the "SPECIFIC RULES FOR SOLAR THERMAL COLLECTORS"

Chargée de revue critique : Julie ORGELET

Critical reviewer: Julie ORGELET

Document reviewed: PSR - Specific rules for thermal solar collectors

Version and date: PSR-0017-Ed1-EN-2018

Review period: June-September 2018

Prepared by : Bureau Veritas LCIE on behalf of Uniclima

Review repository:

The objective of the critical review is to verify the document's compliance with the following standards:

- The product category rules of the PEP ecopassport® Programme - PEP-PCR ed3-FR-2015 04 02, available on www.pep-ecopassport.org

- The standards NF EN ISO 14020-2002 and NF EN ISO 14 025-2010

- The standards NF EN ISO 14040-2006 and 14 044-2006

Conclusion :

The revised document does not show any non-conformity with the above-mentioned standards. Therefore, the PSR for solar thermal collectors complies with the requirements of these standards.

Point of vigilance:

The environmental profiles of solar thermal collectors are intended to be integrated into complex systems. The development of rules associated with the other elements of the system shall be consistent with these rules.

Julie ORGELET - DDemain

Expert ACV indépendant