

# PRODUCT ENVIRONMENTAL PROFILE

## Environmental Product Declaration

### AF(S)26/30/38(Z)(B) Contactors



|                                                                                                                            |  |                                                                                     |  |
|----------------------------------------------------------------------------------------------------------------------------|--|-------------------------------------------------------------------------------------|--|
| REGISTRATION NUMBER<br>ABBG-00205-V01.01-EN                                                                                |  | DRAFTING RULES: PCR-ED4-EN-2021 09 06<br>SUPPLEMENTED BY PSR-0005-ED3-EN-2023 06 06 |  |
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| PEP ARE COMPLIANT WITH XP C08-100-1 :2016 OR EN 50693:2019                                                                 |  |                                                                                     |  |
| THE COMPONENTS OF THE PRESENT PEP MAY NOT BE COMPARED WITH COMPONENTS FROM ANY OTHER PROGRAM.                              |  |                                                                                     |  |
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|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EPD Owner</b>                        | ABB France, 11 rue D'Arsonval, Chassieu, France<br><a href="http://www.abb.com">www.abb.com</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Manufacturer name and address</b>    | ABB France, 11 rue D'Arsonval, Chassieu, France                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Company contact</b>                  | EPD_ELSP@in.abb.com                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Reference product</b>                | AF26-30-00 Contactor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Description of the product</b>       | The AF26-30-00 is a 3 pole - 690 V IEC or 600 UL contactor with screw terminals, controlling motors up to 11 kW / 400 V AC (AC-3) or 15 hp / 480 V UL and switching power circuits up to 45 A (AC-1) or 45 A UL general use. Thanks to the AF technology, the contactor has a wide control voltage range (100-250 V 50/60 Hz and DC), managing large control voltage variations, reducing panel energy consumptions and ensuring distinct operations in unstable networks. Furthermore, surge protection is built-in, offering a compact solution.                                                                                                            |
| <b>Functional unit</b>                  | The Functional Unit is to establish and cut off the supply of a downstream installation from an electrical characterized by the composition of the poles or type of contacts NO/NC: 2/2, 3/0, 4/0, a rated voltage of $U_e$ , a rated current $I_e$ , a control circuit voltage $U_c$ , with $N_p$ poles, and Industrial application areas, according to the appropriate use scenario, and during the reference service life of the product of 20 years.<br><br>Maximum Power Circuit Voltage $U_p$ [V]: 690V<br>Maximum allowed intensity by the power circuit $I_p$ [A]: 26-40A<br>Rated Control Circuit Voltage $U_c$ [V]: 24-500V<br>Number of poles: 3/4 |
| <b>Other products covered</b>           | The PEP covers offerings for:<br>- 3-pole contactors AF26, AF30, AF38: AF26/30/38(Z)(B)-30-00(K)(RT), AF(S)26/30/38(Z)-30-22<br>- 4-pole contactors AF26, AF38: AF26/38(Z)(B)-40-00(RT), AF26/38(Z)(B)-22-00(RT).                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Reference lifetime</b>               | 20 years                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Product category</b>                 | Electrical, Electronic and HVAC-R Products                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Use Scenario</b>                     | The use phase has been modeled based on the sales mix data (2022), and the corresponding low voltage electricity countries mix                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Geographical representativeness</b>  | Raw materials & Manufacturing: [Europe / Global]<br>Assembly: [France]<br>Distribution / Use: [Global] specific sales mix<br>EoL: [Global]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Technological representativeness</b> | Materials and processes data are specific for the production of AF26-30-00 Contactor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>LCA Study</b>                        | This study is based on the LCA study described in the LCA report 1SBD250584E0004                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>EPD type</b>                         | Product Family Declaration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>EPD scope</b>                        | "Cradle to grave"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Year of reported primary data</b>    | 2022                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>LCA software</b>                     | SimaPro 9.5.0.1 (2023)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>LCI database</b>                     | ecoinvent v3.9 (2023)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>LCIA methodology</b>                 | EN 50693:2019                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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# ABB Purpose & Embedding Sustainability

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels. With a history of excellence stretching back more than 130 years, ABB's success is driven by about 110 thousand talented employees in over 100 countries.

ABB's Electrification business offers a wide-ranging portfolio of products, digital solutions and services, from substation to socket, enabling safe, smart and sustainable electrification. Offerings encompass digital and connected innovations for low voltage and medium voltage, including EV infrastructure, solar inverters, modular substations, distribution automation, power protection, wiring accessories, switchgear, enclosures, cabling, sensing and control.

ABB is committed to continually promoting and embedding sustainability across its operations and value chain, aspiring to become a role model for others to follow. With its ABB Purpose, ABB is focusing on reducing harmful emissions, preserving natural resources and championing ethical and humane behavior.



## General Information

The ABB facility located in Chassieu, is for the Smart Power Division, the competence center for Contactors <100A and >9A.

All the products are produced in an automated system with precision and accuracy. These are supplied to utilities, industrial, and tertiary sector customers.

ABB adopts and implements for its own activities an integrated Quality/Environmental/Health Management System in compliance with the following standards:

SS-EN ISO 9001: 2015 - Quality Management Systems- Requirements

SS-EN ISO 14001: 2015 - Environmental management systems - Requirements with guidance for use

AF contactors are most commonly used for controlling electric motors and switch various none-motor loads. Contactors can break current over a wide range of currents, from a few amperes to thousands of amperes, and voltages up to 1000V AC.

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# AF Contactors product cluster

Product cluster declared in this PEP includes the following AF(S)26/30/38(Z)(B) Contactors:

| Product Range    | Product                                      | Number of Main poles [N <sub>p</sub> ] | Number of Auxiliary poles | Max. Rated Operating Voltage [U <sub>e</sub> ] | Max. Rated Current of Main poles [I <sub>e</sub> {AC3}] | Rated Current of Aux. poles [I <sub>p</sub> ] | Rated Control Circuit Voltage [U <sub>c</sub> ] |
|------------------|----------------------------------------------|----------------------------------------|---------------------------|------------------------------------------------|---------------------------------------------------------|-----------------------------------------------|-------------------------------------------------|
| AF26/30/38(Z)(B) | AF26/30/38(Z)(B)-30-00(K)(RT);               | 3                                      | 0                         | 690V                                           | 26A/33A/40A                                             | 0A                                            | 24-250V                                         |
|                  | AF26/30/38(Z)-30-22;<br>AFS26/30/38(Z)-30-22 | 3                                      | 4                         | 690V                                           | 26A/33A/40A                                             | 6A                                            | 24-250V                                         |
|                  | AF26/30/38(Z)-30-11                          | 3                                      | 2                         | 690V                                           | 26A/33A/40A                                             | 6A                                            | 24-250V                                         |
|                  | AF26/38-40/22-00                             | 4                                      | 0                         | 690 V                                          | 23.2A                                                   | 0                                             | 24-500 V                                        |
|                  | AF26Z/38Z-40/22-00                           | 4                                      | 0                         | 690 V                                          | 23.2A                                                   | 0                                             | 24-250 V                                        |
|                  | AF26/38(Z)(B)-40-00                          | 4                                      | 0                         | 690 V                                          | 23.2A                                                   | 0                                             | 250-500 V                                       |
|                  | AF26/38(Z)(B)-22-00                          | 4                                      | 0                         | 690 V                                          | 23.2A                                                   | 0                                             | 250-500 V                                       |
|                  | AF26/38(Z)B-40-00RT<br>AF26/38(Z)B-22-00RT   | 4                                      | 0                         | 690 V                                          | 23.2A                                                   | 0                                             | 24-250 V                                        |

Table 1: Technical characteristics of AF(S)26/30/38(Z)(B) Contactors.

The accessories associated with these products are also included in the study.

## Reference Product:

The reference product for the LCA of the complete range of AF(S)26/30/38(Z)(B) is AF26-30-00 (3-pole).



## Constituent Materials

The AF26-30-00 weights about 0.348 kg including its installed accessories, packaging, and paper documentation.

| AF26-30-00   |                  |              |               |               |
|--------------|------------------|--------------|---------------|---------------|
| Materials    | Name             | IEC 62474 MC | [g]           | %             |
| Metals       | Steel            | M-119        | 131.51        | 37.7%         |
|              | Cu and Cu Alloys | M-121        | 72.57         | 20.8%         |
|              | Precious Metals  | M-159        | 5.99          | 1.7%          |
|              | Stainless Steel  | M-100        | 2.59          | 0.7%          |
| Plastics     | Polyamide        | M-258        | 114.83        | 33.0%         |
|              | Elastomer        | M-320        | 0.12          | <0.1%         |
| Other        | Paper/Cardboard  | M-341        | 13.79         | 4.1%          |
|              | Others           | N/A          | 7.06          | 2.0%          |
| <b>Total</b> |                  |              | <b>348.46</b> | <b>100.0%</b> |

Table 2: Weight of materials AF26-30-00

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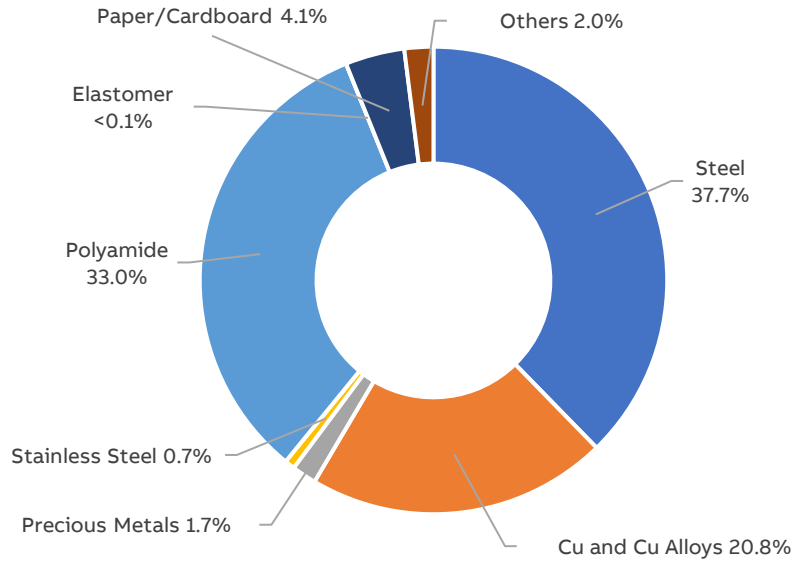


Figure 1: Composition of AF26-30-00

Along the whole AF(S)26/30/38(Z)(B) product cluster, a set of different build configurations have been covered by this analysis.

Packaging weighs 13.8g, with the following substance composition:

| Material             | Unit | Total        | %           |
|----------------------|------|--------------|-------------|
| Corrugated Cardboard | g    | 13.55        | 3.9%        |
| Paper                | g    | 0.24         | <0.1%       |
| <b>Total</b>         |      | <b>13.79</b> | <b>4.0%</b> |

Table 3: Weight of Packaging for AF26-30-00

Official declarations 2CMT2021-006277 [10] and 2CMT2021-006202 [11] states compliance of ABB AF Contactors respectively to RoHS and REACH regulations; 2CMT2021-006277 [10] provides exemptions considered for RoHS while 2CMT2021-006202 [11] lists REACH substances present in a concentration above 0.1% adding reference to products where involved parts are mounted.

## Functional unit and Reference Flow

The Functional Unit is to establish and cut off the supply of a downstream installation from an electrical characterized by the composition of the poles or type of contacts NO/NC: 2/2, 3/0, 4/0, a rated voltage of  $U_e$ , a rated current  $I_e$ , a control circuit voltage  $U_c$ , with  $N_p$  poles, and Industrial application areas, according to the appropriate use scenario, and during the reference service life of the product of 20 years. (table 1)

The Reference Flow of the study is a single Contactor (including its packaging and accessories) with mass described in table 2.

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## System boundaries and life cycle stages

The life cycle of the Contactor, an EEPS (Electronic and Electrical Products and Systems), is a “from cradle to grave” analysis and covers the following main life cycle stages: manufacturing, including the relevant acquisition of raw material, preparation of semi-finished goods, etc. and processing steps; distribution; installation, including the relevant steps for the preparation of the product for use; use including the required maintenance steps within the RSL (reference service life of the product) associated to the reference product; end-of-life stage, including the necessary steps until final disposal or recovery of the product system.

The following table shows the stages of the product life cycle and the information stages according to EN 50693:2019 [3] for the evaluation of electronic and electrical products and systems.

| Manufacturing                    | Distribution                                 | Installation                                             | Use         | End-of-Life (EoL)           |
|----------------------------------|----------------------------------------------|----------------------------------------------------------|-------------|-----------------------------|
| Acquisition of raw materials     |                                              | Installation                                             |             | Deinstallation              |
| Transport to manufacturing site  |                                              |                                                          |             |                             |
| Components/parts manufacturing   | Transport to distributor/<br>logistic center | EoL<br>treatment of<br>generated<br>waste<br>(packaging) | Usage       | Collection and<br>transport |
| Assembly                         | Transport to place of use                    |                                                          | Maintenance |                             |
| Packaging                        |                                              |                                                          |             | EoL treatment               |
| EoL treatment of generated waste |                                              |                                                          |             |                             |

Table 4: Phases for the evaluation of construction products according to EN50693:2019 [3].

## Temporal and geographical boundaries

The ABB component suppliers are sourced all over the world. All primary data collected are from 2022, which is a representative production year. Secondary data are also representative for this year, as provided byecoinvent [6].

The selected ecoinvent [6] processes in the LCA model have a global representativeness, due to the unclear origin of each component. In this way, a conservative approach has been adopted.

## Boundaries in the life cycle

As indicated in the PCR capital goods such as buildings, machinery, tools and infrastructure, the packaging for internal transport which cannot be allocated directly to the production of the reference product, may be excluded from the system boundary.

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Infrastructures, when present, such as processes deriving from the ecoinvent [6] database have not been excluded.

## Data quality

In this LCA, both primary and secondary data are used. Site specific foreground data have been provided by ABB. Main data sources are the bill of materials & drawings which are available on the ERP (SAP) & Windchill. For all processes for which primary are not available, generic data originating from the ecoinvent database [6], allocation cut-off by classification, are used. The ecoinvent database available in the SimaPro software [7] is used for the calculations.

The data quality characterized by quantitative and qualitative aspects, is presented in Appendix 1. Each data quality parameter has been rated according to DQR tables from Chapter 7.19.2.2 of the Product Environmental Footprint Guide v.6.3 to give an indication of geography, technology and temporal representativeness.

## Environmental impact indicators

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. According to “PCR-ed4-EN-2021 09 06” and EN 50693 [3] the environmental impact indicators must be determined using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019 [8].

PCR-ed4-EN-2021 09 06 and the EN 50693:2019 [3] standard establish four indicators for GWP: GWP (total) which includes all greenhouse gases; GWP (fossil fuels); GWP (biogenic) which includes the emissions and absorption of biogenic carbon dioxide and biogenic carbon stored in the product; GWP (land use) - land use and land use transformation. Other indicators as per the PCR[1].

## Allocation rules

Allocation coefficients are based on the AF(S)26(Z)(B) line’s occupancy area for electricity consumption since, apart from assembly processes, the whole production line is temperature-regulated throughout the year. The allocation of the total amount of waste generated by the production line and water consumption, has been based on this criterion.

## Limitations and simplifications

Raw materials life cycle stage includes the extraction of raw materials as well as the transport distances to the manufacturing suppliers. These distances are assumed to be 1000 km as per PCR. This distance has been added to the one already included in the market processes used for the model, as a result of a conservative choice made by the LCA operators.

Production, use and disposal of the packaging of components and semi-finished intermediates from raw materials extraction up to the factory gate has been included with the assumption as per PSR-0005-ed3-

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EN- 2023 06 06 “Product Specific Rules for Electrical Switchgear and Control gear Solutions” Section 3.1.5.1.3. Packaging of raw materials and components. An average packaging content of 5% of the mass of the reference equipment (equipment + packaging) has been considered, broken down as follows: Wood 50%, Cardboard 40%, Low-density polyethylene 10%.

Surface treatments like galvanizing, tin and silver plating as well as their related transport processes (back and forth from the finishing suppliers) have been considered in the LCA model.

Scraps for metal working and plastic processes are included when already defined in ecoinvent[6].

## Energy Models

| LCA Stage                              | EN 15804:2012 +A2:2019 module | Energy model                                                                                     | Notes                                                                      |
|----------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Raw material extraction and processing | A1-A2                         | Electricity, {RER}  market group for   Cut-off<br>Electricity, {GLO}  market group for   Cut-off | Based on materials and supplier locations                                  |
| Manufacturing                          | A3                            | Electricity, {FR}  market for   Cut-off                                                          | Specific Energy model for ABB Chassieu manufacturing plant, 100% renewable |
| Installation (Packaging EoL)           | A5                            | Electricity, {GLO}  market group for   Cut-off                                                   |                                                                            |
| Use Stage                              | B1                            | Electricity, [country]x   market for   Cut-off, S **                                             | Low voltage, based on 2022 country sales mix                               |
| EoL                                    | C1-C4                         | Electricity, {GLO}  market group for   Cut-off                                                   |                                                                            |

Table 5: Energy models used in each LCA stage

\*\* Please refer the use phase page 11 for further description



## Inventory analysis

In this LCA, both primary and secondary data are used. Site specific foreground data have been provided by ABB. For data collection, Bills of Material (BOM) extracted from ABB's internal SAP software were used. They are a list of all the components and assemblies that constitute the finished product, organized by level. Each item is matched with its code, quantity, weight and supplier. The BOMs were then processed, adding material, surface area and other weight data, taken from technical drawings. Finally, the manufacturing process and surface treatment were assigned, according to information provided by R&D personnel. Road distances between the suppliers and ABB were calculated using Google Maps, and marine distances using Distances & Time (Searates).

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All primary data collected from ABB are from 2022, which was a representative production year. The ecoinvent v3.9 cut-off by classification system processes [6] are used to model the background system of the processes.

Due to a lot of components in the Contactors, raw material inputs have been modelled with data from ecoinvent representing either a European [RER] or Global [RoW] market coverage based on the supplier's location. These datasets are assumed to be representative.

## Manufacturing stage

The Contactors are composed of a multitude of components, all of which are made from of numerous materials. Most of the inputs to the products' manufacturing stage are already produced component parts.

The single use packaging as well as paper documentation are also included in the analysis in the manufacturing stage. ABB receives packaging components from outside suppliers and packages the Contactors before shipping them.

Most of the inputs to the products' manufacturing stage are already produced component parts from the supply chain. In the ABB manufacturing plant, the different components and subassemblies are assembled into the Contactor. All the semi-finished and ancillary products are produced by ABB's suppliers.

The entire AF Contactors suppliers' network has been modelled with the calculation of each transportation stage: from the first manufacturing supplier to the next. All the distances from the last subassembly suppliers' factories to the ABB manufacturing facility have been calculated.

All the distances from the last subassembly suppliers' factories to the ABB manufacturing facility have been calculated.

In the ABB factory, the different components and subassemblies are assembled into the Contactor. All the semi-finished and ancillary products are produced by ABB's suppliers.

The energy mix used for the production phase is representative for ABB Chassieu production site and includes renewable energy only (Hydroelectric +Solar +Wind +Biogas).

The complete energy mix has been modeled considering the certificate on Guarantee of origins provided to ABB for the year 2022.

## Distribution

The transport distances from ABB manufacturing plant to the distribution centers (regional distribution centers / local sales organizations) have been calculated considering the specific 2022 sales mix data for AF(S)26/30/38(Z)(B) Contactors product cluster (SAP ERP sales data as a source).

Since no specific data is available for the transport distances from the Distribution Centre to place of actual use (Customer site), distances of 1000 km are assumed (local/domestic transport by lorry, according to PCR [1]).

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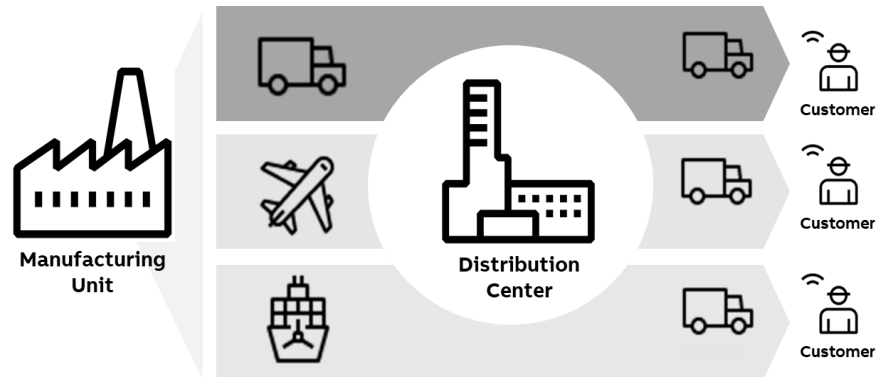


Figure 2: Distribution Methodology

## Installation

The installation phase only implies manual activities, and no energy is consumed. This phase also includes the disposal of the packaging of the AF Contactor.

For the disposal of the packaging after installation of the AF Contactor at the end of its life, a transport distance of 1000 km (according to PCR[1]) was assumed. The chosen transportation datasets from Ecoinvent [6].

The actual disposal site is unknown and is managed by the customer.

## Use

Use and maintenance are modelled according to the PCR [1].

During the use phase, AF Contactor, dissipates some electricity due to power losses. They are calculated according to the data provided in the catalogue of the AF Contactor and following the PCR [1] & PSR [2] rules:

| Parameters                          |         |        |
|-------------------------------------|---------|--------|
| $I_u$                               | [A]     | 26-40A |
| Load Rate                           | [%]     | 50     |
| h/year                              | [h]     | 8760   |
| RSL                                 | [years] | 20     |
| Time operating coefficient $\alpha$ | [%]     | 50     |

Table 6: Use phase parameters

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The formula for the calculation of the electricity consumed is shown below and it is described as follows, where  $P_{use}$  is the power consumed by the Contactor at a given value of current:

$$E_{use} \text{ [kWh]} = \frac{P_{use} * 8760 * RSL * \alpha}{1000}$$

The above calculations have been performed according to the number of poles on which relevant current flows during use phase.

The Energy model used for this phase has been modeled based on the 2022 actual sales mix data (SAP ERP sales data as a source). From the Ecoinvent [6] database, the low voltage electricity country mix for each country(x) has been selected with its respective percentage on the total sales mix (Electricity, low voltage [country]x | market for | Cut-off, S).

Since no maintenance happens during the use phase, the environmental impacts linked to this procedure have been considered as null in the analysis.

## End of life

The end-of-life stage is modelled according to PCR [1] and IEC/TR 62635 [9]. The percentages for end-of-life treatments of materials are taken from IEC/TR 62635 [9].

Since no specific data is available, the transport distances from the place of use to the place of disposal are assumed to be 1000 km (local/domestic transport by lorry, according to PCR [1]).

Disassembly manuals can be provided to the customer to support product disposal.

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# Environmental impacts

The following tables show the environmental impact indicators of the life cycle of a single Contactor, as indicated by PEP Ecopassport PCR and EN 50693:2019 [3]. The indicators are divided into the contribution of the processes to the different modules (upstream, core and downstream) and stages (manufacturing, distribution, installation, use and end-of-life).

AF26-30-00

| Impact category | Unit                | Total    | Manufacturing | Distribution | Installation | Use      | End of Life |
|-----------------|---------------------|----------|---------------|--------------|--------------|----------|-------------|
| GWP-total       | kg CO2 eq           | 1.33E+02 | 4.59E+00      | 5.25E-01     | 2.73E-02     | 1.28E+02 | 1.11E-01    |
| GWP-fossil      | kg CO2 eq           | 1.30E+02 | 4.55E+00      | 5.25E-01     | 3.59E-03     | 1.24E+02 | 1.09E-01    |
| GWP-biogenic    | kg CO2 eq           | 3.30E+00 | 3.57E-02      | 1.44E-04     | 2.37E-02     | 3.24E+00 | 1.25E-03    |
| GWP-luluc       | kg CO2 eq           | 4.60E-01 | 6.06E-03      | 6.97E-05     | 1.65E-06     | 4.53E-01 | 1.01E-04    |
| ODP             | kg CFC11 eq         | 1.32E-06 | 1.81E-07      | 8.43E-09     | 7.64E-11     | 1.13E-06 | 1.06E-09    |
| AP              | mol H+ eq           | 6.51E-01 | 6.47E-02      | 2.43E-03     | 1.57E-05     | 5.84E-01 | 5.31E-04    |
| EP-freshwater   | kg P eq             | 1.06E-01 | 9.68E-03      | 1.07E-05     | 3.01E-07     | 9.59E-02 | 2.59E-05    |
| EP-marine       | kg N eq             | 1.20E-01 | 1.11E-02      | 9.43E-04     | 1.03E-05     | 1.08E-01 | 1.32E-04    |
| EP-terrestrial  | mol N eq            | 1.15E+00 | 1.26E-01      | 1.01E-02     | 6.39E-05     | 1.01E+00 | 1.25E-03    |
| POCP            | kg NMVOC eq         | 3.54E-01 | 3.22E-02      | 3.21E-03     | 2.40E-05     | 3.18E-01 | 4.15E-04    |
| ADP-m&m         | kg Sb eq            | 5.08E-03 | 4.17E-03      | 2.57E-07     | 9.22E-09     | 9.11E-04 | 1.17E-07    |
| ADP-fossil      | MJ                  | 1.81E+03 | 6.12E+01      | 6.90E+00     | 4.97E-02     | 1.74E+03 | 1.18E+00    |
| WDP             | m3                  | 2.90E+01 | 2.17E+00      | 1.43E-02     | 2.53E-04     | 2.68E+01 | 9.88E-03    |
| PENRE           | MJ                  | 1.80E+03 | 5.84E+01      | 6.90E+00     | 4.97E-02     | 1.74E+03 | 1.18E+00    |
| PENRM           | MJ                  | 2.81E+00 | 2.81E+00      | 0.00E+00     | 0.00E+00     | 0.00E+00 | 0.00E+00    |
| PENRT           | MJ                  | 1.81E+03 | 6.12E+01      | 6.90E+00     | 4.97E-02     | 1.74E+03 | 1.18E+00    |
| PERE            | MJ                  | 3.40E+02 | 6.27E+00      | 3.26E-02     | 7.84E-04     | 3.33E+02 | 9.69E-02    |
| PERM            | MJ                  | 2.36E-01 | 2.36E-01      | 0.00E+00     | 0.00E+00     | 0.00E+00 | 0.00E+00    |
| PERT            | MJ                  | 3.40E+02 | 6.51E+00      | 3.26E-02     | 7.84E-04     | 3.33E+02 | 9.69E-02    |
| SM              | kg                  | 1.09E-01 | 1.09E-01      | 0.00E+00     | 0.00E+00     | 0.00E+00 | 0.00E+00    |
| RSF             | MJ                  | 0.00E+00 | 0.00E+00      | 0.00E+00     | 0.00E+00     | 0.00E+00 | 0.00E+00    |
| NRSF            | MJ                  | 0.00E+00 | 0.00E+00      | 0.00E+00     | 0.00E+00     | 0.00E+00 | 0.00E+00    |
| PET             | MJ                  | 2.15E+03 | 6.77E+01      | 6.93E+00     | 5.05E-02     | 2.07E+03 | 1.28E+00    |
| FW              | m3                  | 1.12E+00 | 6.31E-02      | 5.00E-04     | 9.35E-06     | 1.05E+00 | 3.84E-04    |
| HWD             | kg                  | 4.80E-03 | 9.23E-04      | 4.61E-05     | 3.05E-07     | 3.82E-03 | 4.15E-06    |
| N-HWD           | kg                  | 9.53E+00 | 7.47E-01      | 7.98E-02     | 7.33E-03     | 8.64E+00 | 6.38E-02    |
| RWD             | kg                  | 5.87E-03 | 1.59E-04      | 6.84E-07     | 1.59E-08     | 5.71E-03 | 1.48E-06    |
| CfR             | kg                  | 0.00E+00 | 0.00E+00      | 0.00E+00     | 0.00E+00     | 0.00E+00 | 0.00E+00    |
| MfR             | kg                  | 3.82E-01 | 5.20E-02      | 0.00E+00     | 1.91E-02     | 0.00E+00 | 3.11E-01    |
| MfER            | kg                  | 1.41E-02 | 8.20E-04      | 0.00E+00     | 9.05E-03     | 0.00E+00 | 4.19E-03    |
| EN              | MJ by energy vector | 0.00E+00 | 0.00E+00      | 0.00E+00     | 0.00E+00     | 0.00E+00 | 0.00E+00    |
| Efp             | disease inc.        | 3.83E-06 | 3.29E-07      | 1.05E-08     | 3.56E-10     | 3.48E-06 | 9.01E-09    |
| IrHH            | kBq U-235 eq        | 2.35E+01 | 4.77E-01      | 3.00E-03     | 6.56E-05     | 2.30E+01 | 6.01E-03    |
| ETX FW          | CTUe                | 9.34E+02 | 6.90E+02      | 3.55E+00     | 3.87E-02     | 2.40E+02 | 4.22E-01    |
| HTX CE          | CTUh                | 5.11E-08 | 1.10E-08      | 7.61E-11     | 1.92E-12     | 3.99E-08 | 1.16E-10    |
| HTX N-CE        | CTUh                | 2.41E-06 | 6.23E-07      | 6.40E-09     | 7.47E-11     | 1.77E-06 | 7.03E-09    |
| IrLS            | Pt                  | 3.60E+02 | 4.39E+01      | 1.26E+00     | 5.03E-02     | 3.14E+02 | 7.76E-01    |

Table 7: Impact indicators for AF26-30-00

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| Impact Category                                     | Unit | Total   |
|-----------------------------------------------------|------|---------|
| Biogenic carbon content of the product              | kg   | 3.0E-03 |
| Biogenic carbon content of the associated packaging | kg   | 2.9E-02 |

Table 8: Inventory Flow indicators of AF26-30-00

### Environmental impact indicators

|                |                                                                                  |
|----------------|----------------------------------------------------------------------------------|
| GWP-total      | Global Warming Potential total (Climate change)                                  |
| GWP-fossil     | Global Warming Potential fossil                                                  |
| GWP-biogenic   | Global Warming Potential biogenic                                                |
| GWP-luluc      | Global Warming Potential land use and land use change                            |
| ODP            | Depletion potential of the stratospheric ozone layer                             |
| AP             | Acidification potential                                                          |
| EP-freshwater  | Eutrophication potential - freshwater compartment                                |
| EP-marine      | Eutrophication potential - fraction of nutrients reaching marine end compartment |
| EP-terrestrial | Eutrophication potential -Accumulated Exceedance                                 |
| POCP           | Formation potential of tropospheric ozone                                        |
| ADP-m&m        | Abiotic Depletion for non-fossil resources potential                             |
| ADP-fossil     | Abiotic Depletion for fossil resources potential, WDP                            |
| WDP            | Water deprivation potential.                                                     |

### Resource use indicators

|       |                                                                                                                         |
|-------|-------------------------------------------------------------------------------------------------------------------------|
| PENRE | Use of non-renewable primary energy excluding renewable primary energy resources used as raw material                   |
| PENRM | Use of non-renewable primary energy resources used as raw material                                                      |
| PENRT | Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) |
| PERE  | Use of renewable primary energy excluding non-renewable primary energy resources used as raw material                   |
| PERM  | Use of renewable primary energy resources used as raw material                                                          |
| PERT  | Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)     |
| PET   | Total use of primary energy in the lifecycle                                                                            |

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### Secondary materials, water and energy resources

|      |                                      |
|------|--------------------------------------|
| SM   | Use of secondary materials           |
| RSF  | Use of renewable secondary fuels     |
| NRSF | Use of non-renewable secondary fuels |
| FW   | FW: Net use of fresh water           |

### Waste category indicators

|       |                              |
|-------|------------------------------|
| HWD   | Hazardous waste disposed     |
| N-HWD | Non-hazardous waste disposed |
| RWD   | Radioactive waste disposed   |

### Output flow indicators

|      |                               |
|------|-------------------------------|
| CfR  | Component for reuse           |
| MfR  | Materials for recycling       |
| MfER | Materials for energy recovery |
| EN   | Exported energy               |

### Others indicators

|          |                                          |
|----------|------------------------------------------|
| Efp      | Emissions of Fine particles              |
| IrHH     | Ionizing radiation, human health         |
| ETX FW   | Ecotoxicity, freshwater                  |
| HTX CE   | Human toxicity, carcinogenic effects     |
| HTX N-CE | Human toxicity, non-carcinogenic effects |

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## Extrapolation for Homogeneous environmental family

This LCA covers different build configurations than the representative product from the IEC and UL types. All the analyzed configurations have the same main functionality, product standards and manufacturing technology. The different life cycle stages can be extrapolated to other products of the same homogeneous environmental family by applying a rule of proportionality to the parameters in the following tables, divided by different life cycle stages.

| Product                 | GWP-total | GWP-fossil | GWP-biogenic | GWP-luluc | ODP  | AP   | EP-freshwater | EP-marine | EP-terrestrial | POCP | ADP-minerals & metals | ADP-fossil | WDP  |
|-------------------------|-----------|------------|--------------|-----------|------|------|---------------|-----------|----------------|------|-----------------------|------------|------|
| AF26/30/38(Z)(B)-30-00  | 1.00      | 1.00       | 1.00         | 1.00      | 1.00 | 1.00 | 1.00          | 1.00      | 1.00           | 1.00 | 1.00                  | 1.00       | 1.00 |
| AF26/30/38(Z)(B)-30-00K | 0.88      | 0.88       | 0.91         | 0.85      | 0.53 | 0.93 | 0.82          | 0.81      | 0.78           | 0.82 | 0.73                  | 0.88       | 0.99 |
| AF26/30/38Z(B)-30-00RT  | 0.93      | 0.93       | 0.88         | 0.93      | 0.74 | 1.19 | 0.98          | 0.91      | 0.91           | 0.94 | 0.81                  | 0.93       | 1.06 |
| AF26/30/39(Z)-30-22     | 1.15      | 1.16       | 0.95         | 1.15      | 1.06 | 1.11 | 1.11          | 1.15      | 1.13           | 1.14 | 1.13                  | 1.16       | 1.19 |
| AFS26/30/38(Z)-30-22    | 1.11      | 1.11       | 0.93         | 1.09      | 1.04 | 1.09 | 1.06          | 1.09      | 1.08           | 1.08 | 1.05                  | 1.12       | 1.17 |
| AF26/30/38(Z)-30-11     | 1.08      | 1.08       | 0.86         | 1.07      | 1.02 | 1.05 | 1.03          | 1.06      | 1.04           | 1.05 | 1.03                  | 1.08       | 1.12 |
| AF26/38(Z)(B)-40-00     | 0.91      | 0.91       | 0.85         | 0.81      | 0.66 | 0.84 | 0.76          | 0.81      | 0.77           | 0.81 | 0.67                  | 0.92       | 0.97 |
| AF26/38(Z)(B)-22-00     |           |            |              |           |      |      |               |           |                |      |                       |            |      |
| AF26/38(Z)B-40-00       | 0.93      | 0.93       | 0.80         | 0.91      | 0.72 | 1.17 | 0.94          | 0.88      | 0.87           | 0.92 | 0.76                  | 0.94       | 1.09 |
| AF26/38(Z)B-22-00       |           |            |              |           |      |      |               |           |                |      |                       |            |      |

Table 9: Extrapolation factors for AF(S)26/30/38(Z)(B)

Reference product: AF26-30-00 Manufacturing

| Contactora              | LCA Stage    | Factor |
|-------------------------|--------------|--------|
| AF26/30/38(Z)(B)-30-00  | Distribution | 1.00   |
| AF26/30/38(Z)(B)-30-00K |              | 1.01   |
| AF26/30/38Z(B)-30-00RT  |              | 1.09   |
| AF26/30/39(Z)-30-22     |              | 1.18   |
| AFS26/30/38(Z)-30-22    |              | 1.18   |
| AF26/30/38(Z)-30-11     |              | 1.16   |
| AF26/38(Z)(B)-40-00     |              | 1.12   |
| AF26/38(Z)(B)-22-00     |              |        |
| AF26/38(Z)B-40-00       |              | 1.16   |
| AF26/38(Z)B-22-00       |              |        |

Table10: Extrapolation factors Extrapolation factors for AF(S)26/30/38(Z)(B)

Reference product: AF26-30-00 –Distribution

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| Product                                        | Main Current<br>[I <sub>AC-3</sub> ] | Number of<br>main poles | Aux Current [I <sub>AC-15</sub> ] | Number<br>of Aux.<br>poles | Factor |
|------------------------------------------------|--------------------------------------|-------------------------|-----------------------------------|----------------------------|--------|
| AF26(B)-30-00-13(RT)                           | 26                                   | 3                       | 6                                 | 0                          | 1.00   |
| AF26/38Z(B)-40-00(RT)<br>AF26/38Z(B)-22-00(RT) | 22                                   | 4                       | 6                                 | 0                          | 0.78   |
| AF26Z(B)-30-00(RT)                             | 26                                   | 3                       | 6                                 | 0                          | 0.80   |
| AF26Z(B)-30-00K                                | 26                                   | 3                       | 6                                 | 0                          | 0.81   |
| AF26Z(B)-30-11(RT)                             | 26                                   | 3                       | 6                                 | 2                          | 0.82   |
| AF26Z-30-22                                    | 26                                   | 3                       | 6                                 | 4                          | 0.84   |
| AF30Z(B)-30-00(RT)                             | 32                                   | 3                       | 6                                 | 0                          | 0.89   |
| AF30Z-30-11                                    | 32                                   | 3                       | 6                                 | 2                          | 0.91   |
| AF30Z(B)-30-00K                                | 32                                   | 3                       | 6                                 | 0                          | 0.92   |
| AF30Z-30-22                                    | 32                                   | 3                       | 6                                 | 4                          | 0.93   |
| AF26/38(B)-44-00(RT)<br>AF26/38(B)-22-00(RT)   | 22                                   | 4                       | 6                                 | 0                          | 0.99   |
| AF38Z(B)-30-00(RT)                             | 38                                   | 3                       | 6                                 | 0                          | 1.01   |
| AF26(B)-30-00K                                 | 26                                   | 3                       | 6                                 | 0                          | 1.02   |
| AF26-30-11                                     | 26                                   | 3                       | 6                                 | 2                          | 1.02   |
| AF38Z-30-11                                    | 38                                   | 3                       | 6                                 | 2                          | 1.03   |
| AF(S)26-30-22                                  | 26                                   | 3                       | 6                                 | 4                          | 1.04   |
| AF38Z(B)-30-00K                                | 38                                   | 3                       | 6                                 | 0                          | 1.04   |
| AF38Z-30-22                                    | 38                                   | 3                       | 6                                 | 4                          | 1.05   |
| AF30(B)-30-00(RT)                              | 32                                   | 3                       | 6                                 | 0                          | 1.09   |
| AF30-30-11                                     | 32                                   | 3                       | 6                                 | 2                          | 1.11   |
| AF30(B)-30-00K                                 | 32                                   | 3                       | 6                                 | 0                          | 1.12   |
| AF(S)30-30-22                                  | 32                                   | 3                       | 6                                 | 4                          | 1.13   |
| AF38(B)-30-00(RT)                              | 38                                   | 3                       | 6                                 | 0                          | 1.21   |
| AF38-30-11                                     | 38                                   | 3                       | 6                                 | 2                          | 1.23   |
| AF38(B)-30-00K                                 | 38                                   | 3                       | 6                                 | 0                          | 1.25   |
| AF(S)38-30-22                                  | 38                                   | 3                       | 6                                 | 4                          | 1.26   |

Table 11: Extrapolation factors AF(S)26/30/38(Z)(B)  
Reference product: AF26-30-00-Use Phase

|           |                |                             |                 |       |       |       |
|-----------|----------------|-----------------------------|-----------------|-------|-------|-------|
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| Product                                    | GWP-total | GWP-fossil | GWP-biogenic | GWP-luluc | ODP  | AP   | EP-freshwater | EP-marine | EP-terrestrial | POCP | ADP-minerals & metals | ADP-fossil | WDP  |
|--------------------------------------------|-----------|------------|--------------|-----------|------|------|---------------|-----------|----------------|------|-----------------------|------------|------|
| AF26/30/38(Z)(B)-30-00                     | 1.00      | 1.00       | 1.00         | 1.00      | 1.00 | 1.00 | 1.00          | 1.00      | 1.00           | 1.00 | 1.00                  | 1.00       | 1.00 |
| AF26/30/38(Z)(B)-30-00K                    | 1.04      | 1.04       | 1.10         | 1.02      | 1.01 | 1.05 | 1.04          | 1.04      | 1.03           | 1.03 | 1.00                  | 1.03       | 1.02 |
| AF26/30/38Z(B)-30-00RT                     | 1.27      | 1.26       | 2.28         | 1.31      | 1.17 | 1.34 | 1.36          | 1.23      | 1.25           | 1.23 | 1.13                  | 1.26       | 1.28 |
| AF26/30/39(Z)-30-22                        | 1.13      | 1.12       | 1.87         | 1.11      | 1.15 | 1.11 | 1.10          | 1.15      | 1.13           | 1.13 | 1.16                  | 1.13       | 1.12 |
| AFS26/30/38(Z)-30-22                       | 1.13      | 1.12       | 1.89         | 1.11      | 1.15 | 1.12 | 1.10          | 1.15      | 1.13           | 1.14 | 1.16                  | 1.13       | 1.12 |
| AF26/30/38(Z)-30-11                        | 1.08      | 1.07       | 1.82         | 1.05      | 1.09 | 1.06 | 1.04          | 1.09      | 1.07           | 1.08 | 1.10                  | 1.07       | 1.06 |
| AF26/38(Z)(B)-40-00<br>AF26/38(Z)(B)-22-00 | 0.95      | 0.95       | 0.86         | 0.86      | 1.04 | 0.92 | 0.85          | 1.00      | 0.98           | 1.00 | 1.06                  | 0.96       | 0.90 |
| AF26/38(Z)B-40-00<br>AF26/38(Z)B-22-00     | 1.33      | 1.32       | 2.26         | 1.29      | 1.21 | 1.34 | 1.34          | 1.62      | 1.27           | 1.26 | 1.17                  | 1.28       | 1.31 |

Table 12: Extrapolation factors for AF(S)26/30/38(Z)(B)

Reference product: AF26-30-00- End of Life



## Additional environmental information

According to the waste treatment scenario calculation in Simapro, based on the recycling rate in the technical report IEC/TR 62635 Edition 1.0 [9] Table D.6, the following recyclability potentials were calculated. The recyclability potential is calculated based on the product weight (excluding packaging).

|                                | AF26-30-00 |
|--------------------------------|------------|
| <b>Recyclability potential</b> | 94.3%      |

Table 12: Recyclability potential of AF26-30-00

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# References

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(published: 6th September 2021)
- [2] PEP Ecopassport PSR-0005-ed3-EN-2023 06 06 “Product Specific Rules for Electrical Switchgear and Control gear Solutions” (published: May 2016)
- [3] EN 50693:2019 - Product category rules for life cycle assessments of electronic and electrical products and systems
- [4] ISO 14040:2006 - Environmental management -Life cycle assessment - Principles and framework
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- [6] Ecoinvent v3.9 (2023). ecoinvent version 3.9. Swiss, Centre for Life Cycle Inventories, Dübendorf, Switzerland
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- [10] 2CMT2021-006277- RoHS
- [11] 2CMT2021-006202- REACH
- [12] 1SBD250584E0004-LCA Report

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