Environmental Product Declaration

AC machine type AMA 450,
1600 kW power

Organizational framework

Manufacturer

ABB Industry Oy/Machines Group
P.O. Box 186
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Finland

ABB Industry Oy in Finland is part of ABB's Automation segment. The company developes, manufactures and markets electrical machines and drives for customers world-wide and is within the ABB Group responsible for several key products groups, including low and high voltage AC machines and generators.

Environmental management

The ISO 14001 international environmental management standard has been implemented and the Helsinki factory has been certified since 1996. Lifecycle assessment is applied continuously to all product development.

The Helsinki factory was awarded the ISO 9001 quality certificate in 1994 in recognition of its commitment to maintaining the high quality of its AC Machines.

Product description

AMA machines have shaft heights ranging from 315 mm to 500 mm. The range of rated output is 140 - 3000 kW, and voltage ranges from 380 V to 11 500 V. Typical applications of the AMA machines include pumps, fans, blowers, compressors, conveyors, crushers and AC generators. This document applies to the AMA 450 model, a 1600 kW, 6000 V product.

Material for the product is used according to the following table:

Type of material	kg/product	kg/kW
Electrical steel	2500	1.56
Other steel	2350	1.47
Cast iron	50	0.03
Aluminium	120	0.08
Copper	344	0.21
Insulation material	90	0.06
Wooden packing material	60	0.04
Impregnation resin	20	0.01
Paint	16	0.01

Environmental performance

The data and calculations are in accordance with the Product-Specific Requirements (PSR) for Rotating Electrical Machines dated April 2000, which specify the following baselines for the LCA calculation.

Functional unit

The functional unit for the LCA is 1 kW of rated output power.

System boundaries

The lifecycle assessment covers all environmental aspects for extraction and production of raw materials, manufacturing of main parts, assembly of the machine, transportation and use of the product, dismantling, fragmentation, disposal and recycling of scrap at the end of the product's life. It includes consumption of material and energy resources as well as emissions and waste generation.

Calculations are based upon an estimated lifetime of 25 years when operating 6500 hours per year. A Finnish mix of energy has been used to calculate energy consumption during manufacturing and a European mix of energy to calculate energy consumption during use and disposal.

The operational point chosen for the usage phase is 1600 kW, 2980 rpm and efficiency 96.8 %. The operational point in reality will vary considerably depending on the specific application.

Allocation unit

The factor for allocation of common environmental aspects during manufacturing (such as manufacturing waste) is calculated as the rated output power of the product in relation to the total annual production volume of the factory.

Resource utilisation	Manufacturing phase unit/kW	Usage phase unit/kW	Disposal phase unit/kW
Use of non-renewable resources			
Coal kg	3.95	1471.20	-1.50
Aluminium (Al) kg	0.08	0.00	-0.06
Copper (Cu) kg	0.22	0.00	-0.21
Iron (Fe) kg	2.99	0.00	-1.86
Manganese (Mn) kg	0.00	0.00	0.00
Natural Gas kg	0.42	101.72	-0.02
Uranium (U) kg	0.00	0.06	0.00
Oil kg	0.62	154.20	-0.17
Use of renewable resources			
Wood kg	0.05	0.00	0.00
Hydro Power MJ	0.04	0.00	0.00

Energy consumption and losses	kWh/product			kWh/kW		
Energy form	Manufacturing phase	Usage phase	Disposal phase	Manufacturing phase	Usage phase	Disposal phase
Electrical energy	9359	8 595 041	206	5.85	5371.90	0.13
Heat energy	2253	–	–	1.41	–	–

The average Finnish electricity mix is defined as being 10 % gas, 31 % hydro, 40 % nuclear, 2 % oil and 17 % stone coal. The average European electrical energy is defined as being 10 % gas, 15 % hydro, 36 % nuclear, 10 % oil, 19 % stone coal and 10 % lignite coal. The resultant resource utilisation is shown in the table above.

Waste

	kg/kW
Hazardous waste after manufacturing phase	
Oil emulsions	0.03
Various	0.01
Hazardous waste after usage phase	
Various	0.00
Regular waste (to landfill)	
During manufacturing phase	0.07
At disposal phase	0.14

The classification data for emissions are as below:

Environmental effect	Equivalent unit	Manufacturing phase	Usage phase	Total lifecycle
Global warming potential GWP	kg CO_2/kW	15.33	2700.52	2710.94
Acidification potential AP	kmol H+/kW	0.00	0.53	0.53
Eutrophication	kg O_2/kW	0.22	33.85	34.03
Ozone depletion potential ODP	kg CFC-11/kW	0.00	0.00	0.00
Photochemical oxidants POCP	kg ethylene/kW	0.01	0.62	0.63

Additional qualifying factors

Recycling and disposal

The main parts of the product can be recycled. Some parts need to be fragmented to separate different types of material. A list of parts and components that can be fragmented and recycled can be obtained from the manufacturer. See references.

Usage phase in relation to the total

It must be noted that the environmental impact during the usage phase is the most important. As an example, the GWP of the usage phase is approximately 200 times grater than the GWP of the manufacturing phase.

References

- 3BFP 000 020 R0101 REV A, LCA report
- PSR 2000:2 for Rotating Electrical Machines
- P34 AMA 011 G en 9706, Installation and Maintenance Manual
- 3BFP 000 018 R0101 REV A, Recycling and Disposal
- MSR 1999:2 Requirements for Environmental Product Declarations, EPD from the Swedish Environmental Management Council

The above-mentioned documents are available upon request.

Category of impact	Usage in % of total
Global warming GWP	99.70 %
Acidification AP	99.58 %
Eutrophication	99.49 %
Ozone depletion ODP	–
Photochemical oxidants POCP	98.26 %

EPD Glossary

Acidification, AP
Acidification originates from the emissions of sulphur dioxide and oxides of nitrogen. In the atmosphere, these oxides react with water vapour and form acids which subsequently fall down to the earth in the form of rain or snow, or as dry depositions. Acidification potential translates the quantity of emission of substances into a common measure to compare their contributions to the capacity to release hydrogen ions.

Eutrophication
Nutrients (mainly nitrogen and phosphorus) from sewage outfalls and fertilised farmland accelerate the growth of algae and other vegetation in water. The degradation of organic material consumes oxygen resulting in oxygen deficiency and fish kill. Eutrophication translates the quantity of emission of substances into a common measure expressed as the oxygen required for the degradation of dead biomass.

Global warming, GWP
Some of the gases in the earth's atmosphere (in particular water vapour and carbon dioxide) have an ability to absorb infrared radiation. They do not prevent sunlight reaching the earth's surface, but they do trap some of the infrared radiation emitted back into space causing an increase in the surface temperature. Global Warming Potential, GWP100, translates the quantity of emission of gases into a common measure to compare their contributions - relative to carbon dioxide - to the absorption of infrared radiation in 100 years perspective.

Ozone depletion, ODP
Ozone forms a layer in the stratosphere protecting plants and animals from much of the sun's harmful UV-radiation.
The ozone levels have declined as a consequence of CFCs and halons released into the atmosphere. A depletion of the ozone layer will increase the UV-radiation at ground level. Ozone depletion potential translates the quantity of emission of gases into a common measure to compare their contributions - relative to CFC-11 (a freon) - to the breakdown of the ozone layer.

Photochemical ozone creation, POCP
Photochemical ozone or ground level ozone is formed by the reaction of volatile organic compounds and nitrogen oxides in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually during hot summer weather. Photochemical ozone creation potential translates the quantity of emission of gases into a common measure to compare their contributions - relative to ethylene - to the formation of photochemical oxidants.

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