Environmental Product Declaration

for AC-machine type GBA 1120.

Organizational framework

Manufacturer:
ABB Motors AB
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ABB Motors AB belongs to the ***Business Unit*** Motors & Machines, with 14 sites.The subunit Machines has six sites in Finland, France, Italy, South Africa, Sweden and Switzerland. The business unit belongs to the ***Business Area*** Automation Power Products, part of ABB´s Automation segment.

***Environmental management*:** The ISO 14001 international environmental management standard has been implemented at five of the six sites of subunit Machines. GBA type AC machines are manufactured at the Swedish site, which has been certified to ISO 14001 since early 1997. Life cycle assessment is applied continuously to all product development.

Product description: ABB's line of synchronous machines –motors and generators- consists of four product families. The GBA-family, 4- and 6-pole high voltage machines, was introduced in the late 1990's. The GBA has been developed to fulfil the highly variable needs of many different industrial applications, such as:

- Paper industry
- Refiner motors
- Steam turbine generators
- Steel industry
- Gas turbine generators
- Fan motors
- Blower motors
- Power applications
- Pump motors

The studied product is a AC-generator called GBA. They exist of 4 different center heights 800, 1000, 1120 and 1250. The total range of rated output is 4 MW to 70 MW for motors and 4 MVA to 70 MVA for generators

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

Summary of materials

Type of material	kg/product GBA 1120	kg/kW GBA 1120
Electro steel	21 496	0.693
Normal rolled steel	26 644	0.859
Special steel	4 524	0.146
Cast iron	1 262	0.041
Aluminium	192	0.006
Copper	5 184	0.167
Insulation material	1 094	0.035
Wooden boxes and planks	3 040	0.098
Impregnation resin	281	0.009
Paint	63	0.002

The plant that manufactures these generators has been certified to the ISO 9001 quality management standard since 1993.

Environmental performance

The data and calculations are in accordance with Product Specific Requirements (PSR) for Rotating Electrical Machines dated April 2000 which specifies 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 life cycle 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 and disposal and recycling of scrap after end of 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 6,500 hours per year. A Swedish mix of energy has been used for calculating energy consumption during manufacturing and a European mix of energy for calculating energy consumption during use and disposal.

The GBA 1120 of 31 000 kW has been chosen for this Life Cycle Assessment.

The operational point chosen for the usage phase is 1500 rpm and efficiency 98,02% for the GBA 1120. The operational point in reality will vary considerable dependent upon the specific application.

Allocation unit

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

Resource utilization

Inventory	Manufacturing phase GBA 1120	Usage phase GBA 1120	Disposal phase GBA 1120
Use of non-renewable resources			
Iron (Fe) kg/kW	1.53	0.05	-1.21
Aluminium (Al) kg/kW	0.01	0.00	-0.00
Manganese (Mn) kg/kW	0.01	0.00	0.00
Copper (Cu) kg/kW	0.15	0.08	-0.15
Uranium (U) kg/kW	0.0001	0.0345	0.0000
Coal kg/kW	2.13	899.11	-0.92
Oil kg/kW	0.22	94.46	-0.07
Gas kg/kW	0.16	62.20	-0.00
Use of renewable resources			
Wood kg/kW	0.19	0.00	0.00
Hydro power MJ/kW	0.10	0.05	0.00

Energy consumption and losses

	Absolute requirements kWh/product			Requirement per unit of output power kWh/kW		
Energy form	Manufacturing phase GBA1120	Usage phase GBA 1120	Disposal phase GBA 1120	Manufacturing phase GBA 1120	Usage phase GBA 1120	Disposal phase GBA 1120
Electrical energy	96 500	101 760 000	1 800	3.11	3 281	0.06
Heat energy	73 500			2.37		

Waste

Relative weight per unit of Output power	kg/kW GBA 1120
Hazardous waste after manufacturing	
Barrier water	0.007
Water from oil separator	0.014
Oil emulsions	0.009
Hazardous waste after end of life	
Various	0.006
Regular waste (to landfill)	
During manufacturing	0.019
At final disposal	0.055

Recycling is recorded in Resource utilization at Disposal phase

The average Swedish electricity mix is defined as being 0.5% gas, 52% hydro, 44% nuclear, 1.7% oil and 1.8% 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 utilization is shown in the table above.

The classification data for emissions are as below:

Category of impact	Equivalent unit per kW	Manufacturing GBA 1120	Usage phase GBA 1120	Total life cycle GBA 1120
Global warming GWP	kg CO_2/kW	7.92	1 698	1 706
Acidification	kmol H+/kW	0.00	0.32	0.32
Ozone depletion ODP	kg CFC-11/kW	0.0000	0.0001	0.0001
Photochemical oxidants POCP	kg ethylene/kW	0.01	0.38	0.39
Eutrophication	kg O_2/kW	0.11	20.65	20.76

The values are based upon the indexes specified in the document from The Swedish Environmental Management Council (AB Svenska Miljöstyrningsrådet) named MSR 1999:1.

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 is to be observed that the environmental impact during the usage phase is the most important. As an example, GWP for the usage phase is approximatively 400 times larger than GWP for the manufacturing phase.

Category of impact	Usage in % of total GBA 1120
Global warming GWP	99.54
Acidification	99.45
Ozone Depletion ODP	99.39
Photochemical oxidants POCP	96.97
Eutrophication	99.34

References

- LCA report R MKU 2000-32, LCA for GBA 1120.
- PSR 2000:2 for Rotating Electrical machines
- Recycling and disposal 3BSE 017 435
- Risk assessment 3BSE 017 434
- LCA instruction 3BSG000021
- MSR 1999:1 Bestämmelser Certifierade Miljövarudeklarationer, EPD from the Swedish Environmental management Council

The above mentioned documents are available upon request.

GLOSSARY

Acidification, AP. Chemical alternation of the environment, resulting in hydrogen ions being produced more rapidly than they are dispersed or neutralized. Occurs mainly through fallout of sulfur and nitrogen compounds from combustion processes. Acidification can be harmful to terrestrial and aquatic life.

Eutrophication. Enrichment of bodies of water by nitrates and phosphates from organic material or the surface runoff. This increases the growth of aquatic plants and can produce algal blooms that deoxygenate water and smother other aquatic life.

Global warming potential, GWP. The index used to translate the level of emissions of various gases into a common measure to compare their contributions to the absorption by the atmosphere of infrared radiation. GWPs are calculated as the absorption that would result from the emission of 1 kg of a gas to that from emission of 1 kg of carbon dioxide over 100 years.

Life cycle assessment, LCA. A management tool for appraising and quantifying the total environment impact of products or activities over their entire life cycle of particular materials, processes, products, technologies, services or activities. Life cycle assessment comprises three complementary components-inventory analysis, impact analysis and improvement analysis.

Ozone depletion potential, ODP. The index used to translate the level of emissions of various substances into a common measure to compare their contributions to the breakdown of the ozone layer. ODPs are calculated as the change that would result from the emission of 1 kg of a substance to that from emission of 1 kg of CFC-11 (a freon)

Photochemical ozone creation, POCP. The index to translate the level of emissions of various gases into a common measure to compare their contributions to the change of ground-level ozone concentration. POCPs are calculated as the change that would result from the emission of 1 kg of a gas to that from emission of 1 kg of ethylene.

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