

LUE ANGEL

The German Ecolabel

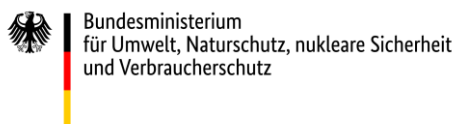


Chillers

DE-UZ 231

Basic Award Criteria
Edition July 2023
Version 1

The environmental label is supported by the following institutions:



The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz) is the owner of the label. It regularly provides information on the decisions taken by the Environmental Label Jury.



The German Environment Agency with its specialist department for "Ecodesign, Eco-Labeling and Environmentally Friendly Procurement" acts as office of the Environmental Label Jury and develops the technical criteria of the Basic Criteria for Award of the Blue Angel.



The Environmental Label Jury is the independent, decision-making body for the Blue Angel and includes representatives from environmental and consumer associations, trade unions, industry, the trade, crafts, local authorities, academia, the media, churches, young people and the German federal states.



RAL gGmbH is the awarding body for the environmental label. It organises the process for developing the relevant award criteria in independent, expert hearings – which involve all relevant interest groups.

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1 Introduction

1.1 Preface

In cooperation with the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, the German Environment Agency and considering the results of the expert hearings conducted by RAL gGmbH, the Environmental Label Jury has set up these Basic Criteria for the Award of the Environmental Label. RAL gGmbH has been tasked with awarding the Environmental Label.

Upon application to RAL gGmbH and on the basis of a Contract on the Use of the Environmental Label to be concluded with RAL gGmbH, the permission to use the environmental label may be granted to all products, provided that they comply with the requirements as specified hereinafter. The product must comply with all the legal requirements in the country in which it is to be marketed. The applicant shall declare that the product meets these conditions.

1.2 Background

Chillers are used in a wide range of cooling applications in the commercial and industrial sectors, as well as for air conditioning in residential and especially non-residential buildings. They contribute to climate change in two ways: firstly through their electricity consumption and the greenhouse gas emissions associated with energy generation (indirect emissions) and secondly through direct emissions of refrigerants that themselves often have a very high global warming potential (GWP).

Against this background, the use of environmentally friendly and energy efficient chillers could reduce greenhouse gas emissions. The key focus is placed here on the use of natural refrigerants and increasing the efficiency of the machines.

1.3 Objectives of the environmental label

This environmental label may be awarded to products that – above and beyond the legal regulations – use natural refrigerants and also stand out due to other environmentally friendly properties. This includes, in particular, an especially high energy efficiency and low noise emissions.

Therefore, the following benefits for the environment and health are stated in the explanatory box:



2 Scope

In the context of this Blue Angel ecolabel, the term “chiller” refers to machines

- designed for the cooling of heat transfer liquids such as water, water-glycol, oils, silicones, etc.,
- whose cooling circuit was fully installed in the factory; although the machine can be filled with operating materials (refrigerant, lubricating oil, etc.) either in the factory or at the installation site,
- that are electrically or thermally driven,
- that use the ambient air or heat transfer liquids to cool the system and
- have a rated cooling capacity of between 2 kW and 2000 kW.

It is possible to utilise the waste heat. The ecolabel can be awarded to comfort chillers and process chillers with higher operating temperatures according to ENER Lot21 (EU Regulation 2016/2281; here: electrically driven chillers) and absorption chillers (here: thermally driven chillers).

Heat pumps that are covered by the scope of the ecodesign regulation for heat pumps with a rated heat output of up to 400 kW (EU Regulation 813/2013) are excluded from the scope of these Basic Award Criteria even if their heat source is connected via liquids. Heat pumps with a rated output of more than 400 kW are also excluded from the scope of these Basic Award Criteria.

3 Requirements

3.1 Refrigerant

The chiller must be free of refrigerants containing halogens.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1. The applicant shall submit a data sheet for the chiller that includes information on the refrigerant and filling volume, as well as a safety data sheet for the refrigerant used in the machine (if available).

3.2 Energy efficiency

3.2.1 Electrically driven chillers

In order to be awarded the Blue Angel ecolabel, electric chillers must comply with the minimum seasonal efficiencies (expressed as the seasonal space cooling energy efficiency, $\eta_{s,c}$) stated in Table 1, depending on the type of heat exchanger (air-cooled or water-cooled) and output range, at nominal cold water temperatures of 12/7 °C. If the chiller is unable to achieve these temperatures for technical reasons (e.g. due to the limits of the refrigerant used in the system), the minimum efficiencies stated in Table 2 at the standard operating temperatures for chilled ceiling applications (23/18 °C) apply.

Table 1: Comparison of the minimum values for the seasonal space cooling energy efficiency at the nominal cold water temperatures of 12/7 °C for comfort chillers in accordance with EU Regulation 2016/2281 (EU REG) and the Blue Angel (BA) requirements for chillers; the SEER values are provided for information purposes only

Gerätekategorie	SEER EU-VO	η_{sc} EU-VO	SEER BE	η_{sc} BE
Luftgekühlte Flüssigkeitskühler <70kW	4.1	161	4.3	169
Luftgekühlte Flüssigkeitskühler 71...400kW	4.1	161	4.6	181
Luftgekühlte Flüssigkeitskühler >400kW	4.6	179	4.9	193
Wassergekühlte Flüssigkeitskühler <70kW	5.1	200	5.4	213
Wassergekühlte Flüssigkeitskühler 71...400kW	5.1	200	6.1	241
Wassergekühlte Flüssigkeitskühler 401kW...1500kW	6.4	252	6.7	265
Wassergekühlte Flüssigkeitskühler >1500kW	6.9	272	7.2	285

Table 2: Requirements for the seasonal space cooling energy efficiency for chillers that can only achieve the nominal cold water temperatures of 23/18 °C in accordance with the Blue Angel (BA) requirements; the SEER values and minimum requirements according to the EU REG are provided for information purposes only

Gerätekategorie	SEER EU-VO	η_{sc} EU-VO	SEER BE	η_{sc} BE
Luftgekühlte Flüssigkeitskühler <70kW	4.1	161	5.1	199
Luftgekühlte Flüssigkeitskühler 71...400kW	4.1	161	5.4	211
Luftgekühlte Flüssigkeitskühler >400kW	4.6	179	5.7	223
Wassergekühlte Flüssigkeitskühler <70kW	5.1	200	6.2	243
Wassergekühlte Flüssigkeitskühler 71...400kW	5.1	200	6.9	271
Wassergekühlte Flüssigkeitskühler 401kW...1500kW	6.4	252	7.5	295
Wassergekühlte Flüssigkeitskühler >1500kW	6.9	272	8.0	315

The ecolabel can be awarded to individual chillers or to model series. A model series is defined above all by the fact that the core components (compressor, evaporator, liquefier and, if relevant, frequency converter) used in all models of the model series are sourced from the same component suppliers.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1. For individual chillers, the applicant shall submit a test report from a testing laboratory accredited according to DIN EN ISO/IEC 17025 for the calculation of the seasonal space cooling energy efficiency ($\eta_{s,c}$) using the measurement requirements described in Regulation (EU) No 2016/2281 (Table 10, Annex II of the Regulation). Test reports completed by the applicant are recognised as being of an equivalent standard when the testing laboratory used for the measurements is accredited by an independent body as an SMT laboratory (supervised manufacturer testing laboratory) or as part of a Test Data Acceptance Program (TDAP).

In addition, the report must state whether the values were measured at the evaporator at a fixed or variable outlet temperature. If the values were measured at the standard operating temperatures for chilled ceiling applications (23/18 °C), the applicant shall also submit a corresponding justification and publish the reason why the chiller cannot be operated at 12/7 °C on the Blue Angel website.

In order to be awarded the ecolabel for a model series, the applicant shall confirm that the same requirements for individual chillers are fulfilled by at least one chiller, although for at least 25% of the models in the series.

The applicant shall also verify that the other models in the model series can achieve the minimum seasonal efficiencies by submitting the design documents for all models in the model series including the calculations for the seasonal space cooling energy efficiency ($\eta_{s,c}$) using the measurement requirements stated in Regulation (EU) No 2016/2281 (Table 10, Annex II of the Regulation). If the seasonal efficiency of the chiller(s) calculated on the basis of the measured values is below the values stated in the design specifications, all of the values stated in the design specifications should be corrected by the maximum deviation measured.

The design documents should also verify that the core components of the cooling circuit (see above) used in the model series were sourced from the same component suppliers.

The product documents must state which chiller(s) were subjected to standard tests to measure the efficiency values.

Example:

A model series comprises 3 air-cooled chillers (models 1, 2 and 3) with rated cooling capacities of less than 70 kW. In the design specifications, the manufacturer calculated seasonal space cooling energy efficiencies ($\eta_{s,c}$) of 172%, 175% and 177%. A test was carried out in an accredited laboratory on chiller 2 and an $\eta_{s,c}$ value of 173% was calculated. The $\eta_{s,c}$ value stated in the design specifications was thus 2% below the value calculated in the test. As a result, the $\eta_{s,c}$ values for chillers 1 and 3 also have to be reduced by 2% (i.e. to 170% and 175%). As the corrected values are still above the minimum requirement of 169% (see Table 1), the ecolabel can still be awarded to this model series.

3.2.2 Thermally driven chillers (absorption chillers)

The following method should be used to evaluate the efficiency of thermally driven chillers:

The reference cooling capacity must be determined using the method given in the fact sheet on the funding of refrigeration and air-conditioning equipment by the BAFA (Federal Office for Economic Affairs and Export Control) (Version: March 2022¹). This fact sheet bases the calculations on the following input temperatures for absorption chillers:

- Cold water: $T = 15\text{ °C}$
- Cooling water/heat exchanger $T = 27\text{ °C}$
- Heating medium $T = 85\text{ °C}$

The following requirements are stated in the above-named fact sheet: the chiller must be converted to operate at these temperatures as far as possible. Normal cooling and low temperature

¹ https://www.bafa.de/SharedDocs/Downloads/DE/Energie/kki_technisches_merkblatt.pdf;jsessionid=55DA8B54823BC5FA7E203D780AF1D604.1_cid362?_blob=publicationFile&v=15

applications should be set to a cold brine temperature of -8 °C. The declared cooling capacity should be increased by 50% in this case. Steam driven absorption chillers should be set to a steam temperature (heating medium) of 120 °C. The declared cooling capacity should be reduced by 25% in this case.

The reference electrical power input of the chiller is calculated by adding together

- the rated electrical input of the chiller according to the type plate (controller, internal pumps, etc.; if circulation pumps for the external hydraulic circuits are installed in the machine, their connected load should not be taken into account),
- the electrical power input required to overcome the internal losses in pressure within the machine at the nominal volume flows for all three hydraulic circuits; this is determined based on the respective hydraulic power output and an average pump efficiency of 50%,
- the electrical power input of an "average" heat exchanger; a specific power input of 0.033 kWel/kWth should be applied based on the heat to be dissipated (this value was taken from DIN 18599-7 for closed evaporative coolers).

The following equation is thus used for the calculation:

$$EER_{SKM+RK} = \frac{\dot{Q}_{NT}}{\left(\frac{\Delta p_{HT} * \dot{V}_{HT} + \Delta p_{MT} * \dot{V}_{MT} + \Delta p_{NT} * \dot{V}_{NT}}{50\%} + \dot{Q}_{NT} * \left(1 + \frac{1}{COP} \right) * 0.033 \right) + P_{el,int}}$$

where:

EER_{AC+HE} : system-specific EER (energy efficiency ratio) for the absorption chiller (AC) including the heat exchanger (HE)

$\dot{Q}_{NT}$: Reference cooling capacity at the temperature conditions stated above in W

COP: Coefficient of performance (ratio of cooling output to power input) at the nominal temperature conditions

$\Delta p_{HT/MT/NT}$: Internal pressure losses in the absorption chiller in the drive circuit (heat source)

(HT), heat exchanger circuit (MT) and cold water circuit (LT) in Pa

$\dot{V}_{HT/MT/NT}$: Nominal volume flows in the drive circuit (heat source) (HT), heat exchanger circuit (MT) and

cold water circuit (LT) in m³/s

$P_{el,int}$: Electrical power input of the chiller at the above-named operating point (controller, internal pumps, etc.) in W

The quotient of the reference cooling capacity and the reference power input gives the system-specific EER. This value must be below 8.5 for the Blue Angel. If this is the case, it can be assumed that machine can be operated very efficiently within the overall system.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and shall calculate the EER_{AC+HE} in accordance with the equation stated above and state all of the input values and their sources. The measurement uncertainty must also be given for the measurement values.

3.3 Noise emissions

In order to minimise the transmission of vibrations from the compressor to the other components of the chiller and thus reduce structure-borne, liquid-borne and airborne noise, the compressor in electric chillers must be isolated or decoupled (internally or externally) to prevent the transfer of vibrations.

For all types of chillers, the manufacturer must also state which of the following measures have been taken to reduce noise emissions from the chiller:

- Two-stage bearings for the compressor with an oscillating plate
- Noise absorption hood for the compressor
- Soundproofing of the housing
- Vibration-isolated installation of the compressor
- Vibration-isolated installation of the liquefier
- Chiller fitted with vibration-isolated installation points or feet as standard
- Soundproofing of the power electronics against high frequencies
- Avoidance of certain (resonance) frequencies using control technology
- Low-noise operating mode with reduced performance and/or efficiency
- Vibration-isolated liquid connections (no rigid couplings)
- Use of bulkheads

The following options must also be stated for air-cooled chillers:

- A noise barrier between the compressor and airflow
- Acoustically optimised geometry of the fans
- Fans with diffusers
- Oversizing the fans for operation at lower speeds

In addition, the installation instructions for the chiller must provide information on the measures that can be taken at the installation site to reduce noise, which framework conditions should be observed and how the measures may impact the performance or efficiency of the chiller.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 on the measures taken to reduce noise emissions. In addition, the installation instructions are attached with reference to the corresponding passages.

3.4 Requirements placed on the manufacturing process

It is assumed that chillers awarded with the Blue Angel ecolabel comply with all applicable German and European regulations. Any exemptions to the regulated substances in EU Regulation 2011/65 (RoHS, here Article 4, Annex III and Annex IV, as well as any later amendments, e.g. as part of Regulation 2019/172) that have been utilised by the manufacturer must be declared.

Furthermore, the manufacturer must submit a declaration to confirm that

- Spare parts (or comparable parts requiring minor adjustments) will be made available for at least 10 years

- Good repairability (during the service life of the machine) and disassembly (at the end of its service life) were taken into account as criteria during the product development process.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and submit a declaration on

- a) any exemptions to the above-named regulation that have been utilised,*
- b) the availability of spare parts and*
- c) that repairability/disassembly were taken into account as criteria during the product development process.*

The declaration on the utilisation of any exemptions to the above-named regulation must also be included with the product documents on the manufacturer's website.

3.5 Ensuring efficient operation

In order to create the conditions for the efficient operation of the chiller, the manufacturer must take the following measures.

3.5.1 Installation, commissioning and maintenance instructions

The chiller must be supplied with comprehensive installation, commissioning and maintenance instructions. The maintenance instructions must address all of the relevant points for chillers in VDMA Guidelines 24186-1:2019-09 "Program of services for the maintenance of technical systems and equipment in buildings - Part 3: Refrigerating devices and systems for cooling and heating purposes", insofar as they apply irrespective of the application or installation site.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and submits the installation, commissioning and maintenance instructions and confirms that all relevant points in the above-named VDMA Guidelines 24186-3:2019-09 have been addressed.

3.5.2 Ability for the manufacturer to remotely access the chiller

The chiller must be made available with at least the option of an interface that allows the manufacturer to remotely access the following parameters.

For electrically driven chillers:

- Inlet and outlet temperatures for all external media circuits (cold water, cooling water for water-cooled chillers)
- For air-cooled chillers: Temperature of the ambient air
- Pressure in the evaporator and liquefier
- Compressor speed
- Internal fault and status messages

For thermally driven chillers:

- Inlet and outlet temperatures for all external media circuits (hot water, cooling water and cold water)
- Internal fault and status messages

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and submits a data sheet with information on the interface for remote access.

3.6 Outlook

The following extensions to these criteria are conceivable as part of a future revision of the ecolabel:

- Expanding the scope to include process cooling
- Inclusion of recommendations for controlling the system
- Information on the efficiency of the chiller during operation (energy efficiency ratio, seasonal energy efficiency ratio)
- Inclusion of requirements for reversible chillers for cooling and heating

4 Applicants and parties involved

Manufacturers or distributors of products according to Paragraph 2 shall be eligible for application.

Parties involved in the award process are:

- RAL gGmbH to award the Blue Angel environmental label,
- the federal state being home to the applicant's production site,
- Umweltbundesamt, (German Environment Agency) which after the signing of the contract receives all data and documents submitted in application for the Blue Angel in order to be able to further develop the Basic Award Criteria.

5 Use of the environmental label

The use of the environmental label by the applicant is governed by a contract on the use of the environmental label concluded with RAL gGmbH.

Within the scope of such contract, the applicant undertakes to comply with the requirements under Paragraph 3 while using the environmental label.

Contracts on the Use of the Environmental Label are concluded to fix the terms for the certification of products under Paragraph 2. Such contracts shall run until 31 December 2027.

They shall be extended by periods of one year each, unless terminated in writing by 31 March 2027 or 31 March of the respective year of extension.

After the expiry of the contract, the Environmental Label may neither be used for labelling nor for advertising purposes. This regulation shall not affect products being still in the market.

The applicant shall be entitled to apply to RAL gGmbH for an extension of the right to use the ecolabel on the product entitled to the label if it is to be marketed under another brand/trade name and/or other marketing organizations.

The Contract on the Use of the Environmental Label shall specify:

- Applicant (manufacturer/distributor)
- Brand/trade name, product description
- Distributor (Label User), i.e. the marketing organization.

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