BLUE ANGEL

The German Ecolabel

Eco-Friendly Ship Design

DE-UZ 141

Basic Award Criteria

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Version 4

The Environmental Label is supported by the following four institutions:

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety is the owner of the label. It regularly provides information on the decisions taken by the Environmental Label Jury.

Umwelt Bundesamt

The German Environmental Agency with its specialist department for "Ecodesign, Eco-Labelling 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.

Jury Umweltzeichen

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

The 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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This document is a translation of a German original. In case of dispute, the original document should be taken as authoritative.

List of Abbreviations

AFS	Anti-fouling Systems
B/15	Definition of distance in MARPOL Annex I: ships's breadth / 15
BFMP	Biofouling Management Plan
BFRB	Biofouling Record Book
BImSchV	Ordinance for the Implementation of the Federal Immission Control Act (17th Federal Emission Protection Ordinance – Ordinance on incineration and co-incineration of waste) (Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes – 17. BImSchV - Verordnung über die Verbrennung und die Mitverbrennung von Abfällen).
BPR	Biocidal Products Regulation
GT	Gross Tonnage
BW	Ballast water
BWMS	Ballast water management system
CDNI	Convention on the collection, deposit and reception of waste generated during navigation on the Rhine and other inland waterways
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent (Measurement unit for standardising the climate impact of different greenhouse gases, based on the greenhouse gas potential of CO_2)
CSS-Code	Code of Safe Practice for Cargo Stowage and Securing
dB	Decibel
DNV GL	International classification society (Det Norske Veritas – Germanischer Lloyd) (new name as of 2021: DNV)
eBC	Elemental black carbon
EDTA	Ethylenediaminetetraacetic acid
EEDI	Energy Efficiency Design Index
EGR	Exhaust Gas Recirculation
EIAPPC	Engine International Air Pollution Prevention Certificate
EU	European Union
CFCs	Chlorofluorocarbons
FTIR	Fourier-transform infrared spectrometer (measuring instrument)
GtL	Gas to Liquid (liquid fuel made from natural gas)
GWP	Global Warming Potential (or CO_2-equivalent)
HAE	Hafenauffangeinrichtungen (port reception facilities)
HCFCs	Partially halogenated chlorofluorocarbons
HFCs	Partially fluorinated hydrocarbons
HFO	Heavy Fuel Oil (also called residual marine fuels)
HSMS	Hull Stress Monitoring System
Hz	Hertz
IACS	International Association of Classification Societies
IAFS Certificate	International Anti-Fouling System Certificate
IAPP	International Air Pollution Prevention Certificate
IBTS	Integrated Bilge Water Treatment System
IEE Certificate	International Energy Efficiency Certificate

IGF Code	International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels
IHM	Inventory of Hazardous Materials
IMO	International Maritime Organization
IOPP	International Oil Pollution Prevention Certificate
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
Km	Kilometer
kn	Knot (nautical miles per hour)
kPa	Kilopascal
LNG	Liquified Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MBBR	Moving Bed Biofilm Reactor
MBR	Membrane bioreactor
MCR	Maximum continuous rating (performance)
MDO	Marine Diesel Oil, Distillate marine fuel (DMB) according to ISO 8217
MED	Marine Equipment Directive (EU Directive)
MEPC	Marine Environment Protection Committee (IMO)
MGO	Marine Gas Oil: Distillate marine fuel according to ISO 8217
MPGS	Marine Growth Prevention Systems
MSC	Maritime Safety Committee (IMO)
MSRL	Marine Strategy Framework Directive (EU)
NECA	NOx Emission Control Area pursuant to MARPOL Annex VI
NO_x	Nitrogen oxides
NTA	Nitrilotriacetic acid
ODP	Ozone Depletion Potential
PAS	Photoacoustic Spectroscopy; measurement method, e.g. examination of gas components
PC	Polar Code (International code for ships operating in polar waters)
PFC	Perfluorinated and polyfluorinated chemicals
PFOS	Perfluorooctane sulfonate
PM	Particulate matter
PBT	Persistent, bioaccumulative and toxic substances
POP	Persistent organic pollutants
RP	Redundant Propulsion (additional class notation of the DNV GL)
SCR	Selective Catalytic Reactor
SECA	Sulphur Emission Control Area pursuant to MARPOL Annex VI
SeeUmwVerhV	(See-Umweltverhaltensverordnung) Verordnung über das umweltgerechte Verhalten in der Seeschifffahrt (Regulations on Environmentally Sustainable Behaviour in Maritime Shipping)
SMS	Safety Management System
SPS-Code	Code of Safety for Special Purpose Ships
SOLAS	International Convention for the Safety of Life at Sea
SO_x	Sulphur oxides
TBT	Tributyltin
tdw	Tonnes dead weight
UBA	Umweltbundesamt (Federal Environment Agency)

ULSFO	Ultra low sulphur fuel oil
VLSFO	Very low sulphur fuel oil
VOC	Volatile organic compounds
WHG	Wasserhaushaltsgesetz – Germany’s Federal Water Act
WHO	World Health Organisation

1 Introduction

1.1 Preface

In cooperation with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, the German Environmental 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 this requirement.

1.2 Objectives

The award criteria for „Eco-friendly ship design" are intended to show that there are various options to implement environmental on-board protection measures in design and construction that go beyond the state of legislation. The comprehensive catalogue of criteria attempts to cover as many environmentally relevant aspects of a seagoing ship as possible. If ambitious environmental goals are already taken into account during the development of the ship design and during construction, the environmental impact of the moving ship can be significantly reduced. Since ships have long service lives it is particularly important to take ambitious steps.

The explanatory box lists the following benefit to the environment:

1.3 Methodology

As it is not possible to develop specific environmental criteria for all ship types, size classes and shipping routes that represent equally ambitious environmental requirements and can be implemented on every ship, the criteria are subdivided into the following ship type categories: Cargo ships, passenger ships on international voyages and passenger ships on national voyages.
Passenger ships on international voyages must comply with the international SOLAS / MARPOL regulations of the IMO valid at time of application. Passenger ships on national voyages are exclusively operated between the ports of one country. Such ships do not have to comply with the IMO regulations, but with the corresponding current national regulations. In the EU, this is Directive 2009/45/EC on "Safety Rules and Standards for Passenger Ships". It has been

implemented in Germany by the Schiffssicherheitsverordnung (SchSV) (Ordinance for the Safety of Seagoing Ships), as amended, and includes provisions that go beyond EU requirements.
These Basic Award Criteria also include "comparable ships" in the "passenger ship" category, e.g. research vessels according to the SPS Code (Code of Safety for Special Purpose Ships).
The ship must be designed and certified so as to be used as a ship most of the time.

Another subdivision is made between mandatory and optional requirements. A ship applying for the Blue Angel ecolabel must comply with all the criteria marked as mandatory for the respective type of ship and, in addition, achieve a certain number of points (cf. table 1) by meeting optional requirements. The number of optional requirements in a category is not equivalent to the environmental relevance of that category; the relevance is also reflected in the ambition of the mandatory requirements.
This system, consisting of mandatory and optional requirements, is intended to allow applicants a certain degree of flexibility as to which measures are reasonable and feasible for the construction of their new ship.
One to six points are assigned to the optional requirements depending on their effect on the environment. Only the points specified in the requirements will be awarded; the expert will not assign intermediate levels (pro rata points).

Nevertheless, in individual cases it may be possible that a requirement on the ship, especially for special purpose ships (e.g. public authority ships), does not mean any added value for the environment. It is then possible to delete this requirement from the catalogue of mandatory and optional measures proved in the expert report. In the case of optional requirements, the points can be deducted from the maximum number of points so that the ambition level is maintained. This is to be explained in the expert report.

The total number of points for the optional requirements varies according to the type of ship; hence, the number of points required to be awarded the Blue Angel ecolabel varies accordingly. The minimum number of points indicated in the table must be achieved for each ship category. It corresponds to about 35% of the possible points for the optional measures.

Table 1: Vessel types and the possible total number of points and the necessary minimum number of points

Type of Ship	**Possible maximum number of points**	**Minimum number of points required**
Cargo ship	105	37
Passenger ship on international voyages	115	40
Passenger ship on national voyages	106	37

All requirements are based on existing IMO and EU regulations, but go beyond the legal standard or represent early compliance with upcoming limits. If an optional requirement becomes mandatory during the term of the Award Criteria the possibility to achieve optional points for it will automatically cease to apply. The minimum number of points required will then be adjusted accordingly so that 35% of the possible maximum number of points must still be achieved.
The combination of mandatory and optional requirements results in a high overall environmental standard for the design of seagoing ships.

1.4 Legal Framework Conditions

1.4.1 MARPOL Convention

The International Convention for the Prevention of Pollution from Ships (MARPOL) governs the various sources of pollution in six annexes. Since its adoption in 1973, the Convention has been continuously supplemented, adapted and extended. The following table shows the structure of the Annexes to the MARPOL Convention:

Table 2: Annexes to MARPOL Convention

Annex I	Prevention of Pollution by Oil
Annex II	Control of Pollution by Noxious Liquid Substances in Bulk
Annex III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
Annex IV	Prevention of Pollution by Sewage from Ships
Annex V	Prevention of Pollution by Garbage from Ships
Annex VI	Prevention of Air Pollution from Ships

1.4.2 Further International Conventions

Other environmental aspects not covered by MARPOL are addressed by international IMO conventions, such as:

- The International Convention On the Control of Harmful Anti-Fouling Systems on Ships (AFS Convention, 2001)
- The International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management Convention adopted in 2004, entered into force on an international basis on 8 September 2017)
- The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (Hong Kong Convention, adopted in 2009 but not yet in force on an international basis.

1.4.3 SOLAS Convention

The International Convention for the Safety of Life at Sea (SOLAS) entered into force in 1958 and was completely rewritten in 1974. The Convention sets standards for the construction and operation of ships to improve safety at sea. The requirements are regularly updated by the IMO.

1.4.4 Fuel Quality Standard ISO 8217

There are hardly any requirements for marine fuel in the IMO conventions, only flash points and sulphur contents are specified in SOLAS and MARPOL (Annex VI). Nevertheless, shipping almost exclusively uses fuels that are certified according to the international DIN ISO 8217[1] standard which defines further parameters, such as density, dew point and ash content. Shipowners thus want to avoid breakdowns and damage to the engine. The ISO 8217 standard contains

[1] DIN ISO 8217 Petroleum products — Fuels (class F) — Specifications of marine fuels

specifications for residual marine fuels, so-called heavy oils (Table 2) and distillate marine fuels (Table 1).

1.4.5 Marine Strategy Framework Directive (MSFD)

Directive 2008/56/EC establishing a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive - MSFD) has provided the framework for a holistic protection of the marine environment in the EU since 2008. The member states are called upon to take measures to maintain or restore the good environmental status of the seas by 2020. Shipping is considered a pressure on the marine environment and concerns various issues (descriptors), such as pollutants, eutrophication, waste, underwater noise and the introduction of non-indigenous species. In a programme of measures, notified to the EU Commission in 2016, Germany also adopted measures affecting shipping. These are, for example, measures to reduce NOx emissions, requirements for the discharge of wastewater from exhaust gas cleaning systems (so-called scrubbers) and the classification of the North Sea and the Baltic Sea as emission control areas for nitrogen oxide (NECA). Another measure calls for the consideration of environmental criteria such as the "Blue Angel" for authority ships and state-subsidized seagoing ships, as well as the creation of incentive systems for environmentally friendly ships. These measures are currently being implemented[2].

1.4.6 EU Marine Equipment Directive

Marine equipment placed on board a ship must be approved in accordance with Regulation (EU) 2020/1170 of 16 July 2020 on design, construction and performance requirements and testing standards for marine equipment. The Blue Angel for Seagoing Ship Design also requires ships not flagged in the EU which otherwise would not fall within the scope of the EU Marine Equipment Directive (MED) to comply with the Directive.

2 Scope

The Award Criteria apply to merchant ships in terms of the current version of the SOLAS Convention and to supply, research and public authority ships registered in a national register of seagoing ships as well as to large SOLAS-approved yachts (Passenger Ship Safety Certificate, approval for charter operation) exceeding 500 gross tonnage (GRT).
Ships registered in a national register outside the EU must meet all European requirements for approval. Excluded from the award of the Blue Angel ecolabel are fishing vessels, naval ships, high-speed crafts within the meaning of the HSC Code, nuclear-powered ships, tankers, large yachts without SOLAS approval under 500 GRT, inland water vessels as well as pleasure crafts.
Due to the broad spectrum of requirements and the fact that the on-board situation usually differs – even on board sister ships – the award of the Blue Angel ecolabel always refers to a ship that can be uniquely identified by its IMO number.

[2] https://www.meeresschutz.info/berichte-art13.html

3 Requirements

3.1 Structural Protection from Accidental Environmental Pollution

3.1.1 Protection of Tanks for Fuels and Oily Substances

Large container ships can carry up to 10,000 tons of bunker oil as fuel. In the event of an accident this amount constitutes a substantial risk to the environment, especially if these are heavy fuel oils. In the event of grounding or collision ship fuels may cause serious pollution of the marine environment.

International / Regional Requirements
According to Regulation 12A of Annex I to the MARPOL Convention ships delivered on or after August 1, 2010 must be equipped with a double hull in the bunker tank section if the total bunker tank volume exceeds 600 m³. The tank size is limited to no more than 2500 m³ per tank[3]. However, tanks for oil sludge, bunker fuel tanks smaller than 30 m3 and certain pipelines may still be installed in the double hull.
Ships whose shipping routes include polar waters must additionally meet the stricter requirements of the Polar Code (PC).

3.1.1.1 Mandatory Requirements

- All tanks for oil sludge (regardless of their size and the origin of the oil-bearing waste) must observe the same distances from the outer hull as specified by MARPOL Annex I Regulation 12A (double hull) for bunker tanks.

3.1.1.2 Optional Requirements

- The bilge water holding tanks, regardless of their size, shall be located within the area protected by the double hull in accordance with MARPOL Annex I, Regulation 12A, [**3 points**].
- On ships with a bunker tank volume < 600 m³ (total bunker tank volume) all bunker tanks shall be protected by a double hull in accordance with MARPOL Annex I, Regulation 12A [**5 points**].
- On ships with a bunker tank volume > 600 m³: all smaller bunker tanks (< 30 m3) shall also be protected by a double hull in accordance with MARPOL Annex I, Regulation 12A [**3 points**].

Compliance Verification

Verification by submitting the general ship plan or the tank plan.
With regard to 3.1.1.2: If applicant can present an expert report demonstrating that the fuel used does not cause any major damage in the event of a leakage into the environment, the optional points can also be achieved without a double hull.

[3] In accordance with international procedures, a comparable level of safety can also be demonstrated by methods of probabilistics.

3.1.2 Additional Safety Measures to Prevent any Accident/Damage

The failure of engine or steering gear is still one of the most frequent sources of danger in maritime shipping. A significant number of all accidents at sea is attributed to the failure of engine components. In addition to the danger to the persons on board, an accident can result in serious marine and coastal pollution, especially in coastal waters and/or in areas with high traffic density. The use of redundant propulsion systems and/or separate engine rooms can keep the ship manoeuvrable in an emergency or enable it to reach a port ("safe return to port" concept). Furthermore, in the event of an accident/damage, it is also very important to establish a towing connection to a tug, but this is usually quite difficult.
In order to improve ship safety, a large number of protection measures are already in force internationally (SOLAS). Additional requirements for award of the Blue Angel are intended to further minimise the risk of collision and negative environmental consequences in the event of a shipping accident (see also 3.1.1).
Furthermore, cargo that is accidentally lost overboard, especially containers, poses an environmental risk, due both to the contents (e.g. hazardous goods, waste) and the fact that collisions with floating containers can cause damage to other ships. Therefore, cargo safety measures also provide significant protection against accidents.

International / Regional Requirements
Passenger ships over 120 m in length constructed on or after 1 July 2010 (keel-laying date) that have three or more vertical fire zones shall be designed in accordance with SOLAS regulation II-2/21. This also includes separate machine rooms and redundant propulsion systems („safe return to port").
In order to improve safety, some classification societies issue additional class notations for redundant propulsion (RP) systems.
At present, IMO requires an emergency towing system only for tankers with a cargo capacity of > 20,000 tdw (Resolution MSC.35(63)). This requirement does not apply to passenger ships and other cargo ships. However, Resolution MSC.256(84) requires these ships since 2010 and 2012, respectively, to carry an emergency towing procedure.
In order to improve cargo security the IMO adopted the "Code of Safe Practice for Cargo Stowage and Securing", in short CSS Code. Even though is not mandatory it is to be regarded as state of the art.

3.1.2.1 Mandatory Requirements

Cargo Ships, Passenger Ships on International Voyages (and > 120 persons[4])

- These ships shall be equipped with a "Decision Support System" in accordance with IMO Resolution A. 796(19) (e.g. bridge-based monitoring system with alarm devices, sensors in the ship etc.). This shall include the "safe return to port" concept for passenger ships and emergency towing procedures for other ships.

Cargo Ships

- The CSS Code shall be mandatory.

[4] The number of persons the ship is certified to carry applies only to this requirement.

Passenger Ships on National Voyages

- Existence of an emergency towing device on board approved under Resolution MSC.35(63) or an equivalent approved emergency towing system (e.g. „strong point/s": special or reinforced bollards or appropriate wire eyes for the towing wire to be shackled to the tug).

3.1.2.2 Optional Requirements

Installation of a redundant propulsion system in accordance with the additional class notation of a recognized classification society that corresponds to a safety level according to the levels of DNV GL[5] (Redundant Propulsion, RP 1 - 3).

RP 1: [**3 points**]
RP 2: [**4 points**]
RP 3: [**6 points**]

Only the points for the respective highest class notation can be credited.

Alternatively, a concept shall be presented that achieves an equivalent level of safety, such as by means of a certified redundant propulsion system[6] [**3 points**].

Compliance Verification

Record of an additional class notation to verify the presence of a redundant propulsion system according to RP 1-3. Comparable additional class notations of a classification society affiliated to IACS will be recognised.
An alternative concept shall be accompanied by an expert assessment of the equivalent safety level.
Ship safety construction certificate or a certificate for the emergency towing system and verification of the on-board installation of the system. Verification of the installation of one or more "strong point(s)".

3.1.3 Hull Stress Monitoring

Monitoring the stress/strain in the structure of a ship using a Hull Stress Monitoring System (HSMS) allows to quickly detect critical conditions during loading, unloading and high seas and to take counteraction in good time, such as reducing the speed or changing the course of the ship. IMO recommends the use of these systems especially for bulk carriers because of the high number of accidents in this sector. Today, the systems are also increasingly used in tankers and large container ships.
The above-mentioned system should not be confused with a ship loading calculator. A hull stress monitoring system, coupled with an alarm, continuously monitors the stresses in ship's hull and sends the data to the bridge.

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[5] http://rules.dnvgl.com/docs/pdf/dnvgl/ru-ship/2019-10/dnvgl-ru-ship-pt6ch2.pdf?_ga=2.10876855.229499212.1591599473-19817972.1543415113#search=redundant%20propulsion (p. 20)

[6] If SOLAS has already made a "Safe return to Port" concept mandatory for the ship optional points can no longer be credited for it.

3.1.3.1 Mandatory Requirements

None

3.1.3.2 Optional Requirements

Cargo Ships

- Installation of a Hull Stress Monitoring System [**2 points**].

Compliance Verification

Certificate of the system and verification of the on-board installation of the system.

3.2 Reduction of Operation-Related Emissions

The reduction of emissions from engine operation depends not only on the technology used and the fuel but also on the efficient operation of the ship. The ship design opens up technical reduction potentials and provides the structural prerequisites for more environmentally friendly operation. An efficient means is, for example, to plan the ship for a lower design speed already in the designing phase.

3.2.1 Sulphur Dioxides

Heavy fuel oils (HFOs) (also called residual fuels) or marine diesel oil/marine gas oil (MDO/MGO) are primarily used as fuels in maritime shipping. Also, the global sulphur limit of 0.50%, which has been in force since the beginning of 2020, continues to be met using heavy fuel oil with reduced sulphur content or in combination with Exhaust Gas Cleaning Systems (EGCS, scrubbers). HFOs are mostly viscous, pollutant-contaminated residues from the refinery process. In order to use the heavy fuel oil on board the ships, it must be processed: It must be both heated to pumpability and cleaned from solids. This treatment produces oil sludge, which has to be disposed of in the port. The sulphur oxide emissions (SOx) from ship exhausts pollute air quality, especially in port cities and coastal regions. These emissions are a health hazard and contribute to acidification and eutrophication of ecosystems (sea and land).
Accidents involving heavy fuel oil also have more serious environmental impacts than accidents involving other fuels which are more likely to evaporate and more rapidly microbially degraded. Even low-sulphur ship fuels like marine diesel oil (MDO) with a sulphur content of 0.10% still contain 100 times more sulphur than road diesel in Europe.

During the construction of the ship, the choice of propulsion concept (engine technology, design for fuel type, exhaust gas aftertreatment system) can help to have an effect on the air pollutant emissions.
As the criteria for award of this Blue Angel have their focus on the design of the ship, there are no direct requirements with respect to the fuel used in operation. To be nevertheless able to address this issue, which is of significance for the environmental impact of the ship, these criteria include a commitment statement on the fuel to be made by the applicant (see mandatory requirements under para. 3.2.1.1).

International / Regional Requirements

MARPOL Annex VI sets a global limit on fuel sulphur content of 0.50% m/m effective from 1 January 2020. In the sulphur emission control areas (SECAs) designated under Annex VI, a stricter limit of 0.10% has already been in force since 1 January 2015. In addition, there are regional regulations, such as the use of 0.10% sulphurous marine fuel at berth (> 2 hours) in all European ports (Directive 2012/33/EU).

Exhaust Gas Cleaning Systems (EGCS) are permitted as an alternative to the use of low-sulphur marine fuels for compliance with the above-mentioned limits under MARPOL, provided that the reduction in emissions is at least as effective as with the use of low-sulphur fuels. Scrubber systems that discharge wastewater into the sea must meet the limits set out in the „Guidelines for Exhaust Gas Cleaning Systems 2015 or 2009"[7] pursuant to Resolution MEPC.259(68) or as amended. Different regulations apply to inland waterways (in Germany these are the Convention on the Collection, Deposit and Reception of Waste during Navigation on the Rhine and Inland Waterways - CDNI[8] and the Wasserhaushaltsgesetz - Federal Water Act - WHG[9]).

3.2.1.1 Mandatory Requirements

- The sulphur content of the fuel must not exceed 0.10% worldwide. No fuels according to ISO 8217(2017) Table 2 "Residual marine fuels" including other low sulphur heavy oil fuels such as ULSFO[10], VLSFO[11] may be used. This requirement shall apply to all on-board internal combustion engines and boiler systems. This shall be confirmed by a commitment statement for the term and the period of usage of the Blue Angel ecolabel.
- The installation of an Exhaust Gas Cleaning System for compliance with the sulphur limit shall not be permitted.

3.2.1.2 Optional Requirements

Passenger Ships on National Voyages

- Only fuels with a sulphur content of no more than 0.01% may be used. This shall be verified by a commitment statement for the term and the period of usage of the ecolabel [**4 points**].

Compliance Verification

Commitment statement on the fuel(s) used specifying the maximum sulphur content, in accordance with Annex 2. In addition, the Bunker Fuel Delivery Note(s) shall be submitted after a period of one year and after expiry of the term to verify compliance with the commitment statement. Furthermore, random checks of compliance with the voluntary commitment by RAL, UBA or an expert shall be made possible during the term and the period of usage of the ecolabel. Verification that no EGCS is installed.

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7 In Germany, this is governed by in the SeeUmwVerhV - Verordnung über das umweltgerechte Verhalten in der Seeschifffahrt (Regulations on Environmentally Sustainable Behaviour in Maritime Shipping). Section 13 (7) of the Regulations still refers to the previous version of 2009 in accordance with MEPC.184(59). An adaptation/update is planned.

8 Übereinkommen über die Sammlung, Abgabe und Annahme von Abfällen in der Rhein- und Binnenschifffahrt - Convention on the Collection, Deposit and Reception of Waste during Navigation on the Rhine and Inland Waterways

9 Wasserhaushaltsgesetz – Federal Water Act

10 ULSFO - Ultra Low Sulphur Fuel Oil

11 VLSFO – Very Low Sulphur Fuel Oil

3.2.2 Nitrogen Oxides

Nitrogen oxides (NOx) form during combustion in the engine. They contribute to the eutrophication of ecosystems. In the sea, an increased nutrient input causes excessive growth of algae and aquatic plants. The consequences can be oxygen depletion and large-scale algal bloom, especially in smaller coastal or inland seas, such as the Baltic Sea. Due to the fact that shipping routes are often close to densely populated coasts, the emissions also have a negative impact on human health. Among other impacts, they lead to respiratory diseases, cardiovascular diseases and the formation of ozone, which is also harmful to health.
Technically, NOx emissions can be reduced both within the engine (to some degree and accompanied by increased fuel consumption) and through exhaust gas aftertreatment systems (e.g. SCR[12] systems) or the use of alternative fuels.

International / Regional Requirements
MARPOL Annex VI, NOx Technical Code, defines the maximum permissible emissions on the basis of a limiting curve dependent on the speed of the engine. The limits for new ships have been tightened according to a timetable in Tier I (since 2005), Tier II (2011) and Tier III. The most stringent Tier III limits only apply to new ships as of the below-mentioned year of construction when entering a NOx Emission Control Area (NECA). So far, the North American coast (since 2016), as well as the North Sea and the Baltic Sea (new since 2021) have been designated as NECAs.
In addition, there are regional limits, e.g. those of the US EPA[13] or the EU Non-Road Stage V, which specify a value of 1.8 g/kWh independent of the engine speed.

3.2.2.1 Mandatory Requirements

- All internal combustion engines including exhaust gas aftertreatment on board the ship shall comply with a value of 1.8 g/kWh NOx – independent of the engine speed.
- If SCR systems are installed to comply with the limit value, they shall be equipped with a closed-loop control system with feedback function so that a maximum ammonia slip (NH3) of 10 ppm is complied with during operation.
- If an exhaust gas recirculation system (EGR[14]) is installed to comply with the NOx limit, the necessary treatment (desulphurisation) of the exhaust gas must be carried out without emissions into seawater. No bleed-off water may be discharged overboard. Instead sufficiently large holding tanks shall be available on board to make sure the wastewater can be disposed of ashore.

3.2.2.2 Optional Requirements

- Additional NO_x sensors shall be installed to allow continuous emissions monitoring of the exhaust gas flow [**2 points**].
- Compliance with an NO_x limit of no more than 0.4 g/kWh independent of the engine speed [**3 points**].

[12] SCR: Selective Catalytic Reduction
[13] US Tier 4 Standards for Marine Diesel Category 1/2 Engines
[14] EGR: Exhaust Gas Recirculation

Cargo Ships and Passenger Ships on International Voyages

- If an SCR system is installed for compliance with the NO_x limit value, the urea tanks shall be designed so as to allow a continuous operation of the SCR system - even outside NECAs [**3 points**].

Compliance Verification

EIAPP Certificate[15] with a certified cycle value (1.8 g/kWh or 0.4 g/kWh) in accordance with the regulations of IMO MARPOL Annex VI and the NOx Technical Code 2008 (NTC 2008).

Verification of the NH3 limit of no more than 10 ppm as cycle value based on the NH3 slip analyses in the design of the SCR system in accordance with the provisions of the IMO SCR Guidelines, Resolution MEPC.313(74) of 17 May 2019 under the procedures described in chapter 6.3. The occurring NH3 slip can be determined e.g. by means of FTIR[16] and certified by analogy to the EIAPP certificate.

The size of the urea tanks is determined by the maximum travel distance the ship has been designed for to the nearest urea bunkering facility. Unfavourable weather conditions (wind, waves, currents) must be taken into account for proper tank sizing by adding a 20% safety margin. Tank sizing shall be applicable to all shipping routes, not only within NECAs.

If an exhaust gas recirculation (EGR) system with an EGCS is installed, it must be ensured that no bleed-off water can get into the sea. Sufficiently large collection tanks must be provided for this purpose, including a safety margin of 20%.

3.2.3 Black Carbon and Particulate Matter Emissions

Particulate Matter (PM) emissions are classified as harmful or carcinogenic. The smaller the particles, the easier they can enter the blood stream via the lungs. Besides, hazardous substances, such as heavy metals or carcinogenic polycyclic aromatic hydrocarbons (PAHs), can be found on the surface of particulate matter. The WHO has classified black carbon (BC) as part of the total particulate matter emissions as carcinogenic.
Moreover, black carbon has an impact on the climate when the dark particulate matter settles on ice and snow surfaces and thus reduce the albedo (Reflectance of solar energy from the earth). BC currently plays the second most important role in global warming after carbon dioxide and along with methane[17].
Measures or systems for PM reduction (particulate filters) have, so far, only been tested or installed in a small number of large combustion engines on seagoing ships. The following measures can reduce PM emissions in principle: engine modifications, low-aromatic fuels, synthetic fuels, onshore power supply for ships in port and the use of particulate matter filters. When comparing these measures, particulate filters achieve the highest reduction rates. Particulate filters are available on the market for engines from other fields of application (non-road, automotive) as well as for high-speed internal combustion engines. So far, however, they have been

[15] Engine International Air Pollution Prevention Certificate (EIAPP)
[16] FT-IR spectrometer (Fourier Transform Infrared Spectrometer)
[17] Climate Change 2014, IPCC Fifth Assessment Report (AR5): Global Warming Potential values, Figure 8.17

rarely used in maritime transport because of the lower fuel quality (higher sulphur and ash content) which causes the filter elements to clog up quickly.

International / Regional Requirements
So far, there are no direct limits for the number or mass of particulates in maritime transport. MARPOL Annex VI, Regulation 14 links particulate emissions to the sulphur content in the fuel because sulphates constitute a major part of the particulates.
Black carbon emissions have been discussed in the IMO at MEPC and PPR for several years. However, neither the measurement methods to be used for determining BC emissions nor limit values have been adopted so far.

3.2.3.1 Mandatory Requirements

- With a focus on the BC emissions, all internal combustion engines installed in the ship are to be tested with respect to their equivalent black carbon (eBC) emissions on the test bench.
- Particulate filters shall be installed for all high-speed internal combustion engines (speed range equal to or greater than 1,500 revolutions). Alternatively, particulate reduction can be achieved by techniques with the same reduction rate as particulate filters.

3.2.3.2 Optional Requirements

- Installation of particulate filters for all other internal combustion engines on board (other engine types than those mentioned under mandatory). Alternatively, particulate reduction can be achieved by techniques offering the same reduction rate as PM filters (e.g. by means of the fuel used):
  All internal combustion engines [**6 points**], some of the internal combustion engines (e.g. auxiliary internal combustion engines) [**3 points**].

Compliance Verification

Submission of the emission test report (analogous to Annex A, Table A.1, ISO 8178-3:2019-01) of the test bench measurements. The equivalent black carbon (eBC) measurements shall be carried out in accordance with the ISO standards ISO 8178-3:2019-01 or ISO 10054 using the Filter Smoke Number (FSN) measurement or, alternatively, by use of the Photoacoustic Spectroscopy (PAS) technique. The eBC emission measurement shall be carried out in analogy to the EIAPP certificate at the cycle points during the test run of the engine making reference to the fuel used during the test. Testing can be done with or without exhaust gas aftertreatment systems.

Verification of the installation of one or more particulate filters (certificate of the system).

Verification that a qualitative reduction of PM emissions can be achieved by the technology / fuel used. The certificate of the system shall be presented. If the requirement regarding the fuel used is met, a commitment statement on its use over the term and the period of usage of the ecolabel shall be submitted (Annex 2). Also, one year after the beginning of the term as well as after the end of the term, the bunker fuel delivery notes shall be submitted as verification of compliance with the commitment statement. Moreover, random checks of compliance with the commitment

statement may be performed by RAL, UBA or an expert during the term and the period of usage of the ecolabel.

Evidence of the equivalence in relation to particulate filter reduction must be provided (for dual-fuel engines, emissions from the ignition oil must also be taken into account).

3.2.4 Efficiency / Greenhouse Gas Emissions from Ship Operation

The efficiency of a ship is assessed on the basis of its fuel consumption per nautical mile and the tonnes/passengers transported (performance). Depending on the consumption and the type of fuel used, CO_2 emissions or CO_{2e} are also a way of measuring efficiency. Efficiency can be improved through a variety of measures – both in design and in operation.

Carbon Dioxide (CO_2)

Carbon dioxide is the most important known greenhouse gas. Even though its global warming potential (GWP) is low compared to other greenhouse gases such as methane, nitrous oxide (laughing gas) or the F-gases[18] the amount of global emissions is much higher. Maritime transport accounts for approximately 3% of total anthropogenic CO_2 emissions. In order to meet the targets set out in the Paris Climate Agreement, maritime transport must also make its contribution to reducing greenhouse gas emissions. In 2018, the IMO adopted an initial strategy for reducing greenhouse gas emissions from ships in order to achieve at least 50 percent less CO_2 emissions by 2050 compared to 2008 levels. Per transport work (tonne nautical mile), emissions are to be reduced by at least 40 per cent by 2030 and by 70 per cent by 2050 compared to 2008. In order to meet the targets set out in the Paris climate agreement greenhouse gas reductions of 70-100 percent will also be required in shipping by 2050.

In the shipping sector, the reduction of CO_2 emissions can be technically achieved by various measures. CO_2 emissions are directly correlated with fuel consumption. Fuel consumption and CO_2 emissions increase exponentially with increasing speed.

Apart from the technical possibilities for increasing energy efficiency and saving energy by improving the ship's operational processes, alternative fuels and propulsion systems (e.g. sail-assisted systems) are increasingly being discussed in shipping and - so far in individual applications or smaller numbers - realised in practice.

There is, however, no international consensus yet as to which post-fossil fuels should be used in maritime transport in the future. Since many fuel options[19], both liquid and gaseous, are currently under discussion, all of which have advantages or disadvantages in terms of application, environmental assessment, availability, etc., no fuel strategy can be outlined within the scope of this Blue Angel ecolabel. Accordingly, no conventional fossil fuels are given priority as possible transition technologies for the Blue Angel. However, due to the fact that the availability of non-fossil and climate-neutral fuels is still limited, they are not made mandatory under the ecolabel, but high demands are placed on the use of fossil fuels, such as LNG.

The use of post-fossil fuels, especially if they are produced from renewable electricity, is welcomed and rewarded by the allocation of optional points.

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[18] F-gases (fluorinated hydrocarbon compounds) include e.g. HFCs, PFCs, SF6, NF3.

[19] e.g. PtL, PtG, methanol, ethanol, OME, hydrogen, ammonia or energy storage systems such as batteries. In this context, it must be taken into account that these are greenhouse gas-reducing/-neutral fuels only if they are produced from renewable surplus electricity.

Methane (CH_4)
Methane already escapes during extraction, transport and the liquefaction to LNG. Upstream emissions can neither be included in the assessment nor be made a requirement under the Blue Angel. When LNG is burned in gas engines, for example, methane can also escape with the exhaust gas flow (methane slip). The level of emissions (g/kWh) depends on the engine concept. Ambitious requirements are therefore placed on the use of LNG on board in order to achieve a reduction in GHG emissions in the overall picture. Methane has a GWP value[20] that is 28 times higher than CO_2 over 100 years[21]. In a twenty-year period (GWP 20), the factor is 84[22].

Other Climate-Impacting Emissions from Engine Operation
The same applies to other climate-relevant substances that are emitted, for example, through leaking pipelines, during refuelling, through incomplete combustion or are produced during combustion and escape with the exhaust gas. In ship operation, these can be, for example, nitrous oxide emissions (GWP 100: 265; GWP 20: 264), which can be emitted when ammonia is used as a fuel or as a follow-up product of the use of urea in SCR systems.
Black carbon too is among the climate-relevant emissions with a GWP 100 of approx. 460 and a GWP 20 of approx. 1,600. BC requirements are listed in para. 3.2.3.

International / Regional Requirements
Shipping is currently still exempt from the international climate protection agreements. Nevertheless, the IMO has implemented measures to improve the energy efficiency of ships. An Energy Efficiency Design Index (EEDI) has been introduced for new ships. The regulation contains reference lines for many ship types, below which the ship must fall depending on the year of construction. EEDI Phase 2 applies until the end of 2024, Phase 3 from 1 January 2025 (cf. Table in Appendix A).

In addition, ship operators are required to prepare and carry on board a Ship Energy Efficiency Management Plan (SEEMP). EEDI and SEEMP are confirmed in the International Energy Efficiency Certificate (IEE Certificate) by the respective flag state.
Furthermore, parameters for recording the annual fuel quantity and calculating the annual CO_2 emissions are documented in the EU Monitoring, Reporting and Verification (MRV) data collection system, since 2018; and in the international IMO Data Collection System (DCS), since 2019. The EU MRV also records additional information, such as cargo carried and the average energy efficiency.
However, all above-named regulations just refer to the CO_2 emissions of the ship. Methane emissions or other climate-damaging emissions (e.g. nitrous oxide, black carbon) have so far neither been regulated on an international nor on a national level.

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[20] Global Warming Potential (GWP), an index that indicates the radiative forcing that follows from the emission of a unit mass of a given substance, accumulated over a chosen time horizon and compared to the reference substance CO_2. The GWP therefore represents the combined effect of the different retention times (usually 20 or 100 years) for which these substances remain in the atmosphere and the effectiveness of these substances in causing radiative forcing.

[21] Source for all GWPs in this paragraph: Working Group I - Contribution to the IPCC Fifth Assessment Report. Climate Change 2013: The Physical Science Basis. Editors.: Intergovernmental Panel on Climate Change. 30 September 2013, Chapter 8: Anthropogenic and Natural Radiative Forcing, see Table 8.1.A, pages 8–88 to 8–99.

[22] For fossil methane, the IPCC gives the GWP 100 as 30 and GWP 20 as 85, which is somewhat higher.

3.2.4.1 Mandatory Requirements

All Types of Ship

- In principle, possible negative environmental effects in other areas (so-called cross-media effects) must be taken into account when applying efficiency-enhancing or CO_2 reducing technologies. The Blue Angel aims to achieve a significant reduction in greenhouse gas emissions in the overall balance (tank-to-propeller assessment).
- All pumps (e.g. seawater pumps, heat pumps, air conditioning, ventilation, etc.) over 500 kW must be equipped with a frequency converter. Alternatively, the application of the EU ECO Design Regulation for electric motors IE-3 is to be regarded as equivalent.
- LED lamps are to be used throughout the ship, provided they are approved for the intended use on board (explosion protection, navigation and signal lights according to COLREG).

Ship Types listed in MARPOL Annex VI, Regulation 21

The MARPOL Convention sets minimum requirements for these ships (> 400 GT). The following additional requirements must be met for the Blue Angel:

- Compliance with the reduction requirements of phase 3 EEDI -10% with immediate effect.
- As soon as Phase 3 becomes mandatory (from 1 January 2025), a more ambitious value of EEDI Phase 3 -20% will apply to the ship.
- Should a Phase 4 be adopted by the IMO, it must be fulfilled ahead of time, but not before 1 January 2024 at the earliest.

Ship Types not listed in MARPOL Annex VI, Regulation 21

- For ships which do not have an EEDI reference line in MARPOL a comprehensive qualitative report shall be prepared to demonstrate that ambitious efficiency potentials have been realized in the following ship design categories:
  - Hull shape
  - Propeller
  - Design speed
  - Internal combustion propulsion engine / alternative propulsion concepts
  - Auxiliary internal combustion engines
  - Hotel operation / Crew areas (e.g. lighting, heating, insulation pool, etc.)
  - Fuel options

  If possible, the reduction potentials (in percent) are to be specified for the respective measures.

  If comparable ships (e.g. predecessor ships, sister ships) exist, these ships are to be included in the assessment.

All Passenger Ships

- In order to reduce the energy demand for the necessary heat generation on board (living spaces, passenger areas), the heat from the engine operation must be recovered, e.g. by means of concepts allowing the use of heat from the cooling water.

Ships using gas-fuelled internal combustion engines
Since EEDI only addresses CO_2, leaving other greenhouse gases unconsidered, for example and in particular, methane, the above-mentioned binding EEDI requirements can be achieved more easily with LNG. This leaves the methane slip unconsidered so that a supplementary mandatory requirement for LNG must be included in the criteria for award of the Blue Angel.

- If gas-fuelled internal combustion engines (including dual-fuel engines) are installed for the main propulsion of the ship, the methane emissions in the exhaust gas must be determined (averaged value at load points in accordance with the NO_x Code). Depending on the type of internal combustion engine, they must not exceed the following limits:

  Table 1: Limit values for methane emissions from gas-powered engines

	Methane Emissions in g/kWh		
	Low-speed 2-stroke engines		Medium-speed 4-stroke engines
Limit valid	High-pressure dual-fuel engines (HPDF) Combustion process: Diesel	Low-pressure dual-fuel engines (LPDF) Combustion process: Otto	
until 31 Dec. 2023	0.2	1.7	1.6
from 1 Jan. 2024	0.2	1.0	0.9

  These limits correspond approximately to a 5 percent GHG reduction (from now until the end of 2023) or a 15 percent GHG reduction (as of 2024) compared to operation with MGO. The limit for 2-stroke HPDFs is more ambitious (reduction of about 25 percent), as this corresponds to the state of the art.
  If exhaust gas aftertreatment techniques are used to minimise greenhouse gas emissions (e.g. catalytic converter for methane), these reductions can be included in the calculation.

- No binding limit values are included in the criteria for gas-fuelled high-speed engines, but a reduction corresponding to that of medium-speed engines (5 % by the end of 2023, 15 % from 2024 compared to MGO operation) should be aimed for. The emissions are to be determined accordingly and documented in the expert report.

- If systems are installed for operation with fuels that have a higher greenhouse gas potential than conventional liquid fuels (e.g. methane), all tanks and pipes must be designed in accordance with the IGF-Code[23] to make sure that no climate-damaging gas can escape (e.g. closed system for complete recovery of boil-off gas: gas sensors, pressure and temperature monitoring of all pipes, systems for nitrogen flushing of the pipes after refuelling, etc.).

3.2.4.2 Optional Requirements

In addition, optional points can be achieved if the following alternative propulsion technologies or fuels are used. In addition to improving efficiency, fuel savings can, as another positive effect, also reduce air pollutant emissions.

[23] International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels

- Hybrid electric propulsion systems [**2 points**]
- Alternative: If hybrid propulsion systems with energy storage systems are used, optional points can be achieved depending on the battery power installed compared to the total power of the ship [10 - 20% of the power is provided by a battery: **4 points**; > 20% of the power: **6 points**].
- Wind propulsion systems [**6 points**],
- Installation of fuel cell(s) [**4 points**],
- Internal combustion engines that can only be operated with one of the following fuels: methanol, ammonia or hydrogen produced from renewable electricity in the medium/long run. This is intended to provide incentives for technology development. Auxiliary internal combustion engines [**3 points**], all internal combustion engines [**6 points**].

Passenger Ships

- Energy-efficient technologies in hotel operations[24] [**2 points**].

Compliance Verification

Mandatory Requirements:
Submission of the documentation of the pumps installed (frequency converters) and of the lamps (LED).

EEDI Requirement:
Submission of the IEE Certificate of compliance with the EEDI Phase as well as verification of compliance with the reduction requirement going beyond this phase.
Provided that no EEDI determination according to MARPOL Annex VI, Regulation 21 is possible: Comprehensive qualitative expert report confirming that efficiency potentials are considered in all the above-mentioned areas, indicating approximate reduction percentages. Verification of implementation must be submitted for all efficiency measures (ship design plans, installation certificate, etc.). If exhaust gas aftertreatment technologies are installed, their effect on greenhouse gas reduction is to be documented (additional consumption versus emission reduction).

The expert report shall cover all greenhouse gas-relevant emissions that may form during the operation of the ship (Tank-to-Propeller-Analysis).

Gas- combustion engines:
If internal combustion engines are used for gas (LNG), it must also be demonstrated how methane leakages as well as the internal engine methane slip are prevented as comprehensively as possible (emissions during bunkering operations, storage in tanks, pipelines, combustion process, exhaust gas flow). The report must contain the following information:
Methane emissions in g/kWh determined on the basis of the NO_x Code; submission of the measurement report of the engine. Verification that the methane slip complies with the above limit values.
If a methane catalyst is installed: verification of the installation and documentation of the reduction rate.

[24] Heat recovery is already mandatory and can longer be additionally credited here.

In order to keep on-board methane emissions as low as possible, closed pipe and tank systems should be used, for example, to make sure that boil-off gas can be completely recovered. These systems shall be equipped with gas sensors, pressure and temperature monitoring of all pipes as well as systems for nitrogen flushing of the pipes after the refuelling process, etc.

Optional Requirements:
Verification of the installation of the corresponding emission-reducing technologies.

3.2.5 Air Pollutant Emissions while at Berth in a Port

Air pollutant emissions are a particular health hazard, especially in densely populated areas and ports. As land-based emissions have been progressively reduced in Europe over the past decades and maritime transport is on an upward trend, the proportion of maritime transport's contribution to total emissions increases.
The EU therefore stipulates that marine fuel of ships in port during their time at berth must not exceed a sulphur content of 0.10 percent (EU Directive 2012/33/EU).
One option to meet the sulphur limit as well as to reduce other emissions is to use onshore power to provide the necessary on-board energy and to stop the main engine. More and more ports are offering onshore power supply, such as Gothenburg, Stockholm, Lübeck and Hamburg. With the AFID Directive[25], the European Union establishes a common framework for the development of shore-side power facilities in ports and calls on the member states to develop the infrastructure in larger ports by 2025.
Auxiliary boilers are usually only used in port to provide the necessary heat for on-board operations when the main engine is not running. On passenger ships in particular, the boilers thus continue to be a source of emissions even while the ship is at berth.

International / Regional Requirements
There are currently no binding international regulations. In some port cities, memoranda of understanding exist or are being sought by local authorities and shipping companies for the use of onshore power supply.
European ports are governed by EU Directive 2012/33/EU which limits the sulphur content in fuel to 0.10% for ships at berth. Alternative methods, such as the use of onshore power, are permissible to comply with the limit value.
Even though there is no obligation to use shore-side power within the scope of this Blue Angel, this should be the aim of all certified ships in operation, provided that shore-side power supply is offered.

3.2.5.1 Mandatory Requirements

- On-board equipment for accepting external power supply.

3.2.5.2 Optional Requirements

- When operating auxiliary boilers, use of procedures leading to a significant reduction in emissions of NO_x, SO_x, PM (e.g. electric heating). [**3 points**].
- On-board power generation at berth in compliance with the limits set out in the 44th BImSchV (Federal Immission Protection Ordinance) for SO_x, NO_x, CO, PM [**5 points**].

[25] 2014/94/EU (Directive on the deployment of alternative fuels infrastructure - AFID)

Compliance Verification

Verification of the installation of the on-board power-receiving station in the technical documentation of the shipyard (e.g. by means of power supply diagrams, wiring diagrams).
Verification of the installation of low-emission auxiliary boilers.
Verification that the on-board power generation complies with the emission limits of the 44th BImSchV for SO_x, NO_x, CO, PM.

3.2.6 Refrigerants

The on-board air-conditioning systems as well as the refrigeration systems installed for cooling provision rooms, fridges, ice machines etc. usually contain climate-relevant and ozone-depleting substances. The use of refrigerants without ozone depletion potential (ODP) and with low global warming potential (GWP) is gaining growing acceptance in shipping and is a genuine contribution to climate protection.
Within the meaning of these award criteria, only equipment belonging to the ship, including the ship's air-conditioning systems, refrigeration rooms, etc., are taken into account, but not, for example, conventional refrigerated containers that are on board only temporarily for the transport of cargo or for special purposes (e.g. on research ships), as the shipyard or shipping company has no influence on such equipment.

International / Regional Requirements
MARPOL Annex VI, Regulation 12 prohibits the installation of equipment containing ozone-depleting substances from the CFC[26] and the HCFC[27] group.
The hydrofluorocarbons (HFCs) often used as substitutes for the ozone-depleting substances usually have a high global warming potential. The GWP value for the HFC tetrafluoroethane (R134a) is 1430, for the HFC mixture R407A it is 2107 and for the mixture R404A the GWP value is 3922[28]. The GWP values refer to CO_2 as the reference substance, the time horizon is 100 years.
The F-Gas Regulation (EU) No. 517/2014 increasingly restricts the availability of HFC refrigerants until 2030, especially refrigerants with high global warming potential such as R404A. With the Kigali decision (2016), the Montreal Protocol also significantly restricts the production and use of HFCs with high greenhouse potential until 2047.
The F-Gas Regulation Article 8 (3) requires the recovery of regulated refrigerants from mobile equipment during servicing, maintenance and decommissioning.
The German Chemicals Climate Protection Ordinance[29], Section 3 (2) requires operators to check their mobile equipment for transport refrigeration containing F-gases for leaks during transport at least once every twelve months using suitable equipment.

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[26] Chlorofluorocarbons
[27] Hydrochlorofluorocarbons, such as chlorodifluoromethane, (R22)
[28] The values refer to Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. OJ EU L150/195- 230. 20 May 2014; GWP values are additionally listed in Appendix B to these Award Criteria.
[29] Verordnung zum Schutz des Klimas vor Veränderungen durch den Eintrag bestimmter fluorierter Treibhausgase (Chemikalien- Klimaschutzverordnung - ChemKlimaschutzV) (Regulation on the protection of the climate against changes caused by certain fluorinated greenhouse gases (Chemicals Climate Protection Regulation – ChemKlimaschutzV) of 2 July 2008, Federal Law Gazette I p. 1139, last amended on 14 February 2017.)

For ships, there are refrigerating systems using natural refrigerants such as CO_2 and ammonia. The aim shall be to use natural refrigerants also for non-fixed equipment onboard ships such as ice-makers or freezers.

3.2.6.1 Mandatory Requirements

All requirements refer to permanently installed refrigeration and air-conditioning systems on board the ship.

- All **refrigeration and air-conditioning systems** must be free of ozone-layer-depleting refrigerants (ODP = 0).
- All **refrigeration and air-conditioning systems** including all refrigerant-containing parts, must be accessible for leak checks, maintenance and repairs.
- All **air-conditioning systems** must not contain refrigerants with a GWP over 1,800.
- All **refrigeration systems** shall be designed without halogenated refrigerants to the extent that the use of natural refrigerants corresponds to the state of the art for the intended use on board. Exceptions to this requirement are possible, but must be justified.
- **Refrigeration and air-conditioning systems** using F-gases (usually HFCs) with a capacity of more than 300 kg must be equipped with an automatic detection system with sufficient sensitivity for the refrigerant(s) used to detect excessive refrigerant concentrations (leak detector / gas warning system).
- The recovery of F-gas refrigerants from **Refrigeration and air-conditioning systems** must be provided (recovery unit, e.g. suction device, refrigerant container or suitable space for setting mobile recovery units).

3.2.6.2 Optional Requirements

- Installation of **air-conditioning systems** using halogen-free refrigerants. Halogen-free refrigerants are, for example, ammonia, CO_2 and hydrocarbons (**4 points**).

Compliance Verification

Data sheet, specification of the refrigerant(s) as well as verification that the refrigerant has been filled into the system and indication of the refrigerants quantity (e.g. service report)
If, in exceptional cases, a halogenated refrigerant is used, it must be substantiated in the expert report why a halogen-free product cannot be used.
Description of the gas warning system.
Drawing of the equipment with information on the refrigerants recovery equipment, the refrigerant container locations and access points to the refrigeration or air-conditioning system. Technical details of the refrigerant recovery equipment including the refrigerant recovery volume.

3.2.7 Fire Extinguishing Agents

Extinguishing agents are used on board to ensure the safety of crew and ship. Extinguishing agents may contain substances with ozone depleting potential (ODP) or high global warming potential (GWP). There are today various fire extinguishing systems in maritime shipping that use environmentally friendly extinguishing agents.
Fire extinguishing foams may contain perfluorinated and polyfluorinated chemicals (PFCs). Perfluorinated chemicals are extremely persistent and do not degrade in the environment. Polyfluorinated substances degrade under environmental conditions to form persistent perfluorinated

substances. Some representatives of the substance group have already been identified as persistent, bioaccumulative and toxic substances (PBT) or as very persistent and very bioaccumulative substances (vPvB) under the European Chemicals Regulation (REACH)[30].
The use of these fire extinguishing foams on board a ship inevitably leads to exposure to the environment.

International / Regional Requirements
MARPOL Annex VI, Regulation 12 prohibits the installation of equipment containing substances with ozone depleting potential (ODP, e.g. CFCs and halons) since 2005. This ban has already been in force in Germany since 1995 and in the EU since 2000. Since 2020, MARPOL also prohibits HCFCs.
Regulation (EU) No 517/2014 also prohibits the placing on the market of perfluorinated hydrocarbons and HFC-23 as fire extinguishing agents. HFCs with low global warming potential and halogen-free extinguishing agents and systems are available as alternatives.
Fire-extinguishing foams containing more than 0.001% by weight of perfluorooctanesulfonic acid and its derivatives (PFOS) have been banned in the EU since June 2011 (Regulation (EU) No 757/2010 / Regulation amending Regulation (EU) No 850/2004 - POP Regulation).
A limit of 25 ppb for perfluorooctanoic acid (PFOA) and 1000 ppb for PFOA precursors (Regulation (EU) 2017/1000) in fire-extinguishing foams applies in the EU from 4 July 2020.

3.2.7.1 Mandatory Requirements

- Compliance with the limit values of ODP = 0 and GWP < 3,500 for units that are permanently installed or necessary for ship operation, including the on-board hand-held fire extinguishers.
- Immediate compliance with EU Regulation 757/2010 by all fire extinguishing foams in hand-held fire extinguishers and permanently installed systems.

3.2.7.2 Optional Requirements

- Use of freely movable fire extinguishing devices / hand-held fire extinguishers using environmentally friendly, halogen-free substances, such as water, nitrogen, argon, carbon dioxide [**2 points**].
- Use of permanently installed extinguishing systems required for ship operation using environmentally friendly halogen-free substances[31], such as water, nitrogen, argon, carbon dioxide. [part of the fire-extinguishing equipment: **2 points**, entire on-board fire-extinguishing system: **4 points**].

Compliance Verification

System certificate and verification of installation.

[30] https://echa.europa.eu/de/candidate-list-table; PBT: perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDA); vPvB: perfluorohexanesulfonic acid. (PFHxS), perfluorocarboxylic acids with 9-14 perfluorinated carbon atoms (C9-C14 PFCAs).
[31] The installation shall only be carried out if there are no safety-relevant provisions to the contrary or if specific extinguishing agents are required.

3.2.8 Prevention, Separation and Disposal of Garbage

Waste that gets into the sea poses a major threat to the marine environment. Plastic waste in particular remains in the sea for centuries. The shipping industry too contributes to the pollution of the marine environment through waste or other materials that go overboard (e.g. in the event of accidents, in heavy weather, through illegal discharge). 51 percent of the waste found, for example, on German North Sea beaches is waste from sea-based sources, above all from shipping and fishing activities.
Countless marine animals perish in larger pieces of garbage, especially packaging materials and fishing nets, as a result of entanglement and strangulation. Smaller pieces of plastic (especially meso- and microplastics) are eaten, cause internal injuries and blockages and may lead to starvation caused by plastic-filled stomachs. In addition, when plastics decompose, they release toxic and hormonally active additives, such as plasticizers, flame retardants and UV filters into the marine environment or the organism.
Ships generate different types of waste. Consequently, on board as well as on land, waste prevention and a sensible handling of waste are very important. Both crew and passengers are called upon to achieve these goals during operation. Indeed, supporting measures can already be taken during the construction of the ship that contribute to waste prevention and more environmentally friendly practices. For example, the use of reusable and large containers as well as the installation of dosing systems for cleaning agents and other operating materials help to reduce packaging waste on board.
The most eco-friendly handling of waste is the complete, separate handover for recycling on land. This requires appropriate storage capacities for separate on-board collection by type of garbage (e.g. paper, wood, plastics, food residues, etc.). Shredders or compactors can help reduce the need for on-board storage capacities.

International / Regional Requirements

MARPOL Annex V imposes a general ban on the discharge of all types of garbage into the oceans. There are, however, exceptions for food waste and cargo residues that are not harmful to the marine environment and which, depending on the sea area, may be disposed of overboard. The regulation is structured according to the distance of the ship from the nearest coast: the closer the ship gets to the coast the stricter the requirements are. In addition, special areas may be designated under MARPOL Annex V where stricter rules apply.
Furthermore, every ship over 100 GT (gross tonnage) or carrying more than 15 persons must have a garbage management plan which must contain information on the reduction, collection, storage, handling and disposal of garbage. Ships larger than 400 GT carrying more than 15 persons on board must also keep a Garbage Record Book to document the handling and disposal of garbage.
In addition to the priority disposal of garbage on land, MARPOL also permits incineration on board. The systems must comply with the current requirements for the IMO type approval certificate - Resolution MEPC.244(66) - which defines the immission limits for incinerators. Installations on ships flying an EU flag must also be certified according to MED.
EU Directive 2000/59/EC on port reception facilities for ship-generated waste and cargo residues governs, in accordance with the guidelines of MARPOL Annex V, Regulation 7, the general disposal obligation of seagoing ships, the provision of port receptions facilities, the preparation of management plans of ports as well as the collection of charges associated with disposal. The directive was revised in 2019, with a 100 per cent inclusion of waste disposal fees in the harbour

dues to be paid. This no-special-fee system is already good practice in many ports in the Baltic Sea. The revised Directive (EU) 2019/883 must be implemented by 28 June 2021.
In the EU, the above-mentioned "Directive on port reception facilities for the delivery of waste from ships" shall replace the old directive 2000/59/EC as of 28 June 2021. The directive primarily sets operational standards for ships, i.e. the obligation to collect waste on board in accordance with the consolidated IMO guidelines, the obligation to dispose of the waste in port as well as corresponding reporting and documentation obligations. The directive provides for a cost reduction in cases where the construction, equipment and operation of the ship demonstrate that it produces reduced quantities of waste and manages its waste in a sustainable and environmentally sound manner. The criteria for such cost reduction are not yet available.

3.2.8.1 Mandatory Requirements

- Structural design that facilitates the use of reusable and large containers.
- Structural design that permits an environmentally sound handling of shipboard garbage in accordance with the "Garbage Certificate" of a recognised classification society or procedure under ISO 21070 (2017).
- Structural design that permits a separate collection in accordance with garbage categories.

Cargo Ships and Passenger Ships on National Voyages

- No shipboard incinerators. For this purpose, appropriate structural storage facilities shall be made available on board, if necessary in combination with devices for volume reduction such as waste compactors, shredders and the like.

Cargo Ships

- For cargo ships carrying solid bulk goods: Facilities for the discharge of cargo residues to port reception facilities.

Passenger Ships on International Voyages

- On-board waste incineration shall be permitted, provided that the incinerator is MED-approved under MEPC.244(66) and the plant's emission values are 20 percent lower than those specified therein for carbon monoxide (CO), soot number and ash.
- Ash generated during combustion and waste from exhaust gas cleaning systems must, as a matter of principle, be disposed of ashore. Adequate structural precautionary measures (e.g. sufficient storage space) are to be taken already at design stage.

3.2.8.2 Optional Requirements

All Passenger Ships

- Structural precautionary measures are to be taken to permit the use of reusable items in restaurant/hotel operations (e.g. sufficient storage space for dishes, return systems, dishwashing rooms etc.) [**3 points**].
- Garbage separation systems (sorted according to its type, such as plastics, paper, glass, residual materials) are to be installed in the passenger areas. The waste disposal facilities (garbage bins) on deck are to be installed in weather-protected locations and/or designed so as to ensure that no waste can inadvertently get into the sea due to wind or ship movements [**2 points**].

Passenger Ships on International Voyages

- No shipboard incinerator. The structural design (including, for example, cold storage rooms for prolonged storage) must ensure the complete disposal of all garbage in ports by means of an appropriate disposal infrastructure [**5 points**].
- The incinerator complies with the limits of the BImSchV (Federal Immission Protection Ordinance) as specified for onshore incineration plants with similar capacity: daily average for NO_x 150mg/m³, for CO 100 mg/m³, SO_x 50 mg/m³ and for dust (particulates) 10 mg/m³ [**5 points**].
- A pyrolysis incinerator is installed as an alternative [**5 points**].

Compliance Verification

Verification of the structural design to ensure sufficient storage space for returnable and bulk containers (e.g. storage space for empty returnable packaging) in accordance with the intended use of the ship, including a 20 percent safety margin of storage space capacity.

For bulk carriers, verification that sufficient storage space is available for cargo residues and description of the concept for disposal on land.

Submission of the general plan of the ship to demonstrate that no incinerator plant is installed.

If an incinerator is installed: Verification that the system complies with the above limits (system certificate).

The dimensions of the garbage storage capacity must be sufficient to ensure that the garbage can be properly separated, pressed if necessary, and stored over the maximum voyage distance for which the ship is used until the next adequate shore-based disposal option is available. A 20 percent safety margin of storage volume must be included in the planning process.

3.2.9 Cleaning Agents

Cleaning agents are used in all sections of the ship. Continuous changes of staff and, usually, also of cleaning agents may lead to wrong dosing and often to overdosing. Overdosed wash water can disturb the sensitive biological balance in the wastewater treatment plant and, at the worst, kill the microorganisms, causing the plant to fail and the wastewater to be released into the environment untreated and highly contaminated.
The same is true for the use of cleaning agents on deck. This wash water always enters the sea untreated. Here, too, it is essential to use dosing systems to reduce the amount of cleaning agents.
When using cleaning agents they should be free from phosphate, NTA and EDTA[32].
There are systems on the market for ships that automatically prepare correctly dosed cleaning agents from detergent concentrates. Usually, just a few concentrates are needed, each of which can be dosed differently for different applications. The necessary equipment shall be permanently installed on board: The concentrates are available worldwide. At best, they are environmentally friendly, e.g. biodegradable.

[32] NTA: nitrilotriacetic acid; EDTA: ethylenediaminetetraacetic acid

3.2.9.1 Mandatory Requirements

- Installation of a system for proper dosing of cleaning agents for use inside the engine room and posting of the process description (dosage instructions) for the products.
- Installation of a system for dosing cleaning agents for use outside the engine room and posting of the process description (dosage instructions) for the products.
- Dosing systems for the kitchen and laundry sections.

3.2.9.2 Optional Requirements

None

Compliance Verification

Document confirming the installation of the system(s) as well as verification that appropriate process descriptions have been posted in proper places.

3.2.10 Sewage (Black and Grey Water)

In addition to organic pollutants, sewage also contains the nutrients nitrogen (N) and phosphorus (P). These nutrients can cause overfertilization which may lead to undesirable effects, such as increased algae growth, formation of toxic algae blooms, massive development of large algae and oxygen deficiency due to microbial oxygen-consuming degradation processes.
In addition to black water from toilets and urinals as well as the from hospital area, grey water is generated in showers and wash basins in the living quarters of crew and passengers. Other sources of grey water are the on-board laundry and kitchen. Individual greywater streams may be particularly polluted, as is the case, for example, with kitchen sewage because of its high nutrient and fat content. These Blue Angel criteria address these sewage streams together with black water.
Efficient on-board sewage treatment helps reduce nutrients and oxygen-consuming substances in the sewage and thus helps reduce the burden on the environment if the treated water is discharged into the sea, especially in heavily trafficked waters. The use of chlorine-containing agents for disinfection of sewage is viewed critically, as it may lead to the formation of harmful organic chlorine compounds that contribute to environmental pollution. Alternatives include, for example, systems with membrane filtration as well as UV irradiation following the biological sewage treatment.

International / Regional Requirements
MARPOL Annex IV generally prohibits the discharge of black water into the sea from ships larger than 400 GT or carrying more than 15 persons. The following exceptions are, however, permissible depending on the distance to the nearest shore:

- The ship uses a type-approved sewage treatment plant
- Outside 3 nm: discharge from a certified sewage treatment plant (mechanically treated and disinfected),
- Outside 12 nm: discharge without treatment at a minimum speed of 4 knots.

MARPOL does not set any requirements for grey water. If grey water is mixed with black water, MARPOL considers it as black water and it must be treated as such.

The requirements of MARPOL Annex IV[33] are currently being reviewed by the IMO. Since 2010, the permitted amount of residual chlorine for disinfecting sewage has been limited to 0.5 ppm in the type test[34].

In 2013, the Baltic Sea was the first to be designated as special area for the discharge of sewage (black water) from passenger ships.
The MARPOL regulation entered into force in June 2019 for new passenger ships; for existing passenger ships it will be effective from June 2021. Hence, according to Resolution MEPC.227(64), type-approved sewage treatment plants shall be installed and operated to meet the discharge criteria for total nitrogen (20 mg/l or 70% reduction) and total phosphorus (1 mg/l or 80% reduction) of treated sewage.
In special areas, sewage can, alternatively, be discharged to port reception facilities.

The Polar Code also requires all Category A and B ships and all passenger ships built after January 1, 2017 to have a sewage treatment plant installed that has been tested in accordance with Resolution MEPC.227(64).

3.2.10.1 Mandatory Requirements

- Installation of a sewage treatment plant type approved according to MEPC.227(64)[35] to treat all black and grey water generated. (Additional requirements apply to passenger ships, see paragraph below.)
  Alternatively, sufficient tank volumes for black and grey water must be installed in order to be able to retain untreated sewage and dispose of it ashore.
- All pipe outlets for discharging sewage to shore facilities or for the disposal of grey water, pre-treatment products and bio-sludge are to be routed outboard above the waterline. Standardised discharge connections (so-called international shore connections) as specified in Regulation 10 of MARPOL IV shall be used for discharge in ports.
- No use of chlorine-containing chemicals for sewage treatment[36].
- Installation of separate collection tanks for the collection of pre-treatment products and bio-sludge for disposal on land.
- Sewage treatment plants are to be equipped with suitable sampling points.

Passenger Ships

- Provided that facilities for discharging treated sewage into the sea are installed, the discharge standards and limits set out in Resolution MEPC.227(64) paragraphs 4.1 and 4.2 must be met. The systems shall be designed so as to ensure that the requirements can be met in all waters as well as outside the 1 nautical mile zone:
  - N-elimination: 20 mg/l or 70% reduction
  - P-elimination: 1 mg/l or 80% reduction[37].

[33] Note: these requirements are currently being updated by the IMO.
[34] MEPC.159(55), MEPC.227(64)
[35] Existing systems may also be approved in accordance with resolution MEPC.159(55) – cf. comments under "Compliance Verification".
[36] Membrane cleaning is excluded from this requirement, unless the manufacturer allows alternatives.
[37] These limits correspond to the requirements for special areas under MARPOL Annex IV (to be met in these areas from 1 June 2021).

- Installation of a membrane bioreactor (MBR) or, alternatively, a moving bed bioreactor (MBBR) and proper phase separation using e.g. flotation or similarly efficient technologies suited for ship operations (tested under real-life conditions).

3.2.10.2 Optional Requirements

- Installation of water-saving fittings in the sanitary area. A maximum flow rate of 6 l/min must be observed for washbasin faucets, and a maximum flow rate of 9 l/min for showers [**2 points**].
- Installation of self-closing fittings or (electronic) automatic fittings in the sanitary area [**2 points**].

Compliance Verification

System certificate and verification of installation in accordance with MEPC.227(64).
An approval pursuant to Resolution MEPC.159(55) can also be accepted for existing installations if the sewage is not diluted or if it is verified that the effluent limits are met even when taking the dilution factor under Resolution MEPC.227(64) into account.

Verification of sufficient holding tanks for black water, grey water, bio-sludge and/or pre-treatment products that correspond to the ship's purpose/area of operation. The tanks must be designed so as to enable the ship to safely travel the maximum voyage distance for which the ship is to be used until the next shore-based disposal option plus a 20 percent safety buffer.
Verification of the installation of pipelines and connection flange as per requirements (DIN 86282, DIN 86284).
Verification of the installation of sampling points pursuant to DIN 86292.

An approval under Resolution MEPC.159(55) can also be accepted for existing installations if there is no dilution or if it is verified that the effluent limits are met even when taking the dilution factor under Resolution MEPC.227(64) into account.

Verification of the on-board installation of sufficient collection tanks for pre-treatment products and bio-sludge (and, if any, black water). The tanks must be designed so as to enable the ship to safely travel the maximum voyage distance for which the ship is to be used until the next shore-based disposal option plus a 20 percent safety buffer.

Verification of the installation of pipelines and connection flange as per requirements.
Verification that the fittings in the sanitary area comply with the above-mentioned limit values for water-saving installations. The values are based on VDI guideline 6024.

3.2.11 Bilge Water

Bilge water is, among other things, drain water and condensate accumulating in the machinery spaces.
Bilge water can contain all types of oil residues as well as e.g. corrosion protection agents, cold cleaners, cooling water additives, other chemicals and dirt (e.g. rust, sand, paint residues, metal abrasion products).

Water contaminated in this way can pose a risk to the marine environment if discharged into the sea. The limit set by MARPOL only applies to the oil content in the bilge water discharged.

International / Regional Requirements
MARPOL Annex I limits the amount of residual oil in the bilge water, if discharged into the sea, to 15 ppm.

3.2.11.1 Mandatory Requirements

Cargo and Passenger Ships on International Voyages
- A Bilge Oily Water Separator, including bilge alarm and automatic stopping device , shall be installed to ensure a residual oil content of the bilge water after de-oiling of less than 5 ppm if discharged into the sea.

Passenger Ships on National Voyages
- All bilge water is to be disposed of ashore. Accordingly, no Bilge Separator with an outboard discharge piping may be installed and sufficient tank capacity must be provided.

3.2.11.2 Optional Requirements

Cargo and Passenger Ships on International Voyages
- A system, including bilge alarm and automatic stopping device, shall be installed to ensure a residual oil content of the bilge water after de-oiling of less than 2 ppm if discharged into the sea [**2 points**].
- Conceptual realisation of the "Integrated Bilge Water Treatment System" (IBTS) for the treatment of bilge water in the machinery spaces in accordance with MEPC Circ.760[38] [**3 points**].

Compliance Verification

Type approval test certificate of the shipboard Bilge Oily Water Separator and verification that the system can achieve a stable value of less than 5 ppm or less than 2 ppm, respectively, in accordance with international test specifications (Resolution MEPC 107(49)).
Submission of the layout of the machinery spaces bilge system to verify that no system is installed. The holding tanks must be designed so as to enable the ship to safely travel the maximum voyage distance for which the ship is to be used until the next shore-based disposal option plus a 20 percent safety buffer.

3.2.12 Ballast Water

The introduction of invasive species with the ballast water (BW) can damage ecosystems or cause other undesirable effects. In some regions, this has already caused lasting changes in aquatic biocoenoses as well as economic damage. The International Ballast Water Management Convention is intended to significantly reduce the risk of introduction of invasive species. It accepts ballast water exchange in certain areas as a temporary regulation (D-1 standard) until all ships meet the final standard (D-2 standard) laid down in the Annex to the Ballast Water

[38] Guidelines for systems for handling oily wastes in machinery spaces of ships incorporating guidance note for an Integrated Bilge Water Treatments system (IBTS), MEPC.1/Circ.511 and amendment MEPC.1/Circ.760, dated August 25, 2011 – currently under revision.

Management Convention, i.e. they must be equipped with a ballast water management system (BWMS).
A number of different conceptual systems for shipboard ballast water treatment systems are already available on the market – others are under development. The systems use physical and/or chemical processes.

International / Regional Requirements
The 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management Convention – BWM Convention) entered into force globally on 8 September 2017. Ballast water exchange in accordance with Regulation D-1 and B-4 of the Annex to the Ballast Water Management Convention and on the basis of the 2017 Guidelines for ballast water exchange (G6) (Resolution MEPC.288(71)) is an effective first measure to reduce the introduction of non-indigenous species into coastal regions, estuaries and inland waters.

However, due to various general conditions (ship stability, load limits exceeded for the ship's construction, lack of time, non-compliance with IMO criteria for BW exchange areas), this measure cannot, to some extent, be implemented. This is why the exchange of BW is only intended by the Ballast Water Convention as an interim standard which will be replaced by the obligation to comply with Regulation D-2 of the Annex to the Ballast Water Convention. According to MEPC 71 (2017) the date by which the last ships will be required to comply with the D-2 standard is September 8, 2024. Until then, rules for D-2 compliance will take effect in stages.

While newly built ships have to comply immediately with Regulation D-2 of the Annex to the Ballast Water Convention, retrofits (existing ships) are not required to comply with D-2 until the next IOPP renewal survey, provided that this is scheduled to take place after September 8, 2019 (Resolution MEPC 71).

3.2.12.1 Mandatory Requirements

- Application of Regulation D-2 to all ships requiring ballast water management system under the Convention irrespective of the year of construction of the ship.

3.2.12.2 Optional Requirements

- Installation of a closed-loop BWMS or
  alternatively: Designing of a ballast water-free ship [**3 points**].

Compliance Verification

Submission of a certified ballast water management plan.
Provided that a BWMS exists: type approval certificate of the BWMS and verification of the installation and initial operation inspection of the system.
Verification of a closed-loop BWMS or a ballast water-free ship (for example, by presentation of the structural design).

3.2.13 Anti-fouling

Aquatic organisms can settle on the hull of ships, in niche areas such as sea chests but also in seawater pipes (biofouling) which thus can be introduced into other ecosystems by shipping. These alien and potentially invasive species can damage native ecosystems or have other negative effects. At the same time, the fouling increases friction and, thus, the fuel consumption of the ship. The accumulation of aquatic organisms on systems or in pipelines (biofouling) can also pose a safety hazard.

Today, biocidal anti-fouling systems (AFS) are most commonly used to prevent or reduce the accumulation of biofouling. Coatings are usually used to protect hull and niche areas (product type 21[39]), while chemico-technical products are more commonly used in cooling and process systems (product type 11). But despite these countermeasures (generally referred to as anti-fouling), a certain degree of fouling still occurs with the negative consequences described above. Fouling on the hull and in niche areas, in particular, is therefore in some cases additionally removed by mechanical cleaning. As the coatings are usually not designed for mechanical treatment, this can lead to an increased release of biocides and a reduced anti-fouling performance. There is a number of different methods to prevent or minimise fouling without biocides. In the field of hull coatings, these include, for example, non-stick coatings or cleanable hard coatings. When using alternative anti-fouling systems, attention must always be paid to holistic biofouling management (monitoring the degree of fouling and the associated cleaning of the hull and niches as required). The IMO Biofouling Guidelines must be implemented (among other things, by developing a Biofouling Management Plan (BFMP) and maintaining a Biofouling Record Book (BFRB)).

International / Regional Requirements

The International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001 (AFS Convention[40]) is in force.

In order to prevent the introduction of invasive species as a result of biofouling, the IMO adopted the Biofouling Guidelines in 2011 (Resolution MEPC.207(62))[41].

The use of tributyltin (TBT) and other highly toxic organotin compounds in AFS has been globally banned since September 2008 when the IMO AFS Convention entered into force. In addition, the use and marketing of anti-fouling systems containing cybutryne has been prohibited throughout the EU since January 2017.

The Biocidal Products Regulation (BPR, Regulation (EU) No 528/2012) governs the marketing and use of biocidal products in Europe.

3.2.13.1 Mandatory Requirements

- Anti-fouling coatings containing cybutryne must not be used.
- The use of anti-fouling products is limited to products that are marketable within the EU at the time of shipbuilding.
- No systems may be installed for the internal elements, such as piping, that require the addition of chlorine or bromine compounds.

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[39] Classification of biocidal products into 22 biocidal product types according to Regulation (EU) No 528/2012

[40] International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001

[41] Guidelines for the control and management of ship's biofouling to minimize the transfer of invasive aquatic species (MEPC.207(62)); currently under revision.

- All niche areas must be accessible from the outside so that inspection and mechanical cleaning is possible, for example, by divers or autonomous cleaning systems (e.g. removable grids).

3.2.13.2 Optional Requirements

- Use of biocide-free AFS on the hull (including „Foul Release Coatings") in combination with a Biofouling Management Plan (BFMP) tailored to the specific operation and the AFS [**2 points**].
- Alternatively: use of biocide-free abrasion-resistant hard coatings to prevent not only biocides but also paints or similar substances, such as microplastics, from getting into the water in combination with a Biofouling Management Plan (BFMP) tailored to the specific operation and the coating [**4 points**].
- Use of biocide-free physical AFS (Thermal Heating Systems or other environmentally safe systems) in the inside areas, such as seawater cooling systems [**2 points**].

Compliance Verification

Manufacturer's specification, verification of application, International Anti-Fouling System Certificate (IAFS Certificate) for ships of and above 400 GT.

3.2.14 Lubricants and Hydraulic Oils

Every mechanical system needs to be lubricated. Lubrication reduces friction and wear, it ensures the transmission of power or removes abrasion and wear particles or other impurities from lubrication points. In this process, the emission of lubricants cannot be avoided. Lubricants in closed-loop systems can get into the environment through exudation, leakages and regularly occurring minor and major accidents. Lubricants used in loss lubrication are usually released from the technical system into the environment as intended.
Conventional lubricating and hydraulic oils are usually based on mineral oils. They may have a strong negative impact on the environment because they are toxic and persistent. It is assumed that on land 45% of lubricants are emitted during their use (loss lubrication), 32% are collected and disposed of and 23% cannot be assigned.
In principle, the ship, i.e. the internal combustion engines and other technical equipment, should be designed so as to ensure that as few lubricating and hydraulic oils as possible are needed and emitted during operation.

International / Regional Requirements
None

3.2.14.1 Mandatory Requirements

- Biodegradable stern tube oil.
- Sealing of the stern tube without oil-water interface (oil-lubricated systems with compressed air chamber between oil system and outer seal), unless oil-free systems are used.
- Lubricating oil consumption < 0.5 g/kWh for all 4-stroke medium-speed diesel engines.

3.2.14.2 Optional Requirements

- Installation of deck machinery approved by the manufacturer for use with biodegradable lubricants / hydraulic oils. [**2 points**].
- Doing without lubricating or hydraulic oil by using water lubrication or water hydraulics instead. If this concept is adopted, the mandatory requirement for using biodegradable oils in the stern tube will no longer be applicable. [**2 points**].
- Installation of units (e.g. rudder propeller systems, bow thrusters, controllable pitch propeller systems) which have direct contact with the water below the waterline and for which biodegradable lubricants / hydraulic oils have been approved. [**2 points**].
- Installation of units in the ship's hull (e.g. side flaps, stern/bow ramps) approved for use with biodegradable lubricants and/or hydraulic oils [**2 points**].

Compliance Verification

Biodegradable lubricants and hydraulic oils in accordance with an EU Ecolabel, Blue Angel or a comparable environmental certification. Biodegradability refers to the ability of an organic substance to be decomposed by microorganisms[42]. A substance is considered biodegradable if more than 60 percent of it biodegrades within 28 days in the course of the test procedure.
Documentation of the manufacturer's approval that biodegradable lubricants or hydraulic oils may be used.
Verification of the installation of the respective equipment.

3.2.15 Corrosion Prevention

Corrosion of a ship's outer hull is generally reduced by attaching galvanic zinc anodes to the hull. The material inputs caused by the dissolution of the so-called sacrificial anodes can add up to several tonnes per year, depending on the size of the ship. If the anode material dissolves, substances hazardous to the marine environment can be emitted. Zinc anodes are mostly used in the marine sector. Zinc compounds can be toxic to organisms. Aluminium anodes are also problematic to the marine environment because they contain harmful substances such as zinc and indium, which do, however, support the functionality of the anode. Other hazardous substances (e.g. cadmium) originate from impurities in the raw materials, the production process, etc. These inputs can be avoided if other systems, e.g. an impressed-current system, are used.

International / Regional Requirements
There are currently no international requirements regarding the use of sacrificial anodes or the prevention of zinc emissions into the water.

3.2.15.1 Mandatory Requirements

- In order to prevent or reduce corrosion on the ship's hull, techniques or materials shall be used that **do not emit pollutants** (e.g. impressed-current system).
  If it obviously does not make sense to install a pollutant-free alternative to galvanic anodes, e.g. in areas that are beyond the range of an impressed current system[43], exceptions may be made on **a case-by-case basis**. In such individual cases, the emission of pollutants

[42] http://www.umweltdatenbank.de/lexikon/biologische_abbaubarkeit.htm
[43] e.g. rudder system

must be kept to a minimum. For example, aluminium anodes (saltwater area) or magnesium anodes (brackish water/transitional area) with the lowest possible content of other substances should be used. The use of zinc anodes is generally not permitted.

3.2.15.2 Optional Requirements

None

Compliance Verification

Verification of the anodes used by means of the construction and system drawing or the In-water Manual.
Should it be impossible to use a pollution-free corrosion protection this must be justified by an expert opinion. Such expert opinion shall also demonstrate that the discharge of pollutants into the marine environment is kept as low as possible. If aluminium or magnesium anodes are used, it must be demonstrated that these anodes have the lowest possible content of impurities (notably cadmium). This is to be demonstrated by offers from different manufacturers. The values shall take the limit values specified in the DNVGL standard for corrosion protection of offshore wind structures as a basis[44] (see Appendix C).

3.2.16 Underwater Noise

Underwater noise from ship traffic can negatively affect the communication, enemy avoidance and orientation of marine organisms through masking, Continuous noise can also damage their health.
Today, low-frequency background noise has increased due to ship traffic in the northern hemisphere by approx. 20 dB compared to pre-industrial noise levels. Low-frequency sound can propagate in deep water (e.g. in oceans) over more than 1,000 km. At short distances, high sound levels occur at all frequencies. Below 300 Hz, the sound level in the oceans is dominated by ship traffic.
The propeller (cavitation) and the internal combustion engines are the main sources of noise from ships. The two limits for propeller noise listed as optional requirements are indicators that give reason to expect an overall low sound level.

International /Regional Requirements
There are currently no internationally binding regulations on underwater noise. In 2014, the IMO published non-binding Guidelines for the Reduction of Underwater Noise from Commercial Shipping to address adverse Impacts on Marine Life. (MEPC.1/Circ.833).
The EU Marine Strategy Framework Directive (MSFD) has included the input of energy into the marine environment with a special focus on underwater noise as one of the criteria (descriptors) for assessing "Good Environmental Status".
Some classification societies have already developed Optional Requirements and class notations for noise level reduction.
The International Organisation for Standardisation (ISO) has developed measurement methods on an international level for radiated underwater noise from ships:

[44] DNV–RP–B401; p. 30 Table 10-5; (https://www.dnvgl.com/oilgas/download/dnvgl-rp-b401-cathodic-protection-design.html)

- ISO 17208-1:2016, Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships: Part 1: Requirements for precision measurements in deep water used for comparison purposes.
- DIN ISO 17208-2:2020-11[45]: Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships: Part 2: Determination of source levels from deep water measurements.

3.2.16.1 Mandatory Requirements

- 4-stroke marine propulsion internal combustion engines of over 5 tonnes in weight (including generator) are to be decoupled from the hull by appropriate measures and elastically mounted with a static indentation of at least 3 mm.

Compliance Verification

Verification by presentation of the engine installation plan.

3.2.16.2 Optional Requirements

Examination of the pressure fluctuations caused by the propeller above the propeller in a model test by means of the following measurements:

- Measurement of the underwater noise and provision of data for the development of limit values [**1 point**];
- The pressure pulses generated by the propeller measured on the outer hull above the propeller are less than 3 kPa at propeller blade frequencies of up to 100% MCR[46] [**2 points**].

As an alternative to the above two options:

- Certification in accordance with the DNV *Silent Class notation SILENT-R*[47] for research vessels, *SILENT-E* for passenger ships and *SILENT-E 'Transit'* for all other ships or similar notations of other classification societies. [**4 points**].

Compliance Verification

Submission of the report of the Shipbuilding Research Institute.

If measurement methods other than ISO 17208 are used because of the certification procedure and/or the type of the ship, the measurement methods of the classification societies may be used.
The measurement results (3.2.16.2 first bullet point) shall be made available to RAL, BMU and UBA, who may use them - on request, anonymously - for research purposes.
Regarding 3.2.16.2: Compliance with the criteria set out in bullet points 2 and 3 can be demonstrated in the model study.

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[45] ISO 17208-2:2019 (EN)
[46] Maximum Continuous Rating
[47] http://rules.dnvgl.com/docs/pdf/DNV/rulesship/2011-07/ts624.pdf

3.2.17 Shipboard Noise and Vibration

Shipboard noise (in accommodation / engine rooms) and vibrations in the ship have a negative effect on crew and passengers. Noise can have different damaging effects on humans depending on intensity, duration of exposure, activity and personal attitude. Resolution MSC.337(91) sets limits for airborne noise levels on board a ship. Additional constructional measures can be taken to fall below these limits.
If multi-engine systems are installed in one engine room, falling below the limits amongst the engines requires an elaborate encapsulation of the engines. That is why this field is dealt with separately.

International/Regional Requirements
In order to reduce shipboard noise and vibration, the IMO adopted the "IMO Noise Code" in 2012 (Resolution MSC.337(91); "Code on Noise Levels on Board Ships"), which, together with SOLAS Regulation II-1/3-12, contains requirements for protecting the people on board. So far, however, these requirements are mandatory only for newly built ships > 1,600 GT.

3.2.17.1 Mandatory Requirements

None

3.2.17.2 Optional Requirements

- Above water noise level measurement and falling below the airborne sound level by at least 3 dB (A) (by logarithmic scale halving) compared to the requirements of MSC.337(91) in the work and living areas of the people on board [**2 points**].
- Falling below the airborne sound level by at least 3 dB (A) in engine rooms [**2 points**].

Compliance Verification

Submission of the report of the Shipbuilding Research Institute.

3.3 Material Usage

The materials used to build and equip a ship can be environmentally harmful, especially during ship repair or shipbreaking. Such materials include, for example, tank coatings, insulating materials and chlorine-containing materials.
The IMO requires the keeping of an Inventory of Hazardous Materials (IHM) on board. Such an inventory will help to simplify maintenance work and shipbreaking and make it easier to treat and dispose of environmentally harmful materials in an environmentally sound manner.

International / Regional Requirements
In 2009, at a diplomatic conference, 63 countries adopted the Convention for the Safe and Environmentally Sound Recycling of Ships (Hong Kong Convention[48]). It applies to new and existing ships of 500 GT and above. The convention will enter into force two years after ratification by at least 15 states representing more than 40 per cent of the gross tonnage of the world's merchant shipping and an annual ship recycling volume of not less than 3% of their combined

[48] Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (http://www.imo.org/en/OurWork/Environment/ShipRecycling/Pages/Default.aspx)

gross tonnage. Until now, the Convention has not yet been ratified by a sufficient number of contracting parties.
The Convention focuses on the compilation and ongoing updating of an Inventory of Hazardous Materials (IHM) as well as requirements for the processes and the authorization of ship recycling facilities.
Guidelines dealing with, among other things, the IHM (Resolution MEPC.269(68)) and the preparation of a Ship Recycling Plan (Resolution MEPC.196(62)) have been set up to promote the implementation of the Convention.

In 2013, the EU additionally adopted Regulation (EU) 1257/2013[49] on ship recycling. It applies to ships flying the flag of a Member State. With the exception of Article 12, which applies to ships flying the flag of a third country and calling at a Member State port. This regulation too has already required an IHM certificate for new ships since 31 December 2018.

3.3.1.1 Mandatory Requirements

- Compliance with the provisions of the Hong Kong Convention and Regulation (EU) 1257/2013 with respect to the use of materials on board. The version in force at the time of application shall apply irrespective of the place of construction and the flag of the ship.

3.3.1.2 Optional Requirements

Some key materials bearing the Blue Angel (e.g. furniture, carpeting, insulation), EU Ecolabel or for example halogen-free electrical cables in accordance with IEC 60092-353 (halogen-free Ship Wiring & Marine Cables) or similar materials are installed on board. In this regard, fire protection in accordance with the Marine Equipment Directive (2014/90/EU)[50] must be taken into account [**1 point**].

Compliance Verification

Submission of the Inventory of Hazardous Materials (IHM) as well as IHM Certificate for ships flying the European flag or Certificate of Compliance according to Article 12(6) of Regulation (EU) 1257/2013 or Statement of Compliance pursuant to the Hong Kong Convention for ships not flying the European flag.

Verification of the installation of certified materials.

3.4 Outlook

The following aspects are to be examined and discussed within the context of a future revision of the criteria for this ecolabel:

- Inclusion of high speed crafts into the Scope.
- Installation of a forward-facing sonar system to reduce the risk of collision, e.g. collision with ice (for greater safety).
- Inclusion of the requirement for a sulphur content below 100 ppm for international voyages.

[49] https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=CELEX%3A32013R1257
[50] Marine Equipment Directive – MED, 2014/90/EU and the annually updated Implementing Regulation

- Exclusion of LNG engines and further focusing on post-fossil fuels, energy converters and other efficiency measures that will achieve progress with respect to all types of emissions (air pollutants as well as greenhouse gases).
- Inclusion of further requirements aimed at limiting pollutant emissions. In this regard, the main focus will be on emissions of substances harmful to the environment and human health that may form during the combustion of non-fossil fuels. The formation of formaldehyde in methanol combustion engines can be cited as an example.
- Inclusion of requirements for HC emissions.
- More stringent requirements for extinguishing agents (e.g. GWP less than 1).
- Inclusion of requirements for on-board fresh water supply / production (e.g. energy efficiency of fresh water production).
- Use of Blue Angel eco-labelled anti-fouling products, if corresponding Award Criteria exist and Blue Angel-labelled products for use in the maritime sector are available (a related research project is currently underway at the Federal Environment Agency).
- Extension of the use of biodegradable lubricants and lubricating oils to larger propulsion internal combustion engines.
- Extension of the requirements for the installation of Blue Angel / EU eco-labelled materials (technical area, such as insulation, cables, living area, e.g. carpets, fabrics, etc.).

4 Application / Award

4.1 Testing / Test Centres

The requirements under paras. 3.1 to 3.3 shall be considered met if their compliance is confirmed in a summarising report. Such report can be prepared by:

- an EU-approved classification society (Regulation (EC) No 391/2009 and Directive 2009/15/EC) or
- a European maritime shipping authority[51]

4.2 Applicants and Parties Involved

Shipping companies and ship operating companies according to para. 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 Environmental Agency) which after the signing of the contract receives all data and documents submitted in applications 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.

[51] In Germany, for example, BG Verkehr, Ship Safety Division

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 December 31, 2025.
They shall be extended by periods of one year each, unless terminated in writing by March 31, 2025 or March 31 of the respective year of extension.

The Blue Angel ecolabel may only be used to label the ship during the term of the contract. The continued use of the ecolabel beyond the term of these Award Criteria shall be possible until December 31, 2035 at the latest, provided that the following criteria are met:

[1] When using the Blue Angel logo (labelling on board, advertising, brochures, internet, etc.), the date of issue of the award criteria shall always be indicated under the logo as follows:

Labelling in accordance with the 2021 Criteria (DE-UZ 141)

[2] When using the Blue Angel logo on the ship's hull, the date of issue of the award criteria must also be indicated. Here it may be given in the following abbreviated form:

2021 Criteria

[3] At the end of the term of the ecolabel [31 December 2025], a statement is to be submitted confirming continued compliance with the 2021 criteria and the voluntary commitments (Appendix 2 (sulphur content), Appendix 2 (fuel)).

If labelling is applied to the ship, a photo showing the label is to be submitted to RAL no later than 2 months after affixing the label. When using the logo on other materials/media (flyers, internet, etc.) a copy of such labelling must also be made available to RAL upon request.
When applying for the ecolabel, the date of signing the contract with the shipyard (contract date) shall be the date of application; the award criteria valid at that time shall be applicable. The shipping company must inform RAL of the planned filing of an application by this date (contract date). Otherwise, the award criteria valid at the time of submission of the expert opinion to RAL shall apply (filing shall only be possible after completion of the ship).
If the ship is sold or undergoes major conversion, the Blue Angel Ecolabel will expire. In this case, RAL shall be informed without request. The new owner(s) may, however, reapply for award of the Blue Angel on the basis of the original award criteria. This requires the presentation of a new certificate provided that the sale or conversion has caused changes to elements of the ship's design that are relevant to the award of the Blue Angel. If no changes have been made, this shall be confirmed to RAL and no new expert opinion will be necessary. However, new commitment statements (cf. paras. 3.2.1, 3.2.3 and 3.2.4) must be submitted by the new owner(s).

The Contract on the Use of the Environmental Label shall specify:
- Applicant (shipping company, ship operating company, shipyard)
- Name of the ship (including IMO Number)
- Type of ship
- Flag, classification society, class notation, if applicable

Appendix A EEDI Reduction Factors (in percent) relative to the respective EEDI Reference Line

Extract from MARPOL Annex VI Regulation 21, Table 1;
(The list only shows the values relevant to the Blue Angel as of 2020)

Table 2: EEDI reduction factors (MARPOL Annex VI, Reg. 21)

Ship Type	**Size**	**Phase 2 1. Jan 2020 – 31. Dez 2024 (in %)**	**Phase 3 Ab 1. Jan 2025 (in %)**
Bulk Carrier	20.000 dwt and above	20	30
	10.000 – 20.000 dwt	0-20*	0-30*
Gas Carrier	10.000 dwt and above	20	30
	2.000 – 10.000 dwt	0-20*	0-30*
Tanker	20.000 dwt and above	20	30
	4.000 – 20.000 dwt	0-20*	0-30*
Container Ship	15.000 dwt and above	20	30
	10.000 – 15.000 dwt	0-20*	0-30*
General Cargo Ships	15.000 dwt and above	15	30
	3.000 – 15.000 dwt	0-15*	0-30*
Refrigerated Cargo Carriers	5.000 dwt and above	15	30
	3.000 – 5.000 dwt	0-15*	0-30*
Combination Carrier	20.000 dwt and above	20	30
	4.000 – 20.000 dwt	0-20*	0-30*

* Reduction factor to be linearly interpolated between the two values dependent upon vessel size. The lower value of the reduction is to be applied to the smaller ship size.

Appendix B Global Warming Potential GWP_{100} of Refrigerants for Use in Shipboard Refrigeration and Air-Conditioning Systems

Table 3: Global warming potential GWP_{100} of refrigerants for refrigeration and air conditioning systems on ships

Name	Ingredients of Refrigerant Blends	GWP_{100}
R507	R125 R143a	3 985
R404A	R 125 R 134a R143a	3 922*
R407A	R 32 R 125 R 134a	2 107*
R410A	R 32 R 125	2 088*
R407C	R 32 R 125 R 134a	1 774*
R134a	-	1 430*
Kohlenwasserstoffe (wie Propan R290, Propen R1270, Butan R600, Isobutan R600a)	-	3**
R717 (Ammoniak)	-	0**

As regards other refrigerants, the GWP shall be based on the data provided in the IPCC 2007 report.

Sources for GWP:

*) IPCC 2007: IPCC 4th Assessment Report, Climate Change 2007 at:
http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
(Attention should be paid to possible errata)

**) IPCC 1990: IPCC 1st Assessment Report, Climate Change 1990 (IPCC 2007)

Appendix C Pollutant Limits for Aluminium Anodes listed in the DNVGL-Standard for Corrosion Control of Offshore Wind Turbines

Table 4: Pollutant limits for aluminium anodes from the DNV GL standard for corrosion protection of offshore wind turbines.

Recommended compositional limits for Al-based anode materials	
Alloying/Impurity Element	Al-base (%)
Zn	2.5-5.75
Al	rem.
In	0.015-0.040
Cd	≤ 0.002
Si	≤ 0.12
Fe	≤ 0.09
Cu	≤ 0.003
Pb	Na

Extract from "Table 10-5 Recommended compositional limits for Al-based and Zn-based anode materials (ref. 6.5)." (Source: DNV–RP–B401; p. 30 Table 10-5; https://www.dnvgl.com/oil-gas/download/dnvgl-rp-b401-cathodic-protection-design.html

Appendix D Table listing Mandatory Requirements and Points from Optional Criteria (Excel file in the zip application documents - as Annex 3)

Table 5: Table listing Mandatory Requirements and Points from Optional Criteria

Chpt.-Nr.	Eco-Friendly Ship Design -Edition January 2021: Overview of the Mandatory and Optional Requirements	M/O	Possible max. no of points (only possible by calculation)	Cargo ships	Pax intern. voyage	Pax nat. voyage	Comments
3.1	**Structural Protection from Accidental Environmental Pollution**						
3.1.1	**Protection of Tanks for Fuels and Oily Substances**						
	Tanks for oil sludge inside double hull	**M**		**x**	**x**	**x**	
	Bilge water holding tanks inside double hull	**O**	**3**	**3**	**3**	**3**	
	Bunker tank volume < 600 m³ : all bunker tank inside double hull		**5**	**5**	**5**	**5**	
	Ships with bunker tanks > 600 m³: Bunker tank < 30 m3 inside double hull	**O**	**3**				
3.1.2	**Additional Safety Measures to Prevent any Accident/Damage**						
	„Decision Support System"	**M**		**x**	**x**		*Pax: Mandatory when the ship is certified for > 120*
	Compliance with Code of Safe Practice for Cargo Stowage and Securing	**M**		**x**			
	Emergency towing device according to MSC.35(63) or equivalent					**x**	
	Redundant Propulsion System	**O**					
	RP 1	**O**	**3**				*Points only possible for the highest RP character in each case.*
	RP 2	**O**	**4**				
	RP 3	**O**	**6**	**6**	**6**	**6**	
	Alternative to RP 1-3: comparable concept to red. propulsion system	**O**	**3**				
3.1.3	**Hull Stress Monitoring**						
	Installation of HSMS	**O**	**2**	**2**			
3.2	**Reduction of Operation-Related Emissions**						
3.2.1	**Sulphur Dioxides**						
	Commitment statement on fuel: no heavy fuel oil, 0.10 % sulphur	**M**		**x**	**x**	**x**	
	No scrubber (EGCS) installed	**M**		**x**	**x**	**x**	
	Commitment statement on fuel: 0.01 % sulphur	**O**	**4**			**4**	
3.2.2	**Nitrogen Oxides**						
	1.8 g/kWh NOx independent of engine speed	**M**		**x**	**x**	**x**	
	If SCR systems are installed: ammonia slip ≤ 10 ppm	**M**		**x**	**x**	**x**	
	EGR only without any bleed-off and with sufficient tanks installed	**M**		**x**	**x**	**x**	
	Additional NOx sensors for continuous emissions monitoring	**O**	**2**	**2**	**2**	**2**	
	0,4 g/kWh NOx independent of engine speed	**O**	**3**	**3**	**3**	**3**	
	SCR system with sufficient urea tank for continuous operation	**O**	**3**	**3**	**3**		
3.2.3	**Black Carbon and Particulate Matter Emissions**						
	Determination of eBC emissions on the test bench	**M**		**x**	**x**	**x**	
	Installation of PM filters on high-speed internal combustion engines (≥ 1,500 rpm)	**M**		**x**	**x**	**x**	
	Installation of PM filters (except high-speed engines with ≥ 1,500 rpm): all combustion engines	**O**	**6**	**6**	**6**	**6**	
	Alternative: Installation of PM filters (except high-speed engines with ≥ 1,500 rpm): some engines (e.g. auxiliary combustion engine).	**O**	**3**				

Chpt.-Nr.	Eco-Friendly Ship Design -Edition January 2021: Overview of the Mandatory and Optional Requirements	M/O	Possible max. no of points (only possible by calculation)	Cargo ships	Pax intern. voyage	Pax nat. voyage	Comments
3.2.4	**Efficiency / Greenhouse Gas Emissions from Ship Operation**						
	No cross-media effects through efficiency measures	**M**		**x**	**x**	**x**	
	Frequency inverter for all pumps > 500 kW	**M**		**x**	**x**	**x**	
	LED lamps, if approved for use on board	**M**		**x**	**x**	**x**	
	Gas-fuelled combustion engines (also dual-fuel): Compliance with the engine-specific limits for methane slip (cf. Table 3 in the text section).	**M**		**x**	**x**	**x**	
	Gas-fuelled high-speed engines: Aim for reduction in line with medium-speed engines (cf. Tab.)	**M**		**x**	**x**	**x**	
	Tanks, pipes for gas designed as closed system without GHG emissions slip (IGF code).	**M**		**x**	**x**	**x**	
	Ships according to MARPOL Annex VI Reg 21: Compliance with EEDI Phase 3 -10 % ; if EEDI 3 becomes mandatory by IMO: Phase 3 -20 %	**M**		**x**	**x**	**x**	
	Ships not covered by MARPOL Annex VI Reg 21: comprehensive qualitative report on realized efficiency potentials	**M**		**x**	**x**	**x**	
	Heat recovery for passenger area	**M**			**x**	**x**	
	Hybrid electric propulsion systems	**O**	**2**				
	Alternative: Hybrid with energy storage [> 20 % operation]	**O**	**6**	**6**	**6**	**6**	
	Alternative: Hybrid with energy storage [10-20 % operation]	**O**	**4**				
	Wind propulsion systems	**O**	**6**	**6**	**6**	**6**	
	Installation of fuel cell(s)	**O**	**4**	**4**	**4**	**4**	
	Internal combustion engines with methanol, ammonia or hydrogen (all engines)	**O**	**6**	**6**	**6**	**6**	
	Internal combustion engines with methanol, ammonia or hydrogen (Auxiliary internal combustion engines)	**O**	**3**				
	Energy-efficient technologies in hotel operations	**O**	**2**		**2**	**2**	
3.2.5	**Energy-efficient technologies in hotel operations**						
	On-board equipment for accepting external power supply	**M**		**x**	**x**	**x**	
	Low-emission auxiliary boilers	**O**	**3**	**3**	**3**	**3**	
	Power generation in compliance at berth with BImSchV limits	**O**	**5**	**5**	**5**	**5**	
3.2.6	**Refrigerants**						
	Refrigeration and air-conditioning systems: ODP = 0	**M**		**x**	**x**	**x**	
	Refrigeration and air-conditioning systems must be accessible maintenance and repairs etc.	**M**		**x**	**x**	**x**	
	Air conditioning systems: refrigerant GWP < 1,800	**M**		**x**	**x**	**x**	
	Refrigeration systems without halogenated refrigerants	**M**		**x**	**x**	**x**	*Exception possible if not possible for safety reasons.*
	Refrigeration and air conditioning systems with F-gases: Gas warning system	**M**		**x**	**x**	**x**	
	Refrigeration and air conditioning systems with F-gases: Recovery Unit	**M**		**x**	**x**	**x**	
	Air conditioning systems with halogen-free refrigerants	**O**	**4**	**4**	**4**	**4**	
3.2.7	**Fire Extinguishing Agents**						
	ODP = 0, GWP < 3500	**M**		**x**	**x**	**x**	
	Compliance with EU Regulation 757/2010 for fire extinguishing foams	**M**		**x**	**x**	**x**	
	hand-held fire extinguishers environmentally friendly substances (halogen-free)	**O**	**2**	**2**	**2**	**2**	
	Environmentally friendly, halogen-free substances (entire on-board fire-extinguishing system)	**O**	**4**	**4**	**4**	**4**	
	Environmentally friendly, halogen-free substances (part of the fire-extinguishing equipment)	**O**	**2**				

Chpt.-Nr.	Eco-Friendly Ship Design -Edition January 2021: Overview of the Mandatory and Optional Requirements	M/O	Possible max. no of points (only possible by calculation)	Cargo ships	Pax intern. voyage	Pax nat. voyage	Comments
3.2.8	**Prevention, Separation and Disposal of Garbage**						
	Structural design for reusable and large containers	**M**		**x**	**x**	**x**	
	"Garbage Certificate" according to ISO 21070 (2017)	**M**		**x**	**x**	**x**	
	Structural design for separation according to garbage categories	**M**		**x**	**x**	**x**	
	No waste incineration on board, provide sufficient storage space	**M**		**x**		**x**	
	Arrangement for delivery of cargo residues ashore (bulk carrier)	**M**		**x**			
	Waste incineration permitted with emission abatement: Installations according to MED; limit values -20 % for CO, soot number, ash	**M**			**x**		
	Sufficient storage space for ash/residuals for disposal on land	**M**			**x**		
	Waste prevention on board through reusable systems	**O**	**3**		**3**	**3**	
	Garbage separation systems in passenger area / avoidance of "blowing overboard" waste	**O**	**2**		**2**	**2**	
	Alternative: Incineration in compliance with BImSchV (corresponding onshore incineration plants)	**O**	**5**		**5**		*Optional point can get only for one requirement*
	Alternativ: Abfallverbrennung unter Einhaltung BImSchV (entspr. Landanlagen)	**O**	**5**				
	Alternative: Pyrolysis incinerator	**O**	**5**				
3.2.9	**Cleaning Agents**						
	Dosing system for use inside the engine room	**M**		**x**	**x**	**x**	
	Dosing system for use outside the engine room	**M**		**x**	**x**	**x**	
	Dosing systems for kitchen and laundry sections	**M**		**x**	**x**	**x**	
3.2.10	**Sewage (Black and Grey Water)**						
	Sewage treatment plant type approved according to MEPC.227(64)	**M**		**x**	**x**	**x**	
	Alternatively: sufficient tank volumes for black and grey water	**M**		**x**	**x**	**x**	
	All pipe outlets for discharging / disposal above waterline	**M**		**x**	**x**	**x**	
	No use of chlorine-containing chemicals for sewage treatment	**M**		**x**	**x**	**x**	
	Collection tanks for the collection of pre-treatment products and bio-sludge for disposal on land	**M**		**x**	**x**	**x**	
	Sewage treatment plants equipped with suitable sampling points	**M**		**x**	**x**	**x**	
	For installations according to MEPC.227(64): Compliance with points 4.1 and 4.2 (N and P elimination)	**M**			**x**	**x**	
	Installation of MBR or, alternatively MBBR and phase separation	**M**			**x**	**x**	
	water-saving fittings in the sanitary area	**O**	**2**	**2**	**2**	**2**	
	self-closing fittings or (electronic) automatic fittings in the sanitary area	**O**	**2**	**2**	**2**	**2**	
3.2.11	**Bilge water**						
	Bilge alarm, automatic stopping device, discharge oil-content < 5ppm	**M**		**x**	**x**		
	All bilge water is to be disposed of ashore	**M**				**x**	
	Bilge alarm, automatic stopping device, discharge oil-content < 2ppm	**O**	**2**	**2**	**2**		
	Conceptual implementation of IBTS	**O**	**3**	**3**	**3**		
3.2.12	**Ballast water**						
	Application of Regulation D-2	**M**		**x**	**x**	**x**	
	closed-Coop BWMS or designing of a ballast water-free ship	**O**	**3**	**3**	**3**	**3**	

Chpt.-Nr.	Eco-Friendly Ship Design -Edition January 2021: Overview of the Mandatory and Optional Requirements	M/O	Possible max. no of points (only possible by calculation)	Cargo ships	Pax intern. voyage	Pax nat. voyage	Comments
3.2.13	**Anti-fouling**						
	Anti-fouling coatings without cybutryne	**M**		**x**	**x**	**x**	
	Only antifouling products marketable in the EU	**M**		**x**	**x**	**x**	
	No compounds containing chlorine or bromine for internal elements	**M**		**x**	**x**	**x**	
	Accessibility of all niches for cleaning by divers / autonomous cleaning systems	**M**		**x**	**x**	**x**	
	biocide-free AFS on the hull; in combination with a BFMP	**O**	**2**				
	Alternatively: Abrasion-resistant hard coatings, where no paint / substances / microplastics get into water	**O**	**4**	**4**	**4**	**4**	
	Biocide-free physical AFS in the inside areas	**O**	**2**	**2**	**2**	**2**	
3.2.14	**Lubricants and Hydraulic Oils**						
	Biodegradable stern tube oil.	**M**		**x**	**x**	**x**	
	Sealing of the stern tube without oil-water interface	**M**		**x**	**x**	**x**	
	Lubricating oil consumption < 0.5 g/kWh for all 4-stroke medium-speed diesel engines	**M**		**x**	**x**	**x**	
	Deck machinery approved by the manufacturer for use with biodegradable lubricants / hydraulic oils	**O**	**2**	**2**	**2**	**2**	
	Use of water lubrication or water hydraulics	**O**	**2**	**2**	**2**	**2**	
	Units below the waterline (e.g. variable pitch propeller, bow thruster) for which biological lubricants/hydraulic oils are approved	**O**	**2**	**2**	**2**	**2**	
	Units in the ship's hull (e.g. side flaps, stern/bow ramps) approved for use with biodegradable lubricants and/or hydraulic oils	**O**	**2**	**2**	**2**	**2**	
3.2.15	**Corrosion Prevention**						
	Techniques or materials shall be used that do not emit pollutants (e.g. impressed-current system)	**M**		**x**	**x**	**x**	
3.2.16	**Underwater Noise**						
	4-stroke engines > 5 t are to be elastically mounted	**M**		**x**	**x**	**x**	
	Measurement of the underwater noise of the propeller	**O**	**1**				
	Pressure below 3 kPa Propeller blade frequency	**O**	**2**				
	Alternatively: Certification Silent Class notation SILENT-R47, SILENT-E, SILENT-E "Transit" or similar	**O**	**4**	**4**	**4**	**4**	
3.2.17	**Shipboard Noise and Vibration**						
	Reduction of airborne sound level in the work and living areas by min. 3 dB(A) compared to MSC 337(91)	**O**	**2**	**2**	**2**	**2**	
	Reduction of airborne sound level in the engine room by at least 3 dB(A) compared to MSC 337(91)	**O**	**2**	**2**	**2**	**2**	
3.3	**Material Usage**						
	Compliance with the Hong Kong Convention and Regulation (EU) 1257/2013	**M**		**x**	**x**	**x**	
	Use of materials with Blue Angel, EU Ecolabel or similare certificates	**O**	**1**	**1**	**1**	**1**	
	Maximum possible total score, depending on vessel category		**154**	**105**	**115**	**106**	
	Compulsory minimum score to be achieved (corresponds to 35 %)			**37**	**40**	**37**	