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Large yachts — Diesel engines for main propulsion and essential auxiliaries — Safety requirements

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National foreword

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Large yachts — Diesel engines for main propulsion and essential auxiliaries — Safety requirements

Grands yachts — Moteurs diesel pour la propulsion principale et les moteurs auxiliaires essentiels — Exigences de sécurité

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Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee 12, *Large yachts*.

Introduction

This International Standard defines the safety requirements for diesel engines installed in large yachts and promotes a risk based approach for diesel engines intended for propulsive or essential auxiliaries for power generation.

INTERNATIONAL STANDARD **ISO 14885:2014(E)**

Large yachts — Diesel engines for main propulsion and essential auxiliaries — Safety requirements

1 Scope

This International Standard specifies the safety requirements for diesel engines with a rated power of 100kW and over for propulsion and essential auxiliaries for power generation for large yachts 24 m and over in hull length, measured in accordance with ISO 8666:2002, and of less than 500 GT which are in commercial use for sport or pleasure, and do not carry cargo and do not carry more than twelve passengers.

The engine in terms of this International Standard is understood as the prime mover up to its driving extremitie(s) for power take off(s).

This International Standard does not cover engines used for generating the emergency source of electrical power.

2 Normative references

The following referenced documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3046-1, *Reciprocating internal combustion engines — Performance — Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods — Additional requirements for engines for general use*

ISO 7840, *Small craft — Fire-resistant fuel hoses*

ISO 8666:2002, *Small craft — Principal data*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 15540, *Ships and marine technology — Fire resistance of hose assemblies — Test methods*

ISO 25197, *Small craft — Electrical/electronic control systems for steering, shift and throttle*

IEC 60068-2-6, *Environmental testing — Part 2-6: Test Fc Vibration (sinusoidal)*

IEC 60092-101, *Electrical installations in ships — Part 101: Definitions and general requirements*

IEC 60092-504:2001, *Electrical Installations in ships — Part 504: Special Features — Control and Instrumentation*

IEC 60332-2-1, *Tests on electric and optical fibre cables under fire conditions — Part 2-1: Test for vertical flame propagation for a single small insulated wire or cable — Apparatus*

IEC 60332-2-2, *Tests on electric and optical fibre cables under fire conditions — Part 2-2: Test for vertical flame propagation for a single small insulated wire or cable — Procedure for diffusion flame*

IEC 60533, *Electrical and Electronic Installations in Ships — Electromagnetic Compatibility*

IEC 60695-11-5, *Fire hazard testing — Part 11-5: Test flames — Noodle flame test method — Apparatus, confirmatory test arrangement and guidance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
auxiliary machinery
machinery to provide the vessel with sufficient energy (mechanically, hydraulically or electrically) to operate equipment and systems including essential services on-board the vessel under all foreseen and defined weather and sea conditions

3.2
diesel engine
an internal combustion engine that uses the heat of highly compressed air to ignite a spray of fuel introduced after the start of the compression stroke

3.3
essential auxiliaries
electric generators and associated power sources supplying essential services

3.4
essential services
services essential for propulsion and steering, and safety of the ship

EXAMPLE Steering gears; pumps for controllable pitch propellers; fuel oil supply pumps, fuel valve cooling pumps, lubricating oil pumps and cooling water pumps for main and auxiliary engines necessary for propulsion; azimuth thrusters which are the sole means for propulsion/steering with lubricating oil pumps and cooling water pumps; electrical equipment for electric propulsion plant with lubricating oil pumps and cooling water pumps; electric generators and associated power sources supplying the above equipment; hydraulic pumps supplying the above equipment; control, monitoring and safety devices/systems for equipment to essential services; starting air and control air compressors; fire pumps and other fire extinguishing medium pumps; ventilating fans for engine rooms and machinery spaces; shaft lubrication; navigation, communication, fire detection systems, etc.

3.5
failure
termination of the ability of an item to perform a required function

Note 1 to entry: After failure, the item has a fault.

Note 2 to entry: “Failure” is an event, as distinguished from “fault”, which is a state.

Note 3 to entry: The concept, as defined, does not apply to items consisting of software only.

[SOURCE: IEV, 191-04-01]

3.6
fault
state of an item characterized by inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

Note 1 to entry: A fault is often the result of a failure of the item itself, but can exist without prior failure.

Note 2 to entry: In practice, the terms “fault” and “failure” are often used synonymously.

[SOURCE: IEV, 191-05-01]

3.7
harm
physical injury or damage to health

[SOURCE: ISO 12100:2010, 3.5]

3.8
hazard
potential source of harm

Note 1 to entry: The term "hazard" can be qualified in order to define its origin (for example, mechanical hazard, electrical hazard) or the nature of the potential harm (for example, electric shock hazard, cutting hazard, toxic hazard, fire hazard).

Note 2 to entry: The hazard envisaged by this definition either:

— is permanently present during the intended use of the machine (for example, motion of hazardous moving elements, electric arc during a welding phase, unhealthy posture, noise emission, high temperature), or

— can appear unexpectedly (for example, explosion, crushing hazard as a consequence of an unintended/unexpected start-up, ejection as a consequence of a breakage, fall as a consequence of acceleration/deceleration).

[SOURCE: ISO 12100:2010, definition 3.6]

3.9
machinery spaces
all spaces of category A and all other spaces containing propelling machinery, boilers, oil fuel units, internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces

3.10
machinery spaces of category A
spaces and trunks to such spaces which contain: a) internal combustion machinery used for main propulsion; b) internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375kW; or c) any oil-fired boiler or oil fuel unit

3.11
machinery system
all equipment necessary to operate reliable and safe main and auxiliary machinery

3.12
mass production
<machinery> produced in quantity under quality control of material and parts, where parts are designed and machined to close tolerance for interchangeability and assembled with parts taken from stock requiring little or no fitting

3.13
propulsion
component or components of thrust that permits a craft movement in any direction

3.14
rated power
declared power
value of the power, declared by the manufacturer, which an engine will deliver under a given set of circumstances

[SOURCE: ISO 15540:1999, definition 3.3.1]

3.15
rated speed
declared speed
speed at which, according to the statement of the engine manufacturer, the rated power is delivered

[SOURCE: ISO 15540:1999, definition 3.2.4]

3.16
readily accessible
capable of being reached quickly and safely without the use of tools

3.17
reliability
ability of a machine or its components or equipment to perform a required function under specified conditions and for a given period of time without failing

[SOURCE: ISO 12100:2010, definition 3.2]

3.18
recognised organization
independent company or body which has been authorized by the Flag Administration for inspection and survey duties on its behalf

3.19
risk
expression of the danger that an undesired event represents to persons, to the environment or to material property.

Note 1 to entry: The risk is expressed by the probability and consequences of an accident.

Note 2 to entry: The definition is different from the definition 3.12 of ISO 12100:2010.

3.20
SOLAS
International Convention for the Safety of Life at Sea, 1974, as amended

3.21
thrust
propulsive force from vessel's main propulsion system or bow or stern thrusters, or a combination thereof in order to move or rotate the craft

4 Engine requirements

4.1 General requirements

The diesel engine, associated systems and fittings relating to propulsion and auxiliary power units shall be of a design and construction adequate for the service and environment for which they are intended. The design and instructions shall take into consideration protection so as to reduce any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards.

The diesel engine, equipment and associated systems and controls shall be supplied with all of the instructions essential for correct installation, maintenance and safe operation. Adequate information shall be supplied to identify any risk associated with the interfaces and equipment not within the scope of the engine manufacturer's supply.

4.2 Risk assessment

The requirements of ISO 12100 shall be complied with.

Potential hazards shall be assessed and risks shall be identified. As a minimum, the potential hazards in accordance with the hazard list in Annex A should be assessed. A risk analysis of the identified risks shall be conducted and include diesel engine and its associated systems (including controls). The analysis should demonstrate that suitable risk mitigation has been achieved. Results of a system functional failure analysis shall be documented and confirmed by a practical test programme drawn up from the analysis.

Details of risks, and the means by which they are mitigated, shall be included in the operating manual.

NOTE While FMEA (Failure Modes and Effect Analysis) is commonly adopted as an acceptable risk assessment technique, there are other methods which can be used and which, in certain circumstances, can offer an equally comprehensive insight into particular failure characteristics.

4.3 Ambient conditions

The diesel engine shall be designed to operate under the following environmental conditions:

— ambient machinery space air temperature from 0°C to 45°C;

— sea water temperature up to 32°C.

NOTE 1 The rated power(s), as declared by the manufacturer, are to include ISO power at ISO 3046-1 tropical conditions of 32°C/45°C.

NOTE 2 Other ambient conditions may be used as agreed between engine manufacturer and customer.

4.4 Inclinations

Main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the vessel shall, as fitted in the vessel, be designed to operate when the vessel is upright and when inclined at any angle of list up to and including 15° either way under static conditions and 22,5° under dynamic conditions (rolling) either way and simultaneously inclined statically 5° and dynamically (pitching) 7,5° by bow or stern.

For sailing yachts special consideration shall be taken for any diesel engine to be operated under sailing condition.

4.5 Surface temperature

The hazard a hot surface presents depends on the surface temperature, its location, and if a person is likely to touch it. Depending on the location of the hot surface and its temperature, the engine manufacturer and engine installer should decide if a hazard exists that should be guarded. ISO 13732-1 should be used as a design guide together with the relevant machinery standard. In absence of a specific indication, the normal operating conditions, as found in ISO 13732-1, are at the rated speed and the rated power according to ISO 3046-1. As a general guideline, surfaces having a temperature exceeding 60°C with which the crew are likely to come into contact during operation should be suitably protected or insulated.

Minimum requirement: all surfaces of the machinery with temperatures exceeding 220°C shall be insulated. The insulation shall be impervious to flammable liquids and vapours.

4.6 Vibrations

The design, construction and installation of diesel engines shall be conducted so that any mode of their vibrations shall not cause stresses to this machinery in the normal operating ranges which exceed the maximum permissive stresses as defined by the engine manufacturer.

The engine manufacturer shall present torsional vibration calculation data for the diesel engine allowing a complete analysis to be performed.

4.7 Component testing

The strength of torque transmitting components shall be verified through calculations with an acceptability factor ≥ 1,15 which is the ratio between the fatigue strength of the component material and the equivalent alternating stress for the area evaluated. The calculations shall be performed with due regard to maximum working stresses and operating hours between overhauls.

Other components and systems, including compressors and turbo chargers, should either be proven reliable for its intended application through field testing in a similar application and/or be tested in accordance with a recognized test scheme relevant to the application.

4.8 Service conditions

The design shall facilitate the cleaning, inspection and maintenance of engine manufacturer's specified service items. The potential spillage shall be collected during inspections and routine maintenance by collecting devices.

4.9 Drainage

Fuel, coolant and lubricating oil drains shall be readily accessible. The engine installer shall complete the installation in accordance with engine manufacturer's instructions.

4.10 Intake and exhaust system

The intake and exhaust system shall be designed to minimize risk of fire, explosion or personal injuries/harm. If insulation is used, it shall meet the requirements of 4.5.

4.11 Crankcase

Engines of a cylinder diameter of 200 mm or a crankcase volume of 0,6 m^3 and above shall be provided with crankcase explosion relief valves approved by a Recognized Organization with sufficient relief area and that incorporate a flame arrester.

The relief valves shall be arranged with means to ensure that: discharge from them is directed so as to minimize the possibility of injury to personnel; or, documentation showing that the crankcase has sufficient strength to contain the worst case explosion.

4.12 Lubrication oil system

The lubrication oil pump suction shall be of such arrangement that the required capacity and pressure is maintained under the conditions referred to in 4.4.

The lubrication oil system shall be equipped so that the oil level can be established during operation. Means shall be provided for completely draining the oil sump.

For single installation main propulsion engines, other than sailing yachts, filters shall be able to be cleaned or replaced when the engine is running.

Pipe and hose connections in oil lines shall be screened or otherwise suitably protected to avoid, as far as practicable, oil spray or leakage onto potential hot surfaces, into machinery air intakes or other sources of ignition. The number of joints in such piping shall be kept to a minimum.

Flexible piping shall be tested in accordance with ISO 15540 or ISO 7840 and have a bursting pressure of four times the working pressure. Materials and fittings shall conform to a suitable national or International Standard.

Systems incorporating high pressure of greater than 7 bar are to be specifically evaluated in the risk assessment.

4.13 Fuel system

External high-pressure fuel delivery lines between the high-pressure fuel pumps and fuel injectors together with all high pressure common rail and injection lines shall be protected with a jacketed piping system capable of containing fuel from a high-pressure line failure. The jacketed piping system shall include a means for collection of leakages and arrangements shall be provided with an alarm in case of a fuel line failure.

Common rail fuel components shall be designed to a recognized pressure vessel standard or shall be verified by suitable testing.

Pipe and hose connections in oil lines shall be screened or otherwise suitably protected to avoid, as far as practicable, oil spray or leakage onto potential hot surfaces, into machinery air intakes or other sources of ignition. The number of joints in such piping shall be kept to a minimum.

Flexible piping shall be tested in accordance with ISO 15540 or ISO 7840 and have a bursting pressure of four times the working pressure. Materials and fittings shall conform to a suitable national or International Standard.

For single installation main propulsion engines, other than sailing yachts, filters shall be able to be cleaned or replaced when the engine is running.

4.14 Cooling water system

Where risks of flooding occur, the flexible piping shall comply with requirements of ISO 15540 or ISO 7840 and have a bursting pressure of four times the working pressure. Materials and fittings shall conform to suitable national or International Standard.

4.15 Starting capability

Propulsion and auxiliary engines shall be capable of six consecutive starting attempts within 30 min. If the propulsion engine is the driver for the emergency fire pump, it shall be fitted with a starting device which enables at least six starts to be performed within 30 min, two of these being carried out within the first 10 min.

4.16 Electrical equipment

All electrical equipment used for control, protection and safety of the diesel engine shall withstand the heat, vibrations and humidity, taking into consideration the location where installed.

Electrical equipment shall be designed in compliance with IEC 60092-101 and IEC 60092-504.

NOTE ISO 25197 Environmental requirements/tests according to this standard satisfies this requirement.

General electromagnetic compatibility (EMC) requirements shall be in accordance to IEC 60533.

Electrical equipment installed on engines shall withstand ambient temperatures from +5°C to +55°C.

Electrical equipment shall operate satisfactorily under normal conditions with the craft at inclinations as required in 4.4. For sailing yachts only, a constant heel of ± 45° shall be used.

Electrical equipment installed on engines shall be constructed to withstand vibrations in accordance with IEC 60068-2-6: Test Fc with severity criteria 2,0 Hz to 25 Hz – amplitude ± 1,6 mm and 25,0 Hz to 100 Hz – acceleration ± 4,0 g.

In general all electrical equipment shall be constructed of durable, flame-retardant, oil-resistant, moisture-resistant and UV-resistant materials which are not subject to deterioration either in the atmosphere, temperatures or UV-radiation to which they are likely to be exposed.

Non-metallic protective casings against mechanical damage shall be flame retardant in accordance with IEC 60092-101 or IEC 60695-11-5.

Electric cables and wiring external to equipment shall be of flame-retardant type in accordance with IEC 60332-2-1 and IEC 60332-2-2.

Electrical and electronic equipment, with connections, shall normally have a minimum degree of protection in accordance to IP44. For equipment, where proven suitable, a lower degree of protection

EXAMPLE IP23 should be sufficient.

Overload and short-circuit protection shall be provided for all circuits, except engine starting circuits supplied from batteries.

4.17 Engine controls

All control and safety systems essential for the propulsion shall be independent or designed such that failure of one system does not degrade the performance of another system.

Safety functions shall be independent of control and monitoring functions.

The engine shall be capable of shutting down safely in the event of the manual emergency stop being operated.

The engine control and safety system shall be designed in compliance with IEC 60092-504.

Speed control of main propulsion engines:

— The speed governor shall prevent the engine speed from exceeding the rated speed of the engine by more than 15 %.

— Engines with a rated power of 220 kW, or above, shall be equipped with a separate overspeed protection device that prevents the engine speed from exceeding the maximum rated speed by more than 20 %. The overspeed protection device shall be independent from the speed governor.

Speed control of engines driving generators:

— The speed governor shall prevent momentary speed variations over ± 10 % of the rated speed with a recovery time to steady-state condition not exceeding 5 s, when the maximum step load of the generator is switched on or off.

— At all loads between no load and rated load the permanent speed variation shall not be more than ± 5 % of the rated speed.

— The engine shall be able to take a sudden load in two load steps, first step from 0 % to 50 % and second step from 50 % to 100 % of the rated power of the generator, and should achieve steady-state conditions in no more than 5 s after each load step. The application of a load in more than two load steps for engines with a brake means that effective pressure above 1,4 MPa (14 bar) is acceptable, if the conditions within the ship's power management system permit the use of such prime movers.

— Steady-state conditions are those at which the speed variation does not exceed ± 1 % of the declared speed at the new power.

— Engines with a rated power of 220 kW, or above, shall be equipped with a separate overspeed protection device that prevents the engine speed from exceeding the maximum rated speed by more than 15 %. The overspeed protection device shall be independent from the speed governor.

4.18 Programmable electronics

Programmable electronics shall provide functions to the system in which they are used in a safe, stable and repeatable manner under all operating conditions, including emergency conditions. Response times shall be adequate for all functions, taking into account both normal and abnormal operating conditions (see IEC 60092-504:2001, 10.1.2).

Programmable electronics shall be designed in compliance with IEC 60092-504.

NOTE Programmable electronics designed in compliance with ISO 25197 satisfies this requirement.

Software development shall be carried out according to a quality plan. ISO 9001, or an equivalent International Standard, should be taken as guidance for the quality procedure.

4.19 Alarm and safety system

The engines shall be fitted with adequate safety monitoring and control devices in respect of speed, temperature, pressure and other operational functions. Control of the machinery shall be from the craft's operating compartment.

The monitoring given in Table 1 shall be provided.

Table 1 — Monitoring

Control panels at the local control station or at the engine with indicators for • Engine speed • Lubrication oil pressure • Cylinder cooling water temperature
Alarms and shut-downs
Main propulsion engine: • Engine overspeed: Alarm + shut-down 1) • Lubricating oil pressure, low: Alarm + shut-down 3) • Lubricating oil temperature, high: Alarm • Cylinder cooling water temperature, high: Alarm • Leakage from high pressure fuel injection pipes: Alarm • Fault in the electronic governor system: Alarm • Oil mist detection or equivalent system: Alarm 2) +shut-down 2) Whenever the safety system is activated an alarm shall be initiated.
Auxiliary engine: • Engine overspeed: Alarm + shut-down 1) • Lubricating oil pressure, low: Alarm + shut-down • Leakage from high pressure fuel injection pipes: Alarm • Fault in the electronic governor system: Alarm • Oil mist detection or equivalent system: Alarm 2) +shut down 2) Whenever the safety system is activated an alarm shall be initiated.
1) For engines with a rated power of 220kW or above. 2) For engines with a rated power above 2250kW. 3) Shut down override may be used for propulsion engines.

5 Installation instructions

Installation instructions with installation requirements for safe operation shall be provided with the machinery.

6 Operating and maintenance instructions

Operating and maintenance instructions and engineering drawings for safe operation shall be available in a language agreed between the engine manufacturer and the customer.

7 Marking

Engines shall be marked visibly, legibly and indelibly with the following information:

— business name of the manufacturer;

— designation of the engine;

— designation of series or type;

— serial number;

— rated power;

— rated speed.

8 Diesel engine qualification, manufacturing and testing

8.1 General

The manufacturer shall have an implemented quality control system for the type of engine produced. The quality control system shall include sub-suppliers regarding auditing and acceptance of quality control methods and extent. Materials and components shall be produced in compliance with all the production and quality instructions specified by the engine manufacturer.

ISO 9001, or an equivalent International Standard, should be taken as guidance for the quality procedure.

The procedure for qualification (if required), manufacturing and testing is based on approval from the Flag Administration, or any of its recognised organizations, for mass produced diesel engines and is limited to diesel engines with a bore not exceeding 300 mm.

8.2 Type approval of mass produced diesel engines

The manufacturer requesting a type approval from the Flag Administration, or any of its Recognized Organizations for a mass produced diesel engine shall submit all necessary data concerning this type of engine covering:

— drawings,

— technical specification of the main parts,

— design calculations,

— operating and maintenance manuals, and

— list of subcontractors for the main parts.

A witnessed running test of at least 100 h duration shall be carried out on an engine chosen in the production line according to 8.2.1. Omission or simplification of the type test can be considered for engines of a well-known type.

For prototype engines, the duration and programme of tests shall be specially agreed with the Flag Administration, or any of its Recognized Organizations.

For a type approved engine where a large number of engines have been proved successfully by service experience, an increase in power up to maximum 10 % may be permitted without any further type test by the Flag Administration or any of its Recognized Organizations.

8.2.1 Type test

The duration and scope of tests shall be, if not agreed otherwise, as follows:

— 80 h at rated output;

— 8 h at 110 % overload;

— 10 h at partial loads (1/4, 2/4, 3/4 and 9/10 of rated output);

— 2 h at intermittent loads;

— starting tests;

— testing of regulator – i.e.over speed device, lubricating oil system failure alarm device;

— testing of the engine with turbocharger out of action when applicable;

— testing of minimum speed for main propulsion engines and the idling speed for auxiliary engines.

The tests at the above mentioned outputs shall be combined together in working cycles which shall be repeated subsequently with the whole duration within the limits indicated. The overload shall be alternately carried out with:

— 110 % of rated output and 103 % rpm;

— 110 % of rated output and 100 % rpm.

The following parameters of the condition of the test shall be recorded in S.I. units:

— ambient air temperature;

— ambient air pressure;

— atmospheric humidity;

— external cooling water temperature; and

— fuel and lubrication oil characteristics.

The following parameters, at least, shall be measured and recorded in S.I. units:

— engine rpm;

— brake power;

— torque;

— maximum combustion pressure;

— indicated pressure diagrams where practicable;

— lubricating oil pressure and temperature;

— exhaust gas temperature in exhaust manifold and where facilities are available from each cylinder;

— fuel consumption;

— governor / fuel rack position (where applicable);

— smoke.

and, for supercharged or turbocharged engines:

— rpm of supercharger or turbocharger;

— exhaust gas temperature after turbocharger;

— air temperature and pressures before and after turbine charge, charge air cooler; and

— inlet cooling water temperature to charge air cooler.

Surface temperature measurement shall be measured at rated speed and power to show compliance with surface temperature limits.

After the type test the main parts, especially those subject to wear, shall be disassembled for inspection to ensure engine is fit for purpose by the Flag Administration or any of its Recognized Organizations.

8.2.2 Diesel engine type

Diesel engines can be considered of the same type if they do not vary in any detail included in the definition below and do not substantially differ their design details and the material used.

The type of diesel engine is defined by:

— bore and stroke;

— injection method (direct or indirect);

— valve and injection operation (by cams or electronically controlled);

— kind of fuel (liquid, dual-fuel, gaseous);

— working cycle (4-stroke, 2-stroke);

— turbo-charging system (pulsating or constant pressure);

— the charging air cooling system (e.g. with or without intercooler);

— cylinder arrangement (in-line or V);

— cylinder power, speed and cylinder pressures.

8.3 Manufacturing of mass produced diesel engines

The manufacturer's production plant shall be approved by the Flag Administration, or any of its Recognized Organizations regarding the manufacturing processes, required tests and quality control procedures applied.

The scope shall include:

— organization of quality control system,

— recording of quality control operations,

— extent of testing (material tests, non-destructive testing and pressure tests), and

— qualification and independence of personnel in charge of quality control.

The manufacturer shall:

— maintain records of inspections and testing,

— have a system for identification of parts, and

— shall demonstrate full information about the quality control of the parts supplied by subcontractors to the satisfaction of the Flag Administration, or any of its Recognized Organizations.

8.4 Factory acceptance testing (FAT) and certification of mass produced diesel engines

The engine shall be tested in accordance with engine manufacturer specifications and the pertaining operation values shall be measured and recorded. All results shall be compiled in an acceptance protocol to be issued by the engine manufacturer. All measurements conducted shall be carried out at steady operating conditions in accordance with manufacturer procedure and include a reading at 100 % power.

For any engine to be installed on yachts according to this standard the manufacturer shall supply a statement certifying that the engine is identical to the type as tested according to 8.2.1 and shall include

the factory acceptance test protocol. Each statement shall include engine serial number and shall be made available for the Flag Administration, or any of its Recognized Organizations.

NOTE Some Flag Administrations may require FAT tests to be agreed between the manufacturer and the Flag Administration, or any of its Recognized Organizations.

Annex A
(informative)

List of typical hazards

Table A.1 — List of typical hazards

Item – no.	Hazards	Relevant clauses
1	**Fire**	
2	**Flooding**	
3	**Manoeuvrability**	
4	**Personal injury**	
4.1	**Mechanical hazards**	
4.2	**Electrical hazards**	

NOTE This list is not exhaustive and the engine manufacturer is responsible for preparing their own list of hazards.

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