RULES FOR CLASSIFICATION OF

Ships

PART 6 CHAPTER 3

NEWBUILDINGS
SPECIAL EQUIPMENT AND SYSTEMS – ADDITIONAL CLASS

Periodically Unattended Machinery Space

JULY 2011

The content of this service document is the subject of intellectual property rights reserved by Det Norske Veritas AS (DNV). The user accepts that it is prohibited by anyone else but DNV and/or its licensees to offer and/or perform classification, certification and/or verification services, including the issuance of certificates and/or declarations of conformity, wholly or partly, on the basis of and/or pursuant to this document whether free of charge or chargeable, without DNV's prior written consent. DNV is not responsible for the consequences arising from any use of this document by others.

DET NORSKE VERITAS AS

FOREWORD

DET NORSKE VERITAS (DNV) is an autonomous and independent foundation with the objectives of safeguarding life, property and the environment, at sea and onshore. DNV undertakes classification, certification, and other verification and consultancy services relating to quality of ships, offshore units and installations, and onshore industries worldwide, and carries out research in relation to these functions.

The Rules lay down technical and procedural requirements related to obtaining and retaining a Class Certificate. It is used as a contractual document and includes both requirements and acceptance criteria.

The electronic pdf version of this document found through http://www.dnv.com is the officially binding version
© Det Norske Veritas AS July 2011

Any comments may be sent by e-mail to *rules@dnv.com*
For subscription orders or information about subscription terms, please use distribution@dnv.com
Computer Typesetting (Adobe Frame Maker) by Det Norske Veritas

If any person suffers loss or damage which is proved to have been caused by any negligent act or omission of Det Norske Veritas, then Det Norske Veritas shall pay compensation to such person for his proved direct loss or damage. However, the compensation shall not exceed an amount equal to ten times the fee charged for the service in question, provided that the maximum compensation shall never exceed USD 2 million.
In this provision "Det Norske Veritas" shall mean the Foundation Det Norske Veritas as well as all its subsidiaries, directors, officers, employees, agents and any other acting on behalf of Det Norske Veritas.

CHANGES

General

The present edition of the rules includes amendments and additions approved by the Executive Committee as of June 2011 and supersedes the Januar 2011 edition of the same chapter.

The rule changes come into force as described below.

Text affected by the main rule changes is highlighted in red colour in the electronic pdf version. However, where the changes involve a whole chapter, section or sub-section, only the title may be in red colour.

This chapter is valid until superseded by a revised chapter.

Main changes coming into force 1 January 2012

- **Sec.2 System Arrangement**

— D501 Reference to SOLAS has been added.

- **Sec.3 Class Notation E0**

— Table A1 item 13.0
— Oil Mist Detection (OMD) alarm required (new), in addition to safety action (existing).

Corrections and Clarifications

In addition to the above stated rule requirements, a number of corrections and clarifications have been made in the existing rule text.

CONTENTS

SECTION 1
GENERAL REQUIREMENTS

A. Classification

A 100 Application

101 The rules in this chapter apply to machinery spaces where arrangements are provided to ensure that the safety of the ship in all sailing conditions, including manoeuvring, and when alongside is equivalent to that of a ship having machinery spaces attended.

Cargo handling is not included.

A 200 Class notations

201 When all machinery and auxiliary systems in the engine room, necessary for the performance of the main functions, as specified in Pt.1 Ch.1 Sec.1 A200, are fitted with instrumentation and automation equipment in compliance with the requirements of Pt.4 Ch.9 and the relevant sections of this chapter, class notations **E0** or **ECO** may be granted.

202 Class notation **E0** which is considered to meet the regulations of the International Convention for the Safety of Life at Sea (SOLAS) for unattended machinery spaces is granted when alarms, required for **E0** in this chapter, are relayed to the bridge and the engineers' accommodation, and a bridge control system for the main propulsion machinery, arranged as specified in Pt.4 Ch.1, and a watch responsibility transfer system are fitted.

203 Class notation **ECO** which is considered to meet the regulations of the International Convention for the Safety of Life at Sea (SOLAS) for continuous supervision from a control station is granted when alarms, required for **ECO** in this chapter, are initiated in an attended centralised control station, and a remote control system for the main propulsion machinery is installed at this station.

Guidance note:

It is not required for class notation **ECO** to have remote control, from the bridge, of main propulsion machinery or any safety functions installed in the engine room other than those required by **1A1**.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

204 The assignment of class notations **E0** and **ECO** is based on the assumptions that:

— engineering staff can attend the machinery space at short notice
— periodical test of all field instruments required in this chapter is performed according to an approved plan. The plan shall be kept on board and presented at annual and complete periodical surveys, as specified in Pt.7 Ch.1 Sec.2 C and Pt.7 Ch.1 Sec.4 C. For the format and the contents of the plan, refer to D102.

B. Definitions

B 100 Definitions

101 *Main alarm system* is a system performing signal handling and initiation of an alarm, and communicates with the bridge alarm system, the engineers' alarm and the engineers' watch call system.

102 *Local (sub) alarm systems* is a system performing signal handling and initiates the local alarm, and communicates with the main alarm system.

Guidance note:

The local alarm system may only give visual signal when the audible signal is handled by the main alarm system.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

103 *The extension alarm system* is the main alarm system extension to the engineers' cabins, public spaces and the navigation bridge and shall be in operation when the engine room is unattended.

104 *Engineers' alarm* is an alarm system, which shall be provided to operate from the engine control room or the manoeuvring platform, as appropriate, and shall be clearly audible in the engineers' accommodation.

(SOLAS Ch. II-1/38)

Guidance note:

The engineers' alarm is normally an integral part of the extension alarm system, but may be a separate system.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C. Documentation

C 100 Documentation requirements

101 The basic documentation requirements for control and monitoring systems are given in Pt.4 Ch.9 Sec.1.The additional documentation required for **E0**/**ECO** compliance is listed in below tables C1 and C2:

Table C1 - Documentation requirements for E0			
Object	*Documentation type*	*Additional description*	*For approval (AP) or For information (FI)*
Extension alarm and watch responsibility system	I020 - Functional description		AP
	I030 - Block diagram		AP
	I050 - Power supply arrangement		AP
Essential and important machinery systems	S011 - System diagram (P&ID)	Piping and instrumentation diagram (P&ID)	FI
Machinery control and monitoring systems	I110 - List of controlled and monitored points	All alarms related to **E0** according to table A1 -A10 in Sec.3, including alarm groups and cross reference to P&IDs.	AP
Fire detection and - alarm system in machinery spaces	I020 - Functional description		AP
	I030 - Block diagram		AP
	I050 - Power supply arrangement		AP
Machinery control and monitoring field instruments	I260 - Plan for periodic test of field instruments	See Sec. 1D and Sec.3 Tables A1-A10.	AP
Control systems	Z160 - Operation manuals	Applicable for the control systems installed to meet **E0** requirements. Shall be available on board, not submitted for approval.	FI

For class notation **ECO**, see Sec.4:

Table C2 - Documentation requirements for ECO			
Object	*Documentation type*	*Additional description*	*For approval (AP) or For information (FI)*
Extension alarm and watch responsibility system	I020 - Functional description		AP
	I030 - Block diagram		AP
	I050 - Power supply arrangement		AP
Essential and important machinery systems	S011 - System diagram (P&ID)	Piping and instrumentation diagram (P&ID)	FI
Machinery control and monitoring systems	I110 - List of controlled and monitored points	All alarms related to **E0** according to table A1 -A10 in Sec.3, including alarm groups and cross reference to P&IDs.	AP
Fire detection and - alarm system in machinery spaces	I020 - Functional description		AP
	I030 - Block diagram		AP
	I050 - Power supply arrangement		AP
Machinery control and monitoring field instruments	I260 - Plan for periodic test of field instruments	See Sec. 1D and Sec.3 Tables A1-A10.	AP
Control systems	Z160 - Operation manuals	Applicable for the control systems installed to meet **E0** requirements. Shall be available on board, not submitted for approval.	FI

102 For general requirements to documentation, see Pt.0 Ch.3 Sec.1.

103 For a full definition of the documentation types, see Pt.0 Ch.3 Sec.2.

C 200 Operation instructions

201 On the bridge and at the control stand in the engine room, instructions shall be fitted, stating routines to be followed in connection with transfer of control to and or from the engine room, and precautions to be taken at alarm condition.

D. Periodical Test

D 100 General

101 All field instruments required by the **E0** rules shall be tested regularly according to the plan for periodical test.

102 The plan for periodical test shall identify all field instruments related to the **E0** requirements. The plan shall in addition describe how each instrument is to be tested, describe the expected result and also identify the test intervals according to D301.

Guidance note 1:

The plan for periodical test should contain the following information:

— only the field instruments required by the **E0** rules (alternatively, a clear identification of the instruments required by these rules) and eventual instruments recommended by the manufacturer of the machinery
— unique instrument identification (tag number)
— service description
— measuring range and unit
— limits for alarm, slowdown and shutdown
— test interval
— test method (may be a reference to a detailed description also describing necessary test equipment)
— expected result (e.g. shutdown)
— record / log of performed tests.

The Society may upon request provide a sample plan.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

Guidance note 2:

The plan for periodical test may be in printed or electronic version, but it must be evident that the contents are approved. If the ship is under PMS (planned maintenance system) survey arrangement, the complete content of the plan for periodical test is assumed to be incorporated in the planned maintenance system.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D 200 Testing

201 Testing of field instruments shall in general include the physical sensor and the whole signal loop, and verify correct functionality, indication and alarming.

Guidance note:

Different ways of testing the field instruments may be applied, according to manufacturers' recommendations and as described in the plan for periodical test. Normally, the installation of the field instrument should allow for easy hook-up to a test kit (e.g. via a 3-way valve, thermo-well etc). Where this is not feasible e.g. due to access limitations, alternative test methods may be acceptable, e.g. by comparing two or more sensors measuring the same process parameter, hooking up a temporary reference test sensor, etc. Analogue sensors shall be tested by varying the process parameter over the operating range.

The test equipment necessary to perform the tests identified in the plan for periodical test may be kept on board or brought on board when needed.

The test equipment should be calibrated according to the manufacturers' instructions, at least every 5 years. Calibration of ship's test equipment may be carried out on board by comparison with a portable “master calibrating kit” which has been brought on board, and in turn has a valid calibration status. The ship's personnel may carry out the calibration and the ship's personnel may sign the documentation of the calibration.

Alternatively, when the surveyor has good reason to believe the test equipment has been calibrated but no evidence thereof can be obtained onboard, a written statement from the Captain or Chief Engineer confirming that the test equipment has been calibrated should be obtained and kept together with the survey documentation in the office files.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D 300 Test intervals

301 All field instruments for critical alarms shall be tested every 6 months, unless more frequent testing is specified by the maker of the machinery or system. This applies to shut down alarms for main- and auxiliary engines and boilers. The test intervals for all other field instruments required by the **E0** rules shall not exceed 12 months.

Guidance note:

The critical alarms for rotating machinery are typically low lub oil pressure, overspeed and crankcase explosive conditions; and for boilers low water level.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

SECTION 2
SYSTEM ARRANGEMENT

A. General

A 100 Extent of automation

101 The extent of automation shall be sufficient to permit unattended engine room operation for 24 hours, or for the maximum continuous operation time when less than 24 hours. Normal service at sea and normal manoeuvres are presumed. Normal manoeuvres do not include emergency manoeuvres, where alarm and safety limits may be exceeded.

102 Starting of engine plant and transfer to various operating modes may be accepted as manual operations, if the need for such actions will not arise at short notice.

B. Automatic Control System

B 100 Special requirements

101 Where the bilge pumps are arranged for automatic starting, alarms shall be initiated if the influx of liquid is greater than the pump capacity and when the pump is operating more frequently than what would normally be expected.

102 For reversible engines, the starting air receivers shall be automatically charged.

C. Alarm System

C 100 General

101 A main alarm system shall be installed at the machinery control station in the engine room or in the engine control room, if provided.

102 Local (sub) alarm systems are permitted provided there is one common alarm to the main alarm system from each local alarm system. Local alarm systems may also, on consideration, be permitted to include a safety system, and in such case there shall be at least two separate alarms to the main alarm system from the local alarm system.

The common alarm to the main alarm system shall not be inhibited by acknowledged alarms in the local alarm system, but shall be activated by any new detected alarm by the local alarm system.

103 The alarm system including the extension alarm system shall be continuously powered. In case of loss of the normal power supply, an automatic change over to a continuously available power supply with a capacity for at least 30 minutes is required.

C 200 Alarm system on the bridge

201 When machinery spaces are attended, the engine room alarms and indicators on the bridge shall be minimized. When the propulsion machinery is remote controlled from the navigation bridge, only engine room alarms and indicators which requires the attention of the navigation officers shall be activated on the navigation bridge.

202 When machinery spaces are unattended, any alarm condition from machinery and systems installed in the engine room shall initiate an alarm on the bridge with individual or group wise indication. The visual alarm signal shall remain present until acknowledged in the engine room.

203 Alarm conditions within one group shall not prevent the initiation of alarms in other groups. New alarms within a group shall not be inhibited by acknowledged existing alarms.

204 The extension alarm system on the bridge and in the accommodation shall be so designed that failures such as loss of power supply or broken cable connection to the main alarm system in the engine room, initiate an alarm.

205 It shall not be possible to reduce the light intensity of alarm indicators on the bridge below the intensity necessary in normal daylight. Automatic adjustment of light intensity based on ambient light conditions is accepted".

206 Power failure to the extension alarm system shall initiate an audible alarm with visual indication.

C 300 Alarm systems in the engineers' accommodation

301 An extension alarm system shall be installed in the watch-keeping engineer's cabin, on the navigation bridge and in all public spaces as for example day room, gymnasium and such like. Any alarm condition from machinery and systems installed in the engine room shall initiate an alarm on the responsible watch-keeping engineer's alarm system installation and public space installations (i.e. bridge extension alarm systems) during engine unattended periods.

Local silencing of the audible alarm on the bridge or in the accommodation spaces shall not acknowledge the alarm in the engine room.

It shall be indicated on the bridge when the audible alarm has been silenced in the watch-keeping engineer's cabin.

302 The extension alarm system shall be activated by the watch responsibility transfer system.

303 When the engine room is unattended, the engineers alarm shall be activated if an alarm has not received attention locally, within a limited time.

(SOLAS Ch. II-1/51.1.3)

Guidance note:
Limited time should normally be understood to be between 1 to 3 minutes.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

C 400 Watch responsibility transfer system

401 A system for activating and deactivating the extension alarm system to the navigation bridge shall be provided.

402 The system shall initiate audible and optical (flashing light) warning at both control positions when watch transfer is requested, and the warning shall remain in operation until acknowledged.

403 The responsibility shall not be transferred before acknowledgement at the receiving end.

404 Indication shall be provided showing which control station has the watch responsibility.

405 Transfer of watch keeping responsibility to the navigating bridge shall not be possible before the extension alarm system has been set to a duty engineer's cabin. The watch keeping responsibility panel shall indicate which engineer is on duty.

406 When the engine room is unattended and the vessel is alongside the quay, it shall be possible to disconnect the extension alarm system to the navigation bridge, without disconnecting the extension alarm system to the accommodation.

D. Safety System

D 100 General

101 The safety system shall cover fault conditions which may develop too fast to be counteracted by manual intervention locally.

102 When two or more safety actions are initiated by one failure condition (e.g. start of standby pump and stop of engine at low lubricating oil pressure), these actions shall be activated at different levels.

The least drastic action shall be activated first.

103 Power failure in the safety system is neither to cause loss of propulsion nor steering functions.

104 Whenever the safety system is activated, alarm shall be initiated.

D 200 Automatic start of pumps

201 Faults in the mechanical or electrical system of the running pump are not to inhibit automatic start of the standby pump.

202 Automatic start of the standby pump shall be initiated by the process parameter which is being monitored, e.g. low pressure signal, and shall be arranged so that the standby pump does not stop automatically when first started («locking circuit»).

203 Manual start and stop of the pumps shall be possible without initiating an alarm for the automatic start of the standby pump.

204 Operating circuits for pump units shall be arranged according to Pt.4 Ch.8.

205 When a pump is standby, this shall be clearly indicated on the operator panel.

D 300 Automatic stop of auxiliary engines and propulsion machinery

301 External circuitry for safety and alarm shall be arranged such that a failure to any one system or function cannot spread to another system or function. An alarm shall be initiated for voltage failure.

Guidance note:

The systems for safety and alarm should be separately fused. Similarly, automatic stop circuits for individual units should be separately fused.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

302 The safety system shall be arranged so that a single open circuit in wiring between sensors and control unit, or between control unit and actuators, including external stop circuit, does not cause unintentional stop.

Guidance note:

A single system based on normally open contacts can be accepted; alternatively, a system with normally closed contacts where discrimination between loop failure and stop signals is provided.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

303 The requirements of 302 can be waived if the manoeuvrability is maintained after shutdown of one unit, see Pt.4 Ch.9 Sec.3A.

304 In case of an automatic stop of one engine in a multi engine plant, measures shall be taken to avoid overload of the running engine.

305 All parameters which may cause automatic stop shall normally initiate an alarm prior to stop.

Guidance note:

Propulsion machinery is defined as all machinery which will cause loss of the propulsion function if stopped, with exception of main boilers.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D 400 Automatic stop of oil fired auxiliary boilers

401 Connections between sensors and control unit shall be based upon normally closed contacts, so that an open circuit will lead to shutoff of the oil supply.

402 The parameter causing an automatic stop shall be identified on the control panel.

D 500 Internal communication

501 The two-way voice communication system, according to SOLAS Reg. II-I/50, shall be supplied by a battery or an uninterruptible power supply as a stand-by power supply sufficient to operate the system for at least 30 minutes.

E. Fire Safety and Fire Detection and Alarm System

E 100 General

101 A fixed fire detection and fire alarm system shall be installed in accordance with the relevant provisions of SOLAS, II-2, Part C, Reg.7 (Pt.4 Ch.10) in periodically unattended machinery spaces.

(SOLAS Ch. II-2, Part C, 7.4.1)

102 This fire detection system shall be so designed and the detectors so positioned as to detect rapidly the onset of fire in any part of those spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors shall not be permitted. The detection system shall initiate audible and visual alarms distinct in both respects from the alarms of any other system not indicating fire, in sufficient places to ensure that the alarms are heard and observed on the navigating bridge and by a responsible engineer officer. When the navigating bridge is unmanned the alarm shall sound in a place where a responsible member of the crew is on duty.

(SOLAS Ch. II-2, Part C, 4.2)

Guidance note:

Thermal detectors only may be used in workshops adjacent to machinery spaces when the nature of the work being carried out will cause erroneous alarms. This guidance note only applies if the compartments themselves do not contain fuel oil installations.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

103 Fire detectors shall be type approved.

Guidance note:
Where fire detectors are provided with timers (in workshops) for inhibiting the alarm, these should be arranged to automatically reset the alarm upon completion of timer and should not be possible to negate for period exceeding 15 minutes.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

104 Manually operated call points shall be located at the following positions:

— passageways and stairways, including emergency exits, having nearby entrance to engine and boiler rooms
— navigation bridge
— control station in engine room.

Guidance note:
Manual call points should be located as required by SOLAS Ch. II-2.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

105 Start of fire pumps shall be arranged according to the requirements in SOLAS Ch. II-2, Part C, 10.2.1.2.2.2.

SECTION 3
CLASS NOTATION E0

A. Extent of Monitoring

A 100 General

101 The control and monitoring systems shall cover machinery and auxiliary systems in the engine room, necessary for the performance of the main functions, as specified in Pt.1 Ch.1 Sec.1 A200.

102 The parameters to be monitored will depend upon output and type of engine as well as arrangement of machinery plant. The parameters listed in Table A1 to A10 are in general corresponding to those specified in Pt.4, but some additional parameters are required to comply with **E0** rules. Other combinations than those listed may be accepted, when the chosen monitoring can detect fault conditions in an equivalent satisfactory manner.

A 200 Safety actions

201 The required safety shutdowns for propulsion systems in Pt.4 shall normally be automatically executed. Manual activation from the bridge of safety actions for propulsion machinery may be accepted if running of the machinery does not jeopardize the safety. Manual activation will not be permitted for:

— over speed protection
— crankcase explosive conditions
— short circuit in electrical propulsion plants

The alarm for manual activation of shut down shall be independent from the main alarm system.

202 For automatic shutdowns that do not protect a propulsion engine from immediate break down an emergency device shall be arranged to override these safety actions.

The override facility shall be arranged such that unintentional operation is prevented and initiate a visual and audible indication when operated.

203 For multi-engine propulsion plants, overriding of safety shutdowns is not required if manoeuvrability of the vessel is maintained.

Table A1 Control and monitoring of propulsion engines						
System	*Item*	*Valid for engine type* [1]	*Gr 1 Indication alarm load reduction*	*Gr 2 Automatic start of stand-by pump with alarm* [2]	*Gr 3 Shut down with alarm*	*Comments*
1.0 Fuel oil system	*Leakage from jacketed high pressure pipes*	*C, T*	*A*			*Level monitoring of leakage tank or equivalent*
	Fuel oil pressure after filter (engine inlet)		*IR, LA*	AS		
	Fuel oil temperature or viscosity of heavy fuel		A			
	Common rail fuel oil pressure	*C, T*	*LA*			
2.0 Lubricating oil system	*Lubrication oil to all bearings, inlet pressure* [3]	*C, T*	*IR, IL, LA, LR*	*AS*	*SH*	
	Lubrication oil to all bearings, inlet temperature		*IR, IL, HA*			
	Thrust bearing metal temperature	*C*	*IR, HA, LR*		SH	Shall be activated automatically
	Cylinder lubricating flow	C, T	LA, LR			At least one measuring point for each lubricator unit if applicable.
	Common rail servo oil pressure	*C, T*	*LA*			
3.0 Turbocharger system	*Turbocharger lubrication oil inlet pressure*	*C, T*	*IR, IL, LA*			*Applicable if separately forced lubrication or if turbocharger lubrication is part of engine main lubrication system but separated by pump, throttle or pressure reduction valve*
	Turbocharger lubrication oil outlet temperature		*IR, HA*			*Applicable only when the T/C is served by group of cylinders > 2500 kW*
	Speed of turbocharger		*IR, HA*			*Applicable only when the T/C is served by group of cylinders > 1000 kW*
4.0 Piston cooling system	*Piston coolant inlet pressure (common)*	*C*	*IR or IL, LA, LR*	*AS*		*Load reduction and automatic start of stand-by pump is not required if the coolant is oil taken from the main lubrication oil system of the engine*
	Piston coolant outlet flow each cylinder		*LR*			

Table A1 Control and monitoring of propulsion engines (Continued)

System	*Item*	*Valid for engine type* [1]	*Gr 1 Indication alarm load reduction*	*Gr 2 Automatic start of stand-by pump with alarm* [2]	*Gr 3 Shut down with alarm*	*Comments*
5.0 Cylinder cooling medium	*Cylinder cooling inlet pressure or flow*	*C, T*	*IR or IL, LA, LR*	*AS*		*Monitoring of expansion tank level, with alarm at low level, is an acceptable alternative for engines with cylinder power < 130 kW*
	Cylinder cooling outlet temperature		*IR or IL, HA, LR*			*Temperature to be monitored for each cylinder if individual stop valves are fitted for the cylinder jackets, otherwise main outlet. Sensor location so as to enable alarm in event of closed valve* For trunk engines, two independent sensors are required for alarm and load reduction
6.0 Starting and control air systems	*Control air reservoir pressure (if arranged)*	*C, T*	*IR or IL, LA*			
	Starting air pressure		IR, IL, LA			Before starting valve and after the last downstream valve of the pressure producing equipment
6.1 Pneumatic return of exhaust valve	*Exhaust gas valve air spring pressure*	*C*	*IR or IL, LA*			*Pressure readings shall be taken at the supply line locally on the engine*
7.0 Charge air system	*Charge air pressure*	*C, T*	*IR*			
	Charge air temperature, under each piston (fire detection)	*C*	HA, *LR*			
8.0 Exhaust gas system	*Exhaust gas temp after each cylinder* [4]	*C, T*	*IR, HA, LR* [5]			
	Exhaust gas temp after each cylinder. Deviation from average [4]		*IR, HA, LR*			*Chosen load reduction depends on permissible misfiring condition*
	Exhaust gas temp before T/C [6], [7]		*IR, HA, LR*			*LR is only required when the T/C is served by group of cylinders > 2500 kW*
9.0 Hydraulic oil system	*Leakage from jacketed high*	*C, T*	*A*			*Level monitoring of leakage tank or*

Table A1 Control and monitoring of propulsion engines (Continued)						
System	*Item*	*Valid for engine type* [1]	*Gr 1 Indication alarm load reduction*	*Gr 2 Automatic start of stand-by pump with alarm* [2]	*Gr 3 Shut down with alarm*	*Comments*
10.0/11.0 Engine speed/ direction of rotation	*Engine speed/ direction of*	*C, T*	*IL, IR*			
	Over speed protection		*LR*		*SH*	*SH or LR. Shall be activated*
	Excessive time within barred	*C*	*A*			
	Engine direction of rotation -	*C*	*A*			
12.0 Chain tension	*Position feeler "sensor"*	*C*	*IL*			*Where applicable*
13.0 Crankcase explosive condition [9] [10]	*Oil mist detection* [11]	*C*	*HA, LR*			
		T	*HA*		*SH*	*Shall be activated automatically* One oil mist detector having two independent outputs for detecting alarm and shut-down is acceptable.
	Other systems than oil mist detection	*C, T*	*LR*		*SH*	For trunk engines, shut down of engine and declutching of gear in a multi engine system is required. Request for manual SH is also accepted
14.0 Sea cooling water	*Cooling water pressure*	*C, T*	*LA*	*AS*		
15.0 Fuel valve cooling medium	*Pressure*	*C, T*	*LA*	*AS*		*If installed*
	Temperature	*C, T*	*HA*			

Table A1 Control and monitoring of propulsion engines (Continued)

System	*Item*	*Valid for engine type* [1]	*Gr 1 Indication alarm load reduction*	*Gr 2 Automatic start of stand-by pump with alarm* [2]	*Gr 3 Shut down with alarm*	*Comments*

Gr 1: Sensor(s) for indication, alarm, load reduction (common sensor permitted but with different set points and alarm shall be activated before any load reduction) if no other requirement is stated above

Gr 2: Sensor for automatic start of standby pump

Gr 3: Sensor for shut down

IL = Local indication (presentation of values), in vicinity of the monitored engine component or system

IR = Remote indication (presentation of values), in engine control room or another centralized control station such as the local platform/manoeuvring console

A = Alarm activated for logical value

LA = Alarm for low value

HA = Alarm for high value

AS = Automatic start of standby pump with corresponding alarm

LR = Load reduction, either manual or automatic, with corresponding alarm, either slow down (r.p.m. reduction) or alternative means of load reduction (e. g. pitch reduction), whichever is relevant.

SH = Shut down with corresponding alarm. May be manually (request for shut down) or automatically executed if not explicitly stated above.

For definitions of Load reduction (LR) and Shut down (SH), see Pt.4 Ch.1 of the Rules for Classification of Ships.

1) C = Crosshead engine, T = Trunk engine.

2) To be provided when stand-by pump is required.

3) Pressure to be monitored for all inlets to main bearings, crosshead bearings, torsional vibration dampers and camshaft bearings where pressure may differ due to presence of pumps, throttles, rotor seals or pressure reduction valves.

4) Individual exhaust temperature when cylinder power > 130 kW. See Pt.4 Ch.3 Sec.1 E103 for possible omission of this requirement.

5) Alarm with request for load reduction to be given in case of excessive average exhaust gas temperature. This applies when there is no separate sensor before T/C, and the T/C is served by a group of cylinders > 1000 kW. The alarm level shall be set with due considerations to safe operation of T/C.

6) Applicable only when the T/C is served by a group of cylinders > 1000 kW and if no individual exhaust gas temperature for each cylinder.

7) Temperature measurement after turbine is accepted for T/C served by a group of cylinders < 2500 kW, provided that the alarm levels are set to safeguard the T/C. The alarm level shall be substantiated by the T/C manufacturer.

8) When driving in barred speed range in excess of approved maximum duration set by torsional vibration level in the shafting (where deemed necessary, limitations in duration will be given in connection approval of torsional vibration analysis). This safety device will only be required when so stated in connection with approval of torsional vibration analysis.

9) For trunk engines:
Either a) 'Oil mist concentration' or b) 'Temperature monitoring of main- and crank bearings combined with crank case pressure monitoring'. Other methods, like e.g. ´crank case pressure monitoring´ combined with either 'Oil splash temperature deviation' or 'Metal particle detection' (shunt to filter), may be approved provided their capability with regard to risk of false alarms and speed of detection is proven.
For crosshead engines:
Oil mist concentration or temperature monitoring of main-, crank- and crosshead bearings together with other relevant positions, or other methods may be applied as additional measures of preventing crankcase explosions. These additional measures are optional

10) Applicable to engines of 2250 kW and above, or with cylinder diameter > 300 mm.

11) Oil mist detectors shall be type tested in accordance with IACS UR M67.

Italic text in table is equivalent to Pt.4 Ch.3 Sec.1 Table E1

Table A2 Control and monitoring of propulsion turbines					
System	*Item*	*Gr 1 Indication alarm load reduction*	*Gr 2 Automatic start of stand-by pump with alarm*	*Gr 3 Shut down with alarm*	*Comment*
1.0 Lubricating oil	*Inlet pressure (after filter)*	*IR, IL, LA*	*AS*	*SH* [1)]	
	Inlet temperature	*IR, HA*			
	Filter differential pressure	*IR, HA*			
	Level in system tank	*LA*			
2.0 Bearings	*Bearing temperature*	*IR, HA*			
3.0 Turbine speed	*Overspeed*	*LR*		*SH*	*LR or SH, if applicable, to be activated automatically*
4.0 Condenser system	*Vacuum*	*IR, LA*		*SH*	
	Vacuum pump stopped		*AS*		
	Level	*IR, HA*	*AS*	*SH*	
	Level	*IR, LA*			*If non-cavitating condensate pump*
	Salinity	*HA*			
5.0 Cooling water (main condenser)	*Inlet/outlet differential pressure*	*IR, LA*	*AS*		
6.0 Slow turning arrangement	*Overspeed*			*SH*	
7.0 Gland steam	*Inlet pressure to turbine*	*IR, LA, HA*			
	Exhaust fan stopped	*A*			
8.0 Hydraulic system	*Pressure*	*IR, LA*	*AS*		
9.0 Vibration	*Level*	*HA*		*SH*	
10.0 Rotor	*Axial displacement*	*IR, HA*		*SH*	

Gr 1: Sensor(s) for indication, alarm, load reduction (common sensor permitted but with different set points and alarm shall be activated before any load reduction)
Gr 2: Sensor for automatic start of standby pump
Gr 3: Sensor for shut down.

IL = Local indication – (presentation of values) in vicinity of the monitored component
IR = Remote indication – (presentation of values) in engine control room or another centralized control station such as the local platform/manoeuvring console
A = Alarm activated for logical value
LA = Alarm for low value
HA = Alarm for high value
AS = Automatic start of standby pump with corresponding alarm
LR = Load reduction, either manual or automatic, with corresponding alarm
SH = Shut down with corresponding alarm. May be manually (request for shut down) or automatically executed if not explicitly stated above.

For definitions of Load reduction (LR) and Shut down (SH), see Pt.4 Ch.1 of the Rules for Classification of Ships.

1) The shut down shall be so arranged as not to prevent admission of steam to the astern turbine for braking.

Italic text in table is equivalent to Pt.4 Ch.3 Sec.1 Table E1

Table A3 Control and monitoring of main steam and feed water installation			
	Gr 1 *Alarm* *Load reduction*	*Gr 2* *Automatic start of stand-by pump with alarm* [1]	*Gr 3* *Shut down of boiler with alarm*
1.0 Water system			
Water level, high	HA		
Water level, high	HA		SH [7]
Water level, low	LA		
Water level, low			SH
Water circulation [2]			SH
2.0 Combustion air			
Supply fan stopped			SH
3.0 Rotating air heater			
Motor stopped	A		
4.0 Uptake gas			
Gas temperature [3]	HA		
5.0 Fuel oil system			
Fuel oil pressure	LA	AS	
Fuel oil temperature, or viscosity [4]	LA, HA		
6.0 Oil burner, atomising medium			
Atomising medium, pressure	LA		
7.0 Steam system			
Steam pressure,	LA, HA, LR		
Steam temperature [5]	HA		
8.0 Ignition/flame			
Failed ignition and/or flame failure			SH
9.0 Feed water system			
Atmospheric drain tank, level	LA, HA		
Deaerator, level	LA, HA		
Deaerator, pressure	LA, HA		
10.0 Feed water			
Temperature [8]	HA		
Pressure	LA	AS	
Feed water temperature	HA		
11.0 High pressure feed water			
Level	HA		
12.0 Fresh water generator			
Fresh water outlet, salinity	HA [6]		

Table A3 Control and monitoring of main steam and feed water installation (Continued)

	Gr 1 *Alarm* *Load reduction*	*Gr 2* *Automatic start of stand-by pump with alarm* [1]	*Gr 3* *Shut down of boiler with alarm*

Gr 1: Common sensor for alarm and load reduction, alarm shall be activated prior to load reduction
Gr 2: Sensor for automatic start of standby pump
Gr 3: Sensor for shut down

LA = Alarm for low value
HA = Alarm for high value
A = Alarm activated
AS = Automatic start of standby pump with alarm
LR = Load reduction, turbine slow down
SH = Shut down

1) To be provided when standby pump is required.
2) To be provided for forced circulation boilers
3) To be provided for fire detection
4) To be provided for heavy fuel oil
5) For superheated and de superheated steam outlet (external de super heaters)
6) Automatic stop of generator or by-passing of consumers
7) Turbine shut down
8) Outlet of ejector cooler/gland condenser

For definitions of Load reduction (LR) and Shut down (SH), see Pt.4 Ch.1 Sec.1 of the Rules for Classification of Ships.

Table A4 Control and monitoring of shafting, propeller, gear, clutch and elastic couplings				
	Gr 1 Indication alarm load reduction	*Gr 2 Automatic start of stand-by pump with alarm* [1]	*Gr 3 Shut down with alarm*	*Comment*
1.0 Shafting				
Separate thrust bearings, temperature	*IL or IR, HA*			*To be provided for shaft power > 5000 kW. Sensor to be placed in the bearing metal or for pads, in the oil outlet. Maximum permissible temperature to be marked on the indicators.*
Oil lubricated fluid film bearings, temperature	*IL or IR, HA*			*To be provided for shaft power > 5000 kW. Sensors to be located near the bearing surface at the area of highest load. Maximum permissible temperature to be marked on the indicators.*
Stern tube lubricating oil tank, level	*LA*			
Stern tube lubricating oil, pressure or flow	*LA*			*Applicable to forced lubrication.*
2.0 Additional requirements for TMON				
Aft stern tube bearing, temperature	*HA*			*See 301*
3.0 Servo oil for CP-propeller				
Pressure	*IL, IR, LA*	*AS*		*The indicators shall be able to show sudden peaks in servo pressure.*
Level	*IL, LA*			
Differential pressure over filter	*HA*			
4.0 Gear bearing and lubricating oil				
Oil lubricated fluid film bearings (axial and radial) temperature	*IR, HA*			*Applicable for gears with a total transmitted power of 5 MW or more.*
Thrust bearing, temperature	*IR, HA, LR*			*Applicable for gears with a total transmitted power of 5 MW or more. Sensor to be placed in the bearing metal or for pads in the oil outlet.*
Lubricating oil, pressure	*IL, IR, LA*	*AS*	SH	*At bearings and spray if applicable.* Shut down or clutch disengagement.
Lubricating oil, temperature	*IL or IR, HA*			*At inlet to bearings, i.e. after cooler.*
Lubricating oil, temperature	*IL or IR*			*In sump, or before cooler*
Sump level [2]	*IL or IR*			*For splash lubricated gears.*
5.0 Integrated clutch activating media				
Hydraulic oil pressure	*IL, IR, LA,* LR	*AS*	*SH*	*SH means either declutching or engine stop*
6.0 Twist of elastic couplings				
Angular twist amplitudes	*IR, HA*		*SH*	*Applicable when failure of the elastic element leads to loss of torque transmission.* [3]
Mean twist angle	*IR, HA*			

Table A4 Control and monitoring of shafting, propeller, gear, clutch and elastic couplings (Continued)

Gr 1: Common sensor for indication, alarm, load reduction (common sensor permitted but with different set points and alarm shall be activated before any load reduction)
Gr 2: Sensor for automatic start of standby pump
Gr 3: Sensor for shut down.

IL = Local indication (presentation of values), in vicinity of the monitored component
IR = Remote indication (presentation of values), in engine control room or another centralized control station such as the local platform/manoeuvring console
A = Alarm activated for logical value
LA = Alarm for low value
HA = Alarm for high value
AS = Automatic start of standby pump with corresponding alarm
LR = Load reduction, either manual or automatic, with corresponding alarm, either slow down (r.p.m. reduction) or alternative means of load reduction (e. g. pitch reduction), whichever is relevant.
SH = Shut down with corresponding alarm. May be manually (request for shut down) or automatically executed if not explicitly stated above.

For definitions of Load reduction (LR) and Shut down (SH), see Pt.4 Ch.1 of the Rules for Classification of Ships.

1) To be provided when standby pump is required.
2) For gears with totally transmitted power of 500 kW or less, dipstick inspection is considered adequate.
3) May be omitted if the vessel is equipped with a "take me home" device, e.g. a electric motor connected to the gearbox (so-called PTH or PTI). Exemption may also be accepted for couplings that are of a design that enables the full torque to be transmitted in the event of failure of the elastic elements. Such emergency claw devices are not "getting home" devices, but only meant for temporary emergency in order to prevent loss of manoeuvrability in harbours, rivers, etc

Italic text in table is equivalent to Pt.4 Ch.4

Table A5 Control and monitoring of auxiliary engines

System	*Item*	*Gr 1 Indication alarm load reduction*	*Gr 2 Automatic start of stand-by pump with alarm* [1]	*Gr 3 Shut down with alarm*	*Comment*
1.0 Fuel oil system	*Leakage from jacketed high pressure pipes*	*A*			*Level monitoring of leakage tank or equivalent*
	Fuel oil pressure	LA	AS		When fuel oil treatment system is provided
	High/Low temperature or viscosity of heavy fuel oil	A			
	Common rail fuel oil pressure	*LA*			
2.0 Lubricating oil system	*Lubrication oil to main bearings, inlet pressure*	*IR or IL, LA, LR*	*AS*	*SH*	Automatic shut down for electric power generating engines *LR is accepted as alternative to SH for auxiliary engines other than driving generators*
	Lubrication oil to main bearings, inlet temperature	*IR or IL, HA*			
	Common rail servo oil pressure	*LA*			
3.0 Turbocharger system	*Speed of turbocharger*	*IR or IL, HA*			*Applicable only when the T/C is served by group of cylinders > 1000 kW*

Table A5 Control and monitoring of auxiliary engines (Continued)					
4.0 Cylinder cooling medium	*Cylinder cooling inlet pressure or flow*	*IR or IL, LA*	*AS*		*Monitoring of expansion tank level, with alarm at low level, is an acceptable alternative for engines with cylinder power < 130 kW*
	Cylinder cooling outlet temperature	*IR or IL, HA, LR*		*SH*	Automatic shut down for electric power generating engines *LR is accepted as alternative to SH for auxiliary engines other than driving generators*
5.0 Starting air system	Start air pressure	LA			
6.0 Exhaust gas system	*Exhaust gas temp after each cylinder* 2)	*IR or IL, HA, LR* 3)			*SH may replace LR for electric power generating engines*
	Exhaust gas temp after each cylinder. Deviation from average 2)	*IR or IL, HA, LR*			*Chosen LR depends on permissible misfiring condition.* *SH may replace LR for electric power generating engines*
	Exhaust gas temp before T/C 4), 5)	*IR or IL, HA, LR*			*The LR is only required when the T/C is served by group of cylinders > 2500 kW. SH may replace LR for electric power generating engines*
7.0 Hydraulic oil system	*Leakage from jacketed high pressure pipes for hydraulic operation of valves*	*A*			*Level monitoring of leakage tank or equivalent*
8.0/9.0 engine speed/direction of rotation	*Engine speed*	*IR*			*For engines other than for electric power generation, local indication is an acceptable alternative*
	Over speed protection			*SH*	
10.0 Crankcase explosive condition 6) 7)	*Oil mist detection* 8)	HA		*SH*	One oil mist detector having two independent outputs for detecting alarm and shut-down is acceptable.
	Other systems than oil mist detection	*LR*		*SH*	*LR is accepted as alternative to SH for auxiliary engines other than driving generators*

Table A5 Control and monitoring of auxiliary engines (Continued)

Gr 1: Sensor(s) for indication, alarm, load reduction (common sensor permitted but with different set points and alarm shall be activated before any load reduction)
Gr 2: Sensor for automatic start of standby pump
Gr 3: Sensor for shut down.

IL = Local indication (presentation of values), in vicinity of the monitored engine component or system
IR = Remote indication (presentation of values), in engine control room or another centralized control station such as the local platform/manoeuvring console
A = Alarm activated for logical value
LA = Alarm for low value
HA = Alarm for high value
AS = Automatic start of standby pump with corresponding alarm
LR = Load reduction, either manual or automatic, with corresponding alarm
SH = Automatic shut down with corresponding alarm.

For definitions of Load reduction (LR) and Shut down (SH), see Pt.4 Ch.1 of the Rules for Classification of Ships.

1) To be provided when stand-by pump is required.
2) Individual exhaust temperature when cylinder power > 130 kW. See Pt.4 Ch.3 Sec.1 E103 for possible omission of this requirement.
3) Alarm with request for load reduction to be given in case of excessive average exhaust gas temperature. This applies when there is no separate sensor before T/C, and the T/C is served by a group of cylinders > 1000 kW. The alarm level shall be set with due considerations to safe operation of T/C.
4) Applicable only when the T/C is served by a group of cylinders > 1000 kW and if no individual exhaust gas temperature for each cylinder. The alarm level must be set with due considerations to safe operation of T/C.
5) Temperature measurement after turbine is accepted for T/C served by a group of cylinders < 2500 kW, provided that the alarm levels are set to safeguard the T/C. The alarm level shall be substantiated by the T/C manufacturer.
6) Either a) 'Oil mist concentration' or b) 'Temperature monitoring of main- and crank bearings combined with crank case pressure monitoring'. Other methods, like e.g. ´crank case pressure monitoring´ combined with either 'Oil splash temperature deviation' or 'Metal particle detection' (shunt to filter), may be approved provided their capability with regard to risk of false alarms and speed of detection is proven.
7) Applicable to engines of 2250 kW and above, or with cylinder diameter > 300 mm.
8) Oil mist detectors shall be type tested in accordance with IACS UR M67.

Italic text in table is equivalent to Pt.4 Ch.3 Sec.1 Table E2

Table A6 Control and monitoring of auxiliary turbines

System	*Item*	*Gr 1 Indication Alarm*	*Gr 2 Automatic start of stand-by pump with alarm*	*Gr 3 Shut down with alarm*	*Comment*
1.0 Lubricating oil	*Inlet pressure (after filter)*	*IR or IL, LA*		*SH*	
	Inlet temperature	IR, HA			
	Level in system tank	*LA*			
2.0 Turbine speed	*Overspeed*			*SH*	*SH, if applicable, to be activated automatically, see* Pt.4 Ch.3 Sec.3 E200
3.0 Condenser system	*Pressure*	*IR, HA,*		*SH*	
	Level	HA	AS		If vacuum condenser.
4.0 Steam inlet	*Pressure*	*IR or IL, LA*[1)]			
5.0 Rotor	*Axial displacement*	*IR, HA*		*SH*	*When driving electric generator.*

Gr 1: Sensor(s) for indication and alarm
Gr 2: Sensor for automatic start of standby pump
Gr 3: Sensor for shut down

IL = Local indication – (presentation of values) in vicinity of the monitored component
IR = Remote indication – (presentation of values) in engine control room or another centralized control station such as the local platform/manoeuvring console
A = Alarm activated for logical value
LA = Alarm for low value
HA = Alarm for high value
AS = Automatic start of standby pump with corresponding alarm
SH = Shut down with corresponding alarm. May be manually (request for shut down) or automatically executed if not explicitly stated above.

For definitions of Load reduction (LR) and Shut down (SH), see Pt.4 Ch.1 of the Rules for Classification of Ships.

1) Only for turbines driving generators, may be omitted if LA for boiler steam pressure is provided.

Italic text in table is equivalent to Pt.4 Ch.3 Sec.3 Table E2

Table A7 Control and monitoring of auxiliary boiler			
	Gr 1 Alarm	*Gr 2 Automatic start of stand-by pump with alarm* [1]	*Gr 3 Shut down with alarm*
1.0 Water, not double pressure boilers			
Water level	*LA, HA*		
Water level, low			*SH*
2.0 Water, double pressure boilers			
Water level, primary system	*LA*		*SH*
Water level, secondary system	*LA, HA*		
3.0 Circulation			
Circulation stopped [1]	A	AS	*SH*
4.0 Combustion air supply			
Fan stopped			*SH*
5.0 Heavy fuel oil system			
Temperature or viscosity [2]	*LA, HA*		
6.0 Steam			
Steam pressure	*HA*		*SH* [3]
Steam temperature [4]	*HA*		
7.0 Uptake			
Uptake temperature [5]	HA		
8.0 Feed water system			
Feed water, salinity [6]	HA		
Feed water, oil contamination [7]	HA		
9.0 Condenser			
Condenser pressure	HA		
10.0 Ignition/flame			
Ignition/flame failure [8]			*SH*

Gr 1: Sensor for alarm
Gr 2: Sensor for automatic start of standby pump
Gr 3: Sensor for shut down

LA = Alarm for low value
HA = Alarm for high value
A = Alarm activated
AS = Automatic start of standby pump with alarm
SH = Shut down

1) Forced circulation boilers.
2) For heavy fuel oil.
3) When the automatic control system does not cover the entire load range from zero load.
4) For superheated steam > 350°C.
5) When heat exchangers are integral with the boiler. For fire detection.
6) Boiler pressure > 20 bar.
7) When steam is used in fuel and lubrication oil heat exchangers.
8) Separate monitoring and fuel shut off for each burner.

For definitions of Shut down (SH), see Pt.4 Ch.1 of the Rules for Classification of Ships.

Italic text in table is equivalent to Pt.4 Ch.7 Sec.7 Table B1.

Table A8 Control and monitoring for electrical power plant	
	Gr 1 *Alarm*
1.0 Generator	
Lubricating oil, pressure [1)]	LA
Voltage	LA, HA
Frequency	LA
Disconnection of nonessential consumers	A

Gr. 1: = Sensor for alarm

LA = Alarm for low value
HA = Alarm for high value
A = Alarm activated

1) To be provided if separate system.

Table A9 Monitoring of miscellaneous objects		
Item	*Alarm*	*Comments*
Bilges and bilge wells Level, engine room, high	 x	2 independent alarm circuits. Minimum 2 detectors.
Purifiers Temperature, oil inlet, high Temperature, oil inlet, low Waterseal, loss	 x x x	For heavy fuel oil.
Soot-blowers, sequence stopped	x	
Automatic control system, power failure Alarm and safety system, power failure Remote control system, power failure	x x x	Electric, pneumatic, hydraulic.
Fire alarm systems, failure	x	

Table A10 Monitoring of tanks		
Item	*Alarm*	*Comments*
Sludge and drain tanks, level, high	x	When automatic pumping up of tanks is arranged, alarm shall be released if the level exceeds safe level.
Service tanks, level, low	x	
Expansion tanks, level, low	x	
Circulating tanks, level, low	x	
Fuel oil drain collecting tank, level, high	x	

B. Arrangement on the Bridge

B 100 General

101 Individual alarms are required for:

— automatic shutdown of main boiler
— automatic shutdown and/or slowdown of propulsion machinery
— request for manual shutdown and/or slowdown of propulsion machinery
— power failure bridge alarm system
— failure in the remote control systems with respect to propulsion machinery, including controllable pitch propeller if arranged
— failure in the remote control systems with respect to steering
— low starting air pressure for reversible propulsion engines.

102 The propulsion plant shall be restarted after a blackout, either manually from the navigating bridge or automatically. When manual starting from the navigating bridge is arranged, an indication shall be provided when the propulsion can be restarted, i.e., when all systems are in normal operating condition.

The starting arrangement shall be simple to operate.

Guidance note:

Steam propulsion plants are exempted from these requirements.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

103 Resetting of the propulsion machinery safety system shall be arranged when it is activated at black out. The reset action may either be automatic, or manually activated from the bridge, e.g. by bringing the manoeuvring lever to stop position. The reset shall only be possible when the all applicable parameters are in normal condition.

C. Arrangement in the Engine Room

C 100 General

101 Indicating instruments, alarm displays and manoeuvring devices shall be centralised in a convenient position, in or adjacent to the engine room.

Guidance note:
The layout of instruments in the control desk should comply with generally accepted ergonomic principles. Red lamps should be used only as alarm lamps.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

D. Control of Propulsion Machinery from the Navigation Bridge (SOLAS Ch. II-1/49)

D 100 General

101 In addition to the general requirements in Pt.4 Ch.1 the following shall be complied with.

102 Under all sailing conditions, including manoeuvring, the speed, direction of thrust and, if applicable the pitch of the propeller shall be fully controllable from the navigating bridge.

103 Such remote control shall be performed by a single control device for each independent propeller, with automatic performance of all associated services, including where necessary, means of preventing overload of the propulsion machinery.

104 The main propulsion machinery shall be provided with an emergency stopping device on the navigating bridge independent of the navigating bridge control system.

105 Propulsion machinery orders from the navigating bridge shall be indicated in the main machinery control room or at the propulsion machinery control position as appropriate.

106 Remote control of the propulsion machinery shall be possible only from one location at a time; at such locations interconnected control positions are permitted. At each location there shall be an indicator showing which location is in control of the propulsion machinery. The transfer of control between the navigating bridge and machinery space shall be possible only in the main machinery space or in the main machinery control room. The system shall include means to prevent the propelling thrust from altering significantly when transferring control from one location to another.

107 It shall be possible for all machinery essential for the safe operation of the ship to be controlled from a local position, even in the case of failure in any part of the automatic or remote control systems.

108 The design of the remote automatic control system shall be such that in case of its failure an alarm will be given, and the present speed and direction of thrust of the propeller is maintained until local control is in operation.

109 Indicators shall be fitted on the navigating bridge for:

a) propeller speed and direction of rotation in the case of fixed pitch propellers, or

b) propeller speed and pitch position in the case of controllable pitch propellers.

110 The number of consecutive automatic attempts which fail to produce a start shall be limited to safeguard sufficient starting air pressure. An alarm shall be provided indicating low starting air pressure set at a level which still permits starting operations of the propulsion machinery.

Guidance note:
Air should be understood as any stored energy.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

E. Electric Power Supply

E 100 General

101 Arrangements shall be provided to prevent overloading of the generating sets.

Guidance note:

A generating set consists of one electrical generator and its prime mover.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

102 Standby generating sets are normally to have separate cooling water and lubricating oil pumps. Alternatively, automatic start of standby pumps shall be arranged when they also serve other generating sets.

E 200 Secondary distribution systems

201 For essential consumers with power supply from secondary distribution systems, precautions against power failure shall be similar to those taken for units having power supply from the main system. E.g., the following means may be applied:

— adequate automatic emergency lighting for access to standby transformer for the lighting system and operating gear for manual connection
— automatic connection of standby transformer
— parallel connection of a sufficient number of transformers and arrangement for selective disconnection
— automatic connection of emergency source of power
— dividing the system in two or more circuits with automatic switchover.

In this context, essential consumers are units and equipment necessary for manoeuvring of the ship, including navigation lights and sufficient lighting (either as part of the normal lighting or as separate emergency lighting) in the engine room, on the bridge, in the chart room, in all passageways and stairways of the accommodation.

F. Fire Safety

F 100 General

101 Where the Society finds it necessary, oil fuel and lubricating oil pressure pipelines shall be screened or otherwise suitably protected to avoid as far as practicable oil spray or leakages on to hot surfaces or into machinery air intakes. Fuel oil injection pipes on all engines, irrespective of cylinder bore, shall be effectively shielded and secured. The number of joints in such piping systems shall be kept to a minimum and, where practicable, leakages from high pressure oil fuel pipes shall be collected and safe drainage to a collecting tank shall be provided (see Pt.4 Ch.3 Sec.1 Table E1 and Table E2).

G. Special Requirements for Ships less than 300 Gross Tonnage with Propulsive Output less than 1000 kW per Engine

G 100 General

101 The requirements in A, B, C, E and F do not apply.

G 200 Extent of monitoring

201 An alarm shall be initiated for the following conditions:

— fire in engine room
— bilge level, high
— power failure, alarm and remote control system
— for drivers, power transmissions and driven units according to Pt.4 Ch.3, Pt.4 Ch.4 and Pt.4 Ch.5.

Main and auxiliary engines: See Pt.4 Ch.3.

G 300 Arrangement on the bridge and engineers' accommodation

301 All alarms in the engine room shall initiate an alarm on the navigating bridge, and engineers' accommodation individual or collective.

G 400 Fire safety

401 Fuel oil injection pipes on all engines, irrespective of cylinder bore, shall be effectively shielded and clamped.

G 500 Fire alarm system

501 The ship shall have a fire alarm system that shall be initiated in the event of fire in the engine room and or boiler room.

Guidance note:

The fire detectors may be arranged as a single loop provided it is normally closed.

The fire detectors loop(s) may be connected to the machinery alarm system provided separate indication on the navigating bridge is arranged.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

SECTION 4
CLASS NOTATION ECO

A. General Requirements

A 100 Application

101 This section applies to machinery operation with continuous supervision from a centralised control station. The control station shall provide control and monitoring devices necessary to make the machinery operation as safe and effective as it would be under direct supervision.

B. Control Station

B 100 Arrangement

101 The arrangement shall be such that all supervisions and manual operations which are necessary for safe operation of the machinery plant can be carried out at the control station. This will imply that stopping of machinery, starting of stand-by units etc. in case of machinery faults shall be possible from the control station if not automatically carried out.

102 The control station shall be located in the engine room or in its close proximity. The control station may be arranged on or adjacent to navigating bridge provided it does not interfere with the navigating bridge control positions, and an additional centralised control position is arranged in or adjacent to the engine room. This control position shall permit some machinery control and monitoring facilities as required in A101.

C. System Arrangement

C 100 General

101 The requirements of Sec.2 shall be complied with to the extent applicable.

C 200 Alarm system

201 A system of alarm displays shall be provided in the centralised control station for easy identification of machinery faults.

202 An extension alarm system to the navigation bridge and the engineers' accommodation is not required.

C 300 Safety system

301 The safety systems specified in Sec.2 D can be omitted with the exception of the safety functions required in Pt.4. Corrective actions at machinery faults are presumed to be carried out manually.

C 400 Remote control system

401 Propulsion machinery shall be arranged for remote control from the centralised control station. The requirements given in Sec.2 and Ch.1 Sec.5 shall be complied with to the extent applicable.

C 500 Fire alarm system

501 The fire alarm system shall satisfy the requirement of Sec.2 E.

D. Extent of Monitoring

D 100 General

101 Monitoring of machinery shall comply with the requirements in Sec.3 and Pt.4 Chs.3, 4 and 5.

SECTION 5
SURVEY

A. General

A 100 Trials

101 Upon completion of the installation, trials shall be carried out alongside quay and at sea in the presence of the surveyor.

102 The sea trials should be reserved solely for testing of the automatic and the remote control systems, and the fire alarm system. Other tests should be completed alongside quay.

103 The sea trials shall include a four hours continuous operation with unattended machinery spaces.

Agreement shall be made in advance in each case for personnel that will be present in the control room.

Guidance note:

Personnel for ordinary upkeep and control of the machinery are not to be present in the engine room. Special measurements can be carried out according to agreement, e.g. noise measurements.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

104 A detailed test programme, including expected test results, shall be prepared and submitted for approval well in advance of the trials. The programme shall be kept onboard, all filled in and signed by the surveyor upon completion of the trials.

105 Recording of important automatically controlled parameters may be required as part of the testing.

A 200 Monitoring system

201 Failure conditions shall be simulated as realistically as possible, preferably by letting the monitored parameters exceed the alarm and safety limits. Alternatively, when lack of space on an engine prevents the installation of test valves for pressure transmitters and or thermometer wells for analogue temperature elements, a system for ensuring that both electronic and sensor system part is in order without the use of pressure or temperature calibrators may be accepted. This system shall be quick and easy to use, and be developed and documented by the engine manufacturer. It may only be used in connection with sensors with an analogue value output. The system shall be approved by DNV before testing commences.

The alarm and safety limits shall be recorded in the test programme.

Guidance note:

Test methods:

1) Analogue sensors may be calibrated by in situ comparison to indicating instruments installed close to the sensors. When the deviation in reading is more than 5%, a more precise calibration is necessary.
2) Changing set point to the present system value during normal running may be an acceptable system test method for computer based systems only, provided sensor connection check has been performed separately.
3) It will not be acceptable to change a set point by e.g. potentiometer adjustment to simulate fault conditions.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 Any calibration of sensors prior to installation onboard shall be approved by the surveyor.

A 300 Automatic control systems

301 Automatic control systems shall be tested by varying the parameters having effect upon the controlled process. As far as practicable it shall be verified that all normal control ranges are covered.

Guidance note:

Observation of the automatic control system performance during the tests specified under B for the remote control system will normally be accepted as adequate testing.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

A 400 Electric power generating system

401 At bridge control and half speed ahead, simulate a fault condition causing automatic stop of electric power generator.

402 For plants with automatic start and connection of stand-by unit, check restart of all essential auxiliaries, and that the bridge control system is again operative without manual intervention in the engine room.

403 For plants with more than one generator running in parallel, it shall be checked that the stopped unit is automatically disconnected from the switchboard, and that the generator capacity of the remaining units is sufficient for propulsion and steering functions after tripping of non-essential consumers.

404 Verify that it is possible to start the propulsion machinery from the bridge unless automatically started after black-out. (see Sec.3 B103).

A 500 Fire alarm system

501 After installation the system shall be tested under varying conditions of engine operation and ventilation. (SOLAS Ch. II-2/14.3).

Guidance note:

The test should be performed with all machinery and ventilation running in normal sea going conditions during the sea trial by means of smoke released in positions of high fire risk.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B. Testing of Remote Control Systems

B 100 General requirements for testing of remote control systems

101 Testing of the remote control system for the propulsion machinery shall be carried out at sea. Prior to testing, the propulsion machinery shall run for at least 1 hour.

102 All tests included in the test programme for the remote control system shall be carried out without manual assistance from the engine room, and all systems shall be in operation as normal for unattended machinery space.

103 The remote control system shall be tested at sea to demonstrate stable control and operation of the propulsion system with its necessary auxiliaries over the full operating range, and regardless of the type of propulsion. It shall be demonstrated that necessary ramping / controller functions are implemented to ensure that any operation of the manoeuvring levers do not cause shutdown, instability or damage to the propulsion machinery or power generating units.

104 The different tests described in section B200-600 may be seen as the expected functional test scope for certain propulsion remote control systems, but other equivalent tests may be more appropriate depending on the actual installation onboard.

B 200 Ships with fixed pitch propeller

201 The test programme should as a minimum include the following manoeuvres:

- from stop to dead slow ahead. Proceed stepwise to full ahead. Before each step increase, the r.p.m. of the previous setting shall have reached its steady state condition
- from approximately 2/3 of full speed ahead, go quickly to slow astern. Proceed stepwise to full astern
- stop
- after approximately 5 minutes stop, start ahead
- when the ship has reached approximately 2/3 of full speed ahead, go quickly to half astern
- when the ship is «dead in the water», go quickly to full ahead
- when the ship has reached approximately 2/3 of full speed ahead, go quickly to dead slow ahead
- when the r.p.m. is nearly stabilised, go quickly to full ahead
- when the ship has reached approximately half speed ahead, go to stop and back to dead slow ahead within 1 second.

202 With air compressors stopped, make 12 starts with the remote control system, alternating between ahead and astern. This applies to reversible engines using starting air for re-start.

203 Testing of possible automatic restarts. Go to ahead and let the engine repeat the predetermined starting at tempts. Go to stop. Return to ahead and check that an additional starting attempt is effected. This applies to diesel engines only.

204 Simulate failures causing automatic load reduction or stop of the engine. Cancel if possible this safety action and show that the engine is again controllable from the bridge.

205 During bridge control at half speed ahead, cut out power supply to the remote control system. No immediate critical situation shall arise. Switch over to standby manual control in the engine room, and show that this control system functions satisfactorily.

206 At approximately 2/3 of full speed ahead, test the emergency stop system.

B 300 Ships with controllable pitch propeller

301 The tests specified below apply to remote control systems with a single manoeuvring lever on the bridge.

For plants with dual lever control, one for r.p.m. and one for pitch, the tests to be carried out will be considered in each case.

— start the engine, from the bridge if possible, and go to dead slow ahead. Proceed stepwise to full ahead. Before each step increase, the r.p.m. of the previous setting shall have reached its steady state condition
— from approximately 2/3 of full speed ahead, go quickly to dead slow astern. Proceed stepwise to full astern
— go to neutral position
— after approximately 5 minutes in neutral position, go to ahead
— when the ship has reached approximately 2/3 of full speed ahead, go quickly to 2/3 of full astern
— when the ship is «dead in the water», go quickly to half ahead.

302 Simulate failures causing automatic load reduction or stop of the engine. Cancel if possible this safety action and show that the engine is again controllable from the bridge.

303 During bridge control at half speed ahead, cut out power supply to the remote control system. No immediate critical situation shall arise. Switch over to standby manual control in the engine room, and show that this control system functions satisfactorily.

304 At approximately 2/3 of full speed ahead, test the emergency stop system.

B 400 Steam turbine ships

401 The test programme should as a minimum include:

— from stop to dead slow ahead. Proceed stepwise to full ahead. Before each step increase, the r.p.m. of the previous setting shall have reached its steady state condition
— from full speed ahead, reduce stepwise to stop with the same intervals
— from stop, increase stepwise to full astern. Run until the ship has reached a fair speed astern
— from full astern, reduce stepwise to stop
— show that the automatic turning arrangement operates satisfactorily during the stop period. Go to full ahead
— after approximately 10 minutes full ahead, go quickly to stop
— after approximately 5 minutes stop, go quickly to 2/3 of full astern
— when the ship is «dead in the water», go quickly to full ahead
— when the ship has reached approximately 2/3 of full speed ahead, go quickly to 2/3 of full astern and run until the ship is «dead in the water»
— go to full ahead. When the ship has reached approximately 2/3 of full speed ahead, go to stop and back to dead slow ahead within 1 second. Transfer control to the engine room.

402 Repeat the first four manoeuvres using the manoeuvring system in the engine room. Transfer control to the bridge.

403 During bridge control at half speed ahead, cut out power supply to the remote control system. No immediate critical situation shall arise. Switch over to standby manual control in the engine room, and show that this control system functions satisfactorily.

404 Simulate failures causing automatic load reduction or stop of turbines. Cancel, if possible, this safety action and show that the turbines are again controllable from the bridge.

405 At approximately 2/3 of full speed ahead, test the emergency stop system.

B 500 Ships with gas fuelled machinery

501 LNG carriers and other ships with machinery using gas as main fuel shall carry out testing required in A103 and B100 or B200 in the gas operation mode.

Ships with engines operating either as gas engines or as conventional diesel engines shall in addition carry out testing required in B100 or B200 when operating on fuel oil only.

Guidance note:

Machinery with power generated by a combination of gas-only engines and conventional diesel engines, and machinery with engines operating either as gas engines with pilot oil ignition or as conventional diesel engines (DF either-or type) are regarded as machinery using gas as main fuel.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

502 For LNG carriers with steam propulsion and dual fuel boilers the testing required in A103 and B300 may be carried out with boilers fired with fuel oil only.

In addition testing during dual fuel or gas-only mode as specified in Pt.5 Ch.5 Sec.16 C shall be carried out.

503 For LNG carriers with dual fuel engines of the high pressure gas injection type, the testing required in

A103 and B100 may be carried out with fuel oil only. In addition dual fuel operation shall be tested as specified in Pt.5 Ch.5 Sec.16 C.

504 If fuel gas produced by forced vaporisation of LNG is intended to be used during unmanned operation, testing under 401, 402 and 403 shall also include this mode.

B 600 Other installations for boil-off gas handling

601 Gas combustion units (oxidizing units) shall be tested to verify that automatic operation is possible without manual surveillance, except that start and stop may be manually initiated.

602 Re-liquefaction plants for boil-off gas shall be tested to verify that automatic operation is possible without manual surveillance.

C. Testing of Boiler Plant

C 100 Automatic control system for auxiliary boilers

101 The system shall be tested by varying the boiler load as specified in 102. Recording of the following parameters may be required:

— steam pressure (primary and secondary system)
— water level in boiler
— automatic actions such as start and/or stop of burners, alarms, etc.

102 Boilers serving turbogenerators. One boiler in operation:

— increase load from minimum to full load during a period of minimum 15 minutes
— reduce load from full load to minimum during a period of minimum 15 minutes
— increase load suddenly to minimum 50% of full load by connecting one of the greater consumers
— when stationary conditions are reached, reduce load suddenly to minimum.

Parallel operation of two boilers:

— increase load suddenly to minimum 30% of full load, by connecting one of the greater consumers
— when stationary conditions are reached, reduce load suddenly to approximately 5% of full load and keep that load until stationary conditions are reached.

C 200 Automatic control system for main boilers

201 The system shall be tested by varying the boiler load as specified in 202. Recording of the following parameters may be required:

— steam flow (alternatively position of control valve)
— steam pressure
— temperature of superheated steam
— water level in boiler
— water level in condenser and deaerator
— fuel oil temperature or viscosity
— excess of combustion air in exhaust gas.

202 The boiler load shall be varied in accordance with the manoeuvring tests specified in B300. The boiler plant testing may be carried out simultaneously with testing of the remote control system for the main turbines.

C 300 Monitoring system

301 With all burners in operation, the fuel oil supply to one of the burners shall be shut off. Check that the flame detector of this burner is functioning. The remaining burners shall be tested in the same way.

302 With burners in operation, one of the flame detectors shall be shielded. Check that the automatic shutoff valve for fuel oil is operating. The remaining flame detectors shall be tested in the same way.

303 With boiler in operation, simulate a failure causing automatic stop of combustion air fan. Check that the fuel oil supply is shut off.

304 Reduce water level below safety limit and check that fuel oil supply is shut off.

305 Remaining alarms and safety actions shall be initiated by simulating failures as realistically as practicable.