



NEWBUILDINGS
SPECIAL EQUIPMENT AND SYSTEMS – ADDITIONAL CLASS

Alternative Propulsion

JULY 2010

*This chapter has been amended since the main revision (July 2010), most recently in July 2011.
See “Changes” on page 3.*

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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.

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CHANGES

General

The present edition of the rules includes additions and amendments approved by the executive committee as of June 2009 and supersedes the January 2006 edition of the same chapter.

The rule changes come into force as indicated 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This chapter is valid until superseded by a revised chapter.

Amendments July 2011

- **General**

- The restricted use legal clause found in Pt.1 Ch.1 Sec.5 has been added also on the front page. In addition, the layout has been changed to one column in order to improve electronic readability.

- **Sec.1 General Requirements**

- In Table B1 the reference to documentation type “Z030 – System arrangement plan” has been amended to read “Z030 – Arrangement plan”.

Main changes coming into force 1 July 2010

- **General**

- The name of the notation is changed from Emergency propulsion (respectively **EP-1(a%)(+)**, **EP-2(a%)(+)** and **EP-3(a%)(+)**) to Alternative Propulsion (respectively **AP-1(a%)(+)**, **AP-2(a%)(+)** and **AP-3(a%)(+)**).

- Time limitations for engaging the alternative propulsion system is defined:

- **AP-1(a%)(+)**: it shall be possible to engage alternative propulsion system within maximum 30 minutes after failure to the main propulsion prime mover (may include mechanical work)

- **AP-2(a%)(+)**: it shall be possible to engage alternative propulsion system within maximum 5 minutes after failure to the main propulsion system (shall be possible from bridge)

- **AP-3(a%)(+)**: it shall be possible to engage alternative propulsion system within maximum 5 minutes after failure to the main propulsion system (shall be possible from bridge).

- Redundancy requirements for auxiliary systems serving main and alternative propulsion systems are reduced for **AP-1(a%)(+)** and **AP-2(a%)(+)**, so that both systems may be served by one set of auxiliaries in compliance with **1A1** main class requirements.

Corrections and Clarifications

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

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SECTION 1 GENERAL REQUIREMENTS

A. Classification

A 100 Application

101 The rules in this chapter apply to vessels arranged with alternative propulsion in addition to the main propulsion.

Guidance note 1:

The alternative propulsion and main propulsion may have common passive and active components and a failure in any of the common parts may jeopardise both the alternative propulsion and main propulsion. The arrangement chosen for the alternative propulsion has to be considered by the owner, when taking into account the requirements for separation, time required to make it available, and possible restriction in its availability due to the intended area of operation.

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Guidance note 2:

For single propeller plants there will be no additional requirements beyond main class for the steering gear arrangement.

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Guidance note 3:

Pt.6 Ch.2 “Redundant Propulsion” gives generally a higher degree of redundancy and power requirements.

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102 In the context of these rules the term propulsion system incorporates both propulsion and steering function.

103 Compliance with **AP-1(a%)(+)**, **AP-2(a%)(+)** or **AP-3(a%)(+)** notations will, to a varying degree, provide additional measures to enhance the safety of the ship with respect to grounding risk and the probability of reaching safe harbour of refuge after a single failure in the main propulsion system and its auxiliaries. Exceptions are made for failures in acceptable common active and passive components as given by these rules.

The notations for alternative propulsion are only valid with both propulsion systems intact.

Guidance note:

Accordingly it is not intended that the ship may leave harbour without doing repair work after any single failure, except in emergency.

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104 The requirements in these rules are supplementary to the main class rules.

A 200 Class notations

201 Vessels built and tested in compliance with the requirements of the main class rules and this chapter as applicable may be assigned one of the additional class notations given in Table A1.

Notation	Example of arrangement
AP-1(a%)(+)	<p>Main and alternative propulsion is provided by a common propulsion system (one propeller, one shaft and one rudder/steering gear in accordance with main class) with propulsion machinery redundancy, e.g.:</p> <ul style="list-style-type: none"> — two prime movers with clutch, where one of the prime movers may be of power take in type, connected to a common gear, one shaft line and one rudder — double wound electrical motor (armature and excitation), where two prime movers or two windings in operation constitute the main propulsion system and one in operation constitute the alternative propulsion system. <p>See Fig.1.</p>
AP-2(a%)(+)	<ul style="list-style-type: none"> — Main and alternative propulsion is provided by separate systems (two propellers), e.g.: one prime mover, one shaft line and one rudder providing the main propulsion system and one separate azimuth or pod-thruster providing the alternative propulsion system. — two identical propulsion lines, each with its own rudder and steering gear <p>See Fig.2.</p>
AP-3(a%)(+)	<p>Main and alternative propulsion is provided by separate systems as for AP-2(a%)(+), in addition the main and alternative propulsion system and their auxiliaries are separated by watertight A-60 bulkheads (two propellers and two rudders separated).</p> <p>See Fig.3.</p>

202 In addition, for each of the notations given in 201, a suffix **(a%)** shall be added where: **a** is the percentage of the alternative propulsion power relative to the main propulsion power.

203 In arrangements where the main propulsion utilises both main and alternative prime mover this figure is to be used for the main propulsion power when calculating **a**.

204 In addition if specifically requested, for each of the notations given in 201, a suffix **(+)** will be added when holding capability is proven in accordance with Sec.2 A104.

Guidance note:

Principle sketches of the **AP** class notations:

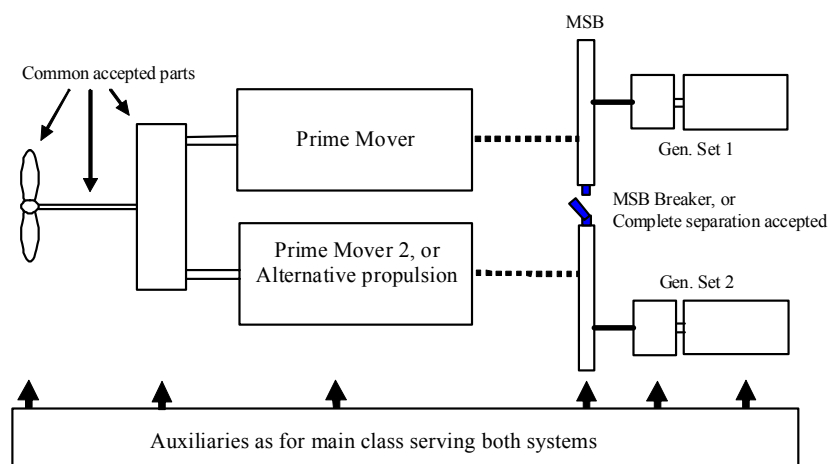


Fig. 1
Principles of AP-1

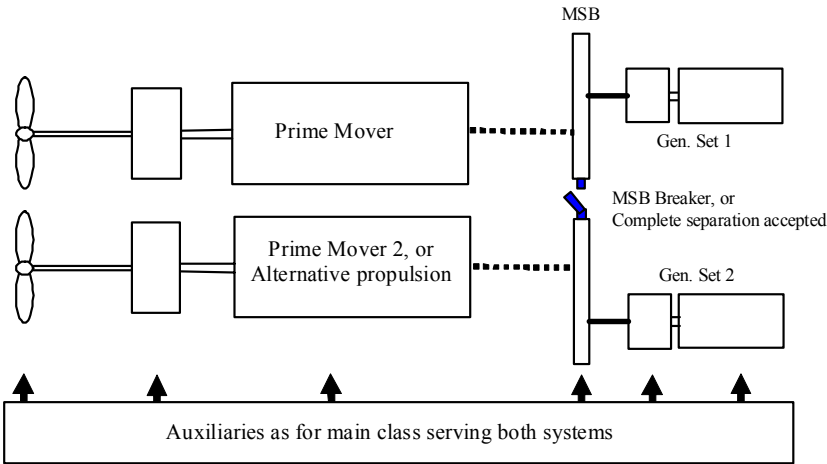


Fig. 2
Principles of AP-2

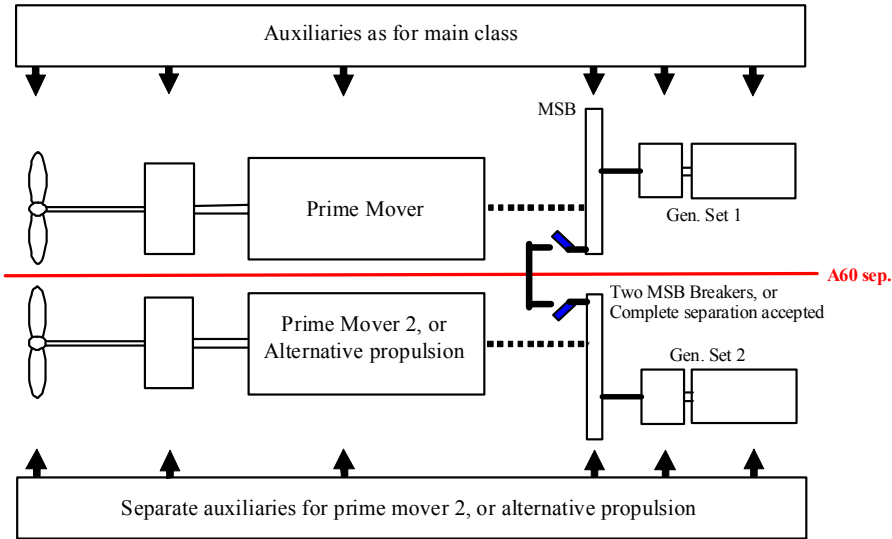


Fig. 3
Principles of AP-3

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B. Documentation

B 100 Documentation requirements

101 Documentation shall be submitted as required by Table B1.

Table B1 Documentation requirements			
System	Documentation type	Additional description	For approval (AP) or For information (FI)
Main and alternative propulsion	Z030 – Arrangement plan	Including main and alternative propulsion capacity, in order to determine suffix (a%).	AP
	Z071 – Failure mode and effect analysis	Including proof that no single failure in required duplicated components and systems will cause loss of both propulsion systems.	AP
	Z140 – Test procedure for quay and sea trial	A test procedure for failure testing at the sea trial, based upon the failure modes identified in the FMEA	AP
	Z240 – Calculation report	Documentation to demonstrate compliance with suffix (+) as described in Sec.2 A104, when requested.	AP

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.

104 FMEA(s) and redundancy test program(s) shall be kept on board. The FMEA(s) and redundancy test program(s) shall at all times be updated to cover alterations to the main and alternative propulsion systems.

C. Certification

C 100 General

101 All equipment shall be certified according to main class requirements.

Guidance note:

Thrusters used for alternative propulsion only, may be certified as propulsion thrusters or dynamic positioning thrusters.

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D. Testing

D 100 Sea trial

101 The main and alternative propulsion systems, with their auxiliaries, shall be subjected to final tests during sea trials, in compliance with the requirements for main class.

102 Additional tests shall be performed to verify the availability and functionality of the main and alternative propulsion systems in accordance with the approved test program required in B104.

103 The time necessary to activate the alternative propulsion system after failure of the main propulsion system shall be demonstrated.

104 A speed trial is to be performed with the alternative propulsion system consisting of at least two legs, each in opposite direction.

Guidance note:

It is not required that the total built-in endurance as required by Sec.2 A106 is demonstrated when time-critical resources are substantiated by adequate tests of rate of consumption.

It is not required that the ability to remain in position as required by Sec.2 A104 is demonstrated.

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SECTION 2 SYSTEM DESIGN

A. General

A 100 Basic requirements

101 The design shall ensure the ability of the main or alternative propulsion system to remain in operation after the occurrence of any single failure, as specified in A200.

102 The alternative propulsion shall be designed for continuous operation.

Guidance note:

Generally no restrictions should be put on the starting intervals of electrical machines. If arranged, the arrangement is subject to approval in each case.

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103 The alternative propulsion system power capacity shall be such that it will enable the vessel to maintain a speed of not less than 7 knots, except for single failures in acceptable common components.

104 In addition, if requested, the alternative propulsion system power capacity shall be such that it, as recovered after any failure (as defined in A200), will enable the vessel to remain in position in wind speed of 17 m/s (33 knots) and significant wave height of 4.5 m (15 ft) with 7.3 seconds mean period, both of which are acting concurrently in the same direction, except for single failures in acceptable common components.

105 The requirement in 104 shall be documented by computation where relevant wave spectrum is utilised or by testing in a model basin, and submitted for information.

106 The vessel shall be able to proceed with the alternative propulsion system for a period of at least 72 hours.

For vessels built for a specific service where the duration of a sea voyage is less than 72 hours, the built-in endurance of the alternative propulsion system may be limited to the duration of the maximum crossing time, but not less than 12 hours.

Guidance note:

In case a vessel is built to proceed with the alternative propulsion system for a period of less than 72 hours, this limitation will be stated in the appendix to the classification certificate.

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107 For the **AP-1(a%)(+)** notation it shall be possible to activate the alternative propulsion system within maximum 30 minutes after failure of the main propulsion system, except for failures in acceptable common active and passive components.

Guidance note:

For the **AP-1(a%)(+)** notation activation of the alternative propulsion may involve manual mechanical work provided that procedures and equipment necessary for activation is carried onboard the vessel, and that activation of the alternative propulsion (with the required capacity) within 30 minutes can be demonstrated at sea trials.

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108 For the **AP-2(a%)(+)** and **AP-3(a%)(+)** notations activation of the alternative propulsion shall not involve mechanical work. It shall be possible to activate the alternative propulsion system from the bridge within maximum 5 minutes after failure of the main propulsion system, except for failures in acceptable common active and passive components.

A 200 Failure modes

201 For the **AP-1(a%)(+)** notation, the defined failure modes include component breakdown, except for failures in acceptable common active and passive components, but excludes the effects of fire and flooding. Acceptable active common components are propeller, shaft and gear or mechanical part of an electric propulsion motor.

202 For the **AP-2(a%)(+)** notation, the defined failure modes include breakdown of active component and systems, but excludes the effects of fire and flooding.

203 For the **AP-3(a%)(+)** notation, the defined failure modes include breakdown of component and systems, including the effects of fire and flooding within each A60 / watertight boundary.

Guidance note:

Loss of stability (e.g. as a result of flooded compartments) is not a relevant failure mode.

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B. System Configuration

B 100 General

101 The basic requirements for providing the alternative propulsion power are as described in Sec.1 A201.

102 For the **AP-3(a%)(+)** notation: Equipment, systems and cabling for the main propulsion system and the alternative propulsion system shall be separated by watertight A-60 bulkheads.

Guidance note:

Restoration of propulsion power within 30 minutes from dead ship condition as required by SOLAS will only be required to be implemented for the main propulsion system.

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B 200 Electrical power generation

201 For propulsion systems, where the propulsion power is produced directly by the main engines, the electrical power required for auxiliary systems shall be generated by a power plant in compliance with main class requirements and in addition separated by use of switch dis-connector(s) or circuit breaker(s) as required by the applicable **AP** notation.

Guidance note:

The electrical power generation for the alternative propulsion power may be arranged as a separate system with no connection to the main electrical system.

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202 For electric propulsion systems, where the propulsion power is produced by generators, the electrical power required for steering and auxiliary systems shall be produced by the electric propulsion generators. Alternatively, the auxiliary electrical power shall be produced by generators in a separate power system in compliance with main class and separated as required by the applicable notation.

203 The vessel shall be capable of operating the main and alternative propulsion system with the emergency switchboard out of operation.

B 300 Electrical power distribution

301 When power for the main and alternative propulsion and their auxiliaries is supplied from one switchboard, the bus-bars of the switchboard shall be arranged for separation into at least 2 sections by switch dis-connector(s) or circuit breaker(s), with the circuits for propulsion and auxiliaries distributed between these sections.

302 When the switchboard is divided into sections, both the main and alternative propulsion systems and their respective auxiliary systems shall be arranged so that at least one of the propulsion systems are capable of being operated, including started, after loss of any single switchboard section.

303 For the **AP-3(a%)(+)** notation: If a common electrical system is provided one bus-tie breaker shall be installed in each separated section. This breaker shall be a circuit breaker capable of breaking the maximum short circuit current in the system.

B 400 Electrical power plant control

401 The power plant control system shall be arranged so that a single failure therein shall not jeopardise both main and alternative propulsion.

C. Auxiliary Systems

C 100 General

101 Main and alternative fire fighting systems shall be arranged in accordance with main class and SOLAS requirements.

102 For the **AP-1(a%)(+)** and the **AP-2(a%)(+)** notations: A set of auxiliary systems in accordance with 1A1 main class requirements is generally accepted for serving both the main and the alternative propulsion system. See C200 to C500 for additional details regarding requirements to specific auxiliary functions.

103 For the **AP-3(a%)(+)** notation: Auxiliary systems for the main and alternative propulsion system shall be duplicated and separated by watertight A-60 bulkheads. See 104 and C200 to C500 for additional details regarding requirements to specific auxiliary functions.

Guidance note:

Cross-over pipes can be accepted provided these are arranged for closing from both sides of separating bulkheads, with one valve on each side of the bulkhead(s) fitted directly or as close as possible to it.

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104 For the **AP-3(a%)(+)** notation: The capacity of the bilge system in each engine room containing propulsion machinery shall be in accordance with the main class rules.

C 200 Fuel oil

201 The transfer and fuel oil pre-treatment systems and tank arrangements shall be able to support the required remaining propulsion capacity in accordance with A106. Fuel pre-treatment shall be understood as all equipment for purification, filtering, heating, and measuring fuel oil.

202 For the **AP-3(a%)(+)** notation. The fuel oil systems including the service tanks shall be installed in each of the separate engine rooms.

C 300 Lubrication oil system

301 Each propulsion system shall have an independent lubrication oil system.

302 The lubrication oil storage and purification system shall be able to support the alternative propulsion capacity in accordance with A106.

C 400 Compressed air system

401 The starting air system shall comply with main class for the main propulsion, and with adequate facilities to enable three starting attempts for the alternative propulsion if this is not part of the main propulsion.

C 500 Ventilation systems

501 For the **AP-1(a%)(+)** and the **AP-2(a%)(+)** notations: No single failure shall cause loss of ventilation for both the main and the alternative propulsion system.

502 For the **AP-3(a%)(+)** notation: Ventilation systems shall not have any common units or cross-over pipes when supplying different fire-division areas.

C 600 Cooling Water

601 Sea and fresh water cooling systems shall comply with the general requirements given in C100.

D. Propulsion, Steering and Auxiliary Control System

D 100 General

101 When a centralised control system is arranged, it shall not jeopardize the redundancy and separation requirements for the applicable class notation.

D 200 Propulsion control system

201 Independent control of propulsion and steering shall be possible for both the main and alternative propulsion system. Such means shall be operable after any failure of the central navigating bridge installation. This includes reliable means of separation of remote and local control.

202 Independent control systems for both main and alternative propulsion system shall be arranged according to main class and consistent with the failure concept given in A200. Each system shall include a separate control panel.

203 Reliable means of communication, also operable during black-out, between the navigating bridge and the emergency/local control stations shall be arranged.

204 For the **AP-1(a%)(+)** notation: Remote control of the propulsion system shall be installed at the navigating bridge. Any navigating bridge main and alternative remote machinery control system shall be independent for the main and alternative prime movers, so that any single failure will only affect one of them.

205 For the **AP-2(a%)(+)** and **AP-3(a%)(+)** notations:
Remote control of both the main and the alternative propulsion systems shall be installed at the navigating bridge. The navigating bridge main and alternative remote propulsion control systems shall be independent of each other, so that any single failure will only affect one of them.

Guidance note:

Mechanical levers are not required to be duplicated.

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D 300 Control power sources

301 Power supply for main and alternative propulsion and steering systems shall be distributed consistent with the redundancy and separation requirements for the applicable class notation.

D 400 Steering system

401 For the **AP-1(a%)(+)** notation: The steering system shall be in compliance with main class requirements.

402 For the **AP-2(a%)(+)** and the **AP-3(a%)(+)** notations:

- a) Steering systems related to main and alternative propulsion shall be independent, and in addition for **AP-3(a%)(+)** separated by watertight A-60 bulkheads.
- b) The steering system for main propulsion shall be in compliance with main class requirements.
- c) For the steering system related to alternative propulsion, strength and capacity shall be as required for main system, but at a vessel speed only corresponding to the maximum speed (minimum 7 knots) when propulsion power is provided by alternative unit only. Compliance with the main class Rules in terms of duplication of auxiliaries is not required
- d) If steering system related to alternative propulsion fulfils Pt.4 Ch.14 Sec.1 B601 b), the steering system for main propulsion does not need to include an auxiliary steering gear.

E. Separation Requirements for AP-3(a%)(+)

E 100 General

101 Equipment and cabling serving main and alternative propulsion shall be separated by bulkheads, which shall be fire insulated A-60 class division, and in addition shall be watertight below the bulkhead deck. Watertight bulkheads shall be strong enough to withstand one sided flooding, and if doors are fitted in such bulkheads, they shall comply with SOLAS reg. II-1/25-9.

Guidance note:

Two A-0 bulkheads separated by a space (cofferdam, tank etc.) may be accepted as equivalent to A-60.

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102 Cabling to remote control for main and alternative propulsion shall not run along the same route and shall be separated by A-0 class fire division. When this is practically unavoidable, cables running together within an A-60 cable duct or equivalent fire protection are accepted. This alternative is not accepted in high fire risk areas, e.g. engine rooms and fuel treatment rooms.

Guidance note:

If cables are located in A-60 cable ducts, means should be provided to keep the temperature inside the duct within the specified temperature for the cables.

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103 The control panels and cabling on the navigating bridge are accepted as not being separated by A-60 partitions, provided control of both the main and the alternative propulsion is possible also from a position outside of the navigating bridge.