



Foreword

001

Chapter 1 Engine Plant Management and Rules

002

1-1. Understanding engine plants

003

1-1-1. Briefing prior to embarkation

003

1-1-2. Immediately after embarkation

003

1-1-3. Once on board

004

1-1-4. Grasp of engine operational state

005

1-2. Ship safety regulations

006

1-2-1. International Maritime Organization (IMO)

006

1-2-2. Port State Control (PSC)

006

1-2-3. International Safety Management (ISM) Code

007

1-2-4. Engine Room Resource Management (ERM)

008

1-2-5. Classification Society

009

Chapter 2 Overview of Marine Engines; Main Propulsion Engines and Shafting Equipment

010

2-1. Types of main engines

012

2-1-1. Diesel main engines

012

2-1-2. Steam turbine main engines

013

2-1-3. Electrical propulsion machinery

016

2-1-4. Dual fuel (DF) engines

016

2-2. Marine main engine operations and trouble cases

017

2-2-1. Handling of diesel main engines and trouble cases

017

2-2-2. Examples of frequently occurring problems and damages

018

2-3. Torque-rich running of diesel main engines

021

2-4. Electronically controlled main diesel engines

022

2-4-1. Outline of electronically controlled main diesel engines

022

2-4-2. Operational management of electronically controlled main diesel engines

025

Chapter 3 Generators

028

3-1. Types of generators

029

3-2. Diesel generators

032

3-3. Steam turbine generators

039

3-4. Emergency generators

043

Chapter 4 Marine Boiler and Exhaust Gas Economizer

044

4-1. Types of auxiliary boilers

047

4-1-1. Vertical smoke tube-type single fuel-fired boiler

047

4-1-2. Vertical smoke tube-type composite boiler

048

4-2. Double-drum D-type water tube boiler

049

4-3. Fin tube-type exhaust gas economizer

050

4-3-1. Exhaust gas economizer and exhaust gas boiler

050

4-3-2. Forced-circulation water tube-type exhaust gas economizer

050

4-4. Trouble cases related to auxiliary boiler damage

051

4-5. Points of boiler and economizer operation and maintenance

052

4-6. Boiler water treatment

053

4-6-1. Boiler water management

054

4-6-2. Boiler water blow

055

4-6-3. Boiler compounds

056

4-7. Marine distilling plants (for diesel ships)

057

Chapter 5 Auxiliary Machinery

060

5-1. Pumps

063

5-1-1. Centrifugal pumps

064

5-1-2. Rotary pumps

067

5-1-3. Pump trouble

069

5-2. Air compressors

072

5-2-1. Classification of air compressors

073

5-2-2. Basic structure

073

5-2-3. Suction and discharge valves

075

5-2-4. Pistons

077

5-3. Oil purifiers

079

5-3-1. Structure and operation of oil purifiers

079

5-3-2. Handling of oil purifiers

081

5-3-3. Cases of oil purifier trouble

083

5-4. Refrigerators

085

5-4-1. Refrigeration cycle of compression refrigerators

086

5-4-2. Refrigerants

090

5-4-3. Precautions to take while refrigerators are in operation

090

5-5. Heat exchangers

091

5-5-1. Shell-and-tube heat exchanger (cylindrical multi-tube heat exchanger)

091

5-5-2. Plate heat exchanger

091



Chapter 6 Deck machinery 096

- 6-1. Steering gear** 097
 - 6-1-1. Prime mover (hydraulic pressure generator) 098
 - 6-1-2. Controlling gear 098
 - 6-1-3. Hunting gear 098
 - 6-1-4. Rudder gear 099
 - 6-1-5. Inspection and handling of steering gear 100
- 6-2. Hydraulic mooring equipment** 101
 - 6-2-1. Outline of hydraulic mooring winches 101
 - 6-2-2. Outline of hydraulic windlasses 102
 - 6-2-3. Basic hydraulic system 103
 - 6-2-4. Mooring equipment trouble 103
- 6-3. Bow thruster (side thruster)** 105

Chapter 7 Electrical equipment 108

- 7-1. Generators** 109
 - 7-1-1. Synchronous generators 110
 - 7-1-2. Parallel running 111
 - 7-1-3. Handling of synchronous generators 112
- 7-2. Motors** 113
 - 7-2-1. Synchronous speed and rotational speed 113
 - 7-2-2. Induction motor (operational characteristics) 114
 - 7-2-3. Motor starting methods 115
 - 7-2-4. Speed control and reverse rotation 117
 - 7-2-5. Handling of motors 117
 - 7-2-6. Motor trouble 118
- 7-3. Power distribution system** 119
 - 7-3-1. Main switchboard 119
 - 7-3-2. Distribution panel 120
 - 7-3-3. Group starter panel 121
 - 7-3-4. Equipment and devices installed in switchboards 121
 - 7-3-5. Switchboard trouble 124
- 7-4. High-voltage switchboard** 124

Chapter 8 Marine fuel oil and lubricating oil 128

- 8-1. Marine fuel oil** 131
 - 8-1-1. Marine gas oil (MGO) and marine diesel oil (MDO) 131
 - 8-1-2. Heavy fuel oil (HFO) 133
 - 8-1-3. Regulation-compatible fuel oils 137

Chapter 8 Marine fuel oil and lubricating oil

- 8-2. Marine lubricating oil** 139
 - 8-2-1. Types of lubricating oil and Lubrication Chart 140
 - 8-2-2. Cylinder oil and system oil 141
 - 8-2-3. Other lubricating oils 146
- 8-3. Bunkering** 150
 - 8-3-1. Bunkering planning and operations 150
 - 8-3-2. Bunker delivery note (BDN) 152

Chapter 9 Treatment of Inboard Bilge Water and Waste Oil 154

- 9-1. Types of bilge water** 155
 - 9-1-1. How to treat inboard bilge water 156
 - 9-1-2. Treatment of oily bilge water and treatment of oily drain/oil sludge 157
- 9-2. Bilge separators** 159
- 9-3. Waste oil treatment** 162
 - 9-3-1. Incinerators 163
- 9-4. Discharge of emergency bilge and clean drain** 168

Chapter 10 Duties in General 170

- 10-1. Watchkeeping** 171
- 10-2. Initial responses to emergencies** 172

Chapter 11 Recently Introduced Regulations, Equipment and Technologies 174

- 11-1. MARPOL Convention Annex VI** 175
 - 11-1-1. Outline of NOx emission control 175
 - 11-1-2. Outline of SOx and particulate matter (PM) emission control 177
 - 11-1-2-1. How to respond to IMO's SOx and PM regulations 2020 178
 - 11-1-2-2. Regulation-compatible fuel oils 178
 - 11-1-2-3. Emission control areas (ECA) and general sea areas 179
 - 11-1-2-4. SOx scrubber (exhaust gas cleaning system) 180
 - (1) Open mode system scrubber 181
 - (2) Closed mode system scrubber 182
 - (3) Hybrid SOx scrubber 183
- 11-2. Measures for reducing greenhouse gas (GHG) emission** 184
 - 11-2-1. Greenhouse gases 184
 - 11-2-2. Short-term goal for GHG reduction 185
 - 11-2-3. Medium- and long-term goals for GHG reduction 187
- 11-3. International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004** 187
 - 11-3-1. How ballast water treatment devices came to be introduced 190
 - 11-3-2. Ballast water treatment devices 191