

轮机航行实习

Sailing Training for Marine Engineering Students

主编 廖和德 闵桂兰

主审 陈景锋



大连海事大学出版社
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内 容 提 要

全书共十二章，采用汉英双语编写。内容包括船舶概况、船舶柴油机、船用泵、甲板机械、船舶压缩空气系统、船舶辅助锅炉及造水装置、船舶制冷与空调装置、船舶电气系统、船舶通用系统、应变部署与应急设备、轮机常用英语以及职责与制度等。书中特别结合“玉龙山”轮和“清华山”轮的实例对船体的结构、机器的工作原理及操作管理进行了讲解，便于轮机专业学生的学习和理解。

本书作为高等航海院校轮机专业本科生的专业教材，也可作为船舶轮机人员和其他有关技术人员的参考用书。

ABSTRACT

This book is written in bilingual languages (in Chinese and English), consisting of 12 chapters, of which the contents include, brief introduction about ships, marine diesel engine, marine pumps, deck machinery, marine compressed air system, marine auxiliary boiler & fresh water generator, marine refrigerating plant & air conditioning plant, marine electrical system, marine general service system, practice muster & emergency equipment, useful English expressions and words for marine engineering, responsibilities and regulations. In particular, the authors, taking many actual facilities as examples on M.V. YU LONG SHAN and M.V. QING HUA SHAN, illustrate the hull construction, the working principles of various machines as well as the machine operation and management. It is easy to learn and understand for the marine engineering students who are first to work as trainees on board the ship and experience the life at sea.

This book is mainly used as the textbook for the marine engineering students in colleges and universities. But also, the marine engineer officers and the concerned technicians can use it as a reference book in their work.

前 言

本书是按照大学本科轮机工程专业的教学大纲进行编写的。轮机专业是一个实践性很强的专业。为了使學生增加感性的认识，同时也是为了满足《STCW 78/95 公约》对海员提出的要求，我们编写了这本书。

《轮机航行实习》是轮机专业本科学生必修的专业实践课。在实习船上，本书作为船上教学的主要教材，其中部分内容学生可以结合船上的实际自学，为以后学校的课堂专业理论学习打下良好的基础。本书主要内容包括：船舶概况、主辅机的设备、系统和操作步骤，另外，还编写有应急设备、环保设备、应变部署、轮机常用英语以及职责和制度等。

本书的手稿和部分插图前后历时一年有余。在编写的过程中注重体现教材的思想性、科学性、实践性为一体，力求做到注意重点，简明扼要，图文结合，既介绍基本原理，又结合“玉龙山”轮和“清华山”轮设备的实例进行讲解，因此，具有较好的适用性。本书主要作为大学轮机专业学生海上航行实习之教材，也可作为有关方面技术人员的参考用书。我们希望本书能为各位读者的学习与工作带来一定的帮助，也希望能起到举一反三的作用。

本书由廖和德、闵桂兰、王永坚、刘建华、郑国杰合作编写。本书采用汉英双语编写。本书中文部分全部由廖和德编写；本书英文部分的前言，目录，第三、四、五、六、七章和第十二章由闵桂兰、廖和德编译；第一、二章由王永坚编译；第八、九章由刘建华编译；第十、十一章由郑国杰编译。廖和德、闵桂兰担任主编，负责本书中英文稿的全面修改。

本书是在廖和德主编的《轮机认识实习指导书》、《海上轮机实习》的基础上并参考有关教材、船舶技术资料编写的。在编写本书时，得到了“玉龙山”轮和“清华山”轮船舶领导、高级船员和师傅们的支持，提供了许多资料和帮助，尤其是得到了吴用沛轮机长的热情支持，同时也得到了集美大学轮机工程学院领导、同事和学生的支持。陈景锋教授担任本书的主审，认真审阅了全书各章节。蔡振雄教授对本书前期的编写工作提出了宝贵意见。在出版的过程中，得到了大连海事大学出版社的支持。对此，一并表示衷心的感谢。

由于编著者水平和资料有限，不当之处在所难免，恳请各位读者不吝指出。

编 者

2008 年 10 月

FOREWORD

This book *Sailing Training for Marine Engineering Students* is written and compiled in accordance with the teaching syllabus for the undergraduate students of the marine engineering (management). The marine engineering is the profession featuring strong practicality. In order to enhance students' perceptual knowledge about the marine engineering, to develop the comprehensive abilities of analyzing and solving problems, also to meet the requirements of STCW78/95 Convention for the mariners, the authors of this book have written and compiled this edition.

Sailing Training for Marine Engineering Students is one of compulsory subjects of professional practice for the marine engineering undergraduate students. On the training ship, this book is used as a main textbook in the *classroom* on the ship, some contents of which can be learned along the real facilities on the ship by students themselves, hence it helps students to lay a good foundation for learning professional knowledge in the school classroom in the near future. The main contents of this book are brief introduction about ships, equipment for marine engine & auxiliary machinery, systems & operational steps, still including, emergency equipment, environmental protection equipment, practice muster, useful English expressions and words for marine engineering, responsibilities and regulations.

It takes the compilers more than one year to complete the manuscript and some illustrations. In the writing and compilation, the compilers of the book emphasize on its ideological contents, science, practicality, attaching great importance to the key points, trying to be brief and to the point, and also to explain the professional theoretical knowledge by means of the real equipment on M.V. YU LONG SHAN and M.V. QING HUA SHAN. So, it has a high applicability. This book can be not only used as teaching materials for the marine engineering students in colleges and universities to conduct sailing practice on the ship, but also as a reference book for the concerned technicians. We hope that this book can bring some helps to readers' study and work, but also hope that readers can draw inferences about other cases from what is talked in the book.

This book is co-compiled by Mr. Liao Hede, Ms. Min Guilan, Mr. Wang Yongjian, Mr. Liu Jianhua, Mr. Zheng Guojie. It is written in bilingual languages (in Chinese and English). Of which the whole Chinese version is compiled by Mr Liao Hede. In English version, foreword, the table of contents, chapters 3, 4, 5, 6, 7 and 12 are translated by Ms. Min Guilan and Mr. Liao Hede, chapters 1 and 2 are translated by Mr. Wang Yongjian, chapters 8 and 9 are translated by Mr. Liu Jianhua, chapters 10 and 11 are translated by Mr. Zheng Guojie. Mr. Liao Hede and Ms. Min Guilan are chief editors and in full charge of revision for the whole book.

This book is written and compiled based on the books which have been printed and published *Guide to Practice at sea for Students of Marine Engineering* and *Practice on the Ship for Marine Engineering Students* by Mr Liao Hede. In the process of the compilation, we also have referred to some related books and marine technological materials by other compilers at home and abroad. In addition, we have received the full support of the leaders, officers, engineers and other crew on M.V. YU LONG SHAN and M.V. QING HUA SHAN, who provide us with a lot of materials and help.

Particularly, we have received the warm support and great help from Chief Engineer, Mr. Wu Yongpei, the leaders and colleagues, as well as some students of Marine Engineering Institute of Jimei University. Professor, Mr Chen Jingfeng has taken time from his busy schedule to read the whole book and correct some of the contents. Professor, Mr. Cai Zhenxiong puts forward some valuable suggestions for preparing work. To publish this book, we have also received the help and support from Dalian Maritime University Press. To all of the above people, along with many others that space does not permit us to name, we extend our most sincere thanks.

This book is of course not without its errors and oversights, due to limited materials and limitations in our human capabilities and also a hectic schedule. We sincerely hope that our readers and users will kindly share any comments and suggestions, so that we may further improve it in future revisions.

Compilers

Oct. 2008

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第一章 船舶概况

Chapter 1 General Introduction to Ships

第一节 船舶分类和实习船简介

一、船舶分类

众所周知，船舶是运送旅客和货物的水上运输工具，随着人类科学技术和社会经济生产的发展，对水上运输的需求也日益增多，需要建造各种类型的船舶方能满足对水上运输不断增长的要求。目前，世界上船舶的类型是多种多样的，要正确的划分其类别比较困难。通常以船舶的主要技术营运特征进行船舶的分类。此外，也可以按照船舶的用途、行驶方法、航行区域、建造材料、推进方式、动力装置和航行状态等进行分类。

1. 按船舶用途分

专用于运输旅客的客船；兼运旅客和货物的客货船；专用于运输货物的货船；专用于运输冷冻产品的冷藏船；用于拖带或顶推驳船的拖（顶）船；无动力装置的载客、货的驳船；捕鱼及加工的渔船；从事水中工程的工程船；进行服务性或专业性工作的工作船及军舰等。

2. 按行驶方式分

本身装有发动机和推进器，可独自行驶的机动船，又称自航船；无动力装置，需依靠其他船舶推动或风帆、桨行驶的非机动船，又称为非自航船。

3. 按航行区域分

行驶无限航区的远洋船；行驶于距岸 25 n mile 以外邻近国际港口的近海船；沿岸航行的沿海船；行驶于江、河、湖泊的内河船；在港内进行作业的港作船等。

4. 按船体材料分

木船、钢船、铝合金船、钢筋水泥船和塑料船等。

5. 按动力装置分

蒸汽机船、内燃机船、汽轮机船、电动船和核动力船等。

6. 按推进方式分

明轮船、螺旋桨船、平旋推进器船、喷气推进船等。

7. 按航行状态分

靠排水而浮于水面的排水型船；靠水翼的升力而浮于水面的水翼船；靠排出气流将船体托出水面的气垫船等。

二、“玉龙山”轮简介

类型：

散装船

船舶总长:	224 m
型深:	18.35 m
总登记吨位:	35 530 t
净登记吨位:	19 897 t
载重量:	64 443 t
满载排水量:	75 250 t
夏季载重吃水:	13.35 m
船舶制造厂:	日本三菱重工株式会社
建造日期:	1980 年 3 月
主机型号:	MHI-SULZER RND76/155
轴功率:	10 290 kW
工作转速:	122 r/min
营运航速:	额定 14 kn, 常用 12.2 kn
螺旋桨:	定距桨、5 叶、直径 5.8 m、螺距 4.11 m
船籍港:	广州
船东:	中海发展股份有限公司

“玉龙山”轮是一艘散装船，主要任务是运输粮食，航行于我国南北航线。2005 年 11 月“玉龙山”轮改造为实习船。改造后，该轮除了正常的运煤任务外，每次可接收一个班大约 35 名学生的航行认识实习任务。

“玉龙山”轮船员编制数正常为 26 人，学生来船实习时，增加一个二厨，共计 27 人。分别如下：

船舶领导：船长、政委。

甲板部：大副、二副、三副、水手长、木匠、水手（6 名），大副为部门长兼医生。

事业部：管事（政委兼）、大厨、二厨、服务员（该船的事业部人员也属于甲板部）。

轮机部：轮机长、大管轮、二管轮、三管轮、电机员、机匠长、机工（5 名），轮机长为部门长。

图 1-1 为“玉龙山”轮总体布置图。

三、“清华山”轮简介

船舶类型:	散装船
总长:	224.6 m
型宽:	32.2 m
型深:	19.6 m
设计吃水:	12.75 m
结构吃水:	13.92 m
总吨位:	40 234 t
净吨位:	22 531 t
载重量:	68 746 t
满载排水量:	91 531 t
夏季载重吃水:	13.92 m

船舶呼号:	BPPV
船舶制造厂:	沪东造船厂
船舶建造日期:	1987 年 3 月
主机机型:	MAN B&W 6L60MC
主机额定功率:	9 900 kW
主机额定转速:	111 r/min
营运航速:	13 kn
缸数×缸径×冲程:	6 × 600 mm × 1 994 mm
螺旋桨:	定距桨、4 叶、直径 6.08 m、螺距 4.548 m
船东:	中海发展股份有限公司货轮公司

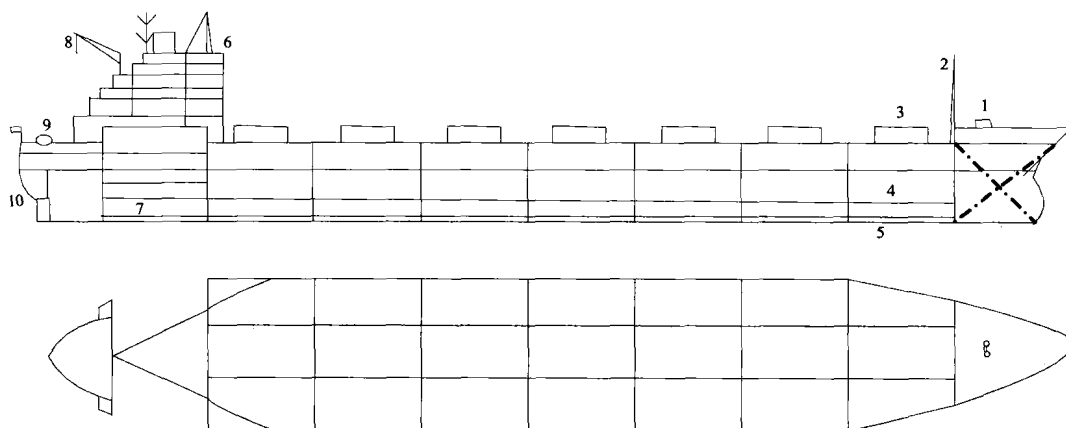


图 1-1 “玉龙山”轮总体布置图

1—起锚机；2—前桅；3—舱盖板；4—货舱；5—双层底柜；6—驾驶台；7—机舱；8—电动克令吊；9—绞缆机；10—舵叶

Figure 1-1 General Arrangement for M.V. QING HUA SHAN

1—windlass; 2—foremast; 3—hatch cover board; 4—cargo hold; 5—double bottom tank; 6—bridge; 7—engine room; 8—electric crane; 9—warping winch; 10—rudder blade

“清华山”轮原船名是“大庆 91”，原为油船。2007 年 7 月改造为散装船，主要任务是运输煤炭，航行于我国南北航线。改造后，该轮除了正常的运输任务外，每次可接收一个班大约 35 名学生的航行实习任务。“清华山”轮船员编制数正常为 26 人，学生来船实习时，增加一名二厨，共计 27 人。

图 1-2 为“清华山”轮总体布置图。

Section 1 Sort of Ships and Brief Introduction to Training Ship

A. Sort of Ships

It is well-known that a ship is a means of water transport which is used to convey passengers and cargoes. Along with the development of technology and social economy, the demand for water transportation is on the rise, therefore, it is necessary to build various kinds of ships to meet the ever-increasing needs of the water transport. At present, around the world, the types of ships are

various. It is difficult to accurately classify the types of ships. In general, ships are classified according to their main technical characteristics of service, besides, ships can be classified in accordance with their uses, sailing methods, navigation regions, building materials, propulsion modes, power plants, voyage state, etc.

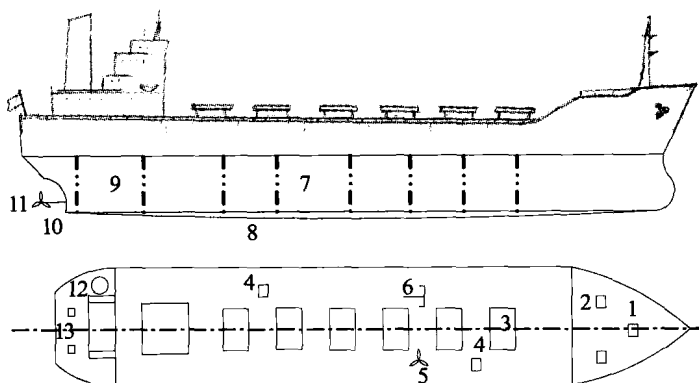


图 1-2 “清华山”轮总体布置图

1—起锚机; 2—前桅; 3—舱盖板; 4—绞缆机; 5—备用螺旋桨; 6—备用锚; 7—货舱; 8—双层底柜; 9—机舱; 10—螺旋桨; 11—舵叶; 12—液压克令吊; 13—船尾绞缆机

Figure 1-2 Overall Layout for M.V. QING HUA SHAN

1—windlass; 2—foremast; 3—hatch cover board; 4—warping winch; 5—spare propeller; 6—spare anchor; 7—cargo hold; 8—double bottom tank; 9—engine room; 10—propeller; 11—rudder blade; 12—hydraulic crane; 13—stern mooring winch

(1) According to the uses of ships, ships can be classified as a passenger ship only used to transport passengers, a cargo-passenger vessel used to carry both cargoes and passengers together, a freighter used to carry cargoes, a refrigerator ship used to transport frozen goods, a tug boat used to drag or push a lighter, a dumb lighter used to ferry passengers or carry cargoes; a fish boat used to catch fishes and process fishes, an engineering ship used to carry out water projects, a working boat used to offer service or special work as well as warships.

(2) According to the ship sailing methods, ships can be classified as a power-driven ship which is assembled with the engine or the propeller, sailing by itself, the power-driven ship is also known as a self-propelled vessel, a non-power-driven ship which is not assembled with the engine but depends on pushes from the other ship or sails, oars to sail, it is also known as a non self-propelled vessel.

(3) According to navigation regions, ships can be classified as an ocean-going ship sailing at any region, an offshore ship sailing between international harbors but 25kn off the shore, an inshore ship (coaster) sailing along the coastal region, inland transportation ship (river service ship) sailing at rivers and lakes, a harbor boat used to work in port.

(4) According to the hull materials, ships can be classified as a wood boat, a steel boat, an aluminum alloy boat, a ferro-cement ship, a plastic boat, etc.

(5) According to the power plant on the ship, ships can be classified as a steam ship, a motor vessel, a steam turbine vessel, an electric ship, a nuclear-power ship, etc.

(6) According to the propulsion mode, ships can be classified as a paddle boat, a propeller ship;

a cycloidal propeller ship, a gas-jet propelled boat, etc.

(7) According to the voyage state, ships can be classified as a displacement ship discharging water overboard to float on water, a hydrofoil boat floating on water which depends on hydrofoil rising-force, a hovercraft floating on water which depends on discharging airflow, etc.

B. Brief Introduction to M.V. YU LONG SHAN

Type:	Bulk carrier
Length O.A.:	224 m
MLD depth:	18.35 m
Gross register tonnage:	35,530 t
Net register tonnage:	19,897 t
Dead weight:	64,443 t
Load displacement:	75,250 t
Summer load draft:	13.35 m
Ship manufacturer:	Mitsubishi Heavy Industry Company, Japan
Building date:	March, 1980
Type of main engine:	MHI-SULZER RND76/155
Shaft power:	10,290 kW
Working revolution:	122 r/min
Service speed:	Rated 14 kn, common used speed 12.2 kn
Propeller:	Fixed pitch propeller, five-blade, diameter 5.8 m, pitch 4.11 m
Register harbor:	Guangzhou
Ship owner:	China Shipping Development Co., Ltd

M.V. YU LONG SHAN is a bulk ship; its main task is to transport grain, sailing between South China and North China. In November 2005, M.V. YU LONG SHAN was changed into a training ship. After that, besides its usual transportation coal, this vessel can accommodate one class about 35 students to carry out their navigation training task on board the ship.

Normally, the number of the seamen on M.V. YU LONG SHAN is 26. When students come to the ship, the second cook is added to work in the kitchen, so the members actually are 27. The name list of seamen is as follows:

Ship leader: captain, political commissar.

Deck Department: chief officer, second officer, third officer, boatswain, carpenter, able seaman (6 members), Chief Officer is the leader of Deck Department and his past-time job is doctor. The members in the purser department belong to the deck department. Its members are a purser (whose work is actually charged by political commissar), the chief cook, the second cook and a steward.

Engine Department: chief engineer, second engineer, third engineer, fourth engineer, electrical engineer, chief motorman, mechanic (5 members); Chief engineer is the leader of Engine Department.

The general arrangement for M.V. YU LONG SHAN is shown in Figure 1-1.

C. Brief Introduction to M.V. QING HUA SHAN

Type of ship:	Bulk Carrier
Length O.A:	224.6 m
MLD breadth:	32.2 m
MLD depth:	19.6 m
Designed draft:	12.75 m
Scantling draft:	13.92 m
Gross tonnage:	40,234 t
Net tonnage:	22,531 t
Dead weight:	68,746 t
Load displacement:	91,531 t
Summer load draft:	13.92 m
Call sign:	BPPV
Ship manufacturer:	Hudong Shipbuilder
Building date:	March, 1987
Type of main engine:	MAN B&W 6L60MC
Main engine rated power:	9,900 kW
Main engine rated speed:	111 r/min
Service speed:	13 kn
Cyl. number × Cyl. Diameter × Stroke:	6 × 600 mm × 1,994 mm
Type of propeller:	FPP, four-blade, diameter 6.08 m, pitch 4.548 m
Ship owner:	China Shipping Development Co., Ltd. Tramp Co.

The former name of M.V. QING HUA SHAN was M.V. DA QING 91 and was an oil tanker. In July, 2007, M.V. YU LONG SHAN was altered as a bulk carrier. Its task is to transport coal, sailing between South China and North China. After reconstruction, besides its usual transportation tasks, this vessel can accommodate one class about 35 students to carry out their navigation training task on board the ship. Normally, the number of the crew on M.V. QING HUA SHAN is 26 members. When students come to the ship, the second cook is added to work in the kitchen, so the members are 27.

The overall layout for M.V. QING HUA SHAN is shown in Figure 1-2.

第二节 船舶各部位及舱室名称

从平面上看,船的前端处叫做船首(bow),后端处叫做船尾(stern),而船首两侧船壳弯曲处叫做艏舷,也称艏部,船尾两侧船壳弯曲处叫艉舷,也称艉部(quarter)。中间部分称为船中(midship)。船的两边叫做船舷,船舷侧板与船底板交接的弯曲部叫做舭部(bilge)。船舶的首尾连接线叫做艏艉线(或纵中线),它将船体分成左右两半,从艉向艏看,在艏艉线右边的部分称为右舷(starboard),在左边的部分称为左舷(port)。在最大船宽处垂直于艏艉线的方向叫正横(abeam),在右边的称右正横,在左边的称左正横。位于船底中心线的船底