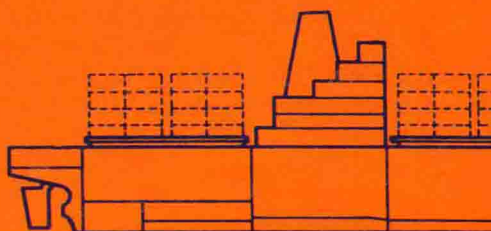
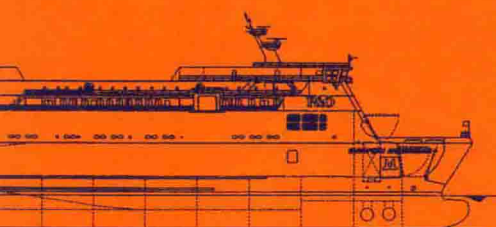


DAVID J. HOUSE

SEVENTH EDITION

CARGO WORK

For Maritime Operations



Cargo Work

For Maritime Operations

Seventh Edition

D.J. House

(formerly Kemp & Young's Cargo Work)



ELSEVIER

BUTTERWORTH
HEINEMANN

AMSTERDAM BOSTON HEIDELBERG LONDON NEW YORK OXFORD
PARIS SAN DIEGO SAN FRANCISCO SINGAPORE SYDNEY TOKYO

Elsevier Butterworth-Heinemann
Linacre House, Jordan Hill, Oxford OX2 8DP
30 Corporate Drive, Burlington, MA 01803

First published as Cargo Work by Stanford Maritime Ltd 1960
Second edition 1965
Third edition 1971
Reprinted 1972, 1974, 1975, 1977
Fourth edition 1980
Fifth edition 1982
Reprinted 1983, 1985, 1987
First published by Butterworth-Heinemann 1990
Reprinted 1991
Sixth edition 1998
Reprinted 2000, 2002, 2003
Seventh edition 2005

Copyright © 1982, 1998 Peter Young. All rights reserved
Copyright © 1998, D.J. House (Chapter 5). All rights reserved
Copyright © 2005, David House. All rights reserved

No part of this publication may be reproduced in any material form (including photocopying or storing in any medium by electronic means and whether or not transiently or incidentally to some other use of this publication) without the written permission of the copyright holder except in accordance with the provisions of the Copyright, Designs and Patents Act 1988 or under the terms of a licence issued by the Copyright Licensing Agency Ltd, 90 Tottenham Court Road, London, England W1T 4LP. Applications for the copyright holder's written permission to reproduce any part of this publication should be addressed to the publishers

Permissions may be sought directly from Elsevier's Science and Technology Rights Department in Oxford, UK; phone: (+44) (0) 1865 843830; fax: (+44) (0) 1865 853333; email: permissions@elsevier.co.uk. You may also complete your request on-line via the Elsevier homepage (<http://www.elsevier.com>), by selecting 'Customer Support' and then 'Obtaining Permissions'

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication Data

2004118249

ISBN 0 7506 6555 6

For information on all Elsevier Butterworth-Heinemann publications
visit our website at www.books.elsevier.com

Typeset by Charon Tec Pvt. Ltd, Chennai, India
www.charontec.com
Printed and bound in Great Britain

Working together to grow
libraries in developing countries

www.elsevier.com | www.bookaid.org | www.sabre.org

ELSEVIER

BOOK AID
International

Sabre Foundation

Preface

The world of cargo operations has changed considerably from the days of the open stowage of merchandise. Unitized cargoes in the form of 'containers' or Roll-on, Roll-off cargoes and palletization have generated a need for alternative handling methods and changing procedures.

The work of the stevedore/longshoreman has moved on to a vastly different role to that previously employed in general cargo holds. The cargo units are labour saving and tend to require a different mode of working. In many cases, ship's crews or rigging gangs have replaced the role of the previous style of dock labour. The fork lift truck and the container gantry have been the source of the major causes of change within the cargo-handling environment and the demise of labour intensive activities.

Unlike the previous editions of '*Cargo Work*', this new text has taken the changes to the industry and included the cargo-handling equipment and the procedures being adopted in our present day. It is anticipated that cargoes can no longer be a stand-alone topic and must incorporate the modern methods of handling, stowage and commodity together.

The two topics of cargoes and handling equipment have therefore been combined in order to appeal to a wider readership and give greater coverage to the prime function of shipping.

This edition has been totally revised by:
D.J. House

Master Mariner
Senior Lecturer Nautical Studies
Marine Author
Patent Holder (GB2240748)

About the author

David House started his sea-going career on general cargo/passenger liners in 1963. During his sea-going career he gained experience of many vessel types and trades, including refrigerated (reefer) vessels to South America on the chilled and frozen meat trade.

His activities included shipping containers from Europe to North America and general cargoes worldwide, during which period he gained extensive knowledge on heavy-lift operations.

His bulk cargo experience was obtained from the carriage of a variety of products, inclusive of grain, sugar, tallow, sulphur and coal.

The types of vessels and various trades in which he was engaged has provided the foundation for this up-to-date version of Kemp & Young's original work.

David House has served on Roll-on, Roll-off vessels, as well as container tonnage, dealing with all aspects of modern cargo-handling techniques: steel cargoes, heavy lifts, special cargoes, foodstuffs, livestock, as well as the bulk commodities and general merchandise. He has been involved as both a Junior and a Senior Cargo Officer, and currently lectures on virtually all nautical subjects at the Fleetwood Nautical Campus.

He has researched and published 13 profusely illustrated Marine publications, which are widely read throughout the maritime world. Amongst his books you can find the following: *Navigation for Masters* (1995); *Marine Survival and Rescue Systems* (1997); *An Introduction to Helicopter Operations at Sea – a Guide for Industry* (1998); *Seamanship Techniques*, Volume III 'The Command Companion' (2000); *Anchor Practice – a Guide for Industry* (2001); *Marine Ferry Transports – an Operators Guide* (2002); *Dry Docking and Shipboard Maintenance* (2003); *Seamanship Techniques*, third edition (2004); *Seamanship Examiner* (2005); *Heavy Lift and Rigging* (in press). www.djhouseonline.com

Acknowledgements

B&V, Industrietechnik GmbH
British Nuclear Fuels
British Standards Institution
Bruntons (Musselburgh) Ltd.
Dubai Dry Docks UAE
International Maritime Organization (publications)
James Fisher Shipping Company
MacGregor International Organisation
Maritime and Coastguard Agency
Motor Ship (published by IPC Industrial Press Ltd.)
Overseas Containers Ltd.
P&O European (Irish Sea) Ferries
Scheuerle Fahrzeugfabrik GmbH
Seaform Design (Isle of Man)
Smit International
TTS – Mongstad AS

Additional photography

Capt. K.B. Millar, Master Mariner, Lect., Nautical Studies of Millar Marine Services
Capt. J.G. Swindlehurst (MN) Master Mariner
Capt. A. Malpass (MN) Master Mariner
Mr M. Gooderman, Master Mariner, B.A. Lecturer Nautical Studies
Mr G. Edwards Ch/Eng (MN) Rtd.
Mr P. Brooks Ch/Off (MN)
Mr J. Leyland (Nautical Lecturer)
I.T. Consultant: Mr C.D. House

List of abbreviations used in the context of Cargo Work

°A	Degrees absolute
AAA	Association of Average Adjusters
ABS	American Bureau of Shipping
AIS	Automatic Identification System
B	Representative of the ship's centre of buoyancy
BACAT	BArge CATamaran
BCH	Bulk Chemical Code
B/L	Bill of Lading
BLU (Code)	The Code of Practice for Loading and Unloading of Bulk Cargoes
BOG	Boil-off gas
BS (i)	Breaking strain
BS (ii)	British Standard
BS (iii)	Broken stowage
BT	Ballast tank
C	Centigrade
CAS	Condition Assessment Scheme
CBM	Conventional buoy mooring
CBT	Clean ballast tank
CCTV	Close Circuit Television
CEU	Car equivalent unit
Ch/Off (C/O)	Chief Officer
cm	Centimetres
CNG	Compressed natural gas
CoF	Certificate of Fitness
C of G	Centre of gravity
COW	Crude oil washing
CO ₂	Carbon dioxide

xiv Cargo Work for Maritime Operations

CSO	Company Security Officer
CSS	Cargo Stowage and Securing (IMO Code of Safe Practice of)
CSWP	Code of Safe Working Practice
CTU	Cargo transport unit
cu	Cubic
D	Density
DGN	Dangerous Goods Notice
DNV	Det Norske Veritas
DOC	Document of Compliance
DWA	Dock water allowance
Dwt	Deadweight tonnage
EC	European Community
EDI	Electronic data interchange
EEBDs	Emergency escape breathing devices
EFSWR	Extra flexible steel wire rope
EU	European Union
F (i)	Fresh
F (ii)	Fahrenheit
FloFlo	Float-on, Float-off
FO	Fuel oil
FPSOS	Floating Production Storage Offloading System
FSE	Free surface effect
FSM	Free surface moment
FSRU	Floating storage and re-gasification unit
FSU	Floating storage unit
FSWR	Flexible steel wire rope
ft	Feet
FW	Fresh water
FWA	Fresh water allowance
G	Ship's centre of gravity
G/A	General average
gal	Gallons
GG ₁	Representation of the movement of the ship's C of G when moving a weight aboard the vessel.
GM	Metacentric height
grt	Gross registered tonnage
GZ	Ship's righting lever
HCFC	Hydro chlorofluorocarbons
HDFD	Heavy duty, floating derrick
HMSO	Her Majesty's Stationary Office
HP (i)	High pressure
(ii)	Horse power

HSC	High-speed craft
HSE	Health and Safety Executive
HSMS	Hull stress monitoring system
HSSC	Harmonized System of Survey and Certification
IACS	International Association of Classification Societies
IBC	International Bulk Cargo (Code)
ICS	International Chamber of Shipping
IG	Inert gas
IGC	Inert Gas Code
IGS	Inert Gas System
ILO	International Labour Organization
IMDG	International Maritime Dangerous Goods (code)
IMO	International Maritime Organization
IOPP	International Oil Pollution Prevention (certificate)
ISGOTT	International Safety Guide for Oil Tankers and Terminals
ISM	International Safety Management
ISPS	International Ship and Port Facility Security (Code)
ISSC	International Ships Security Certification
ITU	Inter-modal transport unit
K	Representative of the ship's keel
kg (k)	Kilograms (kilo)
KM	Representative of the distance from the ship's keel to the metacentre
kN	Kilo-newtons
kt	Knots
kW	Kilowatt
L	Lumber (loadlines)
LASH	Lighter Aboard SHip (system)
lb	Pounds
LCG	Longitudinal centre of gravity
LEL	Lower explosive limit
LFL	Lower flammable limit
L/H	Lower hold
LNG	Liquefied natural gas
Lo-Lo	Load-on, Load-off
LP	Low Pressure
LPG (i)	Liquid propane gas
(ii)	Liquid petroleum gas
m	Metres
M	Metacentre
MA	Mechanical advantage
MARPOL	Maritime Pollution (convention)

xvi Cargo Work for Maritime Operations

MARVs	Maximum Allowable Relief Value Settings
MCA	Maritime and Coastguard Agency
MCTC (MTC)	Moment to change trim 1 cm
MEPC	Marine Environment Protection Committee
MFAG	Medical First Aid Guide (for use with accidents involving dangerous goods)
MGN	Marine Guidance Notice
MIN	Marine Information Notice
mm	Millimetres
MN	Mercantile Marine (Merchant Navy)
MPCU	Marine Pollution Control Unit
MS	Merchant Shipping Act
MSC (i)	Maritime Safety Committee (of IMO)
MSC (ii)	Mediterranean Shipping Company
MSL	Maximum securing load
MSN	Merchant Shipping Notice
MTSA	Maritime Transport Security Act (US)
MV	Motor vessel
MW	Megawatt
NLS	Noxious liquid substances
NMVOC	Non-methane volatile organic compound
NOS	Not otherwise specified
NPSH	Net positive suction head
NRV	Non-return valve
OBO	Oil, bulk, ore (carrier)
OCIMF	Oil Companies International Marine Forum
ORB	Oil Record Book
P	Port
Pa	Pascal
P/A System	Public Address System
PCC	Pure car carrier
PCTC	Pure car and truck carrier
PEL	Permissible exposure limit
PFSP	Port Facility Security Plan
P/L	Protective location
PMA	Permanent means of access
PNG	Pressurized natural gas
ppm	Parts per million
PSC	Port State Control
psi	Pounds per square inch
PSO	Port Security Officer
P/V	Pressure vacuum

R	Resistance
RD	Relative density
RMC	Refrigerated Machinery Certificate
Ro-Pax	Roll-on, Roll-off plus Passengers
Ro-Ro	Roll-on, Roll-off
rpm	Revolutions per minute
RVP	Reid vapour pressure
S (Stbd)(i)	Starboard
S (ii)	Summer
SBM	Single buoy mooring
SBT	Segregated ballast tank
SCBA	Self-contained breathing apparatus
SeaBee	Sea barge
SECU	StoraEnso Cargo Unit
SF	Stowage factor
S.I.	Statutory Instrument
SMC	Safety Management Certificate
SOLAS	Safety of Life at Sea (Convention)
SOPEP	Ships Oil Pollution Emergency Plan
SO _x	Oxides of sulphur
SPG	Self-supporting Prismatic-shape Gas tank
SRV system	Shuttle and Re-gasification Vessel system
SSO	Ship Security Officer
SSP	Ship Security Plan
SW	Salt water
SWL	Safe working load
SWR	Steel wire rope
T	Tropical
T/D	Tween deck
TEU	Twenty feet equivalent unit
TF	Tropical fresh
Tk	Tank
TLVs	Threshold limit values
TPC	Tonnes per centimetre
TWA	Time weighted average
U	Union Purchase – safe working load
UEL	Upper explosive limit
UFL	Upper flammable limit
UHP	Ultra high pressure
UK	United Kingdom
UKC	Under keel clearance
ULCC	Ultra large crude carrier
ULLNGC	Ultra large liquefied natural gas carrier

xviii Cargo Work for Maritime Operations

UN	United Nations
US	United States
USA	United States of America
USCG	United States Coast Guard
U-SWL	Union Rig – safe working load
VCM	Vinyl chloride monomer
VDR	Voyage Data Recorder
VLCC	Very large crude carrier
VOCs	Volatile organic compounds
VR	Velocity ratio
W (i)	Winter
W (ii)	Representative of the ship's displacement
WBT	Water ballast tank
WC	Water-closet (Toilet)
W/L	Waterline
WNA	Winter North Atlantic
wps	Wires per strand
YAR	York Antwerp Rules (2004)

Conversion and measurement table

Imperial/metric measurement

1 in. = 2.5400 cm
1 ft = 0.3048 m
1 in.² = 6.4516 cm²
1 ft² = 0.09293 m²
1 in.³ = 16.3871 cm³
1 ft³ = 0.02832 m³
(where in. represents inches)

1 cm = 0.3937 in.
1 m = 3.2808 ft
1 cm² = 0.1550 in.²
1 m² = 10.7639 ft²
1 cm³ = 0.0610 m³
1 m³ = 35.3146 ft³

Metres to feet							
Cm	Feet	Metres	Feet	Metres	Feet	Metres	Feet
1	0.03	1	3.28	17	55.77	60	196.85
2	0.06	2	6.56	18	59.06	70	229.66
3	0.09	3	9.84	19	62.34	80	262.47
4	0.13	4	13.12	20	65.62	90	295.28
5	0.16	5	16.40	21	68.90	100	328.08
6	0.19	6	19.69	22	72.18	200	656.17
7	0.22	7	22.97	23	75.46	300	984.25
8	0.26	8	26.25	24	78.74	400	1312.33
9	0.30	9	29.53	25	82.02	500	1640.42
10	0.33	10	32.81	26	85.30	600	1968.50
20	0.66	11	36.09	27	88.58	700	2296.58
30	0.98	12	39.37	28	91.86	800	2624.66
40	1.31	13	42.65	29	95.15	900	2952.74
50	1.64	14	45.93	30	98.43	1000	3280.83
60	1.97	15	49.21	40	131.23		
70	2.30	16	52.49	50	164.04		
80	2.62						
90	2.95						

Feet to metres							
Inches	Metres	Feet	Metres	Feet	Metres	Feet	Metres
1	0.03	1	0.30	80	24.38	800	243.84
2	0.05	2	0.61	90	27.43	850	259.08
3	0.08	3	0.91	100	30.48	900	274.32
4	0.10	4	1.22	150	45.72	950	289.56
5	0.13	5	1.52	200	60.96	1000	304.80
6	0.15	6	1.83	250	76.20	1100	335.28
7	0.18	7	2.13	300	91.44	1200	365.76
8	0.20	8	2.44	350	106.68	1300	396.24
9	0.23	9	2.74	400	121.92	1400	426.72
10	0.25	10	3.05	450	137.16	1500	457.20
11	0.28	20	6.10	500	152.40	2000	609.60
12	0.30	30	9.14	550	167.64	3000	914.40
		40	12.19	600	182.88	4000	1219.20
		50	15.24	650	198.12	5000	1524.00
		60	18.29	700	213.36		
		70	21.34	750	228.60		

Tonnage and fluid measurement

	US gallons	Imperial gallons	Capacity cubic feet
1 gal (imp)	×1.2	×1	×0.1604
1 gal (US)	×1.0	×0.8333	×0.1337
1 ft ³	×7.48	×0.2344	×1.0
1 l	×0.2642	×0.22	×0.0353
1-tonne fresh water	×269	×224	×35.84
1-tonne salt water	×262.418	×218.536	×35

Weight	Short ton	Long ton	Metric tonne
Long ton (imp)	×1.12	×1.0	×1.01605
Short ton (USA)	×1.0	×0.89286	×0.90718
Metric tonne	×1.10231	×0.98421	×1.0

Grain	Bushel (imp)	Bushel (USA)	Cubic feet
1 Bushel (imp)	×1.0	×1.0316	×1.2837
1 Bushel (USA)	×0.9694	×1.0	×1.2445
1 ft ³	×0.789	×0.8035	×1.0

Miscellaneous

1 lb	=	0.45359 kg	1 kg = 2.20462 lb
1 ft ³ /tonne	=	0.16 imp gal/tonne	
1 tonne/m ³	=	0.02787 tonne/ft ³	
1 m ³ /tonne	=	35.8816 ft ³ /tonne	

Contents

Preface vii

About the author ix

Acknowledgements xi

List of abbreviations used in the context of cargo work xiii

Conversion and measurement table xix

- Chapter 1. General principles of the handling, stowage and carriage of cargoes 1
- Chapter 2. Hatchwork and heavy-lift cargoes 33
- Chapter 3. Stowage properties of general cargoes 69
- Chapter 4. Bulk cargoes 100
- Chapter 5. Tanker cargoes 126
- Chapter 6. Specialist cargoes – timber, refrigerated and livestock cargoes 188
- Chapter 7. Roll-on, Roll-off operations 202
- Chapter 8. Containers and containerization 230
- Chapter 9. Special cargoes, hazardous goods and deck cargoes 259
- Chapter 10. Security, cargo documentation, stability examples 276

Appendix A Miscellaneous cargo information 290

Appendix B Self-examiner – questions and recommended answers to cargo related examples 295

Appendix C Codes and conventions affecting cargo work operations, additional references and bibliography 303

Commodity and detail index 305

General index 315

Chapter 1

General principles of the handling, stowage and carriage of cargoes

Introduction

The transport of cargoes dates back through the centuries to the Egyptians, the Phoenicians, ancient Greeks and early Chinese, long before the Europeans, ventured beyond the shores of the Atlantic. Strong evidence exists that the Chinese Treasure Ships traded for spices, and charted the Americas, Antarctica, Australia and the Pacific and Indian Oceans, before Columbus reportedly discovered America.*

The stones for the Pyramids of Egypt had to be brought up the River Nile or across the Mediterranean and this would reflect the means of lifting heavy weights, and transporting the same was a known science even before the birth of Christ. Marco Polo reported 200 000 vessels a year were plying the Yangtze River of China in 1271 and it must be assumed that commerce was very much alive with a variety of merchandise being transported over water.

Products from the world's markets have grown considerably alongside technology.

Bigger and better ships feed the world populations and the methods of faster and safer transport have evolved over the centuries.

The various cargoes and merchandise may be broadly divided into the following six types:

1. Bulk solids
2. Bulk liquids
3. Containerized units
4. Refrigerated/chilled
5. General, which includes virtually everything not in (1), (2), (3) and (4) above
6. Roll-on, Roll-off (Ro-Ro) cargoes.

* Menzies, G. (2002) 1421 The Year China Discovered the World, Bantam Press.

2 Cargo Work for Maritime Operations

Bulk cargoes can be loaded and discharged from a ship quickly and efficiently. Conversely, we have yet to see 10 000 tonnes of grain being loaded into a Jumbo Jet. Ships remain the most efficient means of transport for all cargo parcels of any respectable weight or size.

It is here that the business of how it is loaded, how it is stowed and subsequently shipped to its destination is investigated. Later chapters will deal with specifics on the commodities, but the methods of handling prior to starting the voyage and the practical stowage of goods, should be considered an essential element of the foundation to successful trade.

Definitions and cargo terminology

Air draught – means the vertical distance from the surface of the water to the highest point of the ship's mast or aerial.

Bale space capacity – is that cubic capacity of a cargo space when the breadth is measured from the inside of the cargo battens (spar ceiling) and the measured depth is from the wood tank top ceiling to the underside of the deck beams. The length is measured from the inside of the fore and aft bulkhead stiffeners.

Broken stowage – is defined as that space between packages which remains unfilled. The percentage that has to be allowed varies with the type of cargo and with the shape of the ship's hold. It is greatest when large cases are stowed in an end hold or at the turn of a bilge.

Cargo information – means appropriate information relevant to the cargo and its stowage and securing which should specify, in particular, the precautions necessary for the safe carriage of that cargo by sea.

Cargo plan – a ship's plan which shows the distribution of all cargo parcels stowed on board the vessel for the voyage. Each entry onto the plan would detail the quantity, the weight and the port of discharge. The plan is constructed by the Ship's Cargo Officer and would effectively show special loads such as heavy-lifts, hazardous cargoes, and valuable cargo, in addition to all other commodities being shipped.

Cargo runner – a general term used to describe the cargo lifting wire used on a derrick. It may be found rove as a 'single whip' or doubled up into a 'gun tackle' (two single blocks) or set into a multi-sheave lifting purchase. It is part of the derricks 'running rigging' passing over at least two sheaves set in the head block and the heel block, prior to being led to the barrel of the winch. Normal size is usually 24 mm and its construction is flexible steel wire rope (FSWR) of 6×24 wires per strand (wps).

Cargo securing manual – a manual that is pertinent to an individual ship, and which will show the lashing points and details of the securing of relevant cargoes carried by the vessel. It is a ship's reference which specifies the on-board securing arrangements for cargo units, including vehicles and containers, and other entities. The securing examples are based on the transverse, longitudinal and vertical forces which may arise during adverse