

ASCE STANDARD

ASCE/COPRI

77-22

Dry Dock Standard



PUBLISHED BY THE AMERICAN SOCIETY OF CIVIL ENGINEERS

Library of Congress Cataloging-in-Publication Data

Names: American Society of Civil Engineers, author.

Title: Dry dock standard.

Description: Reston, Virginia : American Society of Civil Engineers, [2023] | Series: ASCE standard | Includes bibliographical references and index. | Summary: "Dry Dock Standard, ASCE/COPRI 77-22, provides guidance on safety certification of commercial drydocking facilities through maintenance and inspection that will minimize risk to personnel and ships" – Provided by publisher.

Identifiers: LCCN 2023000707 | ISBN 9780784416006 (soft cover) | ISBN 9780784483923 (pdf)

Subjects: LCSH: Dry docks—Maintenance and repair—Standards. | Dry docks—Safety measures—Standards.

Classification: LCC TC361 .A474 2023 | DDC 623.8/3—dc23/eng/20230130

LC record available at <https://lcn.loc.gov/2023000707>

Published by American Society of Civil Engineers

1801 Alexander Bell Drive

Reston, Virginia, 20191-4382

www.asce.org/bookstore | ascelibrary.org

This standard was developed by a consensus standards development process that has been accredited by the American National Standards Institute (ANSI). Accreditation by ANSI, a voluntary accreditation body representing public and private sector standards development organizations in the United States and abroad, signifies that the standards development process used by ASCE has met the ANSI requirements for openness, balance, consensus, and due process.

While ASCE's process is designed to promote standards that reflect a fair and reasoned consensus among all interested participants, while preserving the public health, safety, and welfare that is paramount to its mission, it has not made an independent assessment of and does not warrant the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed herein. ASCE does not intend, nor should anyone interpret, ASCE's standards to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this standard.

ASCE has no authority to enforce compliance with its standards and does not undertake to certify products for compliance or to render any professional services to any person or entity.

ASCE disclaims any and all liability for any personal injury, property damage, financial loss, or other damages of any nature whatsoever, including without limitation any direct, indirect, special, exemplary, or consequential damages, resulting from any person's use of, or reliance on, this standard. Any individual who relies on this standard assumes full responsibility for such use.

ASCE and American Society of Civil Engineers—Registered in US Patent and Trademark Office.

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be requested by sending an email to permissions@asce.org or by locating a title in ASCE's Civil Engineering Database (<https://cedb.asce.org>) or ASCE Library (<http://ascelibrary.org>) and using the "Permissions" link.

Errata: Errata, if any, can be found at <https://dx.doi.org/10.1061/9780784416006>.

Copyright © 2023 by the American Society of Civil Engineers.

All Rights Reserved.

ISBN 978-0-7844-1600-6 (soft cover)

ISBN 978-0-7844-8392-3 (PDF)

Manufactured in the United States of America.

27 26 25 24 23 1 2 3 4 5

ASCE STANDARDS

In 2016, the Board of Direction approved revisions to the ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by ASCE. All such standards are developed by a consensus standards process managed by the ASCE Codes and Standards Committee (CSC). The consensus process includes balloting by a balanced standards committee and reviewing during a public comment period. All standards are updated or reaffirmed by the same process every five to ten years. Requests for formal interpretations shall be processed in accordance with Section 7 of ASCE Rules for Standards Committees which are available at www.asce.org. Errata, addenda, supplements, and interpretations, if any, for this standard can also be found at www.asce.org.

The provisions of this document are written in mandatory language and, as such, are intended to be suitable for regulatory or contractual purposes.

This standard has been prepared in accordance with recognized engineering principles and should not be used without the user's competent knowledge for a given application. The publication of this standard by ASCE is not intended to warrant that the information contained therein is suitable for any general or specific use, and ASCE takes no position respecting the validity of patent rights. The user is advised that the determination of patent rights or risk of infringement is entirely their own responsibility.

A complete list of currently available standards is available in the ASCE Library (<https://ascelibrary.org/page/books/s-standards>).

CONTENTS

PREFACE	xi
ACKNOWLEDGMENTS	xiii
1 GENERAL	1
1.1 Scope	1
1.2 Application	1
1.3 Definitions, Symbols, and Notation	1
1.4 Consensus Standards and Other Referenced Documents	4
2 TYPES OF DRY DOCKS	5
2.1 Purpose	5
2.2 Floating Dry Docks	5
2.2.1 Pontoon Floating Dry Dock	5
2.2.2 Caisson Floating Dry Dock	5
2.2.3 Sectional Floating Dry Dock	6
2.3 Graving Docks	6
2.3.1 Full Hydrostatic Graving Dock	7
2.3.2 Fully Relieved Graving Dock	7
2.3.3 Partially Relieved Graving Dock	7
2.3.4 Closure Gates	7
2.4 Marine Railways	9
2.5 Vertical Lifts	9
3 DRY DOCK CERTIFICATION REQUIREMENTS	11
3.1 Requirements	11
3.2 Qualifications of the Dry Dock Certifying Agency	11
3.3 Dry Dock Capacity Certificate	11
3.4 Condition Assessment	11
3.4.1 Periodicity of Condition Assessments	12
3.4.2 Drawings	12
3.4.3 Dry Dock Calculations	12
3.4.4 Material Condition Survey	12
3.4.5 Condition Assessment Report	12
3.5 Certification Inspections	13
3.6 Material Condition Survey Reporting	13
3.6.1 Reporting	13
3.7 Specific Requirements for All Dry Dock Types	13
3.7.1 Dry Dock Maintenance	13
3.7.2 Dry Dock Operations	13
3.7.3 Fire Protection	13
3.7.4 Hydrographic Survey	13
3.7.5 Underwater Survey	13
3.7.6 Record Keeping	13
3.8 Specific Requirements for Floating Dry Docks	13
3.8.1 Instrumentation Requirements	13
3.8.2 Wingwall Freeboard	13
3.8.3 Pontoon Freeboard	14
3.8.4 Stability	14
3.8.5 Ballast Tank and Buoyancy Chamber Watertightness	14
3.9 Specific Requirements for Graving Docks	14
3.10 Specific Requirements for Marine Railways	14
3.10.1 Line, Grade, and Gauge Survey	14
3.10.2 Chain Inspection Periodicity	14

3.10.3	Wire Rope	14
3.10.4	Rollers	14
3.11	Specific Requirements for Vertical Lifts	15
4	CONDITION ASSESSMENT REQUIREMENTS FOR FLOATING DRY DOCKS	17
4.1	Document Review	17
4.2	Material Condition Survey	17
4.2.1	Internal Ballast Tanks and Sea Chests	17
4.2.2	Internal Nonballasting Compartments	17
4.2.3	External Portions of the Floating Dry Dock	17
4.2.4	Floating Dry Dock Mooring System	18
4.2.5	Floating Dry Dock Fenders and Vessel Moorings	18
4.2.6	Floating Dry Dock Translation System (if applicable)	18
4.2.7	Vessel Support Blocks	18
4.2.8	Cathodic Protection System	18
4.3	Operational Tests	18
4.3.1	Dry Dock Operation Test	18
4.3.2	Submergence Test	18
4.3.3	Lightweight Survey	18
4.3.4	Translation System Test (if applicable)	19
4.3.5	Verification of Instrumentation and Controls	19
4.4	Dry Dock Calculations	19
4.4.1	Light Weight Determination	19
4.4.2	Buoyant Capacity	19
4.4.3	Stability	19
4.4.4	Transverse Bending	19
4.4.5	Longitudinal Bending Calculations and Deflection Limits	21
4.4.6	Local Strength Analysis	21
4.4.7	Block Loading Analysis	21
4.4.8	Hydrostatic Properties of the Hull	21
4.4.9	Hydrostatic Head Pressures on Internal Bulkheads	23
4.4.10	List and Trim Limits	23
4.4.11	Mooring Analyses	23
4.5	Condition Assessment Report	24
4.5.1	Written Descriptions	24
4.5.2	Calculations	24
4.5.3	Floating Dry Dock Capacity	24
5	CONDITION ASSESSMENT REQUIREMENTS FOR GRAVING DOCKS	25
5.1	Document Review	25
5.2	Material Condition Survey	25
5.2.1	Graving Dock Floor	25
5.2.2	Grade Survey of Graving Dock Floor	25
5.2.3	Graving Dock Walls	25
5.2.4	Graving Dock Sill, Closure Gate Abutments, and Entrance Structures	25
5.2.5	Pumphouse/Pumpwell and other Subsurface Structures	25
5.2.6	Flooding/Dewatering Tunnels	26
5.2.7	Areas Surrounding Graving Dock	26
5.2.8	Closure and Intermediate Gates	26
5.2.9	Graving Dock Fenders and Vessel Moorings	26
5.2.10	Vessel Support Blocks	26
5.2.11	Cathodic Protection System	26
5.3	Operational Tests	26
5.3.1	Dry Dock Operation Test	26
5.3.2	Verification of Calibration of Instruments	26
5.4	Dry Dock Calculations	26
5.4.1	Geotechnical Calculations	27
5.4.2	Loading on Floor	27
5.4.3	Loading on Walls	27
5.4.4	Loading on Dry Dock Sill	27
5.4.5	Uplift Stability	27
5.4.6	Structural Strength of Closure Gate	27

5.4.7	Stability of the Closure Gate	27
5.4.8	Light Weight Determination of Closure Gate	27
5.4.9	Ballast Required to Seat Closure Gate	27
5.4.10	Hydrostatic Head Pressures on the Closure Gate	27
5.4.11	Hydrostatic Head Pressures on Internal Bulkheads of the Closure Gate	27
5.4.12	Vulnerabilities Assessment with the Closure Gate Removed	27
5.4.13	Block Loading Analysis	27
5.4.14	Corrosion Criteria	28
5.5	Condition Assessment Report	28
5.5.1	Written Descriptions	28
5.5.2	Calculations	28
5.5.3	Overall Capacity	28
5.5.4	Rated Load per Foot Capacity	28
6	CONDITION ASSESSMENT REQUIREMENTS FOR MARINE RAILWAYS	29
6.1	Document Review	29
6.2	Material Condition Survey	29
6.2.1	Track Foundation	29
6.2.2	Tracks and Rails	29
6.2.3	Drydocking Cradle	31
6.2.4	Rollers and Wheels	31
6.2.5	Chains or Wire Rope	31
6.2.6	Hauling Machinery	32
6.2.7	Visual Survey of Drydocking Cradle Fenders and Vessel Moorings	32
6.2.8	Vessel Support Blocks	32
6.2.9	Underwater Survey	32
6.2.10	Cathodic Protection System	32
6.3	Operational Tests	32
6.3.1	Dry Dock Operation Test	33
6.3.2	Verification of Instrumentation and Controls	33
6.4	Dry Dock Calculations	33
6.4.1	Capacity of Foundation	33
6.4.2	Capacity of Track	33
6.4.3	Structural Strength of Drydocking Cradle	33
6.4.4	Stability of Drydocking Cradle	33
6.4.5	Capacity of Drydocking Cradle Locking Pin	33
6.4.6	Capacity of Hauling Machinery	33
6.4.7	Capacity of Hauling Chain (or Wire Rope)	33
6.4.8	Block Loading Analysis	34
6.4.9	Line, Grade, and Gauge Tolerances	34
6.4.10	Roller Tolerances	34
6.5	Condition Assessment Report	34
6.5.1	Written Descriptions	34
6.5.2	Calculations	35
6.5.3	Overall Lift Capacity	35
6.5.4	Rated Load per Foot Capacity	35
6.5.5	Allowable Deck Loading	35
7	CONDITION ASSESSMENT REQUIREMENTS FOR VERTICAL LIFTS	37
7.1	Document Review	37
7.2	Material Condition Survey	37
7.2.1	Support Piers and Piles	37
7.2.2	Vertical Lift Platform	37
7.2.3	Vertical Lift Drive and Primary Brake System	38
7.2.4	Vertical Lift Control Systems	38
7.2.5	Lifting Hoists	38
7.2.6	Vertical Lift Fenders and Vessel Moorings	38
7.2.7	Vessel Support Blocks	38
7.3	Operational Tests	38
7.3.1	Dry Dock Operation Test	38
7.3.2	Control and Protection Tests	38

7.4	Dry Dock Calculations	38
7.5	Condition Assessment Report	39
7.5.1	Written Descriptions	39
7.5.2	Maximum Lift Beam Capacity	39
7.5.3	Load per Foot Capacity (MDL)	40
7.5.4	Vessel Support Blocks Load Limits	40
8	CERTIFICATION INSPECTION REQUIREMENTS	41
8.1	Periodicity of Certification Inspections	41
8.2	Document Review	41
8.3	Certification Inspection Scope	41
8.3.1	Review of Existing Data	41
8.3.2	Document and Calculation Review	41
8.3.3	Material Condition Survey	41
8.3.4	Operational Inspections	41
8.3.5	Certification Inspection Checklists	42
8.4	Specific Certification Inspection Requirements	42
8.4.1	Floating Dry Docks	42
8.4.2	Graving Docks	42
8.4.3	Marine Railways	42
8.4.4	Vertical Lifts	42
8.5	Inspection Item Deferral	42
8.6	Correction of Deficiencies	42
8.7	Dry Dock Certification Report	42
9	DRY DOCK MAINTENANCE	43
9.1	Maintenance Program	43
10	DRY DOCK OPERATIONS—GENERAL REQUIREMENTS	45
10.1	Dry Dock Operations Personnel	45
10.1.1	Dry Dock Operations Personnel Qualifications	45
10.1.2	Dockmaster	45
10.2	Operating Procedures	45
10.3	Dry Dock Operation Manning Plan	45
10.4	Verification of Dry Dock Capability	45
10.4.1	Vessel Fit	45
10.4.2	Expected Work	46
10.4.3	Dry Dock Loading	46
10.4.4	Dry Dock System Stability (Dry Dock and Vessel)	46
10.5	Vessel Data Form	46
10.6	Drydocking Calculations	46
10.6.1	Block Loading	46
10.6.2	Dry Dock Loading	46
10.6.3	Vessel Stability	46
10.6.4	Vessel Trim	46
10.6.5	Floating Dry Dock Stability	47
10.6.6	Floating Dry Dock Pumping Plan	47
10.7	Undocking Calculations	47
10.8	Shipyard's Drydocking Plan	47
10.8.1	General Notes	47
10.8.2	Drawing Details	47
10.8.3	Hull Openings below the Waterline	47
10.9	Documentation Requirements	47
10.9.1	Drydocking Report	47
10.9.2	Dry Dock Logbook	47
10.9.3	Dockmaster Log Book	48
10.10	Block Build Requirements	48
10.10.1	Reference Planes	48
10.10.2	Block Materials	48
10.10.3	Block and Cradle Condition	49
10.10.4	Soft Caps	49
10.10.5	Block Position Tolerance	49

10.10.6	Line of Force.	49
10.10.7	Block Stability	49
10.10.8	Verification.	50
11	DRY DOCK OPERATIONS—REQUIREMENTS COMMON TO ALL DRY DOCK TYPES	51
11.1	Drydocking/Undocking Conference	51
11.2	Prior To Drydocking or Undocking Operations.	51
11.2.1	Operating Procedures	51
11.2.2	Communication.	51
11.2.3	Safety Meeting and Assignment of Personnel	51
11.2.4	Dry Dock Systems and Equipment	51
11.2.5	Final Dry Dock Checks	51
11.2.6	Manning	51
11.2.7	Weather.	51
11.3	Drydocking Operations.	51
11.3.1	Vessel Condition	51
11.3.2	Minimum Clearance	51
11.3.3	Transition from Ship or Tug Propulsion to Handling by Dry Dock Lines.	52
11.3.4	Exchange of Responsibility and Operational Control.	52
11.3.5	Positioning the Ship	52
11.3.6	Alignment over the Blocks	52
11.3.7	Landing the Ship.	52
11.3.8	Stopping Drydocking Operations	52
11.3.9	Divers	52
11.3.10	Grounding Cables, Gangways, and Services	52
11.3.11	Final Liquid Load Readings.	52
11.3.12	Examination of the Blocks/Cradles/Shores	52
11.4	Lay Period	53
11.4.1	Corrections to the Vessel Blocking Plan	53
11.4.2	Weight Changes	53
11.4.3	Watertight Integrity	53
11.5	Undocking Operations	53
11.5.1	Vessel Condition	53
11.5.2	Operating Procedures	53
11.5.3	Communication.	53
11.5.4	Safety Meeting and Assignment of Personnel	53
11.5.5	Dry Dock Systems and Equipment	53
11.5.6	Final Dry Dock Checks	53
11.5.7	Manning	53
11.5.8	Weather.	53
11.5.9	Vessel Condition	53
11.5.10	Minimum Clearance	53
11.5.11	Divers	53
11.5.12	Flooding Checks	53
11.5.13	Grounding Cables, Gangways, and Service Lines	53
11.5.14	Floating the Vessel.	53
11.5.15	Transition from Handling Lines to Ship or Tug Propulsion	54
11.5.16	Exchange of Responsibility and Operational Control.	54
11.5.17	Stopping Undocking Operations.	54
11.5.18	Accounting for the Dry Dock's Blocks/Cradles/Shores.	54
12	DRY DOCK OPERATIONS—REQUIREMENTS UNIQUE BY DRY DOCK TYPE	55
12.1	Floating Dry Dock Specific Operations	55
12.1.1	Operating Procedures	55
12.1.2	Baseline Height	55
12.1.3	Pumping Plan	55
12.1.4	Dry Dock Deflection.	55
12.1.5	Dry Dock Stability.	55
12.1.6	Dry Dock Operational Depths.	55
12.1.7	Dry Dock List and Trim.	55
12.1.8	Dry Dock Drafts	55
12.1.9	Cranes	55
12.1.10	Severe Weather.	55

12.2	Graving Dry Docks Specific Operations	56
12.2.1	Operating Procedures	56
12.2.2	Flooding the Graving Dock	56
12.2.3	Specific Gate Operation Requirements	56
12.2.4	Securing Dry Dock Flood Valves	56
12.2.5	Dewatering the Dry Dock	56
12.2.6	Vessel List and Trim.	56
12.2.7	Severe Weather.	56
12.3	Marine Railway Specific Operations.	56
12.3.1	Operating Procedures	56
12.3.2	Drydocking Procedure	56
12.3.3	Undocking Procedure	56
12.3.4	Vessel List and Trim.	57
12.3.5	Severe Weather.	57
12.4	Vertical Lift Specific Operations.	57
12.4.1	Operating Procedures	57
12.4.2	Drydocking Procedure	57
12.4.3	Undocking Procedure	57
12.4.4	Vessel List and Trim.	57
12.4.5	Severe Weather.	57
13	SHIPYARD RECORD-KEEPING REQUIREMENTS	59
13.1	Purpose	59
13.2	General Records	59
13.3	Condition Assessment Report	59
13.4	Certification Inspection Records	59
13.5	Dry Dock Operations	59
	APPENDIX A CERTIFICATION INSPECTION CHECKLISTS	61
	Appendix A1 Certification Inspection Checklist – Floating Dry Docks	61
	Appendix A2 Certification Inspection Checklist – Graving Docks	67
	Appendix A3 Certification Inspection Checklist – Marine Railways	72
	Appendix A4 Certification Inspection Checklist – Vertical Lifts	75
	APPENDIX B RECOMMENDED PREVENTIVE MAINTENANCE PERIODICITIES.	79
	APPENDIX C DRYDOCKING CHECKLIST	83
	INDEX.	87

PREFACE

This initial edition of *Dry Dock Standard*, ASCE/COPRI 77-22, is intended to address a deficiency in commercial shipyards, specifically safety certification of drydocking facilities. The US Navy has a standard (MIL-STD-1625) for certifying facilities that drydock their ships. The US Coast Guard has a procedure (SFLC 8634) for certifying facilities that drydock their ships. However, there is no commercial standard for certifying dry docks. Many dry dock owners/operators obtain “commercial certifications” from third-party engineers; however, these certifications are not performed to a standard and are typically focused on the structural capacity.

The dry dock standard provides requirements for issuing a certification that encompasses the structural design, material

condition, maintenance practices, and operating procedures. This standard is intended for use by dry dock owners, Dockmasters, dry dock maintenance engineers, engineers engaged in dry dock inspection and certification, ship owners, and port engineers.

There have been many dry dock accidents over the past two decades that are attributable to inadequate maintenance and inspections. The intent of this standard is to minimize the risk to personnel and the ships being drydocked. In addition, emphasis on maintenance and inspection will provide the insight for facility owners/operators to enable repairs before the catastrophic loss of their capital asset.

ACKNOWLEDGMENTS

ASCE greatly acknowledges the devoted efforts of the Dry Dock Standards Committee, which is a subcommittee of the Ports & Harbors Committee of the Coasts, Oceans, Ports, and Rivers Institute (COPRI). This committee comprises individuals from many backgrounds. This standard was prepared through ASCE's consensus standardization process in compliance with the ASCE Rules for Standards Committees and the procedures of the ASCE's Codes and Standards Committee (CSC). ASCE's standardization process is accredited by the American National Standards Institute (ANSI).

Voting Members

Paul A. Harren, A.M.ASCE, *Chair*
John L. Watts, P.E., M.ASCE, *Vice Chair*
John R. Anderson, *Secretary*
Robert A. Ernsting, Ph.D, P.E.
Graeme Forsyth, M.ASCE
Paul R. Goetz, Retired P.E.
Robert E. Heger, P.E.
Bradley G. Lamkin, P.E.
James A. Neville
Douglas L. Pearlson, P.E.
Paul Rossetti
Scott C. Sampson

Rusty Sandidge
Waleed Sayed, P.E.
Joe Stiglich
Charles Trobaugh

Associate Members

Matt McCarty, P.E., S.E., M.ASCE
Mike Preece, P.E.
Mark A. Procter, P.E.
David W. Pryor, P.E., M.ASCE
Sieu Quan
David Von Schmidt