

Specification for Marine Drilling Riser Equipment

API SPECIFICATION 16F
SECOND EDITION, NOVEMBER 2017

API MONOGRAM PROGRAM EFFECTIVE DATE: MAY 1, 2018

ERRATA 1, FEBRUARY 2019
ADDENDUM 1, JANUARY 2021
(API MONOGRAM PROGRAM EFFECTIVE DATE: JULY 1, 2021)
ADDENDUM 2, DECEMBER 2022
(API MONOGRAM PROGRAM EFFECTIVE DATE: JUNE 1, 2023)

Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed. The use of API publications is voluntary. In some cases, third parties or authorities having jurisdiction may choose to incorporate API standards by reference and may mandate compliance.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

All rights reserved. No part of this work may be reproduced, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Foreword

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

The verbal forms used to express the provisions in this document are as follows.

Shall: As used in a standard, "shall" denotes a minimum requirement in order to conform to the standard.

Should: As used in a standard, "should" denotes a recommendation or that which is advised but not required in order to conform to the standard.

May: As used in a standard, "may" denotes a course of action permissible within the limits of a standard.

Can: As used in a standard, "can" denotes a statement of possibility or capability.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

Contents

	Page
1 Scope	1
2 Normative References.....	1
3 Terms, Definitions, and Abbreviations.....	4
3.1 Terms and Definitions	4
3.2 Abbreviations and Symbols.....	12
4 Design	14
4.1 General.....	14
4.2 Service Classifications.....	14
4.3 Size and Coupling Model.....	14
4.4 Rated Load	14
4.5 Pressure Ratings	16
4.6 Temperature Criteria.....	16
4.7 Design of Structures and Lifting Attachments.....	16
4.8 Design Documentation.....	16
5 Materials and Welding Requirements.....	17
5.1 General.....	17
5.2 Materials Selection.....	17
5.3 Written Specifications	17
5.4 Metallic Materials	18
5.5 Material Applications	21
5.6 Qualification Test Coupons (QTCs).....	22
5.7 Welding	23
5.8 Metallic Coatings	25
6 Quality Control Requirements.....	26
6.1 General.....	26
6.2 Measuring and Testing Equipment	27
6.3 Quality Control Personnel Qualifications	27
6.4 Quality Control Requirements for Equipment and Parts	28
6.5 NDE of Fabrication and Repair of Weldments	30
6.6 Equipment Traceability	32
6.7 Requirements for Quality Control Records	32
6.8 Manufacturing Data Book	33
7 Riser Tensioner Equipment	33
7.1 General.....	33
7.2 Pressure	34
7.3 Service Ratings	34
7.4 Tension and Pressure vs Stroke	36
7.5 Design Standards	37
7.6 Operational Controls	38
7.7 Temperature Considerations	38
7.8 Fluids.....	38
7.9 Rod Materials and Coatings.....	39
7.10 Failure Control Provisions	39
7.11 Marking	39
7.12 Materials	39
7.13 Quality Control.....	39

Contents

	Page
8 Flex/Ball Joints.....	39
8.1 Service Classification.....	39
8.2 Design	40
8.3 Materials	41
8.4 Dimensions.....	41
8.5 Testing	41
8.6 Marking	41
9 Choke, Kill, and Auxiliary Lines.....	42
9.1 Design-Choke, Kill, and Auxiliary Lines	42
9.2 Testing of Choke, Kill, and Auxiliary Lines.....	42
9.3 Materials—Choke, Kill, and Auxiliary Lines.....	44
9.4 Welding and Quality Process Control-Choke, Kill, and Auxiliary Lines	44
10 Drape Hoses and Jumper Lines.....	44
10.1 Service Classification.....	44
10.2 Design	44
10.3 Process Control	45
10.4 Quality Control	45
11 Telescopic Joint (Slip Joint)	45
11.1 Service Classification.....	45
11.2 Design	46
11.3 Testing	46
11.4 Materials	47
11.5 Quality Control.....	47
11.6 Dimensions	48
11.7 Process Control	48
11.8 Marking	48
12 Riser Joints	48
12.1 Service Classification.....	48
12.2 Design	48
12.3 SAF/SLR	49
12.4 Pressure Ratings	49
12.5 Drift Testing	50
12.6 Materials and Welding	50
12.7 Dimensions	50
12.8 Process Control	50
12.9 Quality Control	50
12.10 Marking	50
13 Buoyancy Equipment	51
13.1 General.....	51
13.2 Syntactic Foam Modules	51
14 Riser Running and Handling Equipment.....	57
14.1 General.....	57
14.2 Coverage	57
14.3 Design	57
14.4 Testing	60
14.5 Materials	61

Contents

	Page
14.6 Quality Control	62
14.7 Dimensions	62
14.8 Marking	62
15 Tensioner Rings	62
15.1 General	62
15.2 Service Classification	63
15.3 Design	64
15.4 Tension Ring or Hands-free Gooseneck—Secondary Locking	64
15.5 Testing	65
15.6 Materials	66
15.7 Quality Control	66
15.8 Dimensions	66
15.9 Marking	66
16 Riser Coupling	67
16.1 General	67
16.2 Service Classification	67
16.3 Design Loads	68
16.4 Design Analysis	68
16.5 Testing	70
16.6 Material	71
16.7 Welding	72
16.8 Quality Control	72
16.9 Marking	72
17 Special Riser System Components	73
17.1 General	73
17.2 Service Classification	73
17.3 Design	73
17.4 Testing	73
17.5 Quality Control	74
18 Lower Riser Adapter	74
18.1 General	74
18.2 Marking	74
18.3 Quality Control	74
19 Operation and Maintenance Manuals	74
19.1 General	74
19.2 Equipment Description	74
19.3 Functional Description	74
19.4 Instructions for Equipment Usage	74
19.5 Maintenance Instructions	75
19.6 Warnings and Cautions	75
Annex A	76
Annex B (informative) Components of a Marine Drilling Riser System	77
Annex C (normative) Design for Static Loading	82
Annex D (informative) Finite Element Stress Analysis	87
Annex E (informative) Thermal Sprayed Aluminum	88

Contents

	Page
Annex F (normative) Manufacturing Data Book Requirements.....	93
Annex G (informative) Example Calculations for Tensioners.....	95
Annex H (informative) Effective Polytropic Constants for Isentropic Compression and Expansion of Air and Nitrogen	99
Annex I (informative) Fatigue Considerations	105
Annex J (informative) Coupling Optional Qualification Tests.....	108
Bibliography.....	109
 Figures	
1 Rated Tension and MTL to MSP, MCP, and MAWP (for Illustration Only)	35
B.1 Marine Drilling Riser System and Associated Equipment	77
C.1 Stress Distribution Across Section A-A	85
G.1 Tension and Pressure vs Stroke	97
G.2 Typical Wire Rope Tensioning System	98
 Tables	
1 Design Temperatures for Various Line Types.....	16
2 Bolting Requirements	22
3 Inclusion Criteria.....	30
4 Elongation Properties	62
E.1 Surface Preparation	90
E.2 Sealer Application.....	91
E.3 TSA Application.....	92
G.1 Tensioner Example Calculation.....	95
H.1 Polytropic Constant Table—Air Compressed to 85 % of Initial Volume.....	99
H.2 Polytropic Constant Table—Air Compressed to 90 % of Initial Volume.....	99
H.3 Polytropic Constant Table—Air Compressed to 95 % of Initial Volume.....	100
H.4 Polytropic Constant Table—Air Expanded to 105 % of Initial Volume	100
H.5 Polytropic Constant Table—Air Expanded to 110 % of Initial Volume	101
H.6 Polytropic Constant Table—Air Expanded to 115 % of Initial Volume	101
H.7 Polytropic Constant Table—Nitrogen Compressed to 85 % of Initial Volume	102
H.8 Polytropic Constant Table—Nitrogen Compressed to 90 % of Initial Volume	102
H.9 Polytropic Constant Table—Nitrogen Compressed to 95 % of Initial Volume	103
H.10 Polytropic Constant Table—Nitrogen Expanded to 105 % of Initial Volume	103
H.11 Polytropic Constant Table—Nitrogen Expanded to 110 % of Initial Volume	104
H.12 Polytropic Constant Table—Nitrogen Expanded to 115 % of Initial Volume	104

Specification for Marine Drilling Riser Equipment

1 Scope

This specification establishes standards of performance and quality for the design, manufacture, and fabrication of marine drilling riser equipment used in conjunction with a subsea blowout preventer (BOP) stack.

This specification provides the requirements for the following major subsystems in the marine drilling riser system:

- riser tensioner equipment;
- flex/ball joints;
- choke, kill, and auxiliary lines;
- drape hoses and jumper lines for flex/ball joints;
- telescopic joint (slip joint) and tensioner ring;
- riser joints;
- buoyancy equipment;
- riser running equipment;
- special riser system components;
- lower riser adapter;
- riser coupling.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies (including any addenda/errata).

API Technical Report 5C3, *Technical Report on Equations and Calculations for Casing, Tubing, and Line Pipe Used As Casing or Tubing; and Performance Properties Tables for Casing and Tubing*

API Specification 5CT, *Specification for Casing and Tubing*

API Specification 5L, *Specification for Line Pipe*

API Specification 6A, *Specification for Wellhead and Christmas Tree Equipment*

API Standard 6ACRA, *Age-hardened Nickel-based Alloys for Oil and Gas Drilling and Production Equipment*

API Specification 7K, *Drilling and Well Servicing Equipment*