

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Specification for Subsea Pipeline Valves

API SPECIFICATION 6DSS FOURTH EDITION,



AMERICAN PETROLEUM INSTITUTE

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

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.

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.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

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.

Copyright © 2017 American Petroleum Institute

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

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.

For API Monogram Program licensees and APIQR Program registrants, this standard shall become effective on the program date printed on the cover but may be used voluntarily from the date of publication.

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.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Contents

Page

1	Scope	1
2	Normative References	1
3	Terms, Definitions, Acronyms, Abbreviations, Symbols, and Units	3
3.1	Terms and Definitions	3
3.2	Acronyms, Abbreviations, Symbols, and Units	10
4	Valve Types and Configurations	12
4.1	Valve Types	12
4.2	Valve Configurations	13
5	Design	15
5.1	Design Standards and Calculations	15
5.2	Pressure and Temperature Rating	15
5.3	Sizes	16
5.4	Face-to-face and End-to-end Dimensions	16
5.5	Valve Operation	16
5.6	Operator Information	17
5.7	Pigging	19
5.8	Valve Ends	19
5.9	Valve Cavity Pressure Relief	21
5.10	Drains, Vents, Body Test Ports, Seal Test Port, and Body Connections	21
5.11	Stem/Seat and Cavity Injection Points	22
5.12	Drain, Sealant, and Vent Valves	22
5.13	Hand-wheels and Wrenches—Levers	22
5.14	Position of the Obturator	22
5.15	Position Indicators	23
5.16	Travel Stops	23
5.17	Valve Operator Interface Requirements	23
5.18	ROT System	24
5.19	Lifting Points and Supports	24
5.20	Drive Trains	24
5.21	Stem Retention	26
5.22	Body and Stem Seals	26
5.23	Valve Stem Seal Integrity Verification	26
5.24	Overpressure Protection	26
5.25	Pressure Cap	26
5.26	Stem/Shaft Protector	26
5.27	Hydraulic Lock	26
5.28	Corrosion/Erosion	26
5.29	Design Validation	27
5.30	Hyperbaric Performance	27
6	Materials	27
6.1	Material Specification	27
6.2	Tensile Test Requirements	28
6.3	Service Compatibility	28
6.4	Cast Material	28
6.5	Forged Material	29
6.6	Composition Limits	29

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Contents

Page	
6.7	Impact Test Requirements 30
6.8	Bolting 31
6.9	Cathodic Protection 32
6.10	Sour Service 32
6.11	Hydrogen-induced Cracking 32
6.12	Drain Connections 32
6.13	Heat Treating Equipment Qualification 32
7	Welding 34
7.1	Welding Consumables 34
7.2	Welding Procedure and Welder/Welding Operator Qualifications 34
7.3	Impact Testing 35
7.4	Hardness Testing 36
7.5	Repairs 36
8	Quality Control 37
8.1	Quality Control Procedures 37
8.2	NDE Requirements 37
8.3	Measuring and Test Equipment 37
8.4	Qualification of Personnel 38
8.5	Welding Inspectors 39
8.6	NDE of Repairs 39
8.7	Production Material Hardness Testing on Critical Parts 39
8.8	Marking, Age Control, and Storage for Nonmetallic Seals 40
9	Valve Assembly 41
10	Factory Acceptance Testing (FAT) 41
10.1	General 41
10.2	Stem Backseat Test 42
10.3	Hydrostatic Shell Test 43
10.4	Operational/Functional Test 43
10.5	Hydrostatic Seat Test 44
10.6	Cavity Relief Test 46
10.7	Draining 48
10.8	Low-pressure Gas Seat Test 48
10.9	High-pressure Gas Shell Test 48
10.10	High-pressure Stem Seal Integrity Testing 49
10.11	High-pressure Gas Seat Test 49
10.12	Check Valves 49
10.13	Installation of Body Connections After Testing 50
10.14	Testing of Body Connections 50
10.15	CP Continuity Test 50
10.16	Post-testing Corrosion Protection 50
11	Coating/Painting 50
12	Marking 51
13	Preparation for Shipment 53
14	Documentation 54

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

14.1 Minimum Documentation and Retention 54

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Contents

Page

14.2 Documentation Provided with the Valve	54
14.3 Supplementary Documentation	55
15 Facility Requirements	55
15.1 Minimum Facility Requirements for the Assembler/manufacturer Category of Manufacturing	55
15.2 Conformance with Specification	56
15.3 Processes Requiring Validation	56
16 Purchasing Guidelines	56
Annex A (informative) Use of API Monogram by Licensees	57
Annex B (informative) Valve Configurations	60
Annex C (normative) Valve End-to-End and Face-to-Face Dimensions	71
Annex D (informative) Actuator—Gearbox Requirements	88
Annex E (informative) Guidance for Travel Stops by Valve Type	89
Annex F (informative) Design Validation	90
Annex G (informative) Hyperbaric Validation Testing	102
Annex H (normative) Pressure Boundary Bolting	106
Annex I (informative) Pressure-containing Castings and Forgings	107
Annex J (normative) Qualification of Heat Treating Equipment	108
Annex K (normative) Requirements for Nondestructive Examination	110
Annex L (informative) Supplementary Test Requirements	115
Annex M (informative) Isolation Valve Features	117
Annex N (normative) External Coating for End Connections	120
Annex O (informative) Marking Example	122
Annex P (informative) Supplementary Documentation Requirements	124
Annex Q (informative) Purchasing Guidelines	125
Bibliography	128

Figures

1 Typical Flange Dimensions	20
2 Bolt Hole Misalignment	21
3 Charpy V-notch WM Specimen Location	35
4 Charpy V-notch HAZ Specimen Location	35
5 Typical Identification Plate for a Valve with One Seat Unidirectional and One Seat Bidirectional	53
B.1 Expanding Gate/Rising Stem Gate Valve	61
B.2 Slab Gate/Through-conduit Rising Stem Gate Valve	62
B.3 Plug Valve	63
B.4 Top Entry Trunnion-mounted Ball Valve	64
B.5 Two-piece Bolted Ball Valve	65
B.6 Two-piece Welded Ball Valve	66
B.7 Full-opening Cast Swing Check Valve	67

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Contents

Page

B.8	Full-opening Forged Swing Check Valve	68
B.9	Axial-flow Check Valve	69
B.10	Axial On-off Valve	70
F.1	Test Procedure for Pressure Temperature Cycle	100
J.1	Thermocouple Location—Rectangular Furnace (Working Zone)	109
J.2	Thermocouple Location—Cylindrical Furnace (Working Zone)	109
M.1	Block and Bleed—Type A	118
M.2	Block and Bleed—Type B	118
M.3	Double Block and Bleed—Type A	118
M.4	Double Block and Bleed—Type B	119
M.5	Double Isolation and Bleed—Type A	119
M.6	Double Isolation and Bleed—Type B	119
N.1	Raised Face	120
N.2	Ring Type Joint or Raised Face Ring Type Joint	120
N.3	Weld Face	121
N.4	Pipe Pup Weld Ends	121
 Tables		
1	Minimum Bore for Full-opening Valves	14
2	Minimum V-notch Impact Requirements for Carbon and Low-alloy Steels (Full-size Specimen)	31
3	Minimum V-notch Impact Requirements for Duplex and Super Duplex Stainless Steel (Full-size Specimen)	31
4	Chemical Composition of Nickel-based Alloy UNS N06625	34
5	Minimum Duration of Stem Backseat Tests	42
6	Valve Marking	52
7	Minimum Facility Requirements	55
C.1	Gate Valves—Face-to-face (<i>A</i>) and End-to-end (<i>B</i> and <i>C</i>) Dimensions	72
C.2	Plug Valves—Face-to-face (<i>A</i>) and End-to-end (<i>B</i> and <i>C</i>) Dimensions	75
C.3	Ball Valves—Face-to-face (<i>A</i>) and End-to-end (<i>B</i> and <i>C</i>) Dimensions	80
C.4	Check Valves—Face-to-face (<i>A</i>) and End-to-end (<i>B</i> and <i>C</i>) Dimensions	84
C.5	Axial On-off Valves—Face-to-face (<i>A</i>) and End-to-end (<i>B</i> and <i>C</i>) Dimensions	87
E.1	Valve Travel Stops	89
F.1	Design Validation for Valves	96
F.2	Room Temperature Gas Leakage Acceptance Criteria	97
G.1	Hyperbaric Qualification Test	102
K.1	NDE Requirements	111
K.2	Extent, Method, and Acceptance Criteria of NDE/item Examination Code	112
M.1	Isolation Valve Types	117
Q.1	Valve Datasheet	126

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Introduction

This specification is the result of updating the requirements from API Specification 6DSS, Second Edition, including Errata1.

The revision of API 6DSS, Third Edition, is developed based on input from the API 6DSS Task Group technical experts. The technical revisions have been made in order to accommodate the needs of industry and to move this specification to a higher level of service to the petroleum and natural gas industry.

In this specification, data are expressed in both U.S. customary (USC) and metric (SI) units.

Except as otherwise required by this specification, to determine conformance with the specified requirements, observed or calculated values are to be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of ASTM E29 or ISO 80000-1, Annex B, Rule A.

This specification is not intended to inhibit a manufacturer from offering, or the purchaser from accepting, alternative equipment or engineering solutions for the individual application. This may be particularly applicable where there is innovative or developing technology.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Specification for Subsea Pipeline Valves

1. Scope

This specification defines the requirements for the design, manufacturing, quality control, assembly, testing, and documentation of axial on-off, ball, check, and gate valves for application in subsea pipeline systems for the petroleum and natural gas industries.

This specification applies to ASME 150, 300, 600, 900, 1500 and 2500.

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 17TR11, Pressure Effects on Subsea Hardware During Flowline Pressure Testing in Deep Water, 1st Ed. or a subsequent edition including addenda.

API Specification 20E, Alloy and Carbon Steel Bolting for Use in the Petroleum and Natural Gas Industries, 3rd Ed. or a subsequent edition including addenda.

API Specification 20F, Corrosion Resistant Bolting for Use in the Petroleum and Natural Gas Industries, 3rd Ed. or a subsequent edition including addenda.

ASME B1.20.1-2013(2018) ¹, Unified Screw and Pipe Threads, or subsequent editions

ASME B16.5:2005, Pipe Flanges and Flanged Fittings: NPS 1/2 Through 24 Metric/Inch Standard, or subsequent editions

ASME B16.10:2022, Face-to-Face and End-to-End Dimensions of Valves, or subsequent editions

ASME B16.25:2022, Buttwelding Ends, or subsequent editions

ASME B16.34:2025, Valves—Flanged, Threaded, and Welding End, or subsequent editions

ASME B16.47:2025, Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard, or subsequent editions

ASME B31.4:2025, Pipeline Transportation Systems for Liquids and Slurries, or subsequent editions

ASME B31.8:2025, Gas Transmission and Distribution Piping Systems, or subsequent editions

ASME Boiler and Pressure Vessel Code (BPVC), Section II: Materials, Part D:2025, Properties, or subsequent editions

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

ASME Boiler and Pressure Vessel Code (BPVC), Section V:2025, Nondestructive Examination, or subsequent editions

ASME Boiler and Pressure Vessel Code (BPVC), Section VIII: Pressure Vessels; Division 1:2025, Rules for Construction of Pressure Vessels, or subsequent editions

ASME Boiler and Pressure Vessel Code (BPVC), Section VIII: Pressure Vessels; Division 2:2025, Alternative Rules, or subsequent editions

ASME Boiler and Pressure Vessel Code (BPVC), Section IX:2025, Welding and Brazing Qualifications, or subsequent editions

ASNT SNT-TC-1A-2024 ², Personnel Qualification and Certification in Nondestructive Testing or subsequent editions.

ASTM A320/A320M-2026 ³, Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service, or subsequent editions.

ASTM A370-2024, Standard Test Methods and Definitions for Mechanical Testing of Steel Products, or subsequent editions.

ASTM A578/A578M-2023, Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications, or subsequent editions.

ASTM A609/A609M-2023, Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof, or subsequent editions.

ASTM E8/E8M-2008, Standard Test Methods for Tension Testing of Metallic Materials, or subsequent editions.

ASTM E10-2023, Standard Test Method for Brinell Hardness of Metallic Materials, or subsequent editions.

ASTM E18-2025, Standard Test Methods for Rockwell Hardness of Metallic Materials, or subsequent editions.

ASTM E29-2022, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications, or subsequent editions.

ASTM E110-14(2023), Standard Test Method for Rockwell and Brinell Hardness of Metallic Materials by Portable Hardness Testers, or subsequent editions.

ASTM E562-2019, Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count, or subsequent editions.

ASTM E1245-2003(2023), Standard Practice for Determining the Inclusion or Second-Phase Constituent Content of Metals by Automatic Image Analysis, or subsequent editions.

ASTM G48-2025, Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
Steels and Related Alloys by Use of Ferric Chloride Solution, or subsequent editions.

AWS QC1-2016, ⁴ Specification for AWS Certification of Welding Inspectors, or subsequent editions.

EN 10204:2004 ⁵ Metallic products—Type of inspection documents, or subsequent editions.

ISO 148-1:2016 ⁶ Metallic materials—Charpy pendulum impact test—Part 1: Test method, or subsequent editions.

ISO 228-1:2000, Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation, or subsequent editions.

ISO 5208:2015, Industrial valves—Pressure testing of valves, or subsequent editions.

ISO 5817:2023, Welding—Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded)—Quality levels for imperfections, or subsequent editions.

ISO 6506-1:2014, Metallic materials—Brinell hardness test—Part 1: Test method, or subsequent editions.

ISO 6508-1:2023, Metallic materials—Rockwell hardness test—Part 1: Test method, or subsequent editions.

ISO 6892-1:2020, Metallic materials—Tensile testing—Part 1: Method of test at room temperature, or subsequent editions.

ISO 9606-1:2012, Qualification testing of welders—Fusion welding—Part 1: Steels, or subsequent editions.

ISO 9712:2021, Non-destructive testing—Qualification and certification of NDT personnel, or subsequent editions.

ISO 10474:2013, Steel and steel products—Inspection documents, or subsequent editions.

ISO 15156:2020 (all parts), Petroleum and natural gas industries—Materials for use in H₂S-containing environments in oil and gas production, or subsequent editions.

ISO 15607:2019, Specification and qualification of welding procedures for metallic materials—General rules, or subsequent editions.

ISO 15608:2025, Welding—Guidelines for a metallic materials grouping system, or subsequent editions.

ISO 15609:2020 (all parts), Specification and qualification of welding procedures for metallic materials—Welding procedure specification, or subsequent editions.

ISO 15614-1:2017, Specification and qualification of welding procedures for metallic materials—Welding procedure test—Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys, or subsequent editions.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

ISO 15614-7:2016, Specification and qualification of welding procedures for metallic materials—Welding procedure test—Part 7: Overlay welding, or subsequent editions.

ISO 17636-1:2022, Non-destructive testing of welds—Radiographic testing—Part 1: X- and gamma-ray techniques with film, or subsequent editions.

ISO 17637:2016, Non-destructive testing of welds —Visual testing of fusion-welded joints, or subsequent editions.

ISO 80000-1:2022, Quantities and units: Part 1—General principles, or subsequent editions.

MSS SP-44:2026⁷, Steel Pipeline Flanges, or subsequent editions.

MSS SP-55, Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components—Visual Method for Evaluation of Surface Irregularities, or subsequent editions.

NACE MR0175:2020⁸ (all parts), Petroleum, petrochemical, and natural gas industries—Materials for use in H₂S-containing environments in oil and gas production, or subsequent editions.

NACE TM0284:2026, Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking, or subsequent editions.

SAE AMS 2750:2024⁹, *Pyrometry*, or subsequent editions.

3 Terms, Definitions, Acronyms, Abbreviations, Symbols, and Units

3.1 Terms and Definitions

For the purposes of this document, the following definitions apply.

3.1.1

assembly

Association of multiple parts/components into a finished product, including, as a minimum, installation of all pressure-containing parts and pressure-controlling parts.

3.1.2

bidirectional seat

Valve seat designed to seal against pressure source in either direction.

3.1.3

bidirectional valve

Valve designed for blocking the fluid in either the upstream or the downstream direction.

3.1.4

bleed (verb)

To drain or vent.

3.1.5

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

block and bleed valve

BB

Single valve with at least one seating surface that, in the closed position, provides a seal against pressure from one end of the valve with the body cavity depressurized.

3.1.6

block valve

Axial on-off, ball, check or gate valve that blocks flow when in the closed position.

NOTE Valves are both single seated or double seated and either bidirectional or unidirectional.

3.1.7

body test port

Connection provided to permit monitoring of seat leakage during test.

NOTE Single seated valves and downstream seating valves have no requirement for a body test port.

3.1.8

breakaway thrust

breakaway torque

Maximum thrust or torque required to operate a valve at maximum pressure differential (MPD).

3.1.9

by agreement

Contractual requirement between the manufacturer and the purchaser needed for a given action to be completed.

3.1.10

closure member

Part of a valve, such as a ball, clapper, disc, gate, or piston, positioned in the flow stream to permit or prevent flow.

NOTE Earlier editions of API 6DSS referred to the closure member as an "obturator."

3.1.11

cycle

Operation from the fully closed to fully open and return to the closed position or fully open to fully closed and return to the open position.

3.1.12

date of manufacture

The month and year of completion of factory acceptance testing.

3.1.13

design review and verification

The process of examining the result of design and development output to determine conformity with specified requirements.

NOTE Design verification activities can include one or more of the following (this is not an all-

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
inclusive list):

- a) confirming the accuracy of design results through the performance of alternative calculations;
- b) review of design output documents independent of activities of design and development;
- c) comparing new designs to similar proven designs.

3.1.15

design validation

The process of proving a design by testing to demonstrate conformity of the product to design requirements.

NOTE Design validation can include one or more of the following (this is not an all-inclusive list):

- a) prototype tests;
- b) functional and/or operational tests of production products;
- c) tests specified by industry standards and/or regulatory requirements;
- d) field performance tests and reviews.

3.1.16

double block and bleed valve

DBB

Single valve with two seating surfaces that, in the closed position, provides a seal against pressure from both ends of the valve with a means of venting/bleeding the cavity between the seating surfaces.

3.1.17

double isolation and bleed valve

DIB

Single valve with two seating surfaces, each of which, in the closed position, provides a seal against pressure from a single source, with a means of venting/bleeding the cavity between the seating surfaces.

NOTE This feature can be provided in one direction or in both directions.

3.1.18

drive train

All parts of a valve drive from the operator to and including the closure member connection that transmit or react to loads.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

3.1.19

locking device

Part or an arrangement of parts for securing a valve in the open or closed position.

3.1.20

maximum allowable stem torque/thrust

MAST

Maximum torque/thrust that it is permissible to apply to the valve drive train without risk of damage, as defined by the valve manufacturer.

3.1.21

maximum allowable working pressure

MAWP

The maximum pressure at which the valve is designed to operate, at a corresponding temperature, as defined by ASME B16.34.

NOTE Pressure–temperature ratings are the maximum allowable working pressure for the corresponding temperature.

3.1.22

maximum pressure differential

MPD

Maximum difference between the upstream and downstream pressure across the closure member at which the closure member may be operated.

3.1.23

nominal pipe size

NPS

Numerical designation of size in inches that is common to components in piping systems.

3.1.24

nominal (diameter) size

DN

Numerical designation of size in millimeters that is common to components in piping systems.

3.1.25

operator

An individual device or assembly for opening and closing a valve that may be controlled manually or under separate power (electric, hydraulic, or gas-driven).

NOTE 1 A manual operator can be a wrench (lever) or hand-wheel with or without a gearbox.

NOTE 2 A powered operator can include an actuator, a gearbox, and/or direct drive device.

3.1.26

outsourced

Function or process that is performed by an external supplier performed on behalf of the manufacturer.

3.1.27

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

packing gland

Components used to retain the stem packing.

3.1.28

**pipe pup
transition piece**

Piece of pipe or forged material that is welded to the valve body.

3.1.29

position indicator

Device to show the position of the valve closure member.

3.1.30

pressure balance hole

An opening in the closure member that provides pressure balance between the valve bore and valve cavity only when in the open position.

NOTE The hole does not provide relief of cavity overpressure in the closed position.

3.1.31

pressure boundary bolting

Threaded fasteners used to connect pressure-containing parts.

EXAMPLE Pressure boundary bolting can include studs, nuts, bolts, and cap screws.

3.1.32

pressure cap

A component designed to contain internal pressure in the event of seal leakage or to prevent ingress due to hyperbaric pressure.

3.1.33

pressure class

A numerical designation as defined in ASME B16.34 that also defines the pressure and temperature rating for the end connector material of the valve.

NOTE The ASME rating class (pressure rating designation) is composed of the word "Class," followed by a dimensionless number (the designation for pressure-temperature ratings); for example: Class 150, Class 300, etc.

3.1.34

pressure-containing parts

Part whose failure to function as intended results in a release of contained fluid into the environment.

NOTE Pressure-containing parts do not include bolting (see Section 8).

3.1.35

pressure-controlling parts

Parts such as those identified in 5.1.3 that are intended to allow or prevent the flow of fluids.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

3.1.36

reduced opening

Valve with the opening through the closure member smaller than at the end connection(s).

3.1.37

remotely operated tool system

ROT system

Dedicated, unmanned, subsea tools used for installation and inspection, maintenance, and repair tasks that require lift and/or handling capacity beyond that of free-swimming remotely operated vehicle (ROV) systems.

NOTE 1 The ROT system comprises wire-suspended tools with control system and support-handling system for performing dedicated subsea intervention tasks.

NOTE 2 ROT systems are usually deployed on lift wires or a combined lift wire/umbilical. Lateral guidance may be via guidelines, dedicated thrusters, or ROV assistance.

3.1.38

remotely operated vehicle

ROV

Free-swimming or tethered submersible craft used to perform tasks such as inspection, valve operations, hydraulic functions, and other general tasks.

3.1.39

seal test port

Connection provided to test the function of individual seals, when multi-barrier seals are provided in series, such as stem seals and body seals, and not intended to demonstrate function of internal seals.

3.1.40

sealing surfaces

Contact surface of the dynamic or static seals within the valve shell, excluding end connector sealing surfaces that mate with other equipment.

EXAMPLES Stem, seat, cover/bonnet seals, and backseat.

3.1.41

seating surfaces

Contact areas of the closure member and seat that affect valve sealing.

NOTE The seat may be integral to the valve body.

3.1.42

self-relieving seat/single piston effect

SR/SPE

Valve seat assembly designed to relieve pressure from the valve cavity.

NOTE Depending upon valve type, the pressure may be relieved to the pressure source or the low-pressure side.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

3.1.43

shaft

Part that supports the closure member on a check valve.

3.1.44

shell test

Test of the assembled pressure-containing parts.

3.1.45

stem

Part that drives the closure member.

3.1.46

stem extension assembly

Parts consisting of the stem extension and the stem extension housing.

3.1.47

stem/shaft protector

Cover to protect valve parts from mechanical damage.

NOTE A pressure cap may also be used for protection.

3.1.48

temperature, maximum allowable

Upper limit for a valve based on continuous operating service conditions.

3.1.49

temperature, minimum allowable

Lower limit for a valve based on continuous operating service conditions.

3.1.50

test fixtures

Equipment/tool/device used to test a specific item or a specific feature of the valve.

NOTE When referred to hyperbaric testing, this might refer to blind flanges, pressure caps, spool pieces, or any other similar item meant to validate the hyperbaric functionality of the valve (if not performed in the hyperbaric chamber).

3.1.51

unidirectional seat

Valve seat designed to seal the pressure source in one direction only.

3.1.52

unidirectional valve

Valve designed for blocking the flow in one direction only.

3.1.53

visible leakage

Leakage of test fluid observed by any visual method during a pressure test.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE Use of a camera is allowed.

3.2 Acronyms, Abbreviations, Symbols, and Units

For the purposes of this document, the following acronyms and abbreviations apply.

BB block and bleed

BM base metal

BTC break-to-close

BTO break-to-open

CE carbon equivalent

CP cathodic protection

CTO crack-to-open

CRA corrosion resistant alloy

DBB double block and bleed

DC direct current

DIB double isolation and bleed

DN nominal size

ENP electroless nickel plating

ETC end-to-close

ETO end-to-open

FAT factory acceptance testing

FEA finite element analysis

HAZ heat-affected zone

HBW Brinell hardness, tungsten ball indenter

HIC hydrogen induced cracking

HRC Rockwell C hardness

MAST maximum allowable stem torque

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

MAWP maximum allowable working pressure

MPD maximum pressure differential

MT magnetic-particle testing

NDE nondestructive examination

NPS nominal pipe size

OD outside diameter

PQR (weld) procedure qualification record

PREN pitting resistance equivalent number

PT penetrant testing

PWHT postweld heat treatment

QL quality level

ROT remotely operated tool

ROV remotely operated vehicle

rpm revolutions per minute

RT radiographic testing

RWP rated working pressure

SMYS specified minimum yield strength

SPE/SR Single Piston Effect/Self Relieving

TC test coupon

TCC tungsten carbide coating

UT ultrasonic testing

VT visual testing

WM weld metal

WPQ welder performance qualification

WPS weld procedure specification

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

C_v flow coefficient in USC units

K_v flow coefficient in metric units

S_m design stress intensity value

t thickness

Ω ohms

4 Application, Configuration, and Performance

NOTE The former QL1 and QL2 have been redesignated as QSL1 and QSL1G (the same as QSL1 with gas testing); and QSL2 and QSL2G (the same as QSL2 with gas testing). In previous editions of this specification, the minimum (default) quality level was QL1 for all valves. In this edition, the new default has no quality level designation which removes some NDE and gas testing for the valve. If the NDE requirements of the previous QL1 designation are required, QSL1 must now be minimally specified. If gas testing is also required, QSL1G must be minimally specified. See Annex I for specific testing and NDE applicable to each QSL.

4.1 Valve Types

4.1.1 General

4.1.1.1 This specification shall apply to the following:

- a) axial on-off valves;
- b) ball valves;
- c) check valves;
- d) gate valves.

4.1.1.2 Valves having a preferred flow direction for operation shall be marked in conformance with Table 12.

4.1.2 Axial On-Off Valves

4.1.2.1 Axial on-off valves shall have a closure member that moves on an axis parallel to the direction of flow.

4.1.3 Ball Valves

4.1.3.1 Ball valves shall have a solid, one-piece nominally spherical closure member that rotates on an axis perpendicular to the direction of flow.

4.1.4 Check Valves

4.1.4.1 Check valves shall have a closure member that responds automatically to block fluid in one direction and to permit fluid flow in the opposite direction.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE 1 Check valves can have an axial flow pattern, sometimes called nozzle check valves. These are different from axial on-off valves.

NOTE 2 Check valves may be supplied with a lock-open feature that would prevent the automatic blocking of fluid flow.

4.1.5 Gate Valves

4.1.5.1 Gate valves shall have a closure member that moves in a plane perpendicular to the direction of flow.

NOTE The closure member can be constructed of one piece (slab-gate valve) or of two or more pieces (expanding-gate valve).

4.1.5.2 Gate valves shall be provided with a backseat or a redundant stem seal in addition to the primary stem seal.

4.2 Conformance and General Performance Requirements

4.2.1 Conformance

4.2.1.1 Valves conforming to this specification shall be manufactured under the manufacturer's quality management system, which shall conform to an industry-accepted standard such as API Q1 or ISO 9001.

4.2.2 Performance Requirements

4.2.2.1 Designs shall conform to Section 5.

4.2.2.2 Testing and NDE requirements identified in Section 4 through Section 14 shall apply to valves manufactured to this specification.

4.2.2.3 The supplemental testing and quality specification levels of Annex I shall apply if specified by the purchaser.

NOTE Annex I identifies supplemental requirements for nondestructive examination and pressure testing that may be performed on a valve if specified by the manufacturer or purchaser.

4.2.2.4 Applicable requirements as stated in Section 4 through Section 14 shall apply to valves manufactured to this specification without modification unless otherwise specified in accordance with the allowances in Annex K.

4.2.2.5 The acceptable deviations as identified in Annex K shall apply if specified by the purchaser.

NOTE Annex K identifies allowable modifications that may be applied to valves when specified by the purchaser. Valves manufactured with any allowed modification in accordance with Annex K conform to this specification.

4.2.2.6 The supplemental requirements in Annex L shall apply if specified by the manufacturer,

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved the purchaser or both.

NOTE Annex L identifies allowable additions or supplements to the requirements in Section 4 through Section 14 that may be applied to valves if specified by the manufacturer or purchaser. Valves manufactured with any allowed addition or supplement in accordance with Annex L conform to this specification.

4.3 Pressure and Temperature Rating

4.3.1 Standard Valves – ASME Pressure Class

4.3.1.1 Standard valves covered by this specification shall be furnished in one of the following pressure classes (see 3.1.33).

- a) Class 150;
- b) Class 300;
- c) Class 600;
- d) Class 900;
- e) Class 1500;
- f) Class 2500

4.3.1.2 Pressure-temperature ratings for class-rated valves shall conform to the rating table for the applicable material group per ASME B16.34.

4.3.1.3 The selection of the pressure class shall be specified and shall include the internal pressure and the head of the process fluid.

4.3.1.4 The seawater external pressure shall not be offset.

4.3.1.5 Pressure differentials caused by trapped pressure between seals on assembly per API 17TR11 shall be included in the design.

4.3.1.6 The effect of external seawater pressure/column height and zero absolute pressure in the valve cavity shall be included in the design.

4.3.1.7 All metallic and nonmetallic pressure-containing and pressure-controlling parts shall be designed to meet the applicable valve pressure–temperature rating.

4.3.1.8 The pressure–temperature rating shall be determined by linear interpolation conforming to ASME B16.34.

4.3.1.9 Intermediate pressure and temperature ratings shall not be applied to valves with ASME flanged ends.

4.3.1.10 Minimum design temperature shall be 35 °F (2 °C), unless otherwise specified.

NOTE Different material or material forms may be used for body and bonnet or cover parts within the same valve.

4.3.1.11 The manufacturer shall determine any limits on the maximum allowable working

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
pressure (MAWP) and shall identify the minimum and maximum allowable temperatures resulting from the nonmetallic parts used.

4.3.2 Non-standard Valves – Pressures and Temperatures

4.3.2.1 Non-standard valves with intermediate pressure and temperature ratings shall conform to K.2.

4.3.2.2 Intermediate pressure and temperature ratings shall not be applied to valves with ASME flanged ends (see K.2).

4.3.2.3 Other end connections shall be permitted.

NOTE Other end connections can include but are not limited to hub, compact flange, swivel flange.

4.3.2.4 Pressure–temperature ratings for valves made from materials not listed in ASME B16.34 shall be determined, up to the temperature limitation of the valve, using the methods defined in ASME B16.34 or in conformance to 5.1.1.

4.4 Valve Bore

4.4.1 Nominal Size

4.4.1.2 Valves manufactured to this specification shall conform to either:

- a) nominal size as listed in Table 1; or
- b) size and bore determined by agreement if no size or minimum bore dimension is listed in Table 1 (see K.3.1).

NOTE Weld-end valves may require a smaller diameter at the weld-end to mate with the pipe.

4.4.1.3 Valves with an intermediate pressure–temperature rating shall have a bore size by agreement. (See K.3.1).

NOTE 1 In this specification, NPS sizes are stated first followed by the equivalent DN size between brackets.

NOTE 2 All axial-flow check valves and axial on–off valves are considered reduced opening.

4.5 Full-opening valves

4.5.1 Full-opening valves shall:

- a) be unobstructed in the fully opened position
- b) have an internal minimum cylindrical opening for categorizing bore size as specified in Table 1 or in conformance to K.3.2.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

4.5.2 If pipe is used in the construction of the valves, the pipe shall meet the tolerances of the applicable pipe specification.

NOTE 1 There is no restriction on the upper limit of valve bore sizes.

NOTE 2 Weld-end valves with a smaller diameter at the weld-end may be called full bore valves.

4.5.3 Except for reduced-opening valves, valve sizes shall be specified by the NPS or nominal diameter (DN).

4.6 Reduced-opening Valves

4.6.1 Reduced-opening valves with a circular opening through the closure member shall conform to one of the following:

- a) valves NPS 4 (DN 100) to NPS 12 (DN 300): one size below nominal size of valve with bore according to Table 1;
- b) valves NPS 14 (DN 350) to NPS 24 (DN 600): one or two sizes below nominal size of valve with bore according to Table 1;
- c) valves that do not conform to 4.4.3.a or 4.4.3.b: see K.3.2;
- d) valve sizes less than NPS 4 (DN 100) or greater than NPS 24 (DN 600) conforming to L.2.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table 1—Minimum Bore for Full-opening Valves

NPS	DN	Minimum Bore by Class in. (mm)			
		Class 150, 300, 600	Class 900	Class 1500	Class 2500
2	50	1.94 (49)	1.94 (49)	1.94 (49)	1.69 (42)
2 ¹ / ₂	65	2.44 (62)	2.44 (62)	2.44 (62)	2.06 (52)
3	80	2.94 (74)	2.94 (74)	2.94 (74)	2.44 (62)
4	100	3.94 (100)	3.94 (100)	3.94 (100)	3.44 (87)
6	150	5.94 (150)	5.94 (150)	5.69 (144)	5.19 (131)
8	200	7.94 (201)	7.94 (201)	7.56 (192)	7.06 (179)
10	250	9.94 (252)	9.94 (252)	9.44 (239)	8.81 (223)
12	300	11.94 (303)	11.94 (303)	11.31 (287)	10.44 (265)
14	350	13.19 (334)	12.69 (322)	12.44 (315)	11.50 (292)
16	400	15.19 (385)	14.69 (373)	14.19 (360)	13.13 (333)
18	450	17.19 (436)	16.69 (423)	16.00 (406)	14.75 (374)
20	500	19.19 (487)	18.56 (471)	17.88 (454)	16.50 (419)
22	550	21.18 (538)	20.55 (522)	19.69 (500)	—
24	600	23.19 (589)	22.44 (570)	21.50 (546)	—
26	650	24.92 (633)	24.29 (617)	23.38 (594)	—
28	700	26.93 (684)	26.18 (665)	25.23 (641)	—
30	750	28.94 (735)	28.03 (712)	27.00 (686)	—
32	800	30.66 (779)	29.92 (760)	28.74 (730)	—
34	850	32.68 (830)	31.81 (808)	30.50 (775)	—
36	900	34.41 (874)	33.66 (855)	32.24 (819)	—
38	950	36.42 (925)	35.59 (904)	—	—
40	1000	38.43 (976)	37.63 (956)	—	—
42	1050	40.16 (1020)	39.61 (1006)	—	—
48	1200	45.90 (1166)	45.24 (1149)	—	—
54	1350	51.65 (1312)	—	—	—
56	1400	53.54 (1360)	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

60	1500	57.40 (1458)	—	—	—
----	------	--------------	---	---	---

4.7 Manufacturing Processes

4.7.1 Process Control

4.7.1.1 The process control activities associated with the manufacturing of a valve shall be performed by the manufacturer or outsourced as identified in Table 2.

4.7.1.2 The manufacturer shall maintain equipment and personnel to achieve conformance to the requirements listed in Table 2 for all activities performed by the manufacturer.

4.7.1.3 If a process is outsourced in conformance with this specification (see Table 2), the manufacturer shall retain responsibility for all applicable elements of its quality management system and for product conformance to specified requirements.

NOTE For use of outsourced machining services, see API 20M for guidance.

Table 2—Process Control Requirements

Item No.	Process Control Activity	Performed by:	
		Manufacturer ¹	Outsourced ²
1	Product design and validation	X	X
2	Material procurement	X	X
3	Verification of externally provided products or activities	X	Not permitted
4	Machining	X	X
5	In-process inspection	X	X
6	Welding and other processes (e.g. ENP-TCC, etc.)	X	X
7	Assembly	X	Not permitted
8	Factory acceptance testing (Section 10)	X	Not permitted
9	Additional specified requirements per Annexes I, J, K, or L ³	X	X ³
10	Marking/tagging/nameplate	X	Not permitted
11	Coating/painting ⁴	X	X
12	Corrosion protection and preparation for transport	X	X
13	Final inspection	X	Not permitted

FOOTNOTES

1 See 3.1.21.

2 See 3.1.28.

3 Requirements of L.9, L.10, L.11, and L.12 shall be performed by the manufacturer and shall not be outsourced.

4 See Annex G.

X = when performed

4.7.2 Processes Requiring Validation

4.7.2.1 The manufacturer shall validate the following processes where the resulting output

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
cannot be verified by subsequent monitoring or measurement:

- a. heat treating (see 6.8 and Annex H);
- b. welding—see Section 7; and
- c. nondestructive examination, including visual examination (see 7.5.3.2, 7.8, 7.9, 7.10 and Annex I)

5 Design

5.1 General

5.1.1 Design Standards and Calculations

- 5.1.1.1 Design and calculations for pressure-containing parts and pressure-boundary bolting shall conform to an industry-accepted design code or standard such as ASME *BPVC*, Section VIII, Division 1 or Division 2; ASME B16.34; EN 12516-1 or EN 12516-2; and EN 13445-3.
- 5.1.1.2 If external loads are specified, the valve design shall accommodate the effects of these loads.
- 5.1.1.3 The manufacturer shall demonstrate, by calculation or test, that under loads resulting from MAWP and any specified loads (including installation) distortion of the valve does not impair functionality or sealing.
- 5.1.1.4 Allowable stress values used for acceptance shall not exceed those specified by the selected design code or standard.
- 5.1.1.5 If the selected design code or standard specifies a test pressure less than 1.5 times the MAWP, the MAWP for the body calculation shall be increased such that the hydrostatic test pressure in 10.3 and I.5 can be applied.

5.2 Pressure Containing Parts

- 5.2.1 Pressure-containing parts shall be the parts that define the pressure boundary, such as bodies, external trunnions, lower plates, end connectors, bonnets/covers, pipe and flanges used on vent or drain systems, and stems/external shaft.

5.3 Pressure Controlling Parts

- 5.3.1 Pressure-controlling parts shall include the closure member and seat.
- 5.3.2 The manufacturer shall document engineering practices and acceptance criteria on which the design is based.
- 5.3.3 The design of the pressure balance hole, if equipped, shall have a ratio between the length of the hole and the hole diameter of less than 10 ($L/D < 10$) up to a maximum hole diameter of 1/2 in. (13 mm).

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

5.4 Bolt Tensioning

- 5.4.1 Bolting preload torques shall be calculated using an industry-accepted standard with a coefficient of friction on the threads and nut face, based on bolting material, bolting coating, and the type of lubricant applied.
- 5.4.2 To address variability in bolt stress by torquing, the theoretical bolt stress due to preload shall not exceed 70 % of yield at the allowable temperature.
- 5.4.3 If more than one seal of different diameters are used to form the internal pressure-containing joint, the following requirements apply:
 - a) The gasket or seal diameter used in the bolting calculation and closure flange stress verification shall be the outer seal diameter of the largest seal; or in the case of spiral wound, solid flat metal or ring joint gaskets, the median diameter shall be used.
 - b) Required sealing stress shall be confirmed for all seals and gaskets.
 - c) When verifying the bolt stress at the outer seal diameter of the largest seal, the bolting stress shall not exceed 0.83 of SMYS at test condition.

5.5 Dimensions

5.5.1 Standard Face-to-face and End-to-end Dimensions

5.5.1.1 General

- 5.5.1.1.1 Standard face-to-face (A) and end-to-end (B and C) dimensions of valves shall conform to the applicable tables in Annex C.
- 5.5.1.1.2 Weld-end valve end-to-end (B) dimensions shall conform to the applicable tables in Annex C.
- 5.5.1.1.3 Standard face-to-face and end-to-end dimensions for valve sizes not specified in Annex C shall be in accordance with ASME B16.10.
- 5.5.1.1.4 Tolerances on the face-to-face and end-to-end dimensions shall be ± 0.06 in. (± 1.5 mm) for valve sizes NPS 10 (DN 250) and smaller and ± 0.12 (± 3.0 mm) for valve sizes NPS 12 (DN 300) and larger.

5.5.2 Non-standard Face-to-face and End-to-end Dimensions

- 5.5.2.1 Non-standard dimensions shall include face-to-face and end-to-end dimensions not shown or not conforming to the values in tables in Annex C or ASME B16.10.
- 5.5.2.2 Non-standard face-to-face and end-to-end dimensions shall conform to K.4.
- 5.5.2.3 If the non-standard end-to-end dimension includes pipe pups/transition pieces, those pieces shall conform to all requirements for the body.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

5.5.2.4 The length of valves having one weld-end and one flanged-end shall be determined by adding half the length of a flanged-end valve to half the length of a weld-end valve.

5.5.2.5 Tolerances on non-standard face-to-face and end-to-end dimensions shall be ± 0.06 in. (± 1.5 mm) for valve sizes smaller than NPS 12 (DN 300) and ± 0.12 in. (± 3.0 mm) for valve sizes NPS 12 (DN 300) and larger.

NOTE Support legs on some valve designs may extend beyond the end-to-end dimensions to ensure that the valve can be safely supported. If required, these support legs may be removed after integration into the subsea structure.

5.5.3 End Connectors

5.5.3.1 Flanged Connectors

5.5.3.1.1 Flanges shall be furnished with a raised face or ring joint face (raised face or full face).

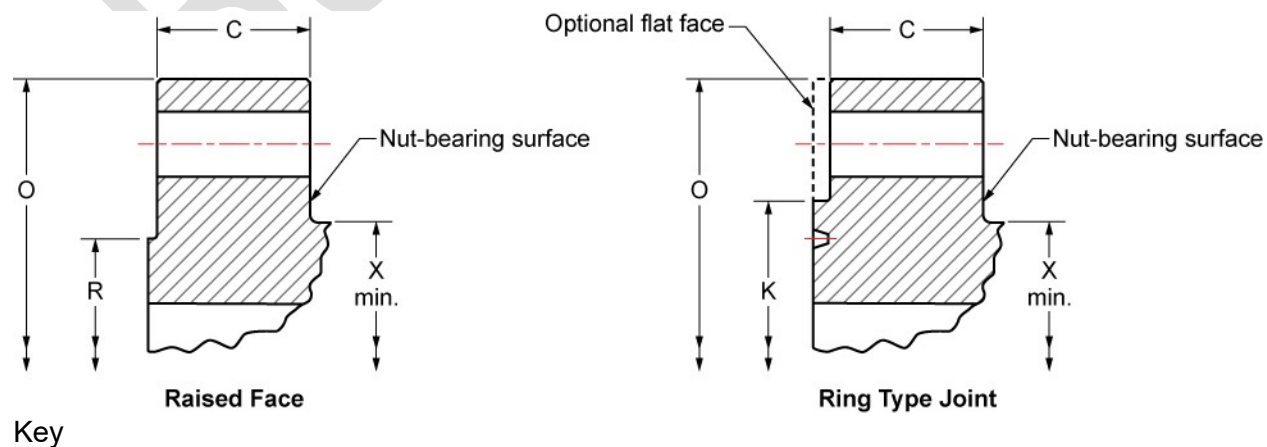
5.5.3.1.2 Specified dimensions, tolerances, and finishes, including drilling templates, flange facing, nut-bearing surfaces (i.e. spot facing and back facing), outside diameters, and thickness (see Figure 1), shall conform to:

- a) ASME B16.5 for sizes up to and including NPS 24 (DN 600); or
- b) ASME B16.47, Series A for NPS 26 (DN 650) and larger sizes; or
- c) MSS SP-44

NOTE See K.5 for optional requirements for end connectors.

5.5.1.1.3 Valves with through-bolted flanged end connectors shall be designed to accommodate heavy hex series nuts having dimensions as specified in ASME B18.2.2.

NOTE For valves with heavy wall sections, flanges with nut stops in accordance with Mandatory Appendix 2 of ASME BPVC, Section VIII, Division 1 may apply.



This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

C flange thickness

O outside diameter of flange

R raised-face diameter

K minimum diameter of raised portion of ring type joint flange

*X*_{min} hub diameter

Figure 1—Typical Flange Dimensions

5.5.3.2 Lateral Alignment of Flanges

5.5.3.2.1 Lateral misalignment (offset) from one flange to the opposite flange shall apply to centerlines of the bores, ring grooves, and bolt circles.

5.5.3.2.2 For valves up to and including NPS 4 (DN 100), the maximum flange misalignment shall be 0.079 in. (2 mm).

5.5.3.2.3 For valves larger than NPS 4 (DN 100), the maximum flange misalignment shall be 0.118 in. (3 mm).

5.5.3.3 Parallelism of Flanges and Weld-end Connector

5.5.3.3.1 For valves up to NPS 24 (DN 600) 2.5 mm/m 0.03 in./ft (2.5 mm/m) not to exceed 0.125 in. (3 mm).

5.5.3.3.2 For valves larger than NPS 24 (DN 600) 0.02 in./ft (1.75 mm/m).

Note For additional information on flange parallelism, see API 686.

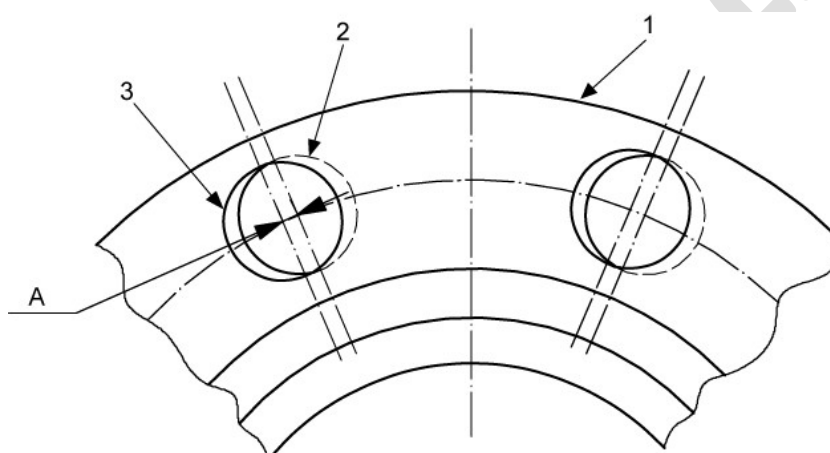
5.5.3.4 Misalignment of Bolt Holes

5.5.3.4.1 For valve end connectors, bolt-hole misalignment of the flange from one end of the valve to the other (see Figure 2) shall conform to the following:

a) For valves NPS 4 (DN 100) and smaller, the maximum misalignment shall be 0.079 in. (2 mm) at the bolt holes (see Figure 2).

b) For valves larger than NPS 4 (DN 100), the maximum misalignment shall be 0.118 in. (3 mm) at the bolt holes.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved



Key

- 1 flange
- 2 hole in first flange
- 3 hole in opposite flange for alignment
- A bolt hole misalignment (see 5.8.1.4)

Figure 2—Bolt Hole Misalignment

5.5.3.4.2 Bolt holes shall be equally positioned on both sides of a reference vertical centerline.

NOTE This reference vertical centerline may not exist in an axial valve.

5.5.3.4.3 The nut-bearing area at the back face shall be parallel to the front face within 1°.

5.5.3.5 Studded-end Valve End Connectors

NOTE See K.6 for optional requirements for studded-end valve end connectors.

5.5.3.5.1 The manufacturer shall notify the purchaser when studded-end connectors are provided on one or more bolt holes.

5.5.3.5.2 Studded-end connectors shall be provided with threaded holes (studded outlet) for engaging flange bolting.

5.5.3.5.3 Threaded-body flange holes for bolts 1 in. or less in diameter shall be threaded in

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

accordance with ASME B1.1, UNC, Class 2B.

5.5.3.5.4 For bolts 1-1/8 in. or larger in diameter, holes shall be threaded in accordance with ASME B1.1, 8-TPI, Class 2B.

5.5.3.5.5 Thread engagement in a flange with threaded holes shall provide full effective thread engagement, not including the chamfered thread, for a length at least equal to the nominal diameter of the bolt thread.

5.5.3.6 Weld-end Connectors

5.5.3.6.1 Weld-end dimensions, for final welding to the pipe shall conform to ASME B16.25, ASME B31.4 or ASME B31.8.

5.5.3.6.2 The following details shall be specified:

- a) outside diameter;
- b) length of pup piece;
- c) wall thickness;
- d) material grade;
- e) specified minimum yield strength (SMYS);
- f) any special chemistry of the mating pipe; and
- g) if any weld overlay has been applied.

NOTE 1 See K.5 for optional requirements for weld-end requirements.

NOTE 2 The pipe pup may be welded and post-weld heat treatment performed, if applicable, prior to valve assembly.

5.5.4 Alternate Valve End Connections

5.5.4.1 Other end connections may be specified, see K.5.

5.6 Drive Train

5.6.1 General

5.6.1.1 The drive train, including the stem, shall be designed such that failure of a part due to an operating condition that exceeds the valve MAST will occur at a point outside the pressure boundary.

5.6.1.2 The valve design shall prevent the misalignment of the valve stem.

NOTE 1 The weight of the operator and associated drive train components may adversely affect the

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

alignment and deflection of the valve stem.

NOTE 2 Drive train bolting includes bolting used to mount an actuator.

5.6.2 Thrust/Torque

5.6.2.1 For axial on-off, ball, and gate valves, the design thrust or torque for all drive train calculations shall be at least 2 times the breakaway thrust or torque as defined by 3.1.8.

5.6.2.2 The manufacturer shall document the design torque or thrust value to be used for acceptance criteria in Section 10.

NOTE Torque or thrust may be determined by calculation or by measurement.

5.6.3 Allowable Stresses

5.6.3.1 Design stresses for tensile stress, shear stress (including torsional shear stress) and bearing stress shall conform to ASME *BPVC*, Section VIII except that the design stress intensity value, S_m , shall be taken as 67 % of yield strength S_y at ambient and maximum design temperatures.

5.6.3.2 The average primary shear stress across a section loaded under design conditions in pure shear (e.g. keys, shear rings, screw threads, etc.) shall be limited to $0.6 S_m$.

NOTE The possibility of a shear failure may exist when bearing loads are applied on parts having free edges, such as at a protruding edge or a keyway.

5.6.3.3 The maximum primary shear under design conditions, exclusive of stress concentration at the periphery of a solid circular section in torsion, shall be limited to $0.8 S_m$.

5.6.3.4 The average bearing stress shall be limited to the yield strength S_y at ambient and maximum design temperatures.

5.6.3.5 Allowable stress limits, other than those noted in this section shall be documented.

5.6.3.6 A joint efficiency factor (strength of weld divided by strength of base material) of 0.75 shall be used for fillet welds.

5.6.4 Allowable Deflections

5.6.4.1 Deflections of the drive train, including extensions if provided, shall not prevent the closure member from reaching the fully closed or fully open position.

5.6.4.2 For all valves, analysis of deflection and strain shall be documented.

NOTE Adherence to the allowable stress limits of design codes alone might not result in a functionally acceptable design.

5.6.4.3 The manufacturer shall demonstrate, by analysis or test, that under loads resulting from

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

MAWP, external pressure and any defined pipe or external loads, distortion of the closure member or seat does not impair functionality or sealing.

5.6.5 Drive Train Bolting

5.6.5.1 Bolting in the drive train shall be designed to accommodate the direct loading applied by the maximum actuator/gearbox torque/thrust and, if applicable, loads from pressure and defined external loads.

5.6.5.2 Bolting shall not be subjected to direct shear.

5.7 Body and Stem Seals

5.7.1 Seals shall be designed and tested for the specified external pressure (water depth) and operating conditions.

5.7.2 Valves with packing that requires adjustment in service shall not be used.

5.8 Valve Stem Seal Integrity Verification

5.8.1 If the stem seal arrangement consists of individual sealing components and the requirement for individual stem seal test ports have been specified, provision shall be made to allow the primary seal to be independently tested (see 5.17.1.1.1.d).

5.9 Operations

5.9.1 Method of Operation

NOTE 1 Valve operational data may be supplied to the purchaser.

NOTE 2 See 5.9.1.6 for options related to valve operational data.

5.9.1.1 Except for bare stem valves, the method of operation shall be specified.

5.9.1.2 If a manual gearbox is provided, the output torque/thrust rating shall be at least 1.5 times the maximum required operating torque/thrust of the valve at minimum and maximum allowable temperatures.

5.9.1.3 The hand-wheel rotary motion of a manual gearbox or wrench (lever) to close a valve shall be clockwise.

5.9.1.4 Rotary motion of anything other than a manual gearbox or wrench (lever) to close a valve shall be per manufacturer specification.

5.9.1.5 The method of operation and the MPD at which the valve is required to be opened by the lever, gearbox, or actuator shall be specified.

5.9.1.6 The manufacturer shall provide the following data to the purchaser, if requested:

a) flow coefficient C_v or K_v ;

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- b) valve top works dimensions;
 - c) The following data (listed as i through vii) shall be provided under the following conditions:
 - 1) MPD at zero water depth, and
 - 2) zero valve internal pressure at operating water depth.
 - i. break-to-open torque or thrust (BTO) ;
 - ii. crack-to-open torque at the overlap angle or thrust at breakaway percent of stroke (CTO);
 - iii. run-to open torque or thrust (RTO);
 - iv. end-to-open torque or thrust (ETO);
 - v. break-to-close torque or thrust (BTC);
 - vi. run-to-close torque or thrust (RTC),
 - vii. end-to-close torque or thrust (ETC);
 - d) valve drive train MAST;
 - e) valve characteristics
 - 1) length and direction of stroke to open and close for linear valves; or
 - 2) angle and direction of rotation for part-turn or check valves; or
 - 3) direction of rotation and number of turns for multi-turn valves;
 - f) thrust necessary to enable the valve to maintain position, if applicable;
 - g) valve breakaway/overlap angle or breakaway percent of stroke;
- NOTE The breakaway/overlap angle or percent of stroke can be significant to actuator sizing when more than 5° or 5 % respectively.
- h) number of turns for manually operated valves;
 - i) maximum allowable stem thrust or torque (MAST) on the valve and, if applicable, the maximum allowable input torque to the gearbox.
 - j) any other specific torque or thrust conditions of the valve.

5.9.2 Wrenches (Levers) and Hands-wheels

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE The terms wrench and lever are synonymous.

5.9.2.1 Torque or Thrust

- 5.9.2.1.1 For axial on-off, ball, and gate valves, the maximum force required at the perimeter of the hand-wheel or wrench (lever) to stroke the valve at the breakaway torque or thrust shall not exceed 40 lbf (180 N) when applied against MPD.
- 5.9.2.1.2 For check valves, the maximum force required at the perimeter of the hand-wheel or wrench (lever) to stroke the valve at zero differential pressure shall not exceed 40 lbf (180 N).

5.9.2.2 Size

- 5.9.2.2.1 Wrenches (levers) for valves shall either be of an integral design or consist of a head that fits on the stem and is designed to take an extended handle.
- 5.9.2.2.2 Wrenches that are of integral design (not loose) shall not be longer than twice the face-to-face or end-to-end dimension of the valve.
- 5.9.2.2.3 Wrenches (levers) longer than 24 in. (600 mm) shall be capable of being removed.
- 5.9.2.2.4 Hand-wheel diameter(s) shall not exceed the face-to-face or end-to-end length of the valve, whichever is smaller.
- 5.9.2.2.5 Spokes on the hand-wheel shall not extend beyond the perimeter of the hand-wheel.

5.9.3 Position Indicators

5.9.3.1 General

- 5.9.3.1.1 Valves shall be furnished with a visible indicator to show the open and the closed position of the closure member.
- 5.9.3.1.2 If the valve stem is provided with a key slot or master spline in ball valves, the key/master spline shall be in line with the ball bore.
- 5.9.3.1.3 For ball valves, the wrench (lever) and/or the position indicator shall be in line with the pipe when the valve is open and transverse when the valve is closed.
- 5.9.3.1.4 The design shall be such that the component(s) of the indicator and/or wrench (lever) cannot be assembled to falsely indicate the valve position.
- 5.9.3.1.5 Valves without position stops shall have provision for the verification of open and closed alignment with the operator/actuator removed.
- 5.9.3.1.6 The position indicator shall not be affected by marine growth.

5.9.3.2 Position of the Closure Member

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- 5.9.3.2.1 Except for check valves, the position of the closure member shall not be altered by dynamic forces of the passing flow; or in the case of screw-operated gate valves, by forces generated from internal or external pressure.

5.9.4 Travel Stops

- 5.9.4.1 Valves that do not require mechanical force to affect a seal shall be provided with travel stops on:
- a) the valve or
 - b) the operator or
 - c) both.
- 5.9.4.2 The travel stops shall limit the closure member movement at or beyond the open and closed positions.
- 5.9.4.3 If the valve and operator are designed with a non-retrievable or integral operator, there are no requirements for travel stops to be integral to the valve.

NOTE See Annex E for guidance for travel stops by valve type.

5.9.5 Operators

- 5.9.5.1 Operators and mounting kits shall conform to API 6DSSX.

5.9.5.2 Sealing

- 5.9.5.2.1 The interface between operator and valve bonnet shall be sealed, e.g. with gaskets or O-rings, to prevent seawater ingress from entering the assembly.

5.9.5.3 Overpressure Protection

- 5.9.5.3.1 Valve assemblies with an actuator or gearbox shall be fitted with a pressure relief function between the stem seal and the actuator to prevent valve-bore fluid ingress and malfunction of the actuator or gearbox device.
- 5.9.5.3.2 If a relief valve is used, the set pressure shall be documented.
- 5.9.5.3.3 Pressure relief ports shall be identified by visible marking adjacent to the port.

5.9.5.4 Extended Stem and Shaft Assemblies

- 5.9.5.4.1 Extended stem and shaft assembly which are integral to the valve, shall conform to 5.6.

5.9.5.5 Valve Operator Interface Requirements

- 5.9.5.5.1 The interface between operator and valve bonnet shall be designed to prevent misalignment or improper assembly of the components and preserve orientation of the closure member.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

5.9.5.5.2 The interface between operator and valve bonnet shall be sealed, e.g. with gaskets or O-rings, to prevent seawater ingress from entering the assembly.

NOTE See Annex D for additional recommendations for operators.

5.9.5.5.3 The need for subsea retrievability of the operator shall be specified.

5.9.5.5.4 If mounting kit, gearbox, or actuator is required to be replaced on the valve while subsea, the valve interface shall as a minimum be provided with the following:

- a) end stops for open and close position designed to withstand the maximum output load from the operator, to permit the closure member to be aligned to the bore in the fully open position and permit full sealing contact in closed position;
- b) valve interface designed for installation of the gearbox or actuator in only one position;
- c) visual indicator to indicate valve position when gearbox or actuator has been removed;
- d) subsea connection to flush any cavity exposed to seawater after subsea installation.
 - 1) The flushing connection may be located on the mounting kit; or
 - 2) the gearbox; or
 - 3) the actuator; or
 - 4) any combination of these.

5.9.6 Supplementary Subsea Valve Design Requirements

5.9.6.1 ROT System – Torque Tool

5.9.6.1.1 If the valve is ROT operated with a torque tool, the Rotary Actuator Intervention Fixture class shall be specified.

5.9.6.1.2 The manufacturer shall define the following:

- a) operating torque or thrust data throughout the operating strokes, for open and closing conditions (see 5.9.1.6);
- b) valve mast ;
- c) number of turns required to operate the valve for one complete stroke.

NOTE 1 Purchasers may choose to standardize on a particular Rotary Actuator Intervention Fixture class, but it may not be practical in all cases to size the entire valve for the maximum Rotary

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Actuator Intervention Fixture loads, requiring the torque tool torque/force to be regulated/restricted when operating the valve.

NOTE 2 Typical ROT system and Rotary Actuator Intervention Fixture Classification are addressed in API 17H.

- 5.9.6.1.3 If an ROT system is connected directly to the valve/actuator/gearbox such that the torque/force reaction is transmitted to the valve assembly, the ROV impact loads shall be analyzed by the valve manufacturer.

5.10 Pressure Cap

- 5.10.1 If specified, the design shall be capable of installing a pressure cap.
- 5.10.2 The cap and the method of attachment shall be capable of withstanding the valve design pressure and external hydrostatic pressure and shall be hydrostatically tested in accordance with this specification per 10.3.
- 5.10.3 The cap shall be capable of venting prior to removal and during installation.

5.11 Stem/Shaft Protector

- 5.11.1 If specified, the design shall be capable of installing a stem/shaft protector.
- 5.11.2 The stem/shaft protector shall not be capable of retaining pressure.

5.12 Hydraulic Lock

- 5.12.1 If valve or valve components are designed for subsea maintenance, the design shall include ability to vent all enclosed cavities to ensure that entrapped fluid does not prevent the disassembly or subsequent reassembly of the components.

5.13 Corrosion and Erosion

- 5.13.1 If specified, the manufacturer shall include corrosion-resistant material or overlay.
- 5.13.2 If a corrosion allowance is specified, the valve supplier shall conduct all calculations based on the corroded thickness.
- 5.13.3 The corrosion allowance shall not apply to any areas of CRA overlay and CRA material.

5.14 Hyperbaric Performance

- 5.14.1 The manufacturer shall demonstrate by calculation (see 5.1) or validation that the valve design is suitable for the required water depth with zero internal pressure in the valve.

NOTE If hyperbaric testing is specified by the purchaser to demonstrate suitability, hyperbaric validation testing may be performed in conformance to the requirements of Annex B.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

5.14.2 Hyperbaric testing or validation of valve and operator separately shall be permitted.

5.15 Inline Inspection

5.15.1 The requirements for pipeline inspection gauge passage of the valves shall be specified.

5.16 Cavity Relief

5.16.1 Cavity relief to the environment shall not be permitted.

5.16.2 Testing for internal cavity relief shall be performed in accordance with 10.6.

5.16.3 The cavity relief mechanism for valve designs that are not internally self-relieving shall be specified.

5.17 Pressure-Boundary Penetrations (Drains, Vents, Body Test Ports, Seal Test Port, and Pressure Containing Part Connections)

5.17.1 Vents and Drains

5.17.1.1 General

NOTE Vents, drains, and body test ports may be used as permanently installed body connections if specified.

5.17.1.1.1 Valves shall be provided with the following connections:

- a) A body test or drain connection in the valve body.
- b) Single seated valves without cavities (e.g. check valves) and downstream sealing valves that can be drained by other means shall not be required to have a drain connection.
- c) A vent connection in the valve body if required for testing.
- d) Body connection(s) provided for in-service purposes such as leak detection, fluid injection, flushing, or hydrate remediation; if specified.

5.17.1.1.2 Vent and drain connectors shall be threaded, welded, studded outlet, or flanged.

5.17.1.1.3 If threaded with tapered threads, the threads shall be capable of providing a seal and shall conform to ASME B1.20.1.

5.17.1.1.4 If threaded with parallel threads, the threads shall conform to ASME B1.20.1 or ISO 228-1.

5.17.1.1.5 On completion of testing, vents, drains, body test ports, and seal test ports shall be sealed after test.

5.17.1.1.6 The method of sealing shall be specified.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

5.17.1.1.7 If sealing the port is by welding, the WPS shall be qualified without PWHT.

5.17.1.1.8 Drain and vent ports shall be at the lowest and highest possible positions of the cavity respectively.

5.17.1.1.9 If multi-barrier seals are provided in series (e.g. stem seals and body seals), seal test ports shall be provided for design validation.

5.17.1.1.10 Test ports shall be drilled on production valves if specified.

5.17.1.2 Drain, Sealant, and Vent Valves

5.17.1.2.1 Drain, sealant, and vent valves shall be permitted if specified.

5.17.2 Injection Points

5.17.2.1 Seat and/or stem injection points shall be permitted if specified.

5.18 Lifting Points and Supports

5.18.1 The manufacturer shall determine the need for and verify the design of the lifting points of the valve or valve and operator assembly.

5.18.2 The manufacturer shall provide a lifting procedure for valve or valve and operator assembly.

5.18.3 The lifting of the valve and operator assembly by the operator shall not be permitted unless the operator lifting points and the connection between the valve and operator are designed for this purpose.

NOTE See API 17D, Annex K for guidance on pad-eyes.

5.18.4 Subsea valves and operator assemblies shall be designed to ensure freestanding stability.

NOTE Regulatory requirements can specify special design, manufacturing and certification of lifting points.

5.19 Stem Retention

5.19.1 Valves shall be designed to ensure that the stem shall not eject under any internal pressure condition or if the packing gland components (see 3.1.27) or valve operator mounting components are removed.

5.20 Cathodic Protection (CP)

5.20.1 If the valve will be exposed to a CP system, materials and stress levels shall be selected to reduce the risk of hydrogen embrittlement due to the presence of the CP system.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

5.20.2 Valves shall be designed such that electrical continuity between all parts, including bolting shall be maintained.

5.20.3 If specified, the equipment manufacturer shall document the following as a minimum:

- a) External total wetted surface area, individual areas for each specific material and for each coated and uncoated surface.
- b) Metallurgy of construction materials exposed to the external wetted surfaces.
- c) Manufacturer and specification of coating systems applied to external wetted surfaces.
- d) Electrical continuity in accordance with 10.10.

5.20.4 Components with external wetted surfaces and exposed to CP system shall not exceed the following hardness limitations:

- a) Carbon and low-alloy steels, including bolting, shall have a hardness not exceeding 34 HRC (319 HBW).
- b) Carbon and low-alloy steels exposed to wellbore fluids shall meet the requirements of NACE MR0175 or ISO 15156.
- c) Precipitation hardening nickel-based alloys materials, including bolting, shall meet the requirements of NACE MR0175 or ISO 15156.

NOTE Design stress levels per DNVGL ST F101 and DNV RP F112 are available for guidance.

5.20.5 Materials for external components shall be suitable for the subsea environment or shall be suitably protected.

5.20.6 Functionality of exposed stems and shafts shall be analyzed based on the possibility of calcareous marine growth as a result of cathodic protection (CP).

5.20.7 Material selection to avoid galvanic coupling shall be documented.

5.21 Overpressure Protection

5.21.1 Operators and any intermediate support assemblies shall be provided with a means of preventing pressure buildup resulting from stem or bonnet seal leakage.

5.22 Design Process

5.22.1 General

5.22.1.1 Designs shall conform to the manufacturer's documented procedures and applicable quality management system requirements.

5.22.1.2 Design requirements shall include but not be limited to those criteria for size, test and

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
operating pressures, material, environmental, and other requirements on which the design is based.

5.22.2 Design Documentation

5.22.2.1 Documentation of designs shall include methods, assumptions, calculations, and analysis.

5.22.2.2 Design documentation media shall be clear, legible, reproducible, and retrievable.

5.22.2.3 Design documentation shall be retained for 10 years after the last unit of that model, size, and rated working pressure is manufactured.

5.22.3 Design Review and Verification

5.22.3.1 The design shall be reviewed and verified by a qualified individual other than the individual who created the original design.

5.22.4 Design Validation

5.22.4.1 All valves shall be validated in accordance with the manufacturer's written procedure and the results of design validation shall be documented.

NOTE The manufacturer or purchaser may specify that design validation testing conforms to the minimum requirements in Annex F.

6 Materials

6.1 Metallic Material Requirements

6.1.1 General

6.1.1.1 Metallic pressure-containing and pressure-controlling materials in contact with process fluids shall have documented material specifications that define the following:

- a) material grade;
- b) chemical analysis;
- c) heat treatment;
- d) mechanical properties (tensile);
- e) certification to report all items listed in 6.1.

6.1.1.2 If applicable, additional requirements of the material specifications shall be as follows:

- a) carbon equivalent (CE) under the conditions as specified in 6.3;
- b) Charpy impacts under the conditions as specified in 6.5;

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

c) hardness under the conditions as specified in 6.6; and;

d) other testing.

NOTE 1 See API 20A, API 20B, and API 20C for guidance on qualification and production for casting and forging material manufacturers. The use of materials that conform to API 20A, API 20B, and API 20C does not require that the materials be supplied from a facility that has been licensed to API 20A, API 20B, or API 20C.

NOTE 2 See API 20J for guidance on the use of outsourced distributors of metallic material.

6.1.2 Cast Parts

6.1.2.1 All cast material shall be manufactured using an industry-accepted process.

NOTE See Annex I for guidance for using cast material.

6.1.3 Forged Parts

6.1.3.1 All forged material shall be formed using a hot-working practice and heat treatment throughout that produces a wrought (no cast dendritic elements) structure throughout the material.

6.1.3.2 All forged pressure-containing material shall have a minimum forging reduction ratio of 3:1.

6.1.3.3 The forging ratio shall be included as part of the material certifications.

NOTE For the purpose of this document, the terms “forged” and “wrought” are used interchangeably.

6.1.4 Sour Service

6.1.4.1 Materials for pressure-containing and pressure-controlling parts and bolting for sour service shall meet the requirements of NACE MR0175 or ISO 15156.

6.1.5 Hydrogen-induced Cracking (HIC)

6.1.5.1 Process-wetted and pressure-controlling parts for valves in sour service applications that are manufactured from plate shall be resistant to HIC.

6.1.5.2 Resistance shall be demonstrated by HIC testing in accordance with NACE TM0284, per heat, per heat treatment batch combination.

6.1.5.3 Acceptance criteria shall be in accordance with NACE MR0175 or ISO 15156-2.

6.1.6 Pressure Boundary Penetrations

6.1.6.1 If provided, materials for drain, vent, injection components, or other parts (see 5.6.1.2) shall be compatible with the valve body material or made from a corrosion-resistant material.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

6.2 Nonmetallic Material Requirements

6.2.1 Nonmetallic seals in contact with process fluids shall have documented material specifications that shall define the following:

- a) generic base polymer, when used (see ASTM D1418);

NOTE Reference to a generic base polymer does not apply to graphite material.

- b) generic thermoplastic, when used (see ASTM D4000);
- c) physical property requirements;
- d) storage requirements.

NOTE For guidance on qualification of polymeric seal manufacturers, see API 20L.

6.2.2 Elastomeric materials for valves in gas service at pressures of Class 600 and above shall be resistant to rapid gas decompression (RGD).

NOTE See L.6 for additional requirements for seals qualification testing.

6.2.3 The manufacturer's documented requirements for nonmetallic seals shall include the following minimum provisions:

- a) batch number/traceability;
- b) cure/mold date;
- c) shelf-life expiration date.

6.3 Composition Limits

6.3.1 The chemical composition of carbon and alloy steel pressure-containing and pressure-controlling parts shall conform to the applicable material standard.

6.3.2 The chemical composition of other carbon steel parts shall conform to the applicable material standard.

6.3.3 The chemical composition of carbon steel weld-ends shall meet the following requirements:

- a) the carbon (C) content shall not exceed 0.23 % by mass.
- b) the sulfur (S) content shall not exceed 0.020 % by mass.
- c) the phosphorus (P) content shall not exceed 0.025 % by mass.
- d) the carbon equivalent (CE) shall not exceed 0.43 %.

6.3.4 The CE shall be calculated in accordance with the Equation (1):

$$CE = \%C + \%Mn/6 + (\%Cr + \%Mo + \%V)/5 + (\%Ni + \%Cu)/15 \quad (1)$$

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

6.3.5 The carbon content of austenitic stainless steel weld ends shall not exceed 0.03 % by mass.

6.3.6 The carbon content of stabilized austenitic stainless steel weld ends shall not exceed 0.08 % by mass .

6.3.7 Duplex stainless steel used for pressure-containing and pressure-controlling parts shall include a microstructure examination as follows:

- a) Test specimens shall be cut from a separate or attached block taken from the same heat in the final heat-treated condition.
- b) Duplex or super duplex intermetallic phases and nitride precipitates shall be examined as follows:

- 1) The microstructure shall be examined and shall be free from detrimental intermetallic phases and precipitations at minimally 200X magnification.

NOTE Higher magnification (e.g. 400X to 500X) may be needed to ensure this requirement is met. See ASTM A923 for guidance on acceptance.

- 2) Any presence of intermetallic phases and/or precipitates shall be reported.
 - 3) If intermetallic phases and/or precipitations are detected, the acceptance of product shall be based upon the corrosion and Charpy V-notch test results.
 - 4) The ferrite content shall be determined by point counting according to ASTM E562 or by image analysis according to ASTM E1245. The relative accuracy shall be less than 20 %. The ferrite content shall be within 35 % to 65 %.

6.3.8 Duplex stainless steel used for pressure-containing and pressure-controlling parts shall have a corrosion test performed as follows:

- a) Material taken from the TC after the final heat treatment cycle shall be corrosion tested in accordance with ASTM G48.
- b) Method A.
 - 1) If the TC is a solid block, one ASTM G48 test specimen shall be taken from the center of the block.
 - 2) If the TC has a hole, two ASTM G48 test specimens shall be taken.
 - i. One shall be taken adjacent to the inside surface.
 - ii. One shall be taken from the center of the thickest cross-section.
 - 3) The specimen surface shall be parallel to the internal surface (for the TCs with a hole).

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- 4) Sides of the test specimen shall be ground to a 120-grit finish (or better) with the edges rounded.
- c) Test temperature shall be 25 ± 2 °C for 22Cr and 50 ± 2 °C for 25Cr duplex stainless and the exposure time 24 hours.
- d) The acceptance criteria are as follows:
 - 1) Test material shall show no evidence of pitting after 24 hours immersion in the test solution when examined with a low power magnification (minimum 20X).
 - 2) The maximum weight loss shall be less than 4 g/m².

6.3.9 PREN Calculation

6.3.9.1 Duplex stainless steel used for pressure-containing and pressure-controlling parts shall have the PREN be calculated in accordance with the Equation (2):

$$\text{PREN} = \% \text{Cr} + 3.3 \% (\text{Mo} + 0.5\text{W}) + 16 \% \text{N: all \% by weight} \quad (2)$$

6.3.9.2 Acceptance criteria shall be as follows:

- a) For 22Cr, the PREN shall be ≥ 35.0 .
- b) For 25Cr, the PREN shall be ≥ 40.0 .

6.4 Tensile Test Requirements

6.4.1 Tensile test specimens shall be removed from a test coupon (TC) after the final heat treatment cycle performed to achieve required mechanical properties.

6.4.2 Test specimens shall be cut from a separate or attached block taken from the same heat, reduced by forging where applicable, and heat treated together including stress relieving, as the product materials, except that it is not necessary to retest pressure-containing parts stress relieved at or below a previous stress-relieving or tempering temperature.

6.4.3 Pressure-containing and pressure-controlling parts made from metallic materials shall have a minimum of one tensile test performed at ambient temperature in accordance with the ASTM A370, ASTM E8/E8M, or ISO 6892-1.

6.4.4 For metallic materials, the tensile strength, yield strength and elongation shall minimally conform to the industry material standards and the mechanical properties required in 6.1.1, in the final heat-treated condition.

6.4.5 If the results of the tensile test(s) do not satisfy the applicable requirements, two additional tests removed from the same TC, with no additional heat treatment, shall be permitted to qualify the material.

6.4.6 The results of both additional tensile tests shall satisfy applicable requirements.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE 1 Depending on the hardenability of a given material, the TC results may not correspond to the properties of the actual parts at all locations throughout their cross-section.

NOTE 2 See API 6HT for guidance and good practices for heat treatment of parts with large cross-section.

6.5 Impact Test

6.5.1 Carbon, alloy, and stainless steel (except austenitic grades) for pressure-containing and pressure-controlling parts in valves with a specified design temperature below 35 °F (2 °C) shall be impact tested.

6.5.2 The test method shall be the V-notch technique in accordance with ASTM A370 or ISO 148-1.

6.5.3 When using ISO 148-1, a striker with a radius of 8 mm shall be used.

NOTE Design standards or local requirements may require impact testing for minimum design temperatures higher than 35 °F (2 °C).

6.5.4 A minimum of one impact test, comprised of a set of three specimens, shall be performed on a representative test bar of each heat of the material in the final heat-treated condition.

6.5.5 Test specimens shall be removed from a TC after the final heat treatment cycle.

6.5.6 Test specimens shall be cut from a separate or attached block taken from the same heat, reduced by forging where applicable, and heat treated to the same heat treatment, including stress relieving, as the product materials, except that it is not necessary to retest pressure-containing parts stress relieved at or below a previous stress-relieving or tempering temperature.

6.5.7 The impact test shall be performed at the lowest temperature as defined in the applicable material specifications or the valve minimum operating temperature, whichever is lowest.

6.5.8 Impact test results for full-size specimens shall meet the requirements of Table 4 or Table 5.

6.5.9 Impact test results for bolting material shall meet the requirements of the applicable material specification.

6.5.10 If the material specification for the subsea pipeline design standard requires impact values to be higher than those shown in Table 4 or Table 5, the higher values shall apply.

Table 4—Minimum V-notch Impact Requirements for Carbon and Low-alloy Steels (Full-size Specimen)

Specified Minimum Yield Strength		Average of Three Specimens		Minimum of Single Specimen	
psi	MPa	ft lb	Joules	ft lb	Joules
≤40,000	≤275	21	28	16	21

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

40,000 to 43,500	276 to 300	22	30	17	23
43,500 to 47,125	300 to 325	24	32	18	25
>47,125	>325	27	37	21	28

Table 5—Minimum V-notch Impact Requirements for Duplex and Super Duplex Stainless Steel (Full-size Specimen)

Minimum Test Temperature		Average of Three Specimens		Minimum of Single Specimen	
°F	°C	ft lb	Joules	ft lb	Joules
−50	−46	33	45	26	35

6.5.11 If any impact test fails, then a retest of 1 set of 3 Charpy specimens shall be removed from the same TC with no additional heat treatment, shall be permitted to qualify the material. Each impact specimen shall satisfy the required average value.

NOTE As an alternate, sub-sized impact test specimens may be permitted only by agreement; however, the minimum V-notch impact requirements in Table 4 and Table 5 still apply.

6.5.12 If subsize specimens are used, the Charpy V-notch impact requirements shall be equal to that of the 10 mm x 10 mm specimens multiplied by the adjustment factor listed in Table 6 at the full-size specimen test temperatures.

Table 6 – Adjustment Factors for Subsize Impact Specimen

Specimen (Dimension)	Adjustment Factor
10 mm x 10 mm (full size)	1 (none)
10 mm x 7.5 mm	0.833
10 mm x 6.7 mm	0.780
10 mm x 5.0 mm	0.667
10 mm x 3.3 mm	0.440
10 mm x 2.5 mm	0.333

6.5.13 Charpy impact values for other materials shall conform to K.8.

6.6 Production Heat-treating Equipment

6.6.1 General

6.6.1.1 These requirements shall not apply to surface coatings or localized PWHT.

6.6.1.2 Heat-treating using batch or continuous type furnaces for pressure-containing, pressure-controlling parts and TCs shall be performed with “production-type” equipment that is used to process production parts meeting the requirements of this specification.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE "Production-type" heat treating equipment is identified as equipment that is routinely used to process production parts.

6.6.2 Furnace Requirements

6.6.2.1 General

6.6.2.1.1 The heat-treatment supplier shall define the temperature range for each operation.

6.6.2.1.2 Automatic controlling and recording instruments shall be used.

6.6.2.1.3 Thermocouples shall be placed in the furnace working zone(s) and protected from furnace atmospheres by means of suitable protective devices.

6.6.2.2 Instrument Accuracy

6.6.2.2.1 The controlling and recording instruments used for the heat-treatment processes shall be accurate to $\pm 1\%$ of their full-scale range.

6.6.2.3 Instrument Calibration

6.6.2.3.1 Temperature-controlling and recording instruments shall be calibrated at least once every three months.

6.6.2.3.2 Equipment used to calibrate the production-type equipment shall be accurate to $\pm 0.25\%$ of full-scale range.

6.6.2.4 Batch-type Furnaces

6.6.2.4.1 Heat treatment of production parts shall be performed with heat-treating equipment that satisfies one of the following:

a) calibrated in accordance with 6.8.2.2 and 6.8.2.3 and heat-treat batch-type furnaces that have been surveyed in accordance with Annex H; or

b) calibrated and surveyed in accordance with SAE AMS2750 and Table 7.

6.6.2.4.2 The temperatures within each batch-type furnace shall be surveyed within one year prior to use of the furnace for heat treatment.

Table 7—Heat Treatment Thermal Uniformity Survey (TUS) Requirements

Heat Treatment Type	Furnace Classes				
	Class 1 TUS Tolerance $\pm 5^{\circ}\text{F}$ ($\pm 3^{\circ}\text{C}$)	Class 2 TUS Tolerance $\pm 10^{\circ}\text{F}$ ($\pm 6^{\circ}\text{C}$)	Class 3 TUS Tolerance $\pm 15^{\circ}\text{F}$ ($\pm 8^{\circ}\text{C}$)	Class 4 TUS Tolerance $\pm 20^{\circ}\text{F}$ ($\pm 10^{\circ}\text{C}$)	Class 5 TUS Tolerance $\pm 25^{\circ}\text{F}$ ($\pm 14^{\circ}\text{C}$)
Normalizing	X	X	X	X	X
Annealing	X	X	X	X	X

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Solution	X	X	X	X	X
Austenitizing	X	X	X	X	X
Tempering	X	X	X	N/A	N/A
Precipitation hardening	X	X	X	N/A	N/A
Aging	X	X	X	N/A	N/A
Stress relieving	X	X	X	N/A	N/A
N/A – Not Applicable					

6.6.2.5 Continuous-type Furnaces

6.6.2.5.1 Heat treatment of production parts shall be performed with continuous-type furnaces that satisfy the following:

- a) be operated, maintained, modified, and repaired in conformance with SAE AMS2750 or SAE AMS-H-6875 and
- b) be surveyed in conformance with Annex H.

6.6.2.6 Furnace Repairs

6.6.2.6.1 When a furnace is repaired or rebuilt the SAE AMS2750 sections on furnace modifications and furnace repairs shall be used to determine whether a new furnace survey is required.

6.6.2.6.2 All furnace repairs and modifications shall be documented

6.6.2.6.3 The responsible Quality Assurance organization shall determine whether an additional furnace survey and calibration is required based on the repairs or modifications in conformance with SAE AMS2750 or SAE AMS-H-6875.

6.6.2.7 Furnace Calibration and Survey Records

6.6.2.7.1 Records of furnace calibration and surveys shall be maintained for a period of not less than ten years.

6.6.2.7.2 The minimum records of furnace calibration/survey shall be a certificate of conformance in accordance with Annex H.

6.7 Service Compatibility

6.7.1 Metallic materials shall be selected to avoid corrosion and galling, that would impair function and/or pressure-containing capability.

6.7.2 If specified, the manufacturer shall include corrosion-resistant material or overlay on the sealing areas of the pressure-containing and pressure-controlling parts of the valves.

NOTE Graphite should not be used for stem packing, seals, or gaskets that can come into contact with seawater.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

7 Welding

7.1 General

7.1.1 HVOF is not a welding process and shall not be required to meet the requirements of Section 7.

7.2 Outsourced Welding

NOTE See API 20G for guidance on the use of outsourced welding services.

7.3 Welding Consumables

7.3.1 The manufacturer shall have a documented procedure for storage and control of welding consumables.

7.3.2 Materials of low-hydrogen type (including electrodes, wires, and fluxes) shall be stored and used, as recommended by the manufacturer of the welding consumable, to retain their original low-hydrogen properties.

7.4 Qualification

7.4.1 Welding, including repair welding, of pressure-containing and pressure-controlling parts shall be performed in accordance with procedures conforming to the requirements of 7.4, 7.5, and 7.6, and qualified to:

- a) ASME BPVC, Section IX or
- b) ISO 15607, ISO 15609, and ISO 15614-1, or
- c) both a) and b).

7.4.2 Welders and welding operators shall be qualified in conformance with:

- a) ASME BPVC, Section IX or
- b) ISO 9606-1 or
- c) EN 287-1 or
- d) any combination thereof.

NOTE The purchaser, pipeline or piping design standards, material specifications, or local requirements may specify additional requirements.

7.4.3 The results of all qualification tests shall be documented in a procedure qualification record (PQR) and retained in conformance to the requirements of 14.1.

7.4.4 PWHT shall be performed in accordance with the applicable material specification or design

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
code.

7.5 Weld Overlay

7.5.1 General

7.5.1.1 Qualification shall be in conformance to:

- a) ASME *BPVC*, Section IX, Articles II and III, or
- b) ISO 15614-7, or
- c) both.

7.5.2 Hard-facing Weld Overlays

7.5.2.1 Weld overlays for hard-facing shall be applied to thickness and other limitations as detailed in the qualified welding procedure and procedure qualification record (WPS and PQR).

7.5.3 Corrosion-resistant Alloy (CRA) Weld Overlays

7.5.3.1 For any CRA weld overlay with nickel-based alloy UNS N06625, the weld metal chemical analysis at the final qualified minimum clad thickness identified on the procedure qualification shall be iron dilution class Fe 10: iron mass fraction 10 % maximum, unless the purchaser specifies otherwise (see K.9).

7.5.3.2 The iron dilution achieved at the finished minimum qualified thickness shall be identified on the weld procedure qualification records.

7.5.3.3 For all other compositions of weld overlay, the chemical analysis of the weld metal shall conform to the manufacturer's documented specification at the minimum qualified thickness.

7.5.3.4 The minimum thickness of the finished corrosion-resistant weld overlay on all surfaces shall be at least 0.12 in. (3.0 mm).

7.5.3.5 Thicknesses less than 0.12 in (3.0 mm) shall be permitted in conformance with K.10.

7.5.3.6 Weld Overlay NDE in the Final Supplied Condition

7.5.3.6.1 CRA weld overlays in the final supplied condition shall be visually inspected in conformance with ASME *BPVC*, Section V, Article 9.

7.5.3.6.2 The following acceptance criteria shall apply:

- a) The undercut shall not reduce the thickness in the area (considering both sides) to below the minimum thickness.
- b) Surface porosity and exposed slag shall not be permitted on or within 1.77 in. (45 mm) of sealing surfaces.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

7.5.3.6.3 Surface NDE shall be performed on the weld overlay in the final supplied condition using penetrant testing in conformance with ASME BPVC, Section V, Article 6 or ASTM E 165.

7.5.3.6.4 Acceptance shall conform to ASME BPVC, Section VIII, Division 1, Appendix 8.

7.6 Impact Testing

7.6.1 Qualifications of procedures for welding of pressure-containing parts and for repair welding shall conform to 7.4.

7.6.2 Impact testing shall be carried out for the qualification of procedures for welding on valves with a design temperature of 35 °F (2 °C) or below.

7.6.3 If subsize specimens are used, the Charpy V-notch impact requirements shall be equal to that of the 10 mm x 10 mm specimens multiplied by the adjustment factor listed in Table 6 at the full-size specimen test temperatures.

7.6.4 As a minimum, one set of three WM impact specimens shall be taken from the WM at the location shown in Figure 3.

7.6.5 The specimens shall be oriented with the notch perpendicular to the surface of the material.

7.6.6 Multiple sets of WM impact specimens shall be required when more than one welding process is used.

7.6.7 WM impact testing shall be performed to represent each welding process being qualified.

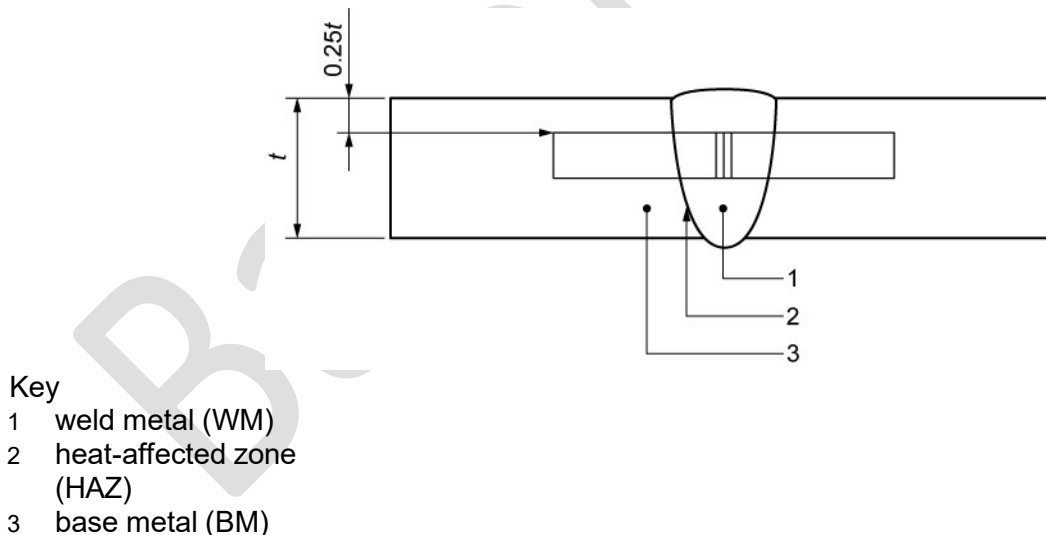
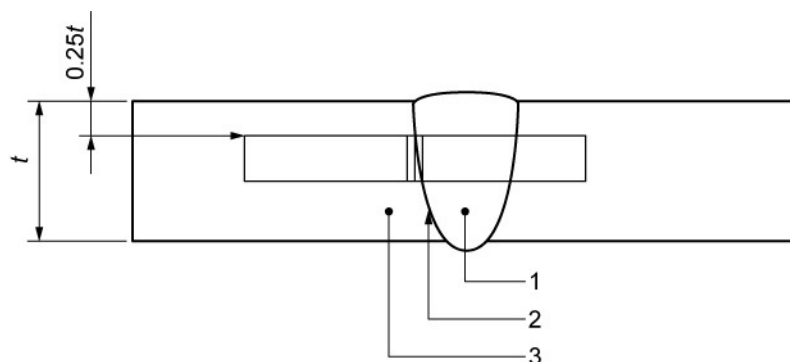


Figure 3—Charpy V-notch WM Specimen Location

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

7.6.8 A set of three impact specimens shall be taken from the heat-affected zone (HAZ) at the location shown in Figure 4.

7.6.9 The notch shall be placed perpendicularly to the material surface at a location resulting in a maximum amount of HAZ material located in the resulting fracture.



Key

- 1 weld metal (WM)
- 2 heat-affected zone (HAZ)
- 3 base metal (BM)

7.6.10 The HAZ tests shall be conducted for each of the materials being joined if:

- a) the base materials being joined are of a different P-number or group number in accordance with ASME BPVC, Section IX or ISO 9606-1, ISO 15607, ISO 15609, ISO 15614-1, and ISO TR 15608:2013; or
- b) one or both of the base materials being joined are not listed in the P-number or group number.

7.6.11 Impact testing shall be performed in accordance with ASTM A370 or ISO 148-1 using the Charpy V-notch technique.

7.6.12 Impact specimens shall be etched to determine the location of the weld and HAZ.

7.6.13 When using ISO 148-1, a striker with a radius of 8 mm shall be used.

7.6.14 The impact test temperature for welds and HAZs shall be at or below the minimum design temperature specified for the valve

7.6.15 Impact test results for full-size specimens shall meet the requirements of Table 4 or Table 5.

7.6.16 If the material specification requires higher impact values than those shown in Table 4 or Table 5, the higher values shall apply.

7.7 Hardness Testing

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

7.7.1 Hardness testing shall be carried out as part of the welding procedure qualification on pressure-containing and pressure-controlling parts in valves required to meet NACE MR0175 or ISO 15156.

7.7.2 Hardness surveys shall be performed on base metal (BM), weld metal (WM), and heat-affected zone (HAZ) in conformance with the requirements of NACE MR0175 or ISO 15156 as applicable.

7.8 Visual Inspection - Welds to Pressure-containing Parts

7.8.1 Welds to pressure-containing parts shall be visually inspected in conformance with ASME BPVC, Section V, Article 9.

7.8.2 The following acceptance criteria shall apply:

- a) The undercut shall not reduce the thickness in the area (considering both sides) to below the minimum thickness.
- b) Surface porosity and exposed slag shall not be permitted on or within 1.77 in. (45 mm) of sealing surfaces.

7.9 Visual Inspection - Pressure-containing and Pipe Pup Welds

7.9.1 Pressure-containing welds and pipe pup-to-valve welds shall be visually inspected in conformance with ASME BPVC, Section V, Article 9.

7.9.2 The following acceptance criteria shall apply:

- a) The undercut shall not reduce the thickness in the area (considering both sides) to below the minimum thickness.
- b) Surface porosity and exposed slag shall not be permitted on or within 1.77 in. (45 mm) of sealing surfaces.

7.10 NDE of Welds Joining Pipe Pups to the Valve

7.10.1 For all pressure-containing pipe pup-to-valve welds, surface NDE shall be performed using at least one of the following methods:

- a) Magnetic particle testing on weld bevels of weld ends after machining, prior to welding, and of the final weldment shall conform to ASME BPVC, Section V, Article 7 or ASTM E709.

Acceptance criteria shall conform to ASME BPVC, Section VIII, Division 1, Appendix 6.

- b) Penetrant testing on weld bevels of weld ends after machining, prior to welding, and of the final weldment shall conform to ASME BPVC, Section V, Article 6 or ASTM E165.

Acceptance shall conform to ASME BPVC, Section VIII, Division 1, Appendix 8.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

7.10.2 For pressure-containing pipe pup-to-valve welds, volumetric NDE examination shall be performed using at least one of the following methods:

- a) Radiographic testing on 100 % of the welds in conformance to ASME BPVC, Section V, Article 2.

Acceptance criteria shall conform to ASME BPVC, Section VIII, Division 1, UW-51 for linear indications and ASME BPVC, Section VIII, Division 1, Appendix 4, for rounded indications.

- b) Ultrasonic testing on 100 % of the welds in conformance to ASME BPVC, Section V, Article 4.

Acceptance criteria shall conform to ASME BPVC, Section VIII, Division 1, Appendix 12.

NOTE See L.8 for additional requirements for NDE for weld end connectors.

7.11 Manufacturing Repair

7.11.1 General

7.11.1.1 Repair of defects shall be performed in accordance with a documented procedure specifying requirements for defect removal, welding, heat treatment, nondestructive examination (NDE), and reporting as applicable.

NOTE Minor defects may be removed by grinding provided there is a smooth transition between the ground area and the original contour and the minimum wall thickness requirements are not affected.

7.11.1.2 A major weld repair shall be any prepared cavity that exceeds 20 % of the part wall thickness or 1 in. (25.4 mm) depth, whichever is smaller or surface areas greater than 10 in.² (65 cm²).

7.11.1.3 The weld repair shall be in accordance with the applicable material standard, including any PWHT.

7.11.1.4 A weld map shall be required for each casting, which details the surface area and configuration (length, width, and depth) of each major weld repair.

7.11.1.5 A unique number or symbol shall be required and assigned to each casting with an associated weld map, which has been weld repaired.

7.11.1.6 A hardness measurement on the weld deposit of one of the major weld repairs shall be required and made after the final PWHT operation.

7.11.1.7 The information and test results from the above requirements shall be documented and reported on the materials test report or other documents.

7.11.1.8 All major weld repairs of castings shall require PWHT.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

7.11.1.9 Weld repair of all castings shall be limited to 25 % of total surface area.

7.11.1.10 No casting weld repair shall exceed 50 % of the wall thickness of the affected area.

7.11.1.11 Repair of welds shall be performed in accordance with the applicable design code or standard listed in 5.1.1, including any PWHT where applicable.

7.11.2 Casting Repair at the Material Supplier

7.11.2.1 The manufacturer's documented material specification for castings shall specify the limitations for welding repair at the casting material supplier as follows:

- a) Requirements for qualified weld procedures and qualified welders in conformance with ASTM A488/A488M, ASME BPVC Section IX or ISO 15607, ISO 15609, ISO 15614-1 and ISO 15614-7, or equivalent.
- b) Requirement to perform new mechanical testing in conformance with the original material specification, in case the PWHT temperature is less than 50 °F (28°C) below the final tempering temperature of the original material.
- c) Requirement to perform new mechanical testing in conformance with the original material specification if the PWHT is a solution anneal.

NOTE Per API 20A, repair welding is defect removal resulting in a wall thickness below an acceptable value as specified in purchasing documents.

7.11.3 Casting Repair at the Manufacturer

7.11.3.1 Repair of defects shall be performed in conformance with a documented procedure specifying requirements for defect removal, welding, heat treatment, nondestructive examination (NDE), and reporting.

7.11.3.2 Removal of surface defects shall not compromise the minimum wall thickness and shall provide a smooth transition between the ground area and the original contour. After surface defect removal, the excavated area shall be examined at least one of the following methods:

- a) Magnetic-particle (MT) inspection conforming to ASME BPVC, Section V, Article 7, or ASTM E709.

Acceptance criteria shall conform to ASME BPVC, Section VIII, Division 1, Appendix 7.

- b) Liquid-penetrant (PT) examination conforming to ASME BPVC, Section V, Article 6, or ASTM E165.

Acceptance criteria shall conform to ASME BPVC, Section VIII, Division 1, Appendix 7.

7.11.3.3 After completion, repair welds on pressure-containing parts shall be examined using MT or PT, as well as the same NDE method that was used to identify the defect when another method was used.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

7.11.3.4 If visual inspection was used to identify a defect, inspection by MT or PT alone shall be acceptable.

7.11.3.5 Method and acceptance criteria shall be as specified in 7.11.3.

7.11.3.6 The final NDE activities shall be conducted after any required post-weld heat treatment.

7.11.3.7 Repair weld of castings shall be performed in conformance with the applicable material standard, including any PWHT when required.

7.11.3.8 If the PWHT temperature is less than 50 °F (28 °C) below the final tempering temperature of the original material, new mechanical testing shall be performed in conformance with the original material specification.

7.11.3.9 If the PWHT is a solution anneal; new mechanical testing shall be performed in conformance with the original material specification.

7.11.4 Forgings and Plate

7.11.4.1 Weld repair on forgings and plates shall be limited to being performed to only correct machining errors.

7.11.4.2 Weld repair of forgings and plates to correct material defects shall conform to K.11.

7.11.5 Repair of Welds

Repair of welds shall be performed in accordance with the applicable design code or standard listed in 5.1.1, including any PWHT where applicable.

8 Bolting

8.1 Pressure boundary bolting shall conform to:

- a) API 20E, BSL-2 for alloy and carbon steel bolting if the specified bolting materials are listed in API 20E; or
- b) API 20F, BSL-2 for corrosion-resistant bolting if the specified bolting materials are listed in API 20F; or
- c) the manufacturer's documented material specification and design code listed in 5.1.1 if the specified bolting materials are not listed in API 20E or API 20F.

8.2 Carbon and low-alloy steel bolting material, with a hardness exceeding HRC 34 (HBW 319), shall not be used for valve applications where hydrogen embrittlement can occur.

NOTE 1 Use of bolting that conforms to API 20E and API 20F does not require that the bolting be supplied from a facility that has been licensed to API 20E or API 20F.

NOTE 2 Use of bolting that conforms to API 20E and API 20F includes identification of the bolts in accordance with the specified marking requirements.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE 3 See API 21TR1 for guidance on the selection of bolting materials.

8.3 Low-temperature carbon and alloy steel bolting shall conform to ASTM A320/A320M for the specific grade of material.

8.4 Pressure boundary carbon steel bolting in CP system shall not be zinc plated.

9 Quality Control

9.1 Measuring and Test Equipment Control

9.1.1 Equipment used to inspect, test, or examine valves or valve parts shall be identified, controlled, calibrated, and adjusted at specified intervals in accordance with documented valve manufacturer instructions, and consistent with nationally or industry-accepted standards specified by the measuring and test equipment supplier, to maintain the accuracy required by this specification.

9.2 Pressure-measuring Devices

9.2.1 Type and Accuracy

9.2.1.1 Test pressure-measuring devices shall be accurate to at least ± 2.0 % of the calibration pressure.

9.2.1.2 If pressure gauges are used in lieu of pressure transducers, they shall be selected such that the test pressure is indicated within 20 % and 80 % of the full-scale value.

9.2.1.3 The requirements of 9.2 shall not apply to a pressure-recording device unless the device is used for both measurement and recording.

9.2.2 Calibration Procedure

9.2.2.1 A pressure-measuring device shall be calibrated with a master pressure-measuring device or deadweight tester to:

- a) A minimum of three points equally spaced across the full scale of the device. See Example 1.
Or,
- b) The full-scale end points (zero and 100 %) are not required calibration points; however, if they are included in the calibration, the scale end points shall be in addition to the calibration points selected in 9.2.2.1.a). See Example 2.

EXAMPLE 1 For the minimum requirement of three calibration points, $x = 3$, and the calibration intervals would be $(100 \%) / (3 + 1) = (100 \%) / 4 = 25 \%$. Calibration would be performed at 25 %, 50 %, and 75 % of full scale as a minimum.

EXAMPLE 2 For a requirement of five calibration points including full scale, $x = 4$, because the full scale calibration is not included in x . The calibration intervals then would be $(100 \%) / (4 + 1) = (100 \%) / 5 = 20 \%$. Calibration would be performed at 20 %, 40 %, 60 %, 80 %, and 100 % of full scale.

9.2.3 Calibration Intervals

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

9.2.3.1 Calibration intervals shall be established by the valve manufacturer for calibrations based on repeatability and degree of usage.

9.2.3.2 Calibration intervals shall be a maximum of 90 days until recorded calibration history can be established by the valve manufacturer.

9.2.3.3 Increases to the interval between calibrations shall be limited to 90-day increments, with a maximum calibration interval between calibrations to not exceed 1 calendar year.

9.2.3.4 Calibration intervals shall be adjusted based on review of the recorded calibration history, and determination of interval adjustments shall be defined in the manufacturer's documented procedure.

9.2.3.5 The calibration interval shall start on the date of first use, not to exceed 90 days from the date of calibration.

9.2.3.6 The date of first use shall be recorded.

9.2.3.7 If the calibration interval is not started within 90 days of the date of calibration, the equipment shall be identified as out of calibration

9.2.4 Temperature-measuring Devices

9.2.4.1 Temperature-measuring devices shall be capable of indicating and recording temperature fluctuations of 9 °F (5 °C).

9.2.5 Pressure Recording Devices

9.2.5.1 Pressure recording devices shall be accurate to at least ± 2.0 % of the calibration pressure of the recording device (see).

9.2.6 Heat Treatment Equipment Calibration

9.2.6.1 Heat treatment equipment calibration shall be performed prior to putting the equipment in service and shall be recalibrated at a frequency not longer than 12 months from the last calibration.

9.3 Welding Inspectors

9.3.2.1 Personnel performing visual inspection of welding operations and completed welds are not required to meet the requirements of 9.4.1.

9.3.2.2 Personnel performing visual inspection of welding operations and completed welds shall be qualified and recorded in conformance with the manufacturer's documented procedures.

9.4 Visual Inspection

9.4.1 Visual Examination Personnel

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

9.4.1.1 Personnel performing visual inspection for acceptance shall take and pass an annual vision examination in accordance with the manufacturer's documented procedures that meet the applicable requirements of ASNT SNT-TC-1A or ASNT Central Certification Program (ACCP) or ISO 9712.

NOTE Alternative standards are acceptable provided they meet the minimum requirements of ASNT SNT-TC-1A.

9.4.3 Visual Inspection of Castings

9.4.3.1 At a minimum, visual inspection of all pressure-containing and pressure-controlling steel castings shall conform to MSS SP-55.

9.4.3.2 The following acceptance criteria shall apply:

- a) Type I: none acceptable;
- b) Type II to XII: Category A and B only.

9.4.3.2 For cast materials not covered by MSS SP-55, visual inspection and acceptance criteria shall conform to the manufacturer's documented procedures.

9.4.4 Visual Inspection of Forgings

9.4.4.1 At a minimum, visual inspection of pressure-containing and pressure-controlling steel forgings shall be performed and shall conform to ASME BPVC Section VIII, Division 1, UF-45, and UF-46.

9.4.4.2 Acceptance criteria shall be that no visible defects, including seams, laps, and folds, shall be accepted.

9.4.5 Other Personnel

9.4.5.1 Personnel performing other quality control activities directly affecting material and product quality shall be qualified in accordance with manufacturer's documented requirements.

9.5 Production Material Hardness Testing

9.5.1 A production material hardness test shall be performed on metallic pressure-containing, pressure-controlling, and pressure boundary bolting (magnetic, nonmagnetic, duplex, or CRA materials).

9.5.2 Hardness testing shall not be performed on finished machined sealing surfaces.

9.5.3 The method of hardness testing shall be performed in accordance with the following.

- a) For Brinell hardness measurements, testing shall be performed in accordance with ASTM E10 or ISO 6506-1.
- b) For Rockwell hardness measurements, testing shall be performed in accordance with

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
ASTM E18 or ISO 6508-1.

c) Portable hardness measurements shall be performed in accordance with ASTM E110.

9.5.4 Results of the production hardness testing shall be reported and records maintained (see Section 14).

NOTE This hardness test may be performed by the supplier of the material and reported on the material test report.

9.6 Storage for Nonmetallic Seals

9.6.1 The manufacturer's written requirements for nonmetallic seals, that are not assembled into equipment, shall include the following information at a minimum:

- a) age control;
- b) indoor storage;
- c) maximum temperature not to exceed 120 °F (49 °C);
- d) protected from direct natural light;
- e) stored unstressed (see NOTE in 9.6.2);
- f) stored away from contact with liquids;
- g) protected from ozone and radiographic damage.

9.6.2 Packaging and storage of elastomeric seals shall not impose tensile or compressive stresses sufficient to cause permanent deformation or other damage.

NOTE Recommendations are typically available from seal manufacturers. If applicable, for a given seal design, rings of large inside diameter and relatively small cross-section may be formed into three equal super imposed loops to avoid creasing or twisting, but it is not possible to achieve this condition by forming just two loops.

9.7 Valve Assembly

9.7.1 Valves shall be assembled per documented procedures developed by the manufacturer.

9.7.2 The procedure shall include bolt tightening requirements for pressure-boundary bolting.

9.7.3 If lubricant is used for the assembly of pressure-controlling parts, the lubricant shall not exceed the viscosity range of SAE 10W motor oil or equivalent.

NOTE 1 Other parts, such as threads, bearings, sliding parts, etc., may be lubricated for assembly using an appropriate oil or grease.

NOTE 2 See K.12 for guidance on restriction of assembly lubricant.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

10 Factory Acceptance Testing

10.1 Pressure Testing - General

10.1.1 Procedure

10.1.1.1 Each valve shall be tested in accordance with Section 10.

NOTE See K.13 for testing one-piece bodies in non-assembled condition.

10.1.1.2 Documented test procedures that identify test methodology, test durations, and acceptance criteria shall be developed and maintained for all pressure testing performed in conformance to this specification.

10.1.1.3 The equipment used to perform the required pressure tests shall not apply external forces that affect seat or body seal leakage.

10.1.1.4 If an end-clamping fixture is used, the valve manufacturer shall demonstrate that the test fixture does not affect the seat or body joint sealing capability of the valve being tested.

10.1.1.5 Pressure testing shall be carried out before external coating of the valve.

10.1.1.6 If the valve has been previously tested to the requirements of this specification repeat hydrostatic and gas testing shall be permitted without removal of the valve external coating.

10.1.1.7 Testing shall be performed in the following order based on the applicable valve configuration and manufacturer requirements:

- a) stem backseat (10.2) prior to hydrostatic shell test (10.3); or
- b) hydrostatic shell test (10.3) prior to stem backseat test (10.2).
- c) hydrostatic shell (see 10.3):
 1. standard (10.3.1);
 2. with pipe pups (10.3.2).
- d) hydrostatic seat (see 10.5):
 1. check valves (10.5.2);
 2. axial on-off, ball, and gate valves (10.5.3).

10.1.2 Test Conditions

10.1.2.1 The hydrostatic test fluid shall be water and shall contain a corrosion inhibitor.

NOTE The hydrostatic test fluid may have antifreeze (glycol) added at the discretion of the

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved manufacturer.

10.1.2.2 The chloride content of test fluid in contact with austenitic and duplex stainless steel wetted components of valves shall not exceed 30 µg/g (30 ppm by mass).

10.1.2.3 The chloride content in the test fluid shall be tested at least every 12 months and records shall be maintained in accordance with Section 14.

10.1.2.4 The test fluid temperature shall be maintained between 35 °F (2 °C) minimum and 100 °F (38 °C) maximum during the testing period.

10.1.2.5 Ambient temperature during testing shall be held between 40 °F and 100 °F (4 °C and 38 °C) during the test period.

10.1.2.6 All hydrostatic and gas shell tests specified shall be:

- a) performed with the valve unseated and partially open; or
- b) performed with the valve fully open, provided the body cavity is simultaneously filled and pressurized through a cavity connection.

10.1.2.7 The supply pressure shall be isolated from the valve during hydrostatic/gas shell testing.

10.1.2.8 The valve internal pressure shall be stabilized prior to the start of pressure testing duration.

10.1.2.9 The stabilization criteria shall be documented in the manufacturer's pressure testing procedure.

10.1.2.10 If the valve body connections are not available for direct monitoring, methods for monitoring pressure or leakage or both shall be determined by other methods.

10.1.2.11 The pressure/temperature measuring device shall be installed in the test apparatus in such a manner that the device continuously monitors/records the internal test pressure/temperature of the valve assembly.

10.1.2.12 The pressure tests shall be held for the minimum test durations listed in Table 8, Table 9, and Table 10 once the pressure has stabilized.

10.1.2.13 A calibrated chart recorder or other suitable recording devices shall be used to provide a record for all hydrostatic and gas tests.

NOTE Supplementary pressure tests are found in Annex L and are required if specified by the purchaser at time of order placement.

10.1.3 Leakage

10.1.3.1 For hydrostatic or gas testing, visible leakage (see 3.1.53) shall be any release of test fluid observed during the pressure test duration.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

10.1.3.2 Test fluid released during the seat test pressure build-up or pressure bleed-down shall not be recognized as visible leakage.

10.1.3.3 Visible leakage shall be observed directly, including through a window or by video equipment.

10.1.3.4 If video equipment is used, resolution and brightness shall be sufficient to detect leakage.

10.2 Stem Backseat Test

10.2.1 Testing of the backseat shall be performed on valves that have this feature and shall be performed without the packing installed, or with the packing installed and the packing gland loose; unless a test port is provided.

10.2.2 Self-energized packing or seals shall be removed unless a test port is provided for this test.

10.2.3 The valves shall be filled with the ends closed off and the closure member in the partially open position until leakage of the test fluid around the stem is observed.

10.2.4 The backseat shall then be closed and a minimum pressure of 1.1 times the pressure rating determined in accordance with 5.2 for material at 100 °F (38 °C) applied for the duration specified in Table 5.

10.2.5 Monitoring for leakage shall be through a test access port or by monitoring leakage around the loosened packing.

10.2.6 There shall be no visible leakage permitted during the stem backseat test.

Warning—Appropriate safety precautions must be taken.

Table 8—Minimum Duration of Stem Backseat Tests

Valve Size		Test Duration min
NPS	DN	
≤4	≤100	5
≥6	≥150	10

10.3 Hydrostatic Shell Test

10.3.1 Hydrostatic Shell Test Preparation, Method, and Acceptance Criteria

10.3.1.1 Valve ends shall be blocked and the closure member placed in any position according to 10.1.2.6.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

10.3.1.2 Final pressure-containing fittings that are not used for leakage monitoring or detection shall be fitted for hydrostatic shell testing.

10.3.1.3 The test pressure for the hydrostatic shell test shall be a minimum of 1.5 times the pressure rating conforming to 4.3 for material at 100 °F (38 °C) based on the valve end connector material.

10.3.1.4 The test duration shall conform to Table 9 based on the valve end connector size.

Table 9—Minimum Duration of Hydrostatic Shell Tests

Valve Size		Test Duration ^a (minutes)
NPS	DN	
≤2 to 10	50 to 250	15
12 to 18	300 to 450	30
20 and larger	500 and larger	60
^a Test duration starts once the valve is stabilized per manufacturer's procedures.		

10.3.1.5 There shall be no visible leakage permitted during the hydrostatic shell test.

10.3.1.6 Supplemental gas shell testing is specified in Annex L.

10.3.2 Hydrostatic Shell Test with Pipe Pups

10.3.2.1 A hydrostatic shell test shall be required if pipe pups are to be welded to the valve as part of the final valve assembly by the manufacturer.

10.3.2.2 Test pressure, duration, and acceptance criteria shall be in accordance with 10.3.1.

10.3.2.3 If the allowable test pressure rating of the pipe pup is less than the required hydrostatic test pressure, the valve shall first be hydrostatic tested without the pipe pups welded to the valve.

10.3.2.4 Subsequently, the pipe pups shall be welded to the valve followed by a hydrostatic shell test of the assembly at a specified lower pressure.

10.3.2.5 The test duration shall start after stabilization and shall not be less than half the duration specified in Table 9.

10.3.2.6 There shall be no visible leakage permitted during the hydrostatic shell test with pipe pups.

10.3.2.7 Following the hydrostatic test of assembly the external weld surface shall be subject to NDE (MT or PT) as specified in Table I.1 for pressure-containing welds.

10.4 Operational/Functional Test

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

10.4.1 General

10.4.1.1 The maximum thrust or torque required to operate axial on-off, ball, or gate valves shall be measured at the pressure specified, in the following operations:

- a) open-to-closed with the bore pressurized and
 - 1) the cavity at atmospheric pressure for valves with no pressure balance hole, for valves with an upstream seat; or
 - 2) the cavity at test pressure for valves with pressure balance hole, or downstream seated valve;
- b) closed-to-open with both sides of the closure member pressurized and the cavity at atmospheric pressure, for valves with an upstream seat;
- c) closed-to-open with one side of the closure member pressurized and the cavity at atmospheric pressure for upstream seated valves and the cavity at upstream pressure for valves with a downstream seat;
- d) as in item c), but with the other side of the closure member pressurized;
- e) closed-to-open and open-to-closed without pressure.

10.4.1.2 If lubricant is used for the assembly of pressure-controlling parts, the lubricant shall not exceed the viscosity range of SAE 10W motor oil or equivalent.

10.4.1.3 The measured torque or thrust results shall be recorded.

10.4.2 Manual or ROT Operated Valves

10.4.2.1 Each manual or ROT-operated valve, excluding check valves, shall be operated per 10.4.1 while subject to the differential pressure specified in 5.9.1.5.

10.4.2.2 If the valve is operated by a gearbox, the torque applied to the input shaft of a manual gearbox shall be measured.

10.4.2.3 The measured torque shall be multiplied by the mechanical advantage of the gearbox to obtain the gearbox output torque/thrust.

10.4.2.4 The gearbox output torque/thrust obtained in 10.4.2.3 shall not exceed the valve torque/thrust specified 5.6.2.2.

10.4.2.5 Direct operated or lever operated valves with torque or thrust values exceeding the design torque or thrust specified in 5.6.2.2, shall be rejected.

10.4.3 Actuated Valves

10.4.3.1 Each actuated valve, excluding check valves, shall be operated per 10.4.1 while subjected to the differential pressure specified in 5.2.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

10.4.3.2 For bidirectional valves, the valves shall be tested in each direction.

10.4.3.3 Valves with thrust or torque values exceeding the design torque specified in 5.6.6.2, shall be rejected.

10.4.4 Check Valves

10.4.4.1 Each check valve fitted with an operating mechanism shall be operated (close–open–close) four times while the entire body cavity is subjected to the rated pressure listed in 5.2.

10.4.4.2 Valves that fail to operate, fail to seal after cycling or require torque exceeding the design torque values specified in 5.6.6.2 shall be rejected.

10.4.5 Measuring Device Calibration

10.4.5.1 Calibration of torque/thrust-measuring devices shall be as follows:

- a) Torque/thrust measuring devices shall be accurate to within $\pm 2.0\%$ of the full scale.
- b) Torque/thrust measuring devices shall be calibrated with a master device to at least three equidistant points of full scale (excluding zero and full scale as required points of calibration).

10.5 Hydrostatic Seat Test

10.5.1 Hydrostatic Seat Test Preparation, Method, and Acceptance Criteria

NOTE See K.14 for guidance on performing alternate seat testing.

10.5.1.1 The test pressure for all seat tests shall not be less than 1.1 times the pressure rating determined in accordance with 4.3 for material at 100 °F (38 °C) based on the valve end connection material.

10.5.1.2 Seat test acceptance criteria shall be based on the bore diameter of the closure member.

10.5.1.3 The hydrostatic seat test shall consist of three tests as follows:

- a) Cycle the valve fully open and fully closed after each test.
- b) Reduce pressure to zero after each test.
- c) Check valves shall be unseated and reseated after each test.
- d) Method for unseating and reseating shall be per manufacturer's written procedure.

10.5.1.4 The duration listed in Table 10 shall apply to all valve sizes.

Table 10 – Minimum Duration of Hydrostatic Seat Test

Test Cycle	Duration
1	15 minutes

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

2	30 minutes
3	15 minutes

10.5.1.5 Seat leakage shall be monitored from the downstream side of the seat when under hydrostatic seat test.

10.5.1.6 The acceptance criteria for leakage shall be as follows:

- a) Leakage for soft-seated valves shall not exceed ISO 5208, Rate A (no visible leakage for the duration of the test at test pressure).
- b) For metal-seated valves, other than check valves, the liquid leakage rate shall not exceed ISO 5208, Rate C.
- c) For metal-seated check valves, the liquid leakage rate shall not exceed ISO 5208, Rate D.

10.5.2 Hydrostatic Seat Test—Check Valves

10.5.2.1 The seat test pressure for check valves shall be applied in the direction of the required flow blockage.

10.5.3 Hydrostatic Seat Test—Axial On-Off, Ball, and Gate Valves

10.5.3.1 Unidirectional Valve

10.5.3.1.1 For axial on-off, ball, and gate valves, with the valve half-open, the valve and its cavity shall be entirely filled with test fluid.

10.5.3.1.2 The valve shall then be closed, and the test pressure applied to the appropriate end of the valve.

10.5.3.1.3 Leakage shall be monitored at the downstream side of the tested seat, i.e., in the valve body cavity in case of an upstream seated valve or at the downstream side of the valve in the case of a downstream seated valve.

10.5.3.2 Bidirectional Valve

10.5.3.2.1 For axial on-off, ball, and gate valves, with the valve half-open, the valve and its cavity shall be entirely filled with test fluid.

10.5.3.2.2 The valve shall then be closed, and the test pressure applied sequentially to both ends of the valve.

10.5.3.2.3 Leakage shall be monitored at the downstream side of the tested seat, i.e., in the valve body cavity in case of an upstream seated valve or at the downstream side of the valve in the case of a downstream seated valve.

10.5.4 Additional Seat Testing

10.5.4.1 If the functionality for the valve is specified to be that of double block and bleed (DBB)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

valves, the test described in L.9 shall be performed.

10.5.4.2 If the functionality for the valve is specified to be that of double isolation and bleed with both seats bidirectional (DIB-1), the test described in L.10 shall be performed.

10.5.4.3 If the functionality for the valve is specified to be that of double isolation and bleed with one seat unidirectional and one seat bidirectional (DIB-2), the test described in L.11 shall be performed.

10.5.4.4 If DIB-1 or DIB-2 operational performance verification is specified, the test described in L.12 shall be performed.

10.5.4.5 The testing specified in L.9, L.10, L.11, and L.12 shall be performed by the manufacturer and shall not be outsourced.

10.5.4.6 Supplemental gas seat testing is specified in Annex L.

10.6 Cavity Relief Test

10.6.1 Cavity relief testing shall conform to the requirements of Annex I, Table I.4 and I.7.

10.7 Draining

10.7.1 Upon completion of all liquid tests, valves shall be drained of test fluids and dried with shop air or nitrogen.

10.8 Installation of Body Connections After Testing

10.8.1 Final body fittings and stem seal test ports, such as plugs, shall be fitted on completion of testing in accordance with documented procedures.

10.9 Testing of Pressure Boundary Connections

10.9.1 Pressure boundary (see 5.2) connections shall have a high-pressure gas test performed using inert gas as the test medium by using one of the following methods:

- 1) Method 1: Test shall be performed using 100 % nitrogen measured using a bubble counter or soap solution.
- 2) Method 2: Test shall be performed using 100 % nitrogen submerged in a water bath.
- 3) Method 3: Test shall be performed using 90 % nitrogen with a 10 % helium tracer measured using a mass spectrometer.

10.9.2 The minimum test pressure shall be 1.1 times the pressure rating determined in accordance with 5.2 for the material at 100 °F (38 °C).

10.9.3 Test duration shall be 20 minutes minimum after stabilization.

10.9.4 Acceptance criteria for Method 1 and Method 2 shall be with no visible leakage

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved allowed.

10.9.5 Acceptance criteria for Method 3: shall be a leakage rate not to exceed 1×10^{-4} std cm³/s (1×10^{-5} Pa-m³/s).

10.9.5 Following the test of body welded connections with gas, a surface NDE (PT) of the weldment shall be performed in accordance with I.1 as a minimum.

10.10 Cathodic Protection Continuity Test

10.10.1 External surfaces of the valve, operator and other connected equipment shall be checked for electrical continuity before coating.

10.10.2 The electrical resistance shall be measured and recorded as follows.

- a) Axial on-off and Ball valve: between the body and cover/bonnet, body and bolting, body and stem.
- b) Check valve: between the body and cover/bonnet, body and bolting, body and gland body external components.
- c) Gate valve: between the body and bonnet, body and bolting, body and stem.

10.10.3 The measured resistance shall not exceed 0.1 Ω .

10.10.4 A calibrated meter with calibration intervals in accordance with 9.2.3 shall be used to measure the resistance.

10.11 Post-testing Corrosion Protection

10.11.1 Upon completion of all tests a rust preventative shall be applied to all accessible internal surfaces of non-corrosion-resistant valves in accordance with Section 11.

11 Coating and Painting

11.1 All valves shall be coated or painted externally in accordance with the purchaser's requirements.

NOTE 1 See Section 13.2 for details on corrosion protection.

Caution—If external coating or painting operations are performed by the manufacturer or their coating or painting contractor, preventative measures should be taken to ensure that no foreign material enters the internal cavity of the valve and external parts that may impact the valve function.

11.2 Flanges, operator mounting flange sealing surfaces, weld bevel ends, and exposed stems shall not be coated.

11.3 The coating requirements of Annex N for both flange and weld end connections that shall be applied after all testing is completed.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

12 Marking

12.1 General

12.1.1 Valve body marking shall conform to the requirements of Table 11 and 12.

Table 11—Valve Marking on Body

Item No.	Marking		Section	Format Example
1	Manufacturer's name ^{a,c}		— ^e	Per manufacturer requirements
2	Unique serial number ^b		14.1	Per manufacturer requirements
3	ASME Pressure Class Rating ^b		4.3.1	150, 300, 600, 900, 1500, or 2500
	or Intermediate Pressure Rating ^b		4.3.2	PN155, 2250 psi
4	Body/end-connector material designation ^{b, f, g, i}		6	Material grade
5	Body/end-connector melt identification ^{f, g}		— ^e	Cast or heat number
6a	Nominal valve size ^{b, d}	Full-opening valves: nominal valve size	4.4.2	8 or DN 200
6b		Reduced-opening valves with circular opening ^d	4.4.3	8 × 6 or DN 200 × 150 or 8R x bore or DN 200R x bore
6c		Reduced-opening valves with noncircular opening	4.4.4	8R (DN200R)
7	SMYS (units) of valve ends ^h		5.1	SMYS 40 KSI or SMYS 276 MPa
8	Ring joint groove number ⁱ		— ^e	R49
9	Flow direction (for check valves only)		12.1	Flow ^k → or ← Flow ^k

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

FOOTNOTES

- a Shall be on either the body or the nameplate at a minimum; may be on both.
- b Shall be on both the body and the nameplate.
- c Additional use of trademark/brand names with the manufacturer's name is optional.
- d Bore may be marked in in. or (mm).
- e No specific document reference identified.
- f When the body is manufactured from more than one type of material, all materials of the body and end connector shall be identified—MSS SP-25 gives guidance on marking.
- g Body includes body/end connector.
- h On body weld ends only.
- i On flange OD for flanged connectors conforming to 5.2.3.1.1.
- j If the grade and class does not uniquely identify the material specification, the material specification, grade, and class shall be marked. Example: A516-70 or A537 CL2.
- k The word “flow” is optional.

12.1.2 Check valves shall be marked with an arrow indicating the direction of flow.

12.1.3 Body, end connector, and bonnet/cover marking shall meet the following requirements:

- a) performed using a low-stress die-stamp (rounded “V” or dot face type); or
- b) laser engraved; or
- c) cast; or
- d) any combination of the above.

12.1.4 The marking on the body, end connector, and bonnet/cover shall be visually legible prior to painting/coating the valve.

12.1.5 For valves NPS 2 (DN 50) and larger, the size of marking shall be 6 mm (0.25 in.) in or greater in height.

12.1.6 Additional marking shall conform to Table 12.

Table 12—Additional Marking

Item No.	Marking	Format	Location
1	Bonnet/cover material designation ^a (see Section 6)	Material grade	On bonnet/cover
2	Bonnet/cover melt identification (cast or heat number)	A516-70/12345	On bonnet/cover

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

3	Seat sealing direction (for valves with preferred direction)	(see Figure 5)	On separate identification plate affixed to valve body, bonnet/cover, or end connector
4	Safe working limit (SWL) of lifting points	Per manufacturer requirements	Per manufacturer requirements
^a If the grade and class does not uniquely identify the material specification, the material specification, grade, and class shall be marked. Example: A516-70 or A537 CL2, etc.			

12.2 Valve Size Marking

12.2.1 Except for reduced-opening valves, valve sizes shall be marked with the nominal pipe size (NPS) or nominal diameter (DN).

12.2.2 When there are no minimum bore dimensions listed for a valve pressure class and size stated in Table 1, the size and bore shall be by agreement (see 4.4.1.2.b) and the manufacturer shall stamp/mark the size and bore on the nameplate.

12.2.3 Reduced-opening valves with a circular opening shall be marked with the nominal size of the end connectors and the nominal size of the reduced opening in conformance with Table 1 or marked with the nominal size followed by "R" and the actual bore.

EXAMPLE 1 An NPS 16 (DN 400) Class 150 valve with a reduced 11.93 in. (303 mm) diameter circular opening shall be specified as NPS 16 (DN 400) × NPS 12 (DN 300).

EXAMPLE 2 An NPS 16 (DN 400) Class 150 valve with an actual bore 14.75 in. (375 mm) diameter circular opening shall be specified as NPS 16R (DN 400R) × 14.75 in (375 mm).

12.2.4 Reduced-opening valves with a noncircular opening and other valves per 4.4.4 shall be marked with the nominal size in conformance with Table 1 corresponding to the end connectors, followed by the letter "R".

EXAMPLE 3 A reduced-bore valve with an NPS 16 (DN 400) end connector and a 15 in. × 12 in. (381 mm × 305 mm) rectangular opening shall be specified as 16R.

12.3 Nameplate

12.3.1 Valve nameplate marking shall conform to the requirements of Table 13.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table 13—Valve Marking on Nameplate

Item No.	Marking		Section	Format Example
1	Manufacturer's name ^{a, c}		— e	Per manufacturer requirements
2	Specification		— e	"6DSS" or "API 6DSS"
3	Unique serial number ^b		14.1	Per manufacturer requirements
4	Date of manufacture		— e	MM-YY (e.g. 05-26 is for May 2026)
5	Manufacturer country		12.3	NL; Made in Italy; Made in U.K.
6	ASME Pressure Class Rating ^b		4.3.1	150, 300, 600, 900, 1500 or 2500
	or Non-standard valve pressure rating ^b		4.3.2	PN155, 2250 psi
7	Pressure–temperature rating: a) maximum allowable working pressure at maximum temperature and b) maximum allowable working pressure at minimum temperature		4.3	1480 psi at 250 °F; 10.2 MPa or 102 bar at 121 °C 1500 psi at –20 °F; 10.4 MPa or 104 bar at –29 °C
8	Face-to-face/end-to-end dimensions, if not shown in or does not conform to Table C.1 to Table C.6		5.2	11.26 in. or 286 mm
9	Body/end connector material designation ^{a, f}		6.1	Material grade
10	Trim identification ^g : material grade symbols indicating metallic materials for stem, sealing faces of closure members, non-metallic seat to closure member seal materials		6.1	Stem 13Cr; Disc 13Cr; Seat 13Cr/PEEK; Seals FKM
11a	Nominal valve size ^b	Full-opening valves: nominal valve size	4.4.2	8 or DN 200
11b		Reduced-opening valves ^d	4.4.3	8 × 6 or DN 200 × 150 or 8R x bore or DN 200R x bore
11c		Non-standard opening valves	4.4.4 K.3.2	8R (DN200R)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

12	Supplemental double block or isolation tests (if applicable)	L.9, L.10, or L.11	DBB, DIB-1, or DIB-2
13	QSL, when specified	Annex I	QSL1, QSL1G, QSL2 or QSL2G
14	Maximum water depth	5.4.6.6	5000 feet; 1000 m

FOOTNOTES

- ^a Shall be on *either* the body or the nameplate, at a minimum; may be on both.
- ^b Shall be on *both* the body and the nameplate.
- ^c Additional use of trademark/brand names with the manufacturer's name is optional.
- ^d Bore may be marked in in. or (mm).
- ^e No specific document reference identified.
- ^f When the body is manufactured from more than one type of material, all materials of the body and end connector shall be identified.
- ^g MSS SP-25 gives guidance on marking.

12.3.2 Each valve shall be provided with an austenitic stainless steel nameplate securely affixed and so located that it is easily accessible.

12.3.3 The nameplate shall be securely affixed to the valve body; however, based on valve design, the nameplate may be attached to the bonnet/cover or end connector at the option of the manufacturer.

12.3.4 For NPS 2 (DN 50) valve size, the use of braided corrosion-resistant wire to securely affix the nameplate, shall be permitted.

12.3.5 The marking on nameplate shall be visually legible.

12.3.6 The nameplate minimum letter size shall be 0.125 in (3 mm).

12.3.7 For non-standard valves, the nominal size and face-to-face or end-to-end dimensions shall be stated on the nameplate; see 5.5.2.

12.3.8 The manufacturer's name, including country, shall be as defined in 3.1.21.

12.4 Supplemental Requirements

12.1 For valves with one unidirectional (single piston effect/self-relieving) seat and one bidirectional (double piston effect) seat, the directions of both seats shall be specified on a separate identification plate as illustrated in Figure 5.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

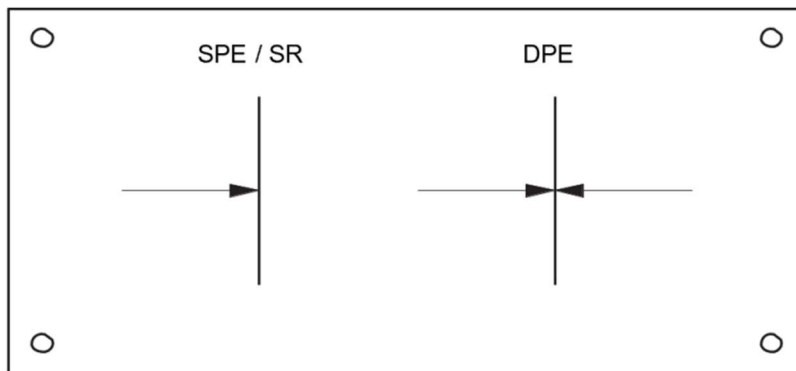


Figure 5—Typical Identification Plate for a Valve with One Seat Unidirectional and One Seat Bidirectional

NOTE In Figure 5, one symbol indicates the unidirectional (single piston effect/self-relieving) seat and the other symbol indicates the bidirectional (double piston effect) seat.

12.2 Each flange/weld end connector shall be marked/stamped with “SPE / SR” on the side that contains a unidirectional (single piston effect/self-relieving) seat and with “DPE” on the side that contains a bidirectional (double piston effect) seat.

13 Draining, Protection, and Preparation for Transport

13.1 Draining

13.1.1 Upon completion of all factory acceptance testing, valves shall be drained of test fluids, dried, and lubricated in conformance with the manufacturer's documented requirements before shipment.

13.2 Protection

13.2.1 The manufacturer shall have documented procedures to address the following:

- a) Corrosion protection using the manufacturer's documented requirements on bare metallic machined surfaces, such as flange faces, weld bevel ends, exposed stems, and internal surfaces of the equipment.
- b) Corrosion protection applied to flange faces, weld bevel ends, and all accessible internal surfaces of the equipment of steels with less than 15 % chromium.
- c) Corrosion protection provided by a corrosion inhibitor having a runoff temperature of minimum 93 °C (200 °F).

CAUTION Failure to remove a corrosion inhibitor on a stem prior to operating the valve can damage stem seals.

- d) Valve end connector shall be covered or plugged to protect the sealing surfaces, threads, weld-end and valve internals from damage.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- e) Protective covers made of wood or wood fiber shall be fitted with a nonporous moisture barrier between the cover and the metal flange or weld-end.
- f) The protective covers shall be securely affixed to the valve.
- g) The design of the covers shall prevent the valves from being installed unless the covers have been removed.

13.3 Preparation for Transport

13.3.1 The manufacturer shall have documented procedures to address the following requirements:

- a) closure member position for transport;
- b) storage;
- c) Exposed seals shall be protected from mechanical damage during storage and shipping.

13.3.2 Check valves shall be shipped with the closure member secured or supported during transport.

13.3.3 A warning label shall be attached to the protective cover with instructions to remove prior to installation, material from inside the valve that secures or supports the disclosure member.

14 Documentation

14.1 Minimum Documentation and Retention

14.1.1 The documentation listed below shall be retained by the manufacturer for a minimum of 10 years following the date of manufacture:

- a) design documentation;
- b) weld procedure specification (WPS);
- c) weld procedure qualification record (PQR);
- d) welder performance qualification (WPQ);
- e) qualification records of NDE personnel;
- f) records of test equipment calibration;
- g) NDE records (for RT, minimum NDE records are reader sheets and technique sheet)—MT, PT, and UT;
- h) production hardness test;

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- i) visual inspection records;
- j) FAT reports(including hydrostatic and gas) and charts/digital recording as applicable;
- k) chloride content in the hydrostatic test water (see 10.1.3);
- l) material test report for body, bonnet/cover(s), and end connector(s)/closure(s) traceable to the unique valve serial number as well material test reports for stems;
- m) weld repair maps for major weld repair of castings;
- n) valve assembly serial number traceable to the following information;
 - 1) material test report for body, bonnet/cover, stem and end connector, and additional related requirements of Annex I
 - 2) pressure test results (including hydrostatic and gas) and additional related requirements of Annex I
 - 3) certificate of conformance to NACE MR0175 or ISO 15156 (all parts) for sour service valves.

NOTE Purchaser or regulatory requirements can specify a longer record retention period.

14.1.2 The documentation provided by the manufacturer shall be in legible, retrievable, and reproducible form and free of damage.

14.2 Documentation Provided with the Valve

14.2.1 General

14.2.1.1 The documentation listed below shall be supplied by the manufacturer with each valve.

- a) Lifting sketches and safe handling instructions (see 5.18) for valves weighing greater than 25 kg (55 lbs).
- b) Test report (including pressure, test duration, leakage rate, ROT input torque/thrust, and test medium) together with pressure test charts/digital recording.
- c) Coating/plating certification.
- d) Material test reports for pressure-containing and pressure-controlling parts.
- e) Statement of quality level (QL) to NDE and applicable records (see Annex K).
- f) Certificate stating the maximum allowable torque/thrust value for the drive train (ball, gate, and plug valves only), if applicable.
- g) Installation, operation, and maintenance instructions/manuals for valve and operator.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

h) General arrangement drawings including if a pressure balance hole is present.

14.2.2 Certificate of Conformance

14.2.2.1 The manufacturer shall supply a certificate of conformance to this specification.

14.2.2.2 The certificate shall identify the following:

- a) valve type (axial, ball, check or gate);
- b) size;
- c) pressure class;
- d) pressure-temperature rating
- e) end connector(s);
- f) serial number(s);
- g) additional requirements when specified by the manufacturer or purchaser in Annex F, Annex I, Annex J, Annex K, Annex L;
- h) a statement that the valve is in conformance with this product specification edition and addenda on the date of manufacture;
- i) design code for pressure-containing parts and pressure-boundary bolting (see 5.1.1);
- j) code used for pressure-temperature rating (see 4.3).
- k) If the valve manufacturer supplies the valve with an actuator, a certificate of conformance to API 6DSSX shall be provided.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex A
(informative)

Use of API Monogram by Licensees

The information in this annex has been intentionally removed.

See API Specification Q1 (Annex A), or the API website for information pertaining to the API Monogram Program and use of the API Monogram on applicable products.

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex B (informative)

Hyperbaric Validation

B.1 General

- B.1.1 This annex provides hyperbaric (external pressure) test procedures and requirements to validate designs in subsea conditions for valves and operators identified in this specification, which shall be applied if specified by the manufacturer or purchaser.
- B.1.2 The type of assembly to be tested (valve only, or valve and operator complete assembly) shall be specified by the purchaser.
- B.1.3 Valve or assemblies shall be tested in hyperbaric conditions at a minimum external pressure equivalent to 1.1 times the design water depth.

B.2 Minimum Design Validation Test Requirements

B.2.1 General

- B.2.1.1 FEA shall be performed prior to validation testing in order to demonstrate that the valve and any pressure-containing mounting spools have the capability to withstand the proposed external test pressure without failure.
- B.2.1.2 The manufacturer shall document the results of the FEA.
- B.2.1.3 Components that are pressure compensated shall not require FEA or pressure testing.
- B.2.1.4 If applicable, the proper functionality of the compensation system shall be evaluated during the validation.
- B.2.1.5 The hyperbaric validation procedure shall include, as a minimum, the tests specified in Table H.1.

Table B.1—Hyperbaric Validation Test

Valve Type	Hyperbaric Ingress Test ^a	Shell Test per 10.3 ^a	Seat Test per 10.5 ^a	Hyperbaric Endurance Test ^b
Axial on-off Ball Gate	B.2.2.2 Step 1	B.2.2.2 Step 2	B.2.2.2 Step 3	B.2.2.2 Step 4 200 dynamic cycles with an external operator
Check	B.2.2.2 Step 1	B.2.2.2 Step 2	B.2.2.2 Step 3	B.2.2.2 Step 4 20 dynamic cycles with an external operator. N/A for check valve without an external operator

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

a Applicable to valve only. b Applicable to valve and operator.				

B.2.2 Hyperbaric Validation Tests

B.2.2.1 Prior to Test

- B.2.2.1.1 Before starting with the validation tests, the following preliminary activities shall be performed.
- a) Hyperbaric chamber shall be at atmospheric pressure and the valve placed into the hyperbaric chamber.
 - b) The valve ends shall be closed, and all test connections shall be in place
 - c) All the test ports shall be connected to the relative pipes and they shall be filled with test fluid.
 - d) With the valve in half open position, all air shall be removed from the valve internal cavity and then filled with test fluid.
 - e) During this operation the hyperbaric chamber shall not be pressurized.
 - f) Perform a hydrostatic shell test at 1.5 times the maximum rating pressure to check all the connection sealing behaviors.
 - g) The test shall be performed with the valve unseated and partially open and may also be performed with the valve fully open, provided the body cavity is simultaneously filled and pressurized through a cavity connection.
 - h) The minimum holding time shall be 15 minutes.
 - i) The pressure shall be monitored.
 - j) Acceptance criteria shall be no pressure drop during this test.
 - k) Release pressure in the valve cavity to atmosphere.
 - l) Fill the hyperbaric chamber with test fluid.
 - m) Apply 5 % to 10 % of the design water depth pressure for 15 minutes. This pressure shall be applied to the valve cavity prior to start of any hyperbaric test.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- n) Relieve the pressure to the atmosphere.

B.2.2.2 Hyperbaric Testing

B.2.2.2.1 General

B.2.2.2.1.1 Hyperbaric testing shall consist of the following steps.

B.2.2.2.2 Step 1—Hyperbaric Ingress Test

B.2.2.2.2.1 Requirements

- a) The hyperbaric ingress test shall be conducted on valves only.
- b) Test shall be completed using one of the following methods:
 - 1) Method 1.
 - i. With the valve in half open position and filled with test fluid, pressurize the hyperbaric chamber with a pressure equal to 1.1 times the design water depth .
 - ii. The valve cavity pressure shall be at atmospheric pressure.
 - iii. The test pressure shall be held for a of 2 hours.
 - iv. Valve internal pressure shall be monitored.
 - 2) Method 2.
 - i. If the valve is equipped with a test port outside the primary external pressure gasket/seal, the test port shall be filled with test fluid and monitored for leakage.
 - ii. The test pressure shall be held for a minimum of 2 hours

B.2.2.2.2.2 Acceptance Criteria

- 1) Method 1. Any increase in the valve internal pressure that cannot be justified by temperature fluctuations shall be cause for rejection.
- 2) Method 2. No visible leakage from any of the test ports.

B.2.2.2.3 Step 2—Hydrostatic Shell Test in Hyperbaric Conditions

B.2.2.2.3.1 Requirements

- a) Test shall be completed using one of the following methods:
 - 1) Method 1.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- i. Perform a hydrostatic shell test with pressures conforming to 10.3 (see Table H.1), with external hyperbaric pressure equal to 1.1 times the design water depth applied.
- ii. The minimum test duration shall be 15 minutes.
- iii. The test pressure in the valve cavity shall be at least 1.1 times the valve maximum rating pressure.
- iv. Valve internal pressure shall be monitored.

2) Method 2.

- i. If the valve is equipped with a test port outside the primary external pressure gasket/seal, the test port shall be filled with test fluid and monitored for leakage.
- ii. The minimum test duration shall be 2 hours.

B.2.2.2.3.2 Acceptance Criteria

- 1) Method 1. The valve internal pressure change is less than 3 % per hour of the test pressure.
- 2) Method 2. No visible leakage from the test ports.

B.2.2.2.4 Step 3—Hydrostatic Seat Test

B.2.2.2.4.1 Requirements

- a) Perform three hydrostatic seat tests with pressures conforming to 10.5 (see Table H.1), with external hyperbaric pressure equal to 1.1 times the design water depth applied.
- b) The minimum test duration shall be 15 minutes for each test.
- c) Reduce pressure to zero after each test.
- d) Valves with bidirectional sealing seat shall be tested in both sealing directions.
- e) Three seat tests are required for each sealing direction.
- f) The minimum test duration shall be 15 minutes for each test.
- g) Reduce pressure to zero after each test.

B.2.2.2.4.2 Acceptance Criteria

- a) The hydrostatic seat test acceptance criteria shall conform to 10.5.3.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

B.2.2.2.5 Step 4—Hyperbaric Endurance Test

B.2.2.2.5.1 Requirements

- a) The endurance test consists of operating the valve for a number of cycles as specified in Table H.1, while subjected to the differential pressure specified in 5.5 and with external hyperbaric pressure equal to 1.1 times the design water depth applied.
- b) The opening torque or force to operate the valve shall be monitored and recorded (starting from the first cycle) and at every 10 cycles, thereafter.
- c) If the valve is operated by an actuator with an ROT interface, then 10 % of the cycles shall be performed using the ROT interface.
- d) A hyperbaric endurance test shall be conducted on all the valve types, except for the check valve without an external operator.
- e) For the check valve provided with an external operator, the procedure in H.2.2.2.5.1 is applicable, but the valve is operated without differential pressure across its closure member.

B.2.2.2.5.2 Acceptance Criteria

- a) The forces or torques shall be within the manufacturer's specifications.
- b) If the valve is operated by a spring-return hydraulic actuator, the minimum hydraulic pressure in the cylinder during the fail-position (i.e. fail open, fail last, fail closed) function shall be a minimum of 100 psi (0.69 MPa) above the hyperbaric pressure, and with atmospheric pressure in the valve body cavity.

B.2.2.2.6 Step 5—Hydrostatic Shell at Ambient Condition

B.2.2.2.5.3 Requirements

- a) For valves only, perform a single internal hydrostatic shell conforming to 10.3.
- b) The minimum test duration shall be 15 minutes.
- c) The test shall be performed after all hyperbaric functional cycles have been completed and hyperbaric conditions depressurized to atmospheric pressure.

B.2.2.2.5.4 Acceptance Criteria

The hydrostatic shell test acceptance criteria for shall conform to 10.3.

B.2.2.2.7 Step 6—Hydrostatic Seat Test at Ambient Condition

B.2.2.2.7.1 Requirements

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- a) For valves only, perform a single internal hydrostatic seat test conforming to 10.5
- b) The minimum test duration shall be 15 minutes.

B.2.2.2.7.2 Acceptance Criteria

The hydrostatic seat test acceptance criteria shall conform to 10.5.3.

B.2.2.2.8 Step 7—Valve Disassembly and Visual Inspection

B.2.2.2.8.1 Requirements

- a) The tested valve shall be disassembled and visually inspected
- b) If the valve disassembly is not practical, then the disassembly and inspection shall be done by manufacturers standard procedure.
- c) The examination shall be performed to ensure that neither the valve nor the component design contains defects to the extent that any performance requirement cannot be met. The results of the examination shall be documented.

B.3 Scaling

- B.3.1 For a given test valve used, scaling shall be permitted to validate valves of the same family within the same pressure class for shallower water depth.
- B.3.2 Testing of one size of a valve family shall validate products as follows:
 - a) one nominal size larger and one nominal size smaller than the tested size for valve sizes up to and including NPS 12 (DN 300) at the closure member,
 - b) two nominal sizes larger and two nominal sizes smaller than the tested size for valve sizes NPS 14 (DN 350) and above at the closure member.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex C (normative)

Valve End-to-End and Face-to-Face Dimensions

NOTE This annex shows valve end-to-end and face-to-face dimensions for gate, plug, ball, and check valves with (A) raised face flange, (B) weld-end, and (C) ring joint flange end connections.

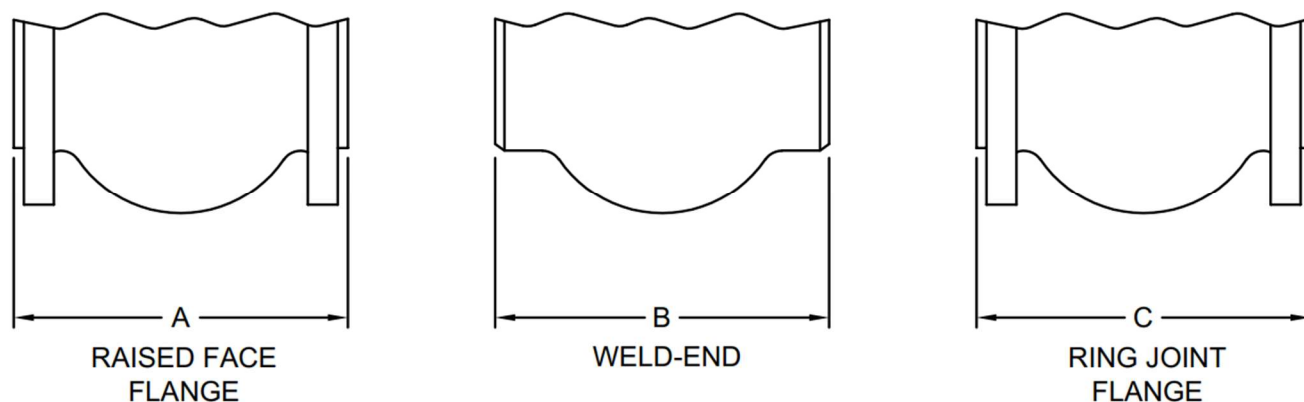


Figure C.1—Face-to-Face and End-to-End Reference Dimensions, A, B, and C

Table C.1—Axial Valves—Face-to-face (A) and End-to-end (B and C) Dimensions

Table C.2—Ball Valves—Side-Entry and Top Entry, Face-to-face (A), and End-to-end (B and C) Dimensions

Table C.3—Check Valves (Full Opening and Reduced Types)—Face-to-face (A) and End-to-end (B and C) Dimensions

Table C.4—Check Valves (Single- and Dual-plate, Long- and Short-pattern, Wafer-type, and Double Flanged)—Face-to-face Dimensions

Table C.5—Gate Valves—Face-to-face (A) and End-to-end (B and C) Dimensions

Table C.1—Axial Valves—Face-to-face (A) and End-to-end (B and C) Dimensions

Dimensions in inches (millimeters)							
NPS	DN	Raised Face	Weld End	Ring Joint	Raised Face	Weld End	Ring Joint
		A	B	C	A	B	C
		Class 150			Class 300		
2	50	11.50 (292)	—	—	11.50 (292)	—	11.63 (295)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

2½	65	—	—	—	—	—	—
3	80	14.00 (356)	14.00 (356)	—	14.00 (356)	14.00 (356)	14.13 (359)
4	100	17.00 (432)	17.00 (432)	—	17.00 (432)	17.00 (432)	17.13 (435)
6	150	22.00 (559)	22.00 (559)	—	22.00 (559)	22.00 (559)	22.13 (562)
8	200	26.00 (660)	26.00 (660)	—	26.00 (660)	26.00 (660)	26.13 (664)
10	250	21.00 (533)	22.00 (559)	—	22.38 (568)	22.00 (559)	23.00 (584)
12	300	24.00 (610)	25.00 (635)	—	25.50 (648)	25.00 (635)	26.13 (664)
14	350	27.00 (686)	30.00 (762)	—	30.00 (762)	30.00 (762)	30.63 (778)
16	400	30.00 (762)	33.00 (838)	—	33.00 (838)	33.00 (838)	33.63 (854)
18	450	34.00 (864)	36.00 (914)	—	36.00 (914)	36.00 (914)	36.63 (930)
20	500	36.00 (914)	39.00 (991)	—	39.00 (991)	39.00 (991)	39.75 (1010)
22	550	—	—	—	—	—	—
24	600	42.00 (1067)	45.00 (1143)	—	45.00 (1143)	45.00 (1143)	45.88 (1165)
26	650	—	—	—	—	—	—
28	700	49.00 (1245)	53.00 (1346)	—	53.00 (1346)	53.00 (1346)	54.00 (1372)
30	750	51.00 (1295)	55.00 (1397)	—	55.00 (1397)	55.00 (1397)	56.00 (1422)
32	800	54.00 (1372)	60.00 (1524)	—	60.00 (1524)	60.00 (1524)	61.13 (1553)
34	850	—	—	—	—	—	—
36	900	60.00 (1524)	68.00 (1727)	—	68.00 (1727)	68.00 (1727)	69.13 (1756)
38	950	—	—	—	—	—	—
40	1000	66.00 (1676)	73.60 (1870)	—	73.60 (1870)	73.60 (1870)	—
42	1100	69.00 (1753)	77.00 (1956)	—	77.00 (1956)	77.00 (1956)	—
48	1200	78.00 (1981)	87.25 (2216)	—	87.25 (2216)	87.25 (2216)	—

Table C.1— Axial Valves—Face-to-face (A) and End-to-end (B and C) Dimensions (continued)

Dimensions in inches (millimeters)

NPS	DN	Raised Face	Weld End	Ring Joint	Raised Face	Weld End	Ring Joint
		A	B	C	A	B	C
		Class 600			Class 900		

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

2	50	11.50 (292)	—	11.63 (295)	14.50 (368)	—	14.63 (371)
2½	65	—	—	—	—	—	—
3	80	14.00 (356)	14.00 (356)	14.13 (359)	15.00 (381)	15.00 (381)	15.13 (384)
4	100	17.00 (432)	17.00 (432)	17.13 (435)	18.00 (457)	18.00 (457)	18.13 (460)
6	150	22.00 (559)	22.00 (559)	22.13 (562)	24.00 (610)	24.00 (610)	24.13 (613)
8	200	26.00 (660)	26.00 (660)	26.13 (664)	29.00 (737)	29.00 (737)	29.13 (740)
10	250	31.00 (787)	31.00 (787)	31.13 (791)	33.00 (838)	33.00 (838)	33.13 (841)
12	300	33.00 (838)	33.00 (838)	33.13 (841)	38.00 (965)	38.00 (965)	38.13 (968)
14	350	35.00 (889)	35.00 (889)	35.13 (892)	40.50 (1029)	40.50 (1029)	40.88 (1038)
16	400	39.00 (991)	39.00 (991)	39.13 (994)	44.50 (1130)	44.50 (1130)	44.88 (1140)
18	450	43.00 (1092)	43.00 (1092)	43.13 (1095)	48.00 (1219)	48.00 (1219)	48.50 (1232)
20	500	47.00 (1194)	47.00 (1194)	47.25 (1200)	52.00 (1321)	52.00 (1321)	52.50 (1334)
22	550	—	—	—	—	—	—
24	600	55.00 (1397)	55.00 (1397)	55.38 (1407)	61.00 (1549)	61.00 (1549)	61.75 (1568)
26	650	—	—	—	—	—	—
28	700	61.00 (1549)	61.00 (1549)	61.50 (1562)	69.00 (1753)	69.00 (1753)	69.88 (1775)
30	750	65.00 (1651)	65.00 (1651)	65.50 (1664)	73.00 (1854)	73.00 (1854)	73.88 (1876)
32	800	70.00 (1778)	70.00 (1778)	70.63 (1794)	77.13 (1959)	77.13 (1959)	78.00 (1981)
34	850	—	—	—	—	—	—
36	900	82.00 (2083)	82.00 (2083)	82.63 (2099)	85.25 (2165)	85.25 (2165)	86.38 (2194)
38	950	—	—	—	—	—	—
40	1000	92.00 (2337)	77.00 (1956)	—	93.50 (2375)	93.50 (2375)	—
42	1100	97.25 (2470)	82.30 (2091)	—	97.65 (2480)	97.65 (2480)	—
48	1200	112.85 (2867)	91.60 (2327)	—	109.88 (2791)	109.88 (2791)	—

Table C.1—Axial On-off Valves—Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions
Dimensions in inches (millimeters)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NPS	DN	Raised Face A	Welding End B	Ring Joint C	Raised Face A	Welding End B	Ring Joint C
		Class 1500			Class 2500		
2	50	14.50 (368)	—	14.63 (371)	17.75 (451)	—	17.88 (454)
2 ¹ / ₂	65	—	—	—	—	—	—
3	80	18.50 (470)	15.00 (381)	18.63 (473)	22.75 (578)	16.55 (420)	23.00 (584)
4	100	21.50 (546)	18.00 (457)	21.63 (549)	26.50 (673)	18.00 (457)	26.88 (683)
6	150	27.75 (705)	24.00 (610)	28.00 (711)	36.00 (914)	24.00 (610)	36.50 (927)
8	200	32.75 (832)	29.00 (737)	33.13 (841)	40.25 (1022)	29.00 (737)	40.88 (1038)
10	250	39.00 (991)	33.00 (838)	39.38 (1000)	50.00 (1270)	33.00 (838)	50.88 (1292)
12	300	44.50 (1130)	38.00 (965)	45.13 (1146)	56.00 (1422)	38.00 (965)	56.88 (1445)
14	350	49.50 (1257)	40.50 (1029)	50.25 (1276)	62.75 (1594)	40.50 (1029)	—
16	400	54.50 (1384)	44.50 (1130)	55.38 (1407)	70.00 (1778)	44.50 (1130)	—
18	450	60.12 (1527)	48.00 (1219)	61.00 (1549)	—	—	—
20	500	65.50 (1664)	52.00 (1321)	66.38 (1686)	—	—	—
22	550	—	—	—	—	—	—
24	600	76.26 (1937)	61.00 (1549)	77.36 (1965)	—	—	—
26	650	—	—	—	—	—	—
28	700	—	—	—	—	—	—
30	750	—	—	—	—	—	—
32	800	—	—	—	—	—	—
34	850	—	—	—	—	—	—
36	900	—	—	—	—	—	—
38	950	—	—	—	—	—	—
40	1000	—	—	—	—	—	—
42	1050	—	—	—	—	—	—
48	1200	—	—	—	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.2—Ball Valves (Side Entry Only)—Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions

Dimensions in inches (millimeters)

NPS	DN	Full Bore and Reduced Bore			Short Pattern, Full Bore, and Reduced Bore		
		Raised Face	Welding End	Ring Joint	Raised Face	Welding End	Ring Joint
		C			C		
Class 150							
2	50	7.00 (178)	8.50 (216)	7.50 (191)	—	—	—
2½	65	7.50 (191)	9.50 (241)	8.00 (203)	—	—	—
3	80	8.00 (203)	11.13 (283)	8.50 (216)	—	—	—
4	100	9.00 (229)	12.00 (305)	9.50 (241)	—	—	—
6	150	15.50 (394)	18.00 (457)	16.00 (406)	10.50 (267)	15.88 (403)	11.00 (279)
8	200	18.00 (457)	20.50 (521)	18.50 (470)	11.50 (292)	16.50 (419)	12.00 (305)
10	250	21.00 (533)	22.00 (559)	21.50 (546)	13.00 (330)	18.00 (457)	13.50 (343)
12	300	24.00 (610)	25.00 (635)	24.50 (622)	14.00 (356)	19.75 (502)	14.50 (368)
14	350	27.00 (686)	30.00 (762)	27.50 (699)	—	—	—
16	400	30.00 (762)	33.00 (838)	30.50 (775)	—	—	—
18	450	34.00 (864)	36.00 (914)	34.50 (876)	—	—	—
20	500	36 (914)	39 (991)	36.5 (927)	—	—	—
22	550	—	—	—	—	—	—
24	600	42.00 (1067)	45.00 (1143)	42.50 (1080)	—	—	—
26	650	45.00 (1143)	49.00 (1245)	—	—	—	—
28	700	49.00 (1245)	53.00 (1346)	—	—	—	—
30	750	51.00 (1295)	55.00 (1397)	—	—	—	—
32	800	54.00 (1372)	60.00 (1524)	—	—	—	—
34	850	58.00 (1473)	64.00 (1626)	—	—	—	—
36	900	60.00 (1524)	68.00 (1727)	—	—	—	—
38	950	—	—	—	—	—	—
40	1000	—	—	—	—	—	—
42	1100	—	—	—	—	—	—
48	1200	—	—	—	—	—	—
54	1400	—	—	—	—	—	—
60	1500	—	—	—	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.2—Ball Valves (Side Entry Only)—Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions (Continued)

Dimensions in inches (millimeters)

NPS	DN	Full Bore and Reduced Bore			Short Pattern, Full Bore, and Reduced Bore		
		Raised Face	Welding End	Ring Joint	Raised Face	Welding End	Ring Joint
				C			C
Class 300							
2	50	8.50 (216)	8.50 (216)	9.13 (232)	—	—	—
2½	65	9.50 (241)	9.50 (241)	10.13 (257)	—	—	—
3	80	11.13 (283)	11.13 (283)	11.75 (298)	—	—	—
4	100	12.00 (305)	12.00 (305)	12.63 (321)	—	—	—
6	150	15.88 (403)	18.00 (457)	16.50 (419)	—	—	—
8	200	19.75 (502)	20.50 (521)	20.38 (518)	16.50 (419)	16.50 (419)	17.13 (435)
10	250	22.38 (568)	22.00 (559)	23.00 (584)	18.00 (457)	18.00 (457)	18.63 (473)
12	300	25.50 (648)	25.00 (635)	26.13 (664)	19.75 (502)	19.75 (502)	20.38 (518)
14	350	30.00 (762)	30.00 (762)	30.63 (778)	—	—	—
16	400	33.00 (838)	33.00 (838)	33.63 (854)	—	—	—
18	450	36.00 (914)	36.00 (914)	36.63 (930)	—	—	—
20	500	39.00 (991)	39.00 (991)	39.75 (1010)	—	—	—
22	550	43.00 (1092)	43.00 (1092)	43.88 (1114)	—	—	—
24	600	45.00 (1143)	45.00 (1143)	45.88 (1165)	—	—	—
26	650	49.00 (1245)	49.00 (1245)	50.00 (1270)	—	—	—
28	700	53.00 (1346)	53.00 (1346)	54.00 (1372)	—	—	—
30	750	55.00 (1397)	55.00 (1397)	56.00 (1422)	—	—	—
32	800	60.00 (1524)	60.00 (1524)	61.13 (1553)	—	—	—
34	850	64.00 (1626)	64.00 (1626)	65.13 (1654)	—	—	—
36	900	68.00 (1727)	68.00 (1727)	69.13 (1756)	—	—	—
38	950	—	—	—	—	—	—
40	1000	—	—	—	—	—	—
42	1100	—	—	—	—	—	—
48	1200	—	—	—	—	—	—
54	1400	—	—	—	—	—	—
60	1500	—	—	—	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.2—Ball Valves (Side Entry and Top Entry)—Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions (Continued)

Dimensions in inches (millimeters)

NPS	DN	Full Bore and Reduced Bore			Full Bore and Reduced Bore		
		Raised Face	Welding End	Ring Joint	Raised Face	Welding End	Ring Joint
		C			C		
Class 600			Class 900				
2	50	11.50 (292)	11.50 (292)	11.63 (295)	14.50 (368)	14.50 (368)	14.63 (371)
2½	65	13.00 (330)	13.00 (330)	13.13 (333)	16.50 (419)	16.50 (419)	16.63 (422)
3	80	14.00 (356)	14.00 (356)	14.13 (359)	15.00 (381)	15.00 (381)	15.13 (384)
4	100	17.00 (432)	17.00 (432)	17.13 (435)	18.00 (457)	18.00 (457)	18.13 (460)
6	150	22.00 (559)	22.00 (559)	22.13 (562)	24.00 (610)	24.00 (610)	24.13 (613)
8	200	26.00 (660)	26.00 (660)	26.13 (664)	29.00 (737)	29.00 (737)	29.13 (740)
10	250	31.00 (787)	31.00 (787)	31.13 (791)	33.00 (838)	33.00 (838)	33.13 (841)
12	300	33.00 (838)	33.00 (838)	33.13 (841)	38.00 (965)	38.00 (965)	38.13 (968)
14	350	35.00 (889)	35.00 (889)	35.13 (892)	40.50 (1029)	40.50 (1029)	40.88 (1038)
16	400	39.00 (991)	39.00 (991)	39.13 (994)	44.50 (1130)	44.50 (1130)	44.88 (1140)
18	450	43.00 (1092)	43.00 (1092)	43.13 (1095)	48.00 (1219)	48.00 (1219)	48.50 (1232)
20	500	47.00 (1194)	47.00 (1194)	47.25 (1200)	52.00 (1321)	52.00 (1321)	52.50 (1334)
22	550	51.00 (1295)	51.00 (1295)	51.38 (1305)	—	—	—
24	600	55.00 (1397)	55.00 (1397)	55.38 (1407)	61.00 (1549)	61.00 (1549)	61.75 (1568)
26	650	57.00 (1448)	57.00 (1448)	57.50 (1461)	65.00 (1651)	—	65.88 (1673)
28	700	61.00 (1549)	61.00 (1549)	61.50 (1562)	—	—	—
30	750	65.00 (1651)	65.00 (1651)	65.50 (1664)	74.00 (1880)	—	74.88 (1902)
32	800	70.00 (1778)	70.00 (1778)	70.63 (1794)	—	—	—
34	850	76.00 (1930)	76.00 (1930)	76.63 (1946)	—	—	—
36	900	82.00 (2083)	82.00 (2083)	82.63 (2099)	90.00 (2286)	—	91.13 (2315)
38	950	—	—	—	—	—	—
40	1000	—	—	—	—	—	—
42	1100	—	—	—	—	—	—
48	1200	—	—	—	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.2—Ball Valves (Side Entry and Top Entry)—Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions (Continued)

Dimensions in inches (millimeters)

NPS	DN	Full Bore and Reduced Bore			Full Bore and Reduced Bore		
		Raised Face A	Welding End B	Ring Joint C	Raised Face A	Welding End B	Ring Joint C
		Class 1500			Class 2500		
2	50	14.50 (368)	14.50 (368)	14.63 (371)	17.75 (451)	17.75 (451)	17.88 (454)
2½	65	16.50 (419)	16.50 (419)	16.63 (422)	20.00 (508)	20.00 (508)	20.25 (514)
3	80	18.50 (470)	18.50 (470)	18.63 (473)	22.75 (578)	22.75 (578)	23.00 (584)
4	100	21.50 (546)	21.50 (546)	21.63 (549)	26.50 (673)	26.50 (673)	26.88 (683)
6	150	27.75 (705)	27.75 (705)	28.00 (711)	36.00 (914)	36.00 (914)	36.50 (927)
8	200	32.75 (832)	32.75 (832)	33.13 (841)	40.25 (1022)	40.25 (1022)	40.88 (1038)
10	250	39.00 (991)	39.00 (991)	39.38 (1000)	50.00 (1270)	50.00 (1270)	50.88 (1292)
12	300	44.50 (1130)	44.50 (1130)	45.13 (1146)	56.00 (1422)	56.00 (1422)	56.88 (1445)
14	350	49.50 (1257)	49.50 (1257)	50.25 (1276)	—	—	—
16	400	54.50 (1384)	54.50 (1384)	55.38 (1407)	—	—	—
18	450	60.50 (1537)	—	61.38 (1559)	—	—	—
20	500	65.50 (1664)	—	66.38 (1686)	—	—	—
22	550	—	—	—	—	—	—
24	600	—	—	77.63 (1972)	—	—	—
26	650	76.50 (1943)	—	—	—	—	—
28	700	—	—	—	—	—	—
30	750	—	—	—	—	—	—
32	800	—	—	—	—	—	—
34	850	—	—	—	—	—	—
36	900	—	—	—	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.2—Ball Valves (Top-Entry)—Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions (continued)

Dimensions in inches (millimeters)

NPS	DN	Full Bore, and Reduced Bore		
		Raised Face <i>A</i>	Weld End <i>B</i>	Ring Joint <i>C</i>
		Class 150 and Class 300		
2	50	11.50 (292)	11.50 (292)	11.63 (295)
2 1/2	65	13.00 (330)	13.00 (330)	13.13 (333)
3	80	14.00 (356)	14.00 (356)	14.13 (359)
4	100	17.00 (432)	17.00 (432)	17.13 (435)
6	150	22.00 (559)	22.00 (559)	22.13 (562)
8	200	26.00 (660)	26.00 (660)	26.13 (664)
10	250	31.00 (787)	31.00 (787)	31.13 (791)
12	300	33.00 (838)	33.00 (838)	33.13 (841)
14	350	35.00 (889)	35.00 (889)	35.13 (892)
16	400	39.00 (991)	39.00 (991)	39.13 (994)
18	450	43.00 (1092)	43.00 (1092)	43.13 (1095)
20	500	47.00 (1194)	47.00 (1194)	47.25 (1200)
22	550	51.00 (1295)	51.00 (1295)	51.38 (1305)
24	600	55.00 (1397)	55.00 (1397)	55.38 (1407)
26	650	57.00 (1448)	57.00 (1448)	57.50 (1461)
28	700	61.00 (1549)	61.00 (1549)	61.50 (1562)
30	750	65.00 (1651)	65.00 (1651)	65.50 (1664)
32	800	70.00 (1778)	70.00 (1778)	70.63 (1794)
34	850	76.00 (1930)	76.00 (1930)	76.63 (1946)
36	900	82.00 (2083)	82.00 (2083)	82.63 (2099)

Table C.3—Check Valves and Axial Check Valves, Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions

Dimensions in inches (millimeters)

NPS	DN	Class 150			Class 300		
		Raised Face	Welding End	Ring Joint <i>C</i>	Raised Face	Welding End	Ring Joint <i>C</i>
2	50	8.00 (203)	8.00 (203)	8.50 (216)	10.50 (267)	10.50 (267)	11.13 (283)
2 1/2	65	8.50 (216)	8.50 (216)	9.00 (229)	11.50 (292)	11.50 (292)	12.13 (308)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

3	80	9.50 (241)	9.50 (241)	10.00 (254)	12.50 (318)	12.50 (318)	13.13 (333)
4	100	11.50 (292)	11.50 (292)	12.00 (305)	14.00 (356)	14.00 (356)	14.63 (371)
6	150	14.00 (356)	14.00 (356)	14.50 (368)	17.50 (445)	17.50 (445)	18.13 (460)
8	200	19.50 (495)	19.50 (495)	20.00 (508)	21.00 (533)	21.00 (533)	21.63 (549)
10	250	24.50 (622)	24.50 (622)	25.00 (635)	24.50 (622)	24.50 (622)	25.13 (638)
12	300	27.50 (699)	27.50 (699)	28.00 (711)	28.00 (711)	28.00 (711)	28.63 (727)
14	350	31.00 (787)	31.00 (787)	31.50 (800)	33.00 (838)	33.00 (838)	33.63 (854)
16	400	34.00 (864)	34.00 (864)	34.50 (876)	34.00 (864)	34.00 (864)	34.63 (879)
18	450	38.50 (978)	38.50 (978)	39.00 (991)	38.50 (978)	38.50 (978)	39.13 (994)
20	500	38.50 (978)	38.50 (978)	39.00 (991)	40.00 (1016)	40.00 (1016)	40.75 (1035)
22	550	42.00 (1067)	42.00 (1067)	42.50 (1080)	44.00 (1118)	44.00 (1118)	44.88 (1140)
24	600	51.00 (1295)	51.00 (1295)	51.50 (1308)	53.00 (1346)	53.00 (1346)	53.88 (1368)
26	650	51.00 (1295)	51.00 (1295)	—	53.00 (1346)	53.00 (1346)	54.00 (1372)
28	700	57.00 (1448)	57.00 (1448)	—	59.00 (1499)	59.00 (1499)	60.00 (1524)
30	750	60.00 (1524)	60.00 (1524)	—	62.75 (1594)	62.75 (1594)	63.75 (1619)
36	900	77.00 (1956)	77.00 (1956)	—	82.00 (2083)	82.00 (2083)	—
38	950	—	—	—	—	—	—
40	1000	—	—	—	—	—	—
42	1100	—	—	—	—	—	—
48	1200	—	—	—	—	—	—
54	1400	—	—	—	—	—	—
60	1500	—	—	—	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.4—Check Valves and Axial Check Valves, Face-to-face (A) and End-to-end (B and C) Dimensions (Continued)

Dimensions in inches (millimeters)

NPS	DN	Class 600			Class 900		
		Raised Face	Welding End	Ring Joint C	Raised Face	Welding End	Ring Joint C
2	50	11.50 (292)	11.50 (292)	11.63 (295)	14.50 (368)	14.50 (368)	14.63 (371)
2 ¹ / ₂	65	13.00 (330)	13.00 (330)	13.13 (333)	16.50 (419)	16.50 (419)	16.63 (422)
3	80	14.00 (356)	14.00 (356)	14.13 (359)	15.00 (381)	15.00 (381)	15.13 (384)
4	100	17.00 (432)	17.00 (432)	17.13 (435)	18.00 (457)	18.00 (457)	18.13 (460)
6	150	22.00 (559)	22.00 (559)	22.13 (562)	24.00 (610)	24.00 (610)	24.13 (613)
8	200	26.00 (660)	26.00 (660)	26.13 (664)	29.00 (737)	29.00 (737)	29.13 (740)
10	250	31.00 (787)	31.00 (787)	31.13 (791)	33.00 (838)	33.00 (838)	33.13 (841)
12	300	33.00 (838)	33.00 (838)	33.13 (841)	38.00 (965)	38.00 (965)	38.13 (968)
14	350	35.00 (889)	35.00 (889)	35.13 (892)	40.50 (1029)	40.50 (1029)	40.88 (1038)
16	400	39.00 (991)	39.00 (991)	39.13 (994)	44.50 (1130)	44.50 (1130)	44.88 (1140)
18	450	43.00 (1092)	43.00 (1092)	43.13 (1095)	48.00 (1219)	48.00 (1219)	48.50 (1232)
20	500	47.00 (1194)	47.00 (1194)	47.25 (1200)	52.00 (1321)	52.00 (1321)	52.50 (1334)
22	550	51.00 (1295)	51.00 (1295)	51.38 (1305)	—	—	—
24	600	55.00 (1397)	55.00 (1397)	55.38 (1407)	61.00 (1549)	61.00 (1549)	61.75 (1568)
26	650	57.00 (1448)	57.00 (1448)	57.50 (1461)	—	—	—
28	700	63.00 (1600)	63.00 (1600)	63.50 (1613)	—	—	—
30	750	65.00 (1651)	65.00 (1651)	65.50 (1664)	—	—	—
36	900	82.00 (2083)	82.00 (2083)	—	—	—	—
38	950	—	—	—	—	—	—
40	1000	—	—	—	—	—	—
42	1100	—	—	—	—	—	—
48	1200	—	—	—	—	—	—
54	1400	—	—	—	—	—	—
60	1500	—	—	—	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.4—Check Valves and Axial Check Valves, Face-to-face (A) and End-to-end (B and C) Dimensions (Continued)

Dimensions in inches (millimeters)

NPS	DN	Class 1500			Class 2500		
		Raised Face A	Welding End	Ring Joint C	Raised Face	Welding End	Ring Joint C
2	50	14.50 (368)	14.50 (368)	14.63 (371)	17.75 (451)	17.75 (451)	17.88 (454)
2½	65	16.50 (419)	16.50 (419)	16.63 (422)	20.00 (508)	20.00 (508)	20.25 (514)
3	80	18.50 (470)	18.50 (470)	18.63 (473)	22.75 (578)	22.75 (578)	23.00 (584)
4	100	21.50 (546)	21.50 (546)	21.63 (549)	26.50 (673)	26.50 (673)	26.88 (683)
6	150	27.75 (705)	27.75 (705)	28.00 (711)	36.00 (914)	36.00 (914)	36.50 (927)
8	200	32.75 (832)	32.75 (832)	33.13 (841)	40.25 (1022)	40.25 (1022)	40.88 (1038)
10	250	39.00 (991)	39.00 (991)	39.38 (1000)	50.00 (1270)	50.00 (1270)	50.88 (1292)
12	300	44.50 (1130)	44.50 (1130)	45.13 (1146)	56.00 (1422)	56.00 (1422)	56.88 (1445)
14	350	49.50 (1257)	49.50 (1257)	50.25 (1276)	—	—	—
16	400	54.50 (1384)	54.50 (1384)	55.38 (1407)	—	—	—
18	450	60.50 (1537)	60.50 (1537)	61.38 (1550)	—	—	—
20	500	65.50 (1664)	65.50 (1664)	66.38 (1686)	—	—	—
24	600	76.50 (1943)	76.50 (1943)	77.63 (1972)	—	—	—

Table C.5—Gate Valves—Face-to-face (A) and End-to-end (B and C) Dimensions

Dimensions in inches (millimeters)

NPS	DN	Raised Face A	Welding End B	Ring Joint C	Raised Face A	Welding End B	Ring Joint C
		Class 150			Class 300		
2	50	7.00 (178)	8.50 (216)	7.50 (191)	8.50 (216)	8.50 (216)	9.13 (232)
2½	65	7.50 (191)	9.50 (241)	8.00 (203)	9.50 (241)	9.50 (241)	10.13 (257)
3	80	8.00 (203)	11.13 (283)	8.50 (216)	11.13 (283)	11.13 (283)	11.75 (298)
4	100	9.00 (229)	12.00 (305)	9.50 (241)	12.00 (305)	12.00 (305)	12.63 (321)
6	150	10.50 (267)	15.88 (403)	11.00 (279)	15.88 (403)	15.88 (403)	16.50 (419)
8	200	11.50 (292)	16.50 (419)	12.00 (305)	16.50 (419)	16.50 (419)	17.13 (435)
10	250	13.00 (330)	18.00 (457)	13.50 (343)	18.00 (457)	18.00 (457)	18.63 (473)
12	300	14.00 (356)	19.75 (502)	14.50 (368)	19.75 (502)	19.75 (502)	20.38 (518)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

14	350	15.00 (381)	22.50 (572)	15.50 (394)	30.00 (762)	30.00 (762)	30.63 (778)
16	400	16.00 (406)	24.00 (610)	16.50 (419)	33.00 (838)	33.00 (838)	33.63 (854)
18	450	17.00 (432)	26.00 (660)	17.50 (445)	36.00 (914)	36.00 (914)	36.63 (930)
20	500	18.00 (457)	28.00 (711)	18.50 (470)	39.00 (991)	39.00 (991)	39.75 (1010)
22	550	—	—	—	43.00 (1092)	43.00 (1092)	43.88 (1114)
24	600	20.00 (508)	32.00 (813)	20.50 (521)	45.00 (1143)	45.00 (1143)	45.88 (1165)
26	650	22.00 (559)	34.00 (864)	—	49.00 (1245)	49.00 (1245)	50.00 (1270)
28	700	24.00 (610)	36.00 (914)	—	53.00 (1346)	53.00 (1346)	54.00 (1372)
30	750	24.00 (610)	36.00 (914)	—	55.00 (1397)	55.00 (1397)	56.00 (1422)
32	800	^a 28.00 (711)	38.00 (965)	—	60.00 (1524)	60.00 (1524)	61.13 (1553)
34	850	30.00 (762)	40.00 (1016)	—	64.00 (1626)	64.00 (1626)	65.13 (1654)
36	900	28.00 (711) ^b	40.00 (1016)	—	68.00 (1727)	68.00 (1727)	69.13 (1756)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.5—Gate Valves—Face-to-face (A) and End-to-end (B and C) Dimensions (Continued)
Dimensions in inches (millimeters)

NPS	DN	Raised Face A	Welding End B	Ring Joint C	Raised Face A	Welding End B	Ring Joint C
		Class 600			Class 900		
2	50	11.50 (292)	11.50 (292)	11.63 (295)	14.50 (368)	14.50 (368)	14.63 (371)
2½	65	13.00 (330)	13.00 (330)	13.13 (333)	16.50 (419)	16.50 (419)	16.63 (422)
3	80	14.00 (356)	14.00 (356)	14.13 (359)	15.00 (381)	15.00 (381)	15.13 (384)
4	100	17.00 (432)	17.00 (432)	17.13 (435)	18.00 (457)	18.00 (457)	18.13 (460)
6	150	22.00 (559)	22.00 (559)	22.13 (562)	24.00 (610)	24.00 (610)	24.13 (613)
8	200	26.00 (660)	26.00 (660)	26.13 (664)	29.00 (737)	29.00 (737)	29.13 (740)
10	250	31.00 (787)	31.00 (787)	31.13 (791)	33.00 (838)	33.00 (838)	33.13 (841)
12	300	33.00 (838)	33.00 (838)	33.13 (841)	38.00 (965)	38.00 (965)	38.13 (968)
14	350	35.00 (889)	35.00 (889)	35.13 (892)	40.50 (1029)	40.50 (1029)	40.88 (1038)
16	400	39.00 (991)	39.00 (991)	39.13 (994)	44.50 (1130)	44.50 (1130)	44.88 (1140)
18	450	43.00 (1092)	43.00 (1092)	43.13 (1095)	48.00 (1219)	48.00 (1219)	48.50 (1232)
20	500	47.00 (1194)	47.00 (1194)	47.25 (1200)	52.00 (1321)	52.00 (1321)	52.50 (1334)
22	550	51.00 (1295)	51.00 (1295)	51.38 (1305)	—	—	—
24	600	55.00 (1397)	55.00 (1397)	55.38 (1407)	61.00 (1549)	61.00 (1549)	61.75 (1568)
26	650	57.00 (1448)	57.00 (1448)	57.50 (1461)	—	—	—
28	700	61.00 (1549)	61.00 (1549)	61.50 (1562)	—	—	—
30	750	65.00 (1651)	65.00 (1651)	65.50 (1664)	—	—	—
32	800	70.00 (1778)	70.00 (1778)	70.63 (1794)	—	—	—
34	850	76.00 (1930)	76.00 (1930)	76.63 (1946)	—	—	—
36	900	82.00 (2083)	82.00 (2083)	82.63 (2099)	—	—	—

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Table C.5—Gate Valves—Face-to-face (*A*) and End-to-end (*B* and *C*) Dimensions (Continued)
Dimensions in inches (millimeters)

NPS	DN	Raised Face	Welding End	Ring Joint C	Raised Face	Welding End	Ring Joint C
		Class 1500			Class 2500		
2	50	14.50 (368)	14.50 (368)	14.63 (371)	17.75 (451)	17.75 (451)	17.88 (454)
2 ¹ / ₂	65	16.50 (419)	16.50 (419)	16.63 (422)	20.00 (508)	20.00 (508)	20.25 (514)
3	80	18.50 (470)	18.50 (470)	18.63 (473)	22.75 (578)	22.75 (578)	23.00 (584)
4	100	21.50 (546)	21.50 (546)	21.63 (549)	26.50 (673)	26.50 (673)	26.88 (683)
6	150	27.75 (705)	27.75 (705)	28.00 (711)	36.00 (914)	36.00 (914)	36.50 (927)
8	200	32.75 (832)	32.75 (832)	33.13 (841)	40.25 (1022)	40.25 (1022)	40.88 (1038)
10	250	39.00 (991)	39.00 (991)	39.38 (1000)	50.00 (1270)	50.00 (1270)	50.88 (1282)
12	300	44.50 (1130)	44.50 (1130)	45.13 (1146)	56.00 (1422)	56.00 (1422)	56.88 (1445)
14	350	49.50 (1257)	49.50 (1257)	50.25 (1276)	—	—	—
16	400	54.50 (1384)	54.50 (1384)	55.38 (1407)	—	—	—
18	450	60.50 (1537)	60.50 (1537)	61.38 (1559)	—	—	—
20	500	65.50 (1664)	65.50 (1664)	66.38 (1686)	—	—	—
22	550	—	—	—	—	—	—
24	60	76.50 (1943)	76.50 (1943)	77.63 (1972)	—	—	—

For Class 2500:

^a Through-conduit valves shall be 26.00 in. (660 mm).

^b Through-conduit valves shall be 32.00 in. (813 mm).

Tolerance: $\pm 1/16$ in. (1.59 mm) on valve sizes 10 in. and smaller $\pm 1/8$ in. (3.18 mm) on valve sizes

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex D
(informative)

Guidance for Travel Stops by Valve Type

This annex provides guidance on travel stops by common valve type (see Table E.1).

Table D.1—Valve Travel Stops

Valve Type	Option/Detail	Travel Stop Requirements	Manual Gearbox	Actuator
Ball	All	Stops for open and close	Stops in gearbox for open and close	Actuator should control position, not valve stops.
Axial-on-off	All	Stops for open and close	Stops for open and close in gearbox	Actuator should control position, not valve stops.
Gate—slab/parallel through conduit	Conventional (down to close), no backseat	Stops for open and close	Stops in valve for open or close (1)	Actuator should control position, not valve stops.
Gate—slab/parallel through conduit	Conventional (down to close), no backseat	Stops for open and close (2)	Stops for open and close in valve. Backseat provides open stop (1).	Actuator torque/thrust adjusted or selected to suit backseat in open.
Gate—slab/parallel through conduit	Reverse acting (up to close), no backseat	Stops for open and close	Close stops may be in yoke or on stem (1).	Actuator should control position, not valve stops.
Gate—slab/parallel through conduit	Reverse acting (up to close), with backseat	Stops for open and close (2)	Stops for open and close in valve (1).	Actuator should control position for open. Actuator torque/thrust adjusted or selected to suit backseat in closed position.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Gate— expanding	Conventional, single expanding with backseat	No stops required. Wedging action provides close stop. Backseat provides open stop.	Stops for open in valve. Backseat provides open stop. Gearbox stop not required.	Actuator torque/thrust adjusted or selected to suit closing load in closed and backseat in open.
Gate— expanding	Conventional, single expanding without backseat	No stops required in closed. Wedging action provides close stop. Stop in valve required in open.	Stops for open in valve. Gearbox stop not required.	Actuator torque/thrust adjusted or selected to suit closing load in close.
Gate— expanding	Conventional, double or expanding without backseat	No stops required. Wedging action provides close and open stop.	Gearbox stop not required.	Actuator torque/thrust adjusted or selected to suit closing load in closed and wedging load in open.
Gate—non- rising stem, multi-turn	Conventional (down to close)	Stops for open and close.	Stops for open and closed in valve.	Actuator may have supplemental stops.
Check	With external clapper lift	Stop in body required for open. No stop required for close.	Gearbox stops in open and closed position to avoid overloading valve shaft in the open position and over-rotating the shaft passed the closed position.	Actuator stops should control open position, not valve stop, to avoid overloading valve shaft.
NOTES (1) Close stops may be in yoke or on stem. (2) Backseat provides open stop.				

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex E (informative)

Isolation Valve Features

E.1 General

E.1.1 Table M.1 is intended to give informative guidance on typical valve functions/features and is not intended to either be all-inclusive or restrictive. Individual valve designs exist that have unique sealing characteristics for which the table may not be appropriate or applicable. The user should take guidance from the manufacturer on establishing particular valve features.

Table E.1—Isolation Valve Types

Valve Type	Sealing Arrangement	Block and Bleed	Double Block and Bleed	Double Isolation and Bleed
Ball:				
Trunnion-mounted ball valve	Upstream sealing, pressure energized, self-relieving (Note 1)	Yes	(Note 4)	No (Note 5)
Trunnion-mounted ball valve DIB-1	Upstream and downstream sealing, pressure energized, e.g. two bidirectional sealing seats (Note 1)	Yes	(Note 4)	(Note 6)
Trunnion-mounted ball valve DIB-2	Upstream and downstream sealing, pressure energized, e.g. one bidirectional and one unidirectional sealing seat (Note 1)	Yes	(Note 4)	Only if the bidirectional seat is on the downstream side (Note 6)
Floating valve	Pressure energized	(Note 2) (Note 4)	(Note 4)	(Note 4)
Gate:				
Slab and/or through-conduit gate	Pressure energized—downstream sealing only/fixed seats (Note 1)	No (Note 2)	No	No

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Slab and/or through-conduit gate DIB-1	Pressure energized—upstream and downstream sealing (Note 1)	Yes	Yes (Note 3)	Yes (Note 3)
Expanding DIB-1	Mechanically energized	Yes	Yes (Note 3)	Yes (Note 3)
<p>NOTE 1 The term upstream and downstream refer to the pressure source and open end/equipment respectively and do not refer to flow direction.</p> <p>NOTE 2 Not possible to bleed from valve body, but bleed may be in downstream pipework/pipeline.</p> <p>NOTE 3 Depending on detail design of the valve, some valves may have preferred sealing direction and/or a specified sequence of operation.</p> <p>NOTE 4 Depending on detailed design.</p> <p>NOTE 5 Downstream seat may provide a second barrier at pressures below the cavity relieving pressure but will not provide a high-pressure barrier.</p> <p>NOTE 6 Depending on detailed design and ability to achieve testing per L.4.</p>				

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- E.1.2 The user is responsible for ensuring the operational requirements are consistent with particular valve features including sealing capability and function.
- E.1.3 The table and sketches are intended to give definition of the terms “block and bleed” (Figure E.1 and Figure E.2), “double block and bleed” (Figure E.3 and Figure E.4), and “double isolation and bleed” (Figure E.5 and Figure E.6) in a single valve or double valve arrangement as defined by this specification. Other documents, including applicable federal regulations, may have a different definition of these terms.

E.2 Block and Bleed (BB)

- E.2.1 BB may be achieved by a connection in the pipework/pipeline downstream of the block valve or from a connection on the valve body when the valve is an upstream seating type.

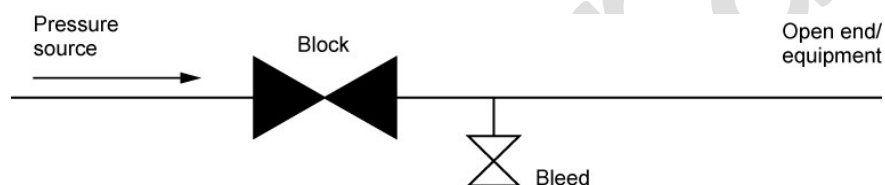


Figure E.1—Block and Bleed—Type A

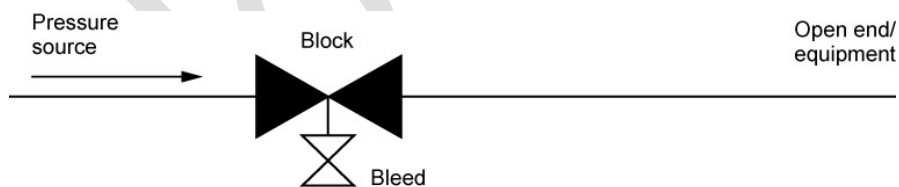


Figure E.2—Block and Bleed—Type B

E.3 Double Block and Bleed (DBB)

- E.3.1 The DBB feature of the valve or valves is the ability to segregate two pressure sources and to bleed/vent pressure in the void between the two sealing elements (blocks). The bleed may be in the pipework/pipeline when two valves are used, or in the valve body between the two seats when the valve has the DBB feature.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

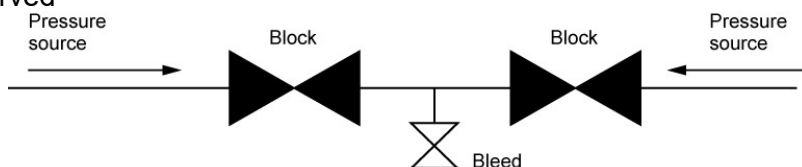


Figure E.3—Double Block and Bleed—Type A

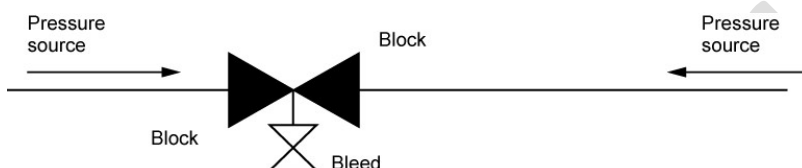


Figure E.4—Double Block and Bleed—Type B

E.4 Double Isolation and Bleed (DIB)

- E.4.1 The DIB feature of the valve or valves is the ability to provide two sealing elements to a single pressure source and to bleed/vent between the two sealing elements. Note that some documents dealing with isolation of equipment may refer to this feature as double block and bleed.

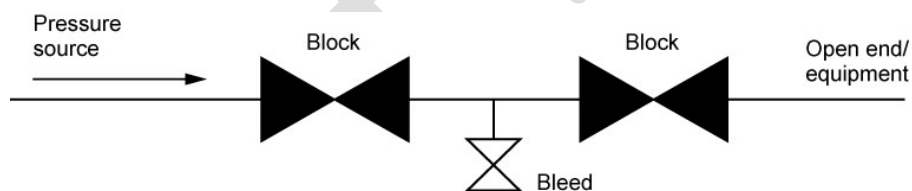


Figure E.5—Double Isolation and Bleed—Type A

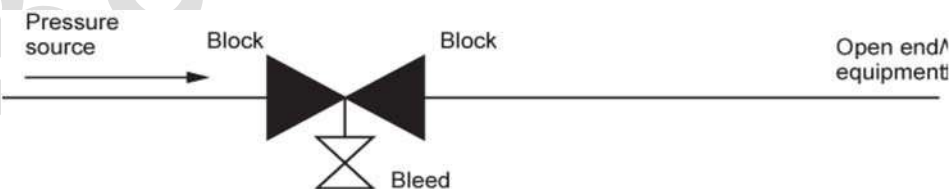


Figure E.6—Double Isolation and Bleed—Type B

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex F (informative)

Design Validation

F.1 General

- F.1.1 This annex provides design validation test procedures for equipment identified in this specification, which shall be applied if specified by the manufacturer or purchaser.
- F.1.2 When this annex is applied, the design validation procedures in this annex shall be applied to the designs of products, including design changes. It is intended that this annex shall not apply to validation of components and or parts.

NOTE Additional procedures may be used by agreement, provided the test requirements of this annex are met or exceeded.

F.2 Effect of Changes in Product

F.2.1 Design Changes

F.2.1.1 A change in one of the following parameters shall require a new design validation:

- a) valve type;
- b) valve configuration;
- c) body style (e.g. two piece versus three piece, top entry versus side entry);
- d) type of sealing element (e.g. O-ring, lipseals, chevrons, BX ring, RTJ);
- e) sizing criteria on pressure-containing parts;
- f) sizing criteria of obturator and seats;
- g) design of seal mating parts;
- h) sizing criteria of seat/obturator interfaces;
- i) sizing criteria of the drive train;
- j) maximum speed of operation (e.g. a valve qualified for a 10 second operation would qualify all slower operating times).

F.2.1.2 Valve operations during the design validation shall be performed at the qualified speed of operation or faster (e.g. a qualified speed of 10 seconds requires all valve operations to be 10 seconds or less).

F.2.1.3 Other changes shall not require new design validation if the manufacturer demonstrates

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

that the performance of the product in the intended pressure, temperature, and service condition shall be maintained.

- F.2.1.4 If a valve with two DPE seats has been previously validated and a valve with two SPE (self-relieving) seats has been previously validated; a valve with a one seat DPE and one seat SPE shall not need further validation.

F.2.2 Metallic Materials

- F.2.2.1 Substitution of metallic materials for pressure-containing, pressure-controlling, and pressure boundary bolting with materials that have lower SMYS shall require a new design validation.
- F.2.2.2 The substitution of wrought material with cast material shall require a new design validation.
- F.2.2.3 For the pressure-containing, pressure-controlling, and pressure boundary bolting any change of materials as defined in ASME *BPVC*, Section II, Part D, Table TM-1 shall require a new design validation.
- F.2.2.4 The substitution of product form (e.g. forged, plates, etc.) shall be acceptable if the manufacturer demonstrates that the performance of the product in the intended pressure, temperature, and service conditions shall be maintained.

F.2.3 Nonmetallic Seals and Bearings

- F.2.3.1 A change in one of the following parameters shall require a new design validation:
- a) type of sealing element (e.g. O-ring, lipseals, chevrons, etc.);
 - b) sizing criteria of seals;
 - c) material of seals or bearing;
 - d) roughness of sealing surfaces;
 - e) contact pressure of bearing.
- F.2.3.2 Other changes shall not require new design validation if the manufacturer demonstrates that the performance of the product in the intended pressure, temperature and service condition shall be maintained.

F.2.4 Hardfacing

- F.2.4.1 A change in one of the following parameters shall require a new design validation:
- a) hardfacing material;
 - b) hardfacing process that may impact product performance;

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- c) sizing criteria for contact pressure;
- d) reduction of minimum specified coating thickness.

F.2.4.2 Other changes shall not require new design validation if the manufacturer demonstrates that the performance of the product in the intended pressure, temperature and service condition shall be maintained.

F.3 Products for Design Validation

F.3.1 General

F.3.1.1 Design validation shall be performed on full-size prototypes or production unit.

NOTE Valves or components that have undergone validation testing may be used for further testing or in a production unit.

F.3.1.2 If the valve is to be reassembled after design validation testing is performed, the following minimum activities shall apply:

- a) all seals replaced;
- b) bearings and thrust washers replaced;
- c) seat springs replaced;
- d) dimensional inspection on pressure-containing and pressure-controlling parts and pressure-boundary bolting performed to verify continued conformance with the manufacturer's drawing dimensions and design acceptance criteria;
- e) sealing surface finishes on pressure-containing and pressure-controlling parts checked to verify continued conformance with the design acceptance criteria;
- f) nonconforming parts reworked or replaced;
- g) for reworked components, manufacturer shall demonstrate that the rework does not affect any of the elements or parameters listed in F.2;
- h) reapply the same surface NDE already applied on the finished machined components during production for pressure-containing, pressure-controlling, and pressure boundary bolting;
- i) FAT/production testing is performed in accordance with Section 10.

F.3.2 Test Valve

F.3.2.1 Design validation shall be performed on full-size products.

F.3.2.2 For valves that are provided with multiple stem seals, each seal mechanism shall be independently verified at the beginning, at the minimum and maximum temperatures, and at the end of the design validation procedure.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE A chevron V-stack packing is considered to be a single sealing set.

F.3.2.3 Valves shall be tested with end caps or blind flanges fitted.

F.4 External Paint or Coatings

F.4.1 The product used in any pressure test shall be free of paint or other coatings.

F.5 Safety

F.5.1 The manufacturer shall identify and implement the actions needed to ensure the safety of personnel and equipment.

F.6 Test Orientation

F.6.1 If the valve orientation, or multiple orientations are specified, the manufacturer shall determine the worst-case scenario and perform the validation in the worst-case scenario orientation.

F.6.2 If the orientation is not specified, the validation shall be performed with the stem in vertical orientation with the bore horizontal.

F.6.3 Different installation between prototype and production valve shall not require a new validation test, if the suitability of the orientation can be substantiated by other means.

F.7 Testing Medium

F.7.1 General

F.7.1.1 The testing medium shall be a fluid that remains in the liquid or gaseous state throughout the testing temperature range.

F.7.1.2 Water with or without additives, gas, hydraulic fluid, or other mixtures of fluids may be used as the test medium.

F.7.2 Substitution of Gas

F.7.2.1 The manufacturer may substitute gas for liquid if hydrostatic testing is specified, provided the testing method and acceptance criteria for gas testing are used.

F.8 Temperature Testing

F.8.1 Location of Temperature Measurement

F.8.1.1 The temperature shall be measured at the defined location by one of the methods below:

F.8.1.2 Method 1

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- a) In contact with the external surface on two locations at a minimum:
 - 1) In the seat area; and
 - 2) on the bonnet adjacent to the stem area.
- b) Thermal analysis shall be performed to establish the outside surface temperature that corresponds to the required temperature for the internal parts.
- c) Hold periods shall start after the external temperature as defined by the analysis has been achieved.

F.8.1.3 Method 2. In contact with the equipment being tested and within 0.5 in. (13 mm) of the surface wetted by the retained fluid.

F.8.1.4 Method 3

- a) For maximum-temperature measurement, the temperature of the fluid used for heating may be used as the measured temperature if the part valve is not artificially cooled.
- b) The fluid shall be applied through the valve bore.
- c) The heating shall be applied such that the entire through-bore or equivalent wetted surface is at or above the maximum temperature, or such that all fluid used for heating contained within the test valve is at or above the maximum temperature.

F.8.2 Application of Cooling for Minimum Temperature Testing

F.8.2.1 The cooling for minimum temperature testing shall be applied:

- a) on the external surface of the equipment; or
- b) through the valve bore; or
- c) per manufacturer's design criteria; or
- d) a combination thereof.

F.9 Test Duration

F.9.1 Start of Test Duration

F.9.1.1 Test duration shall start after pressure and temperature stabilization has occurred and the valve with a pressure-monitoring device has been isolated from the pressure source.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

F.9.1.2 The specified test duration shall be a minimum requirement.

F.9.2 Pressure Stabilization

F.9.2.1 Pressure shall be considered stabilized when the rate of change is no more than 5 % of the test pressure per hour or 500 psi/h (3.45 MPa/h), whichever is less.

F.9.3 Pressure Maintenance

F.9.3.1 Pressure shall not vary by more than 10 % during the test duration.

F.9.3.2 Pressure shall not fall below the test pressure before the end of the test duration.

F.9.4 Temperature Stabilization

F.9.4.1 Temperature shall be recognized as stabilized when the rate of change is less than 0.5 °C/min (1 °F/min).

F.9.4.2 The temperature shall remain at or beyond the extreme during the test duration but should not go beyond the upper and lower temperatures by more than 11 °C (20 °F).

F.10 Scaling

F.10.1 General

F.10.1.1 Design validation of a valve shall be independent of the type of actuation used during the validation test.

NOTE Scaling may be used to validate members of a product family in accordance with the requirement of this paragraph.

F.10.2 Product Family

F.10.2.1 A product family shall meet the following design criteria:

- a) All parameters listed in F.2 are the same.
- b) Principles of functional operation are the same (e.g. nonreturn, linear quarter-turn, etc.).
- c) Design requirements are the same resulting in a comparable safety factor in relation to material properties.

NOTE If finite element analysis (FEA) is available, the design stress levels in relation to material mechanical properties may be based on these same criteria.

F.11 Limitations of Scaling

F.11.1 General Design Validation

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

F.11.1.1 Testing a valve with any type of end connector shall validate the same valve with any other end connector type.

F.11.2 Design Validation by Pressure Rating

F.11.2.1 The test product shall be used to validate products of the same family having equal or lower pressure ratings.

F.11.3 Design Validation by Size

F.11.3.1 The size used for the scaling criteria described in F.11.3 shall be the bore size of the closure member.

F.11.3.2 Testing of one size of a product family shall validate products as follows:

- a) one nominal size larger and one nominal size smaller than the tested size for valve sizes up to and including NPS 12 (DN 300),
- b) two nominal sizes larger and two nominal sizes smaller than the tested size for valve sizes NPS 14 (DN 350) and above.

NOTE When using scaling additional verification by FEA may be required to validate NPS12 (DN 300) and above.

F.11.4 Design Validation by Temperature

F.11.4.1 The temperature range validated by the test product shall validate all temperatures that fall entirely within that range.

F.12 Documentation

F.12.1 Design Validation Files

F.12.1.1 The manufacturer shall maintain a file on each design validation.

F.12.2 Contents of Design Validation Files

F.12.2.1 Design validation files shall contain or reference the following information, if applicable:

- a) test number and revision level, or test procedure;
- b) complete identification of the valve being tested;
- c) date of test completion;
- d) test results and post-test examination conclusions (see F.17);
- e) model numbers and other pertinent identifying data on all other sizes, rated pressures temperature ranges, and standard test fluid ratings of valves of the same product family that are validated by the validation of this specific valve;

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- f) all detailed dimensional drawings and material specifications applicable to the tested product, including seals and non-extrusion devices;
- g) sketch of test rig, valve, and seal or sample; temperature and pressure measurement locations should be shown;
- h) actual sealing-surface dimensions;
- i) all test data specified in this annex, including actual test conditions (pressure, temperature, etc.) and observed leakages or other acceptance parameters; identification of testing media used;
- j) test equipment identification and calibration status;
- k) certification of manufacturer report, including the supplier of test seals, molding dates, compound identifications, and batch numbers for nonmetallic materials;

F.13 Test Equipment Calibration Requirements

- F.13.1 Measuring and test equipment shall be identified, controlled, calibrated, and adjusted as specified in 8.3.

F.14 Design Validation Procedure

- F.14.1 Procedure to validate a valve design shall be as identified in Table F.1.
- F.14.2 For valves with two unidirectional seats, each seat shall be tested in accordance with 10.4.3.1.
- F.14.3 For valves with two bidirectional seats, the upstream seat shall be tested per L.10 with half the cycles in F.19 and F.20, and the downstream seat shall be tested per L.10 with half the cycles in F.19 and F.20.
- F.14.4 For valves with one seat unidirectional and one seat bidirectional, the unidirectional seat shall be tested per 10.4.3.1 with half the cycles in F.19 and F.20 and the bidirectional seat shall be tested per L.11 with half the cycles in F.19 and F.20.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

F.15 Structural Integrity

F.15.1 Product that deforms to an extent that any other performance requirement cannot be achieved shall be considered not acceptable and the product shall be rejected. See F.17.

F.15.2 Pressure Integrity

F.15.2.1 The following shall apply.

- a) Hydrostatic shell test at ambient temperature shall be performed according to 10.3.
- b) Gas test at ambient temperature shall be acceptable.
- c) Leakage rate shall be less than the rates shown in Table F.2, measured at atmospheric pressure, during specified pressure-hold periods.
- d) Minimum/maximum temperature tests: the hydrostatic or gas test at high or low temperature shall be acceptable if the pressure change observed on the pressure-measuring device is less than 5 % of the test pressure or 500 psi (3.45 MPa), whichever is less.

Table F.2—Ambient Temperature Gas Leakage Acceptance Criteria

Valve Type	Seal Type	Allowable Leakage
Axial on-off, ball, check, gate.	Through-bore	See 10.11.2
	Stem seal	No visible leakage
	Static (bonnet seal, end connections)	No visible leakage

F.16 Post-test Examination

F.16.1 The tested prototype shall be disassembled and inspected.

F.16.2 The examination shall be performed to ensure that neither the product nor component design contains defects to the extent that any performance requirement cannot be met

F.16.3 The results of the examination shall be documented.

Table F.1—Design Validation for Valves

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Design Validation Tests	Reference Section
Hydrostatic body test	F.17.1
Seat test	F.17.2
Force or torque measurement	F.18
Open/close cycling dynamic pressure test at room temperature	160 cycles per F.19
Gas seat test	20 cycles per F.20
Open/close cycling dynamic pressure gas test at maximum temperature	F.21
Gas body test at maximum temperature	F.22
Gas seat test at maximum temperature	F.23
Low-pressure seat test at maximum temperature	20 cycles per F.20
Open/close cycling dynamic pressure gas test at minimum temperature	F.21
Gas body test at minimum temperature	F.22
Gas seat test at minimum temperature	F.23
Low-pressure seat test at minimum temperature	F.24
Raise the temperature to room temperature	F.8.1 F.25
Pressure/temperature cycling	F.26
Gas body test at room temperature	F.27
Gas seat test at room temperature	F.18
Low-pressure seat test at room temperature	F.16
Final force or torque measurement	F.17.1

F.17 Pressure Testing at Ambient Temperature

F.17.1 Hydrostatic Body Pressure Test

F.17.1.1 Hydrostatic body testing shall be performed at the maximum rating pressure of the valve.

F.17.1.2 Hydrostatic body testing shall conform to 10.3.

F.17.1.3 Test duration shall be a minimum of 1 hour.

F.17.2 Hydrostatic Seat Pressure Test

F.17.2.1 Hydrostatic seat testing shall conform to 10.4.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

F.17.2.2 Gas seat test shall conform to 10.11.

F.17.2.3 Test duration shall be a minimum of 1 hour.

F.18 Force or Torque Measurement

F.18.1 The breakaway and running torques or forces shall be measured at the maximum design pressure difference.

F.18.2 This shall be applicable to all valves, including check valves provided with an external operator as long as no differential pressure is applied across the obturator.

F.18.3 A procedure to measure breakaway and running torques or forces shall be prepared by the manufacturer. The operating forces or torques shall be within the manufacturer's specifications.

NOTE The force/torque may be determined by direct or indirect measurement (i.e. pressure applied to an area).

F.19 Dynamic (Open/Close Cycling) Pressure Test at Ambient Temperature

F.19.1 Speed of Operation

F.19.1.1 The valve operation during the design validation shall be performed at the same speed that is the qualified speed of operation.

F.19.1.2 The speed of operation shall be recorded.

F.19.2 Procedure for Valves Except Check Valves

F.19.2.1 The valves shall be tested as follows.

- a) Fill the downstream end of the valve with the test medium at 1 % or less of test pressure.
- b) Apply pressure equal to the ambient working pressure against the upstream side of the valve. All subsequent seat tests shall be in the same direction.
- c) Open the valve fully, starting against the full differential pressure. Pressure shall be maintained at a minimum of 50 % of the initial test pressure after the BTO. The opening stroke may be interrupted to adjust the pressure within the above limits.
- d) Close the valve fully while pressure is maintained within the limits of the preceding step.
- e) Bleed the downstream pressure to 1 % or less of test pressure after the valve is fully closed.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- f) Repeat until a minimum of 160 pressure cycles has been carried out.

F.19.3 Procedure for Check Valves

F.19.3.1 Check valves shall be tested as follows.

- a) Apply pressure equal to the RWP to the downstream side of the valve.
- b) Relieve the pressure on the downstream side and apply 1 % or less of test pressure on the upstream side and unseat the valve.
- c) Repeat until a minimum of 160 pressure cycles has been carried out.

F.19.3.2 For check valves provided with external operator, 160 opening closing cycle shall be performed on the external operator without differential pressure across the closure member.

F.20 Dynamic (Open/Close Cycling) Pressure Gas Test at Maximum/Minimum Rated Temperature

F.20.1 The procedure of F.19 shall be followed with the following exceptions:

- a) The test medium shall be gas
- b) 20 cycles at minimum temperature
- c) 20 cycles at maximum temperature.

F.21 Gas Body Test at Maximum/Minimum Rated Temperature

F.21.1 The gas body test shall be performed as follows.

- a) The valves shall be in the partially open position during testing. Check valves shall be tested from the upstream side.
- b) The test pressure shall be the maximum rating pressure at test temperature.
- c) The hold period shall be 1 hour. Acceptance criteria shall be as per F.16.2 c).

F.22 Gas Seat Test at Maximum/Minimum Rated Temperature

F.22.1 The maximum rating pressure shall be applied on the upstream side of the gate or ball and released on the downstream side. Check valves shall be tested from the downstream side.

F.22.2 The hold period shall be a minimum of 1 hour.

F.22.3 The pressure shall be released after the hold period.

F.22.4 A gas seat test at maximum/minimum temperature shall be acceptable if the leakage

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

rate is less than the acceptance criteria specified in F.26.

F.23 Low-pressure Gas Seat Test at Maximum/Minimum Rated Temperature

- F.23.1 The valves shall be subjected to a differential pressure between 5 % and 10 % of the maximum rating pressure, with a minimum of 5.5 barg (80 psi).
- F.23.2 For on-off valves, the pressure shall be applied on the upstream side of the closure member and released on the downstream side.
- F.23.3 For check valves, the low-pressure seat test pressure shall be applied on the downstream end of the valve with the opposite end vented to the atmosphere.
- F.23.4 The hold period shall be a minimum of 1 hour.
- F.23.5 Pressure change observed on the pressure-measuring device shall be less than 10 % of the testing pressure for Class 150 to 600 and less than 5 % for all other classes.

F.24 Gas Body Shell Pressure and Temperature Cycles

F.24.1 General

- F.24.1.1 Pressure/temperature cycles shall be performed as specified in Figure F.1.

F.24.2 Test Pressure and Temperature

- F.24.2.1 The test pressure and temperature extremes shall be as specified in a validation procedure.

F.24.3 Test Procedure

Pressure shall be monitored and controlled during temperature change. The following procedure shall be performed.

NOTE The item letters of the steps of the procedure correspond to the letters shown in Figure F.1.

- a) Apply the test pressure at ambient temperature and maintain at 50 % to 100 % of test pressure while raising temperature to the maximum.
- b) Hold for a period of 1 hour minimum at test pressure.
- c) Reduce the temperature to the minimum while maintaining 50 % to 100 % of test pressure.
- d) Hold for a minimum period of 1 hour at test pressure.
- e) Raise the temperature to ambient temperature while maintaining 50 % to 100 % of test pressure.
- f) Release the pressure, and then raise the temperature to the maximum.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- g) Apply the test pressure, hold for a minimum period of 1 hour, and then release the pressure.
- h) Reduce the temperature to the minimum.
- i) Apply the test pressure, hold for a minimum period of 1 hour, and then release the pressure.
- j) Raise the temperature to room temperature.

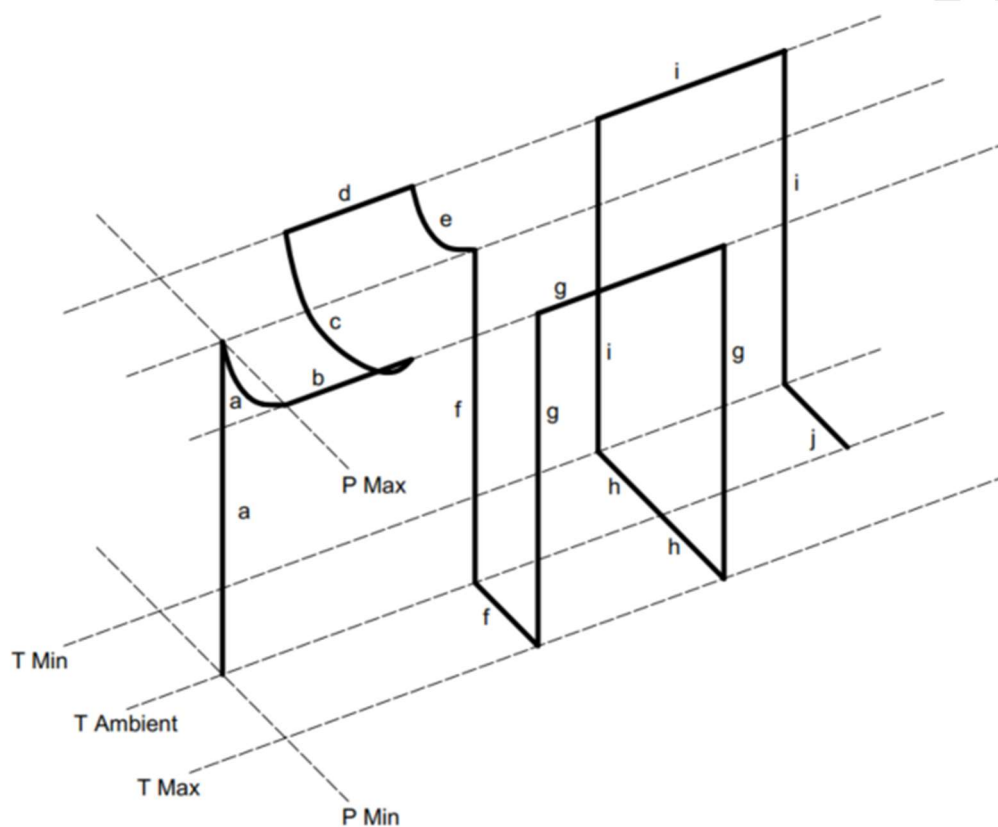


Figure F.1—Test Procedure for Pressure Temperature Cycle

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

F.25 Gas Body Test at Ambient Temperature

F.25.1 General

F.25.1.1 Gas shell testing at ambient temperature shall be conducted using the methodology indicated in I.8.2.

F.25.2 Leak Detection

F.25.2.1 Gas testing at ambient temperature shall be conducted with a method for leak detection.

NOTE 1 The product may be completely submerged in a liquid, or the product may be flooded in the seal areas being validated, such that all possible leak paths are covered.

NOTE 2 The product may be assembled with one end of a tube connected to a blind connector enclosing all possible leak paths being validated.

F.25.2.2 When one end of the tube is connected to a blind connector, the other end of the tube shall be immersed in a liquid or attached to a leakage measurement device.

NOTE Other methods that can detect leakage accurately are acceptable.

F.26 High-pressure Gas Seat Test at Ambient Temperature

F.25.1 General

F.25.1.1 Valves shall undergo a seat test that conforms to I.8.3.

F.25.2 Acceptance Criteria

F.25.2.1 Leakage for soft-seated valves and lubricated plug valves shall not exceed ISO 5208, Rate B.

F.25.2.2 For metal-seated valves, the leakage rate shall not exceed ISO 5208, Rate D.

F.25.2.3 For metal-seated check valves, the leakage rate shall not exceed ISO 5208, Rate F.

F.25.2.4 Actual leakage shall be recorded for all seat tests.

F.26 Low-pressure Gas Seat Test at Ambient Temperature

F.26.1 General

F.26.1.1 Valves shall undergo a seat test that conforms to I.9.

F.26.2 Acceptance Criteria

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

F.26.2.1 Leakage for soft-seated valves and lubricated plug valves shall not exceed ISO 5208, Rate B.

F.26.2.1 For metal-seated valves, the leakage rate shall not exceed ISO 5208, Rate D.

F.26.2.2 For metal-seated check valves, the leakage rate shall not exceed ISO 5208, Rate F.

F.26.2.3 Actual leakage shall be recorded for all seat tests.

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex G (normative)

External Coating for End Connections

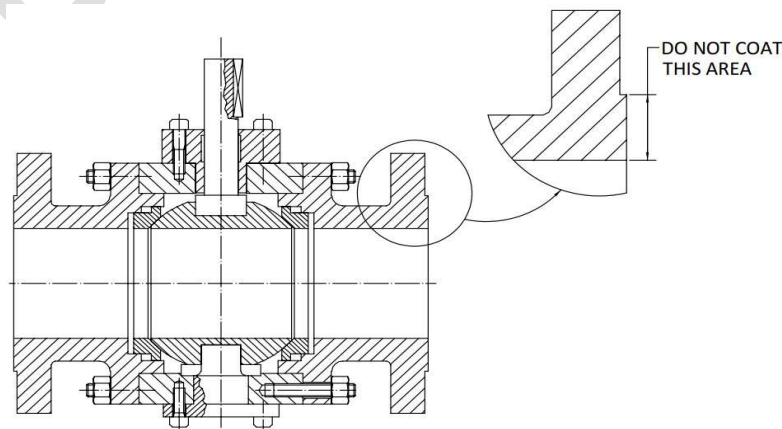
G.1 General

G.1.1 This annex provides coating requirements for flanges, weld-end connectors, and pipe pups that shall be performed after all testing is completed.

G.2 Uncoated Areas

G.2.1 For valves with raised-face end connectors, the area identified in Figure G.1 shall remain uncoated.

G.3 Raised Face



This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Figure G.1—Raised Face

G.4 Ring Type Joint or Raised Face Ring Type Joint

- G.4.1 Valves with ring type joints or raised-face ring type joint end connectors shall have the area identified uncoated (see Figure G.2).

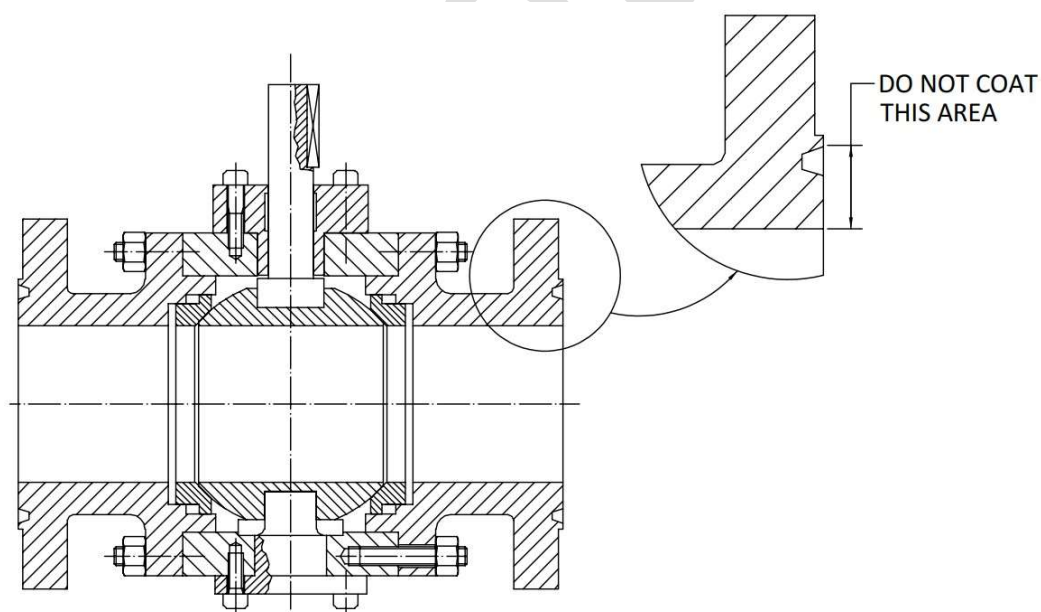


Figure G.2—Ring Type Joint or Raised Face Ring Type Joint

G.5 Weld End

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

G.5.1 Valves with weld end connectors shall have the area identified uncoated (see Figure G.3).

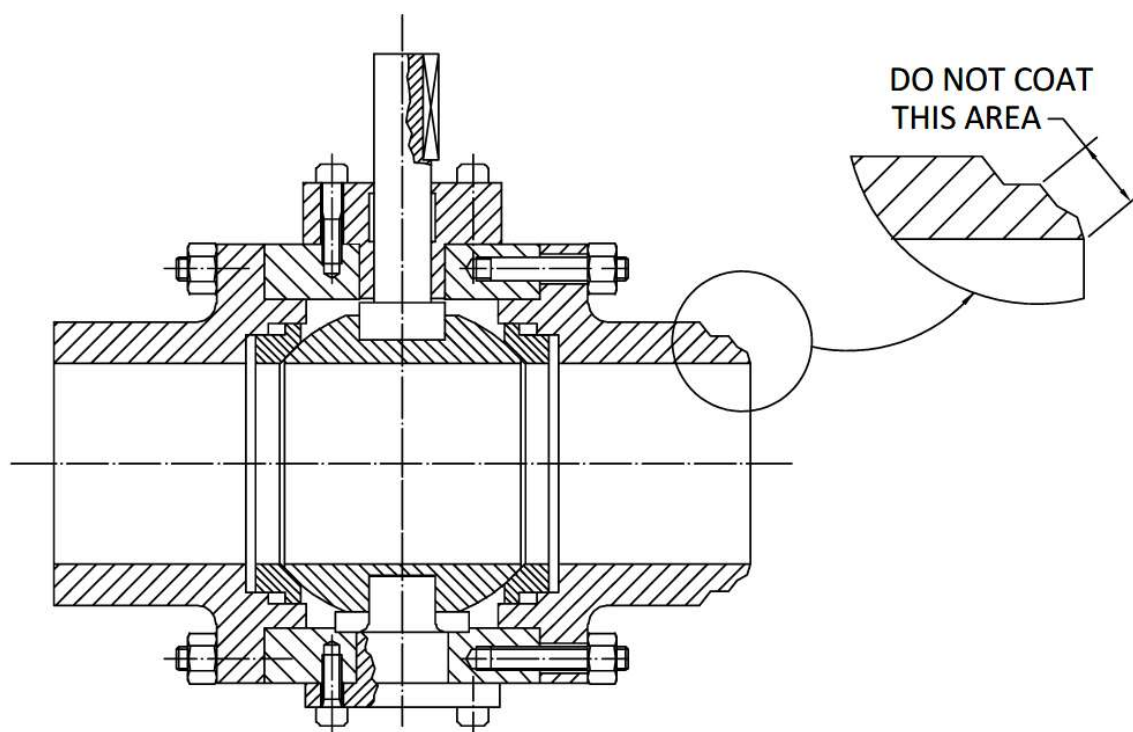


Figure G.3—Weld Face

G.6 Pipe Pup Weld Ends

G.6.1 Valves with the pup pipe welded to end connectors shall have the area identified uncoated (see Figure G.4).

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

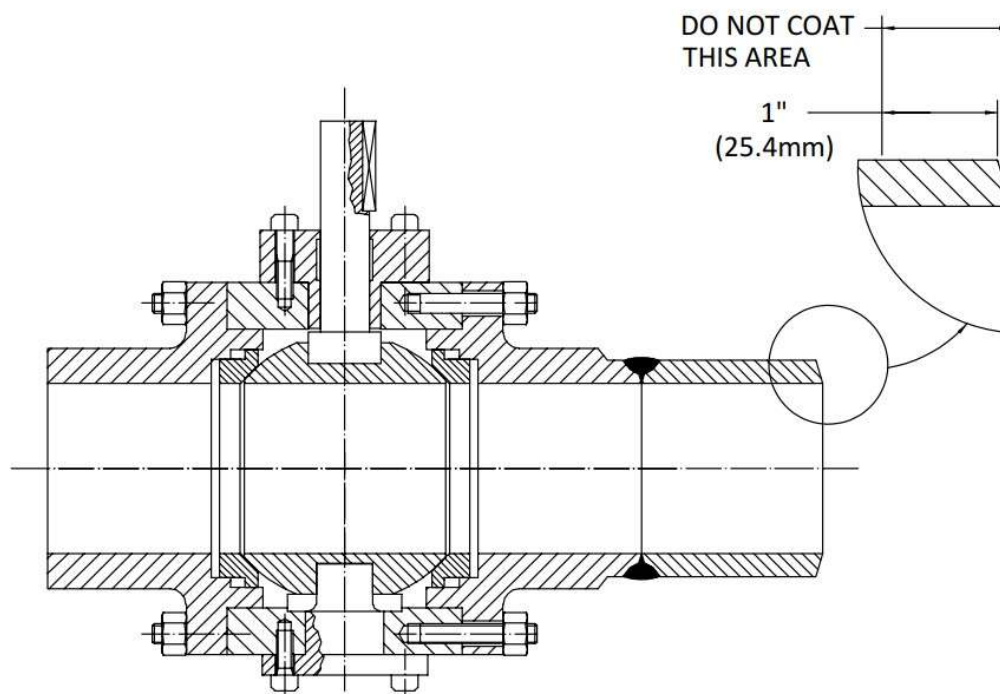


Figure G.4—Pipe Pup Weld Ends

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex H (informative)

Heat-treat Equipment Qualification

H.1 Temperature Survey for Batch-type Furnaces

H.1.1 General

H.1.1.1 Heat treating equipment shall meet the requirements of 6.13.

NOTE This annex provides a method for meeting the requirements of 6.13.

H.1.1.2 Qualification of heat treating equipment shall meet or exceed the requirements of this annex.

H.1.2 Method

H.1.2.1 The furnace working zone shall be defined by the manufacturer.

H.1.2.2 A temperature survey within the furnace working zone(s) shall be performed on each furnace at the maximum and minimum temperatures for which each furnace is being used.

H.1.2.3 For furnaces having a working zone less than or equal to 10 ft³ (0.3 m³), a minimum of three thermocouples located either at the front, center, and rear or at the top, center, and bottom of the furnace working zone shall be used.

H.1.2.4 For furnaces having a working zone greater than 10 ft³ (0.3 m³) and not greater than 1125 ft³ (31.5 m³), a minimum of nine thermocouples shall be used.

H.1.2.5 For each additional 125 ft³ (3.5 m³) beyond 1125 ft³ (31.5 m³) of furnace working zone surveyed, at least one additional thermocouple shall be used, up to a total of 40 thermocouples.

H.1.2.6 The first nine thermocouples shall be located as per Figures B.1 and B.2.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

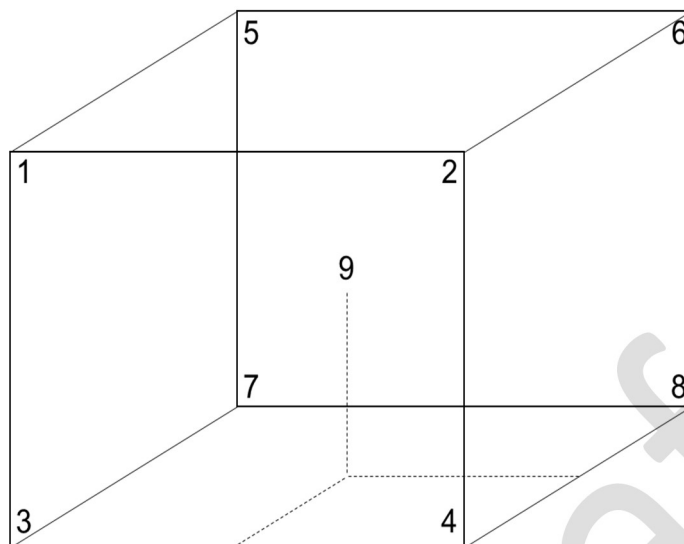


Figure B.1—Thermocouple Location—Rectangular Furnace (Working Zone)

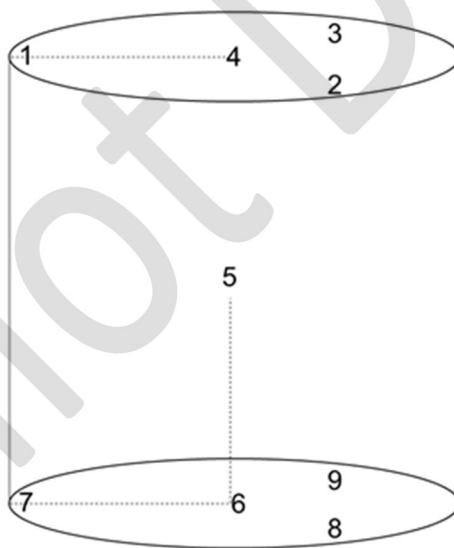


Figure B.2—Thermocouple Locations—Cylindrical Furnace (Working Zone)

- H.1.2.7 Each additional thermocouple location shall be equally spaced in the central additional working zone volume.
- H.1.2.8 After insertion of the temperature-sensing devices, readings shall be taken at least once every 3 minutes to determine when the temperature of the furnace working zone approaches the bottom of the temperature range being surveyed.
- H.1.2.9 Once the furnace temperature has reached the set-point temperature, the temperature of

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

all test locations shall be recorded at 2 minute intervals, maximum, for at least 10 minutes

H.1.2.10 Then, readings shall be taken at 5 minute intervals, maximum, for sufficient time (at least 30 minutes) to determine the recurrent temperature pattern of the furnace working zone.

H.1.2.11 When a furnace is repaired or rebuilt, a new temperature survey shall be carried out before the furnace is used for heat treatment, subject to the following.

a) Repairs that return the furnace to the condition it was in at the time of the last furnace survey and calibration or repairs that do not affect the temperature tolerance of the furnace shall not require a new temperature survey and calibration.

b) The SAE AMS 2750 sections on furnace modifications and furnace repairs shall be used to determine whether a new furnace survey is required.

NOTE Alternative recognized industry standards, such as SAE AMS 2750 or SAE AMS-H-6875, may be used if the furnace thermal uniformity survey (TUS) and furnace instrument calibration requirements in 6.8 are satisfied

H.1.2.12 All furnace repairs and modifications shall be documented and the responsible quality assurance organization shall make determination whether an additional furnace survey and calibration is required based on the repairs or modifications in accordance with SAE AMS 2750.

H.2 Temperature Survey for Continuous-type Furnaces

H.2.1 Furnaces used for continuous heat treatment shall be calibrated in accordance with procedures specified in SAE AMS 2750 or equivalent.

H.3 Instruments

H.3.1 Automatic controlling and recording instruments shall be used.

H.3.2 Thermocouples shall be located in the furnace working zone(s) and protected from furnace atmospheres by means of suitable protective devices.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex I (normative)

Quality Specification Level (QSL)

I.1 General

I.1.1 This annex shall apply to requirements for QSL in accordance with I.1 through I.4 and supplemental testing in I.5 through I.10, when QSL1, QSL1G, QSL2, or QSL2G is specified.

I.1.2 If any of the QSLs are specified, all requirements of a specific QSL shall apply.

NOTE 1 The former QL1 and QL2 have been redesignated as QSL1 and QSL1G (same as QSL1 with gas testing); and QSL2 and QSL2G (the same as QSL2 with gas testing). In previous editions of this specification, the minimum (default) quality level was QL1 for all valves. In this edition, the new default has no quality level designation which removes some NDE and gas testing for the valve. If the NDE requirements of the previous QL1 designation are required, QSL1 must now be minimally specified. If gas testing is also required, QSL1G must be minimally specified.

NOTE 2 The QSLs increase in stringency of requirements with the QSL numbers 1 and 2.

I.1.3 This annex specifies the requirements for NDE, documentation, and pressure testing, and other supplemental requirements that shall be performed by the manufacturer if specified for a given QSL.

I.1.4 The results of testing or other requirements performed to satisfy requirements in Sections 4–14 shall also satisfy all or part of identical requirements of this annex.

I.1.5 If the valve was not previously tested, the QSL pressure testing and documentation requirements of this annex shall apply in lieu of the related requirements of Sections 4–14.

I.1.6 If NDE is performed as part of Section 7 and Section 9, repeating of identical tests shall not be required per this annex.

I.2 NDE Requirements for Quality Specification Levels

I.2.1 The requirements of Table I.1 shall apply for NDE requirements for metallic parts for QSL1, QSL1G, QSL2 and QSL2G

NOTE The requirements of Table I.1 vary by the type of raw material for the item being inspected.

I.2.2 The requirements of Table I.2 shall apply to the extent, method, and acceptance criteria for the various inspection codes used in Table I.1.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

I.2.3 NDE personnel shall be qualified in conformance with the manufacturer's documented training program that is based on the requirements specified in ASNT SNT-TC-1A or ISO 9712.

NOTE Certification under ASNT ACCP-CP-1A can satisfy this requirement.

I.2.4 A qualified Level III examiner that conforms to the requirements of ASNT SNT-TC-1A or ISO 9712 shall approve all NDE procedures.

I.2.5 NDE personnel qualified to Level II or Level III shall perform all NDE inspections.

NOTE For guidance on qualification of nondestructive examination (NDE) service providers, see API 20D.

NOTE See Table I.2 for specification of the examinations referred to in this table.

Table I.1—NDE Requirements

Part	QSL1/1G		QSL2/2G	
	Cast	Wrought	Cast	Wrought
Body or closures and end connections or bonnet or cover or gland housing	VT1	VT2	VT1	VT2
	RT1 or UT1	UT2	RT3 and UT4	UT2
	MT2 or PT2	MT1 or PT1	MT2 or PT2	MT1 or PT1
Welding ends	VT1	VT2	VT1	VT2
	RT4 or UT5	UT5	RT4 or UT5	UT5
	MT2 or PT2	MT1 or PT1	MT2 or PT2	MT1 or PT1
Stem or shaft ^{a c}	-	VT2	N/A	VT2
		-		UT2
		MT1 or PT1		MT1 or PT1
Trunnion ^{b c} or trunnion/bearing plates	VT1	VT2	VT1	VT2
			UT1	UT2
			MT1 or PT1	MT1 or PT1
Pressure-boundary bolting	N/A	VT2	N/A	VT2
				MT1 or PT1
Closure Member ^{a c} Seat rings ^{b c}	VT1	VT2	VT1	VT2
			MT2 or PT2	MT1 or PT1
Clapper disc arm	VT1	VT2	VT1	VT2
			RT3 or UT4	UT2
			MT2 or PT2	MT1 or PT1

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Corrosion-resistant overlay in final supplied condition	VT3 and PT1	VT3 and UT3 and PT1
Welds to pressure-containing parts	VT3	
	MT1 or PT1	
Hardfacing	VT4 and VT5	
	PT1	
Sealing surfaces	VT5	
	MT2 or PT2	
Pressure-containing welds	VT3	
	RT2 or UT3	
	MT1 or PT1	
Plating	VT4	
Seals gaskets	VT4	
Seat springs	VT4	
Reinforcement and stiffening welds	VT3	
<div>NOTE 1 See Table I.2 for specification of the examinations referred to in this table.</div> <div>NOTE 2 N/A means that the manufacturer is not allowed to use this material form for that specific part.</div> <div>NOTE 3 All the NDE activities listed above for a specific product form or forms shall be conducted.</div>		
<div><div><div><div><div></div><div></div></div><div><div></div><div></div></div></div><div><div></div><div></div></div><div><div></div><div></div></div></div><div><div></div><div></div></div><div><div></div><div></div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div> <div><div></div><div></div></div>		

Table K.2—Extent, Method, and Acceptance Criteria of NDE/Item Examination Code

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Exam	Extent	Method	Acceptance
RT1	Critical areas per ASME B16.34 or as defined by manufacturer	ASME BPVC, Section V, Article 2 or ASTM E94	ASME BPVC, Section VIII, Division 1, Appendix 7
RT2	100 % where practicable	ASME BPVC, Section V, Article 2 or ASTM E94 or ISO 17636-1, Class B	ASME BPVC, Section VIII, Division 1, UW-51 for linear indications and ASME BPVC, Section VIII, Division 1, Appendix 4 for rounded indications
RT3	100 %	ASME BPVC, Section V, Article 2 or ASTM E94	ASME BPVC, Section VIII, Division 1, Appendix 7
RT4	100 % of circumference. Minimum length equal to 1.5 times the mating pipe wall thickness or 50 mm, whichever is greater	ASME BPVC, Section V, Article 2	Maximum allowable severity level 1 for shrinkage and level 2 for sand or gas
UT1	Remaining areas not covered by RT1	ASME BPVC, Section V, Article 5 or ASTM A609	ASTM A609/A609M, Table 2, Quality Level 2
UT2	All surfaces	ASME BPVC, Section V, Article 5 or ASTM A388	Forgings: ASME BPVC, Section VIII, Div. 1, UF-55 for angle beam and ASME B16.34 Appendix IV for
UT3	Weldments: All surfaces	ASME BPVC, Section V, Article 4 or ASTM A388	ASME BPVC, Section VIII, Division 1, Appendix 12
	Overlay: All accessible machined surfaces	ASME BPVC, Section V, Article 4 straight beam method or ASTM A388	ASTM A578A/A578M standard Level C
UT4	100 %	ASME BPVC, Section V, Article 5 or ASTM A609	ASTM A609/A609M, Table 2, Quality Level 1
UT5	100 % of circumference. Minimum length equal to 1.5 times the mating pipe wall thickness or 50 mm, whichever is greater.	ASME BPVC, Section V, Article 5 or ASTM A609	ASTM A609/A609M, Table 2, Quality Level 1
MT1	All accessible surfaces	ASME BPVC, Section V, Article 7 or ASTM E709	ASME BPVC, Section VIII, Division 1, Appendix 6
MT2	All accessible surfaces	ASME BPVC, Section V, Article 7 or ASTM E709	ASME BPVC, Section VIII, Division 1, Appendix 7

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

MT3	All sealing surfaces	ASME BPVC, Section V, Article 7 or ASTM E709	No relevant rounded or relevant linear indications in pressure-contact sealing surfaces shall be permitted ^a
PT1	All accessible surfaces	ASME BPVC, Section V, Article 6 or ASTM E165	ASME BPVC, Section VIII, Division 1, Appendix 8
PT2	All accessible surfaces	ASME BPVC, Section V, Article 6 or ASTM E165	ASME BPVC, Section VIII, Division 1, Appendix 7
PT3	All sealing surfaces	ASME BPVC, Section V, Article 6 or ASTM E165	No relevant rounded or relevant linear indications in pressure-contact sealing surfaces shall be permitted ^a
VT1	100 % accessible as cast surfaces	9.4.2	9.4.2
VT2	100 % accessible as forged surfaces	9.4.3	9.4.3
VT3	100 % accessible as welded surfaces	7.5.3.2 or 7.8 or 7.9	7.5.3.2 or 7.8 or 7.9
VT4	100 % accessible surfaces	Per manufacturer requirements	Per manufacturer requirements
VT5	100 % accessible machined surfaces	9.4.4	9.4.4

I.3 Production Material Requirements

I.3.1 Production material requirements shall conform to Table I.3 for the specified QSLs and the use of the following:

- a) API 20A for castings;

NOTE Castings may be specified by the purchaser to conform to API 20A for pressure-containing castings in accordance with casting specification level-2 (CSL-2) or greater for each material group as applicable.

- b) API 20B for open die shaped forgings;

NOTE Open die forgings may be specified by the purchaser to conform to API 20B for pressure-containing forgings in accordance with forging specification level-2 (FSL-2) or greater for each material group as applicable.

- c) API 20C for closed-die forging;

NOTE Closed die forgings may be specified by the purchaser to conform to API 20C for pressure-containing forgings in accordance with forging specification level-2 (FSL-2) or greater for each material group as applicable.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- d) API 20E for alloy and carbon steel bolting or API 20F for corrosion-resistant bolting when the specified bolting materials are listed therein;

NOTE 1 Use of materials or services that conform to API 20A, API 20B, API 20C, API 20E, or API 20F does not require the material or service to be provided by a facility that is specifically licensed to API 20A, API 20B, API 20C, API 20E, or API 20F, respectively.

NOTE 2 Use of materials or services that conform to API 20A, API 20B, API 20C, API 20E, or API 20F includes identification of resulting products in accordance with the specified marking requirements of the API standard used.

- e) The manufacturer's documented material specification, design code listed in 5.1.1, and Section 5 of API 20E for alloy and carbon steel bolting or API 20F for corrosion-resistant bolting when the specified bolting materials are not listed in API 20E or API 20F, respectively.

I.3.4.1 Pressure-containing forgings shall be capable of meeting the NDE requirements of this product specification.

Table I.3—Production Materials Requirements

Level	Applicable Reference	Applicable BSL-CSL-FSL
QSL1/1G	API 20A	See I.3.1
	API 20B	See I.3.1
	API 20C	See I.3.1
	API 20E ^{a, b, c}	See 8.1
	API 20F ^{a, b, c}	See 8.1
QSL2/2G	API 20A	See I.3.1
	API 20B	See I.3.1
	API 20C	See I.3.1
	API 20E ^{a, b, c}	See 8.1
	API 20F ^{a, b, c}	See 8.1
FOOTNOTES ^a When materials listed in API 20E or API 20F are used, the bolts shall conform fully to the BSL and be marked in accordance with API 20E or API 20F. ^b When non-listed materials are used, requirements per BSL level in Section 5 of API 20E or Section 5 of API 20F shall apply. ^c Bolts used from materials not listed in the API 20E or API 20F bolting specification cannot be marked 20E or 20F.		

I.4 Testing Requirements

I.4.1 Testing for QSL1, QSL1G, QSL2, and QSL2G shall conform to the sequence shown in Table

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
I.4.

Table I.4—Testing Sequence for Quality Specification Levels

Sequence	Test Activity	QSL1 a, b	QSL1G a, b	QSL2 a, b	QSL2G a, b
1	Hydrostatic backseat (if provided) test per 10.2	One test	One test	One test	One test
2	Hydrostatic shell test per 10.3 or I.5	One test	One test	Three tests	One test
3	Torque or thrust test per 10.4	Four tests	Four tests	Four tests	Four tests
4	Hydrostatic seat test per 10.4 or I.5	Three tests	Three tests	Three tests	Three tests
5	Seat cavity relief test per I.7	One test	One test	One test	One test
6	High-pressure gas shell test per I.8.2	N/R	One test	N/R	One test
7	High-pressure gas seat test per I.8.3	N/R	Three tests	N/R	Three tests
8	Low-pressure gas seat test per I.9.1	N/R	One test	One test	One test

I.5 Hydrostatic Testing

I.5.1 If specified, hydrostatic testing shall be performed at a pressure higher than that specified in 10.3 or 10.4.

I.5.2 If specified, hydrostatic testing shall be performed for a duration longer than that required by Table 9 or Table 10.

I.6 Torque/Thrust Functional Testing

I.6.1 Functional testing shall conform to 10.4.

I.7 Cavity Relief Testing

I.7.1 General

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

I.7.1.1 A cavity relief test shall be performed if the valve has one or more self-relieving seats or a relief system that connects the valve cavity to one side of the valve.

I.7.1.2 The procedure used for the cavity relief test shall be documented.

I.7.1.3 Cavity relief testing shall be performed on all valves except for those valves designed to not trap pressure in the cavity.

I.7.1.4 Valves with cavity relief functionality shall be tested by one of the methods specified in I.7.2, I.7.3, or I.7.4.

I.7.2 Trunnion-mounted Ball Valves

I.7.2.1 Procedure 1—Self-relieving Seats

I.7.2.1.1 The procedure for cavity-relief testing of trunnion-mounted ball valves with self-relieving seats shall be as follows:

- a) Fill the valve in the half-open position with hydrostatic test fluid and purge trapped air.
- b) Close the valve.
- c) Close the branch vents.
- d) Apply pressure to the valve cavity until one branch pressure starts to rise and the seat relieves the cavity pressure into the valve end; record this relief pressure and port location.

I.7.2.1.2 For valve types with two self-relieving seats, continue to increase the pressure to the cavity until the second branch pressure starts to rise and the second seat relieves; record the relief pressure of the second seat.

I.7.2.1.3 The valve shall relieve at a differential pressure no greater than 33 % of the valve pressure rating.

EXAMPLE 1 Class 150, 275 psi (19.0 bar): The maximum differential pressure relief is 90 psi (6.2 bar).

EXAMPLE 2 Class 2500, 6250 psi (430.9 bar): The maximum differential pressure relief is 2060 psi (142.1 bar).

I.7.2.1.4 Pressure-temperature ratings for class-rated valves shall conform to the applicable rating table for the appropriate material group in ASME B16.34 or per MSS SP-44 for material not listed in ASME B16.34.

I.7.2.2 Optional Procedure 2—One or More Self-relieving Seats

I.7.2.2.1 The procedure for cavity-relief testing of trunnion-mounted ball valves with one or more self-relieving seats shall be as follows:

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- a) Fill the valve in the half-open position with hydrostatic test fluid.
- b) Close the valve.
- c) Pressurize both sides of the valve and the valve cavity simultaneously, up to 1.0 times MAWP.
- d) Isolate both sides of the valve and the valve cavity from the pressure source.
- e) Slowly decrease pressure on one side while monitoring the valve cavity pressure. Record pressure on that side required to activate SPE seat seal relief (point at which the valve cavity pressure decreases).
- f) Repeat steps a) to d) for the other side if it has a self-relieving seat.

I.7.2.2.2 The valve shall relieve at a differential pressure no greater than 33 % of the valve pressure rating.

I.7.2.2.3 Pressure-temperature ratings for class-rated valves shall conform to the applicable rating table for the appropriate material group in ASME B16.34 per MSS SP-44 for material not listed in ASME B16.34.

I.7.2.3 Procedure 3—Relief System Connecting Valve Cavity to One Valve Side

I.7.2.3.1 The procedure for cavity-relief testing of trunnion-mounted ball valves with a relief system that connects the valve cavity to one side of the valve shall be as follows:

- a) Fill the valve in the half-open position with hydrostatic test fluid and purge trapped air.
- b) Close the valve.
- c) Close the branch vents.
- d) Apply pressure to the valve cavity until one branch pressure starts to rise; record this relief pressure and port location.

I.7.2.3.2 The valve shall relieve at a differential pressure no greater than 33 % of the valve pressure rating.

EXAMPLE 1 Class 150, 275 psi (19.0 bar): The maximum differential pressure relief is 90 psi (6.2 bar).

EXAMPLE 2 Class 2500, 6250 psi (430.9 bar): The maximum differential pressure relief is 2060 psi (142.1 bar).

I.7.3 Through-conduit Slab Gate Valves with Self-relieving Seats

NOTE For downstream sealing through-conduit gate valves, a center cavity pressure port is

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
required.

I.7.3.1 Slab gate valves with one or more self-relieving seats that are upstream and/or downstream shall internally relieve the excess cavity pressure.

I.7.3.2 The procedure for cavity-relief testing of through-conduit slab gate valves with internal-relieving seats shall be as follows:

a) Fill the valve in the half-open position with hydrostatic test fluid and purge any trapped air.

b) Close the valve (see NOTE 2).

NOTE For through-conduit gate valves with rising stem hydrostatic test fluid, volume may need to be adjusted during the closing stroke.

c) Close both branch vents.

d) Apply MAWP (or other pressure agreed with the purchaser) via one of the valve branches, with the opposite branch vented to atmosphere.

e) Apply pressure to the valve cavity until the pressure in the pressurized branch starts to rise and the seat relieves the cavity pressure into the valve end; record this relief pressure.

I.7.3.3 The valve shall relieve at a differential pressure no greater than 33 % of the valve pressure rating.

I.7.4 Floating Ball Valves

I.7.4.1 Procedure 1

NOTE This procedure requires a test port in the valve body to have access to body cavity.

I.7.4.1.1 The test shall be performed with a hydrostatic test fluid.

I.7.4.1.2 The procedure shall be as follows:

a) Fill the valve in the half-open position with hydrostatic test fluid and purge trapped air.

b) Close the valve.

c) Apply pressure to the valve cavity until one branch pressure starts to release and the seat relieves the cavity pressure into the valve end; record this relief pressure and port location.

I.7.4.1.3 The valve shall relieve at a differential pressure no greater than 33 % of the valve pressure rating.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

I.7.4.2 Procedure 2

NOTE This procedure does not require a test port in the valve body.

I.7.4.2.1 The test shall be performed with nitrogen.

I.7.4.2.2 The procedure shall be as follows:

- a) With the valve in half-open position, pressurize the valve to the valve pressure rating plus the maximum theoretical cavity relief pressure.
- b) Isolate the valve from the pressure source.
- c) Close the ball.
- d) Vent each end to atmospheric pressure.
- e) Close each end of the valve.
- f) Open the valve to the half-open position for the release of trapped pressure in the body cavity.
- g) Monitor the release pressure into the valve bore (only one pressure gauge can be used and installed).

I.7.4.2.3 Acceptance criteria shall be as follows:

- a) Acceptance criteria of the release pressure shall be defined and calculated considering variation of initial pressure at volume of the valve body cavity (closed position) and final pressure at volume (volume of whole valve body + volume of the isolated test rig portion).
- b) Monitored release pressure above the calculated criteria shall be cause for rejection.

I.8.2 High-pressure Gas Shell Test

I.8.2.1 Method

Warning—High-pressure gas testing involves potential hazards. Safety precautions must be taken.

I.8.2.1.1 All gas shell tests specified shall be performed with the valve unseated and partially open, and may be performed with the valve fully open, provided the body cavity is simultaneously filled and pressurized through a cavity connection.

I.8.2.1.2 Test methods used shall be one of the following:

- 1) Method 1: Valves shall have a high-pressure gas shell test performed using air or nitrogen, with the valve submerged in a water bath during testing.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- 2) Method 2: Valves shall have a high-pressure gas shell test performed using nitrogen, with a minimum of 1 % helium tracer measured using a mass spectrometer.
- 3) Method 3: Valves shall have a high-pressure gas shell test performed in a test cell with leakage monitored using test ports.

I.8.2.1.3 The minimum test pressure shall be 1.1 times the pressure rating determined in conformance with 4.3 for the material at 100 °F (38 °C).

I.8.2.1.4 The test duration shall conform to Table I.5.

Table I.5—Minimum Duration of Gas Shell Tests

Valve Size		Test Duration (minutes)
NPS	DN	
≤ 18	≤ 450	15
20 and larger	500 and larger	30

I.8.2.2 Acceptance Criteria

I.8.2.2.1 Acceptance criteria shall satisfy one of the following:

- 1) Method 1: No visible leakage shall be permitted.
- 2) Method 2: A maximum of 0.27 cc/min of nitrogen + helium gas mixture per 1 % of helium shall be permitted when measured at each mechanical joint.

EXAMPLE For 1 % helium gas mixture, the allowable leakage is 0.27 cc/min. For 3 % helium gas mixture, the allowable leakage is 0.81 cc/min. For 10 % helium gas mixture, the allowable leakage is 2.7 cc/min.

- 3) Method 3: Zero leakage through the test ports.
- 4) Pressure or temperature changes defined by the Ideal Gas Law shall not be cause for rejection.

I.8.3 High-pressure Gas Seat Test

I.8.3.1 Method

I.8.3.1.1 Valves shall have a high-pressure gas seat test performed using inert gas (such as nitrogen, helium, etc.) as the test medium.

I.8.3.1.2 The minimum test pressure shall be 1.1 times the pressure rating determined in conformance with 4.3 for the material at 100 °F (38 °C).

I.8.3.1.3 The test duration shall conform to Table 10.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

I.8.3.2 Acceptance Criteria

- a) Leakage for soft-seated valves shall not exceed ISO 5208; Rate A (no visible leakage).
- b) For metal-seated valves, except check valves, the leakage rate shall not be more than two times ISO 5208, Rate C.
- c) For metal-seated check valves, the leakage rate shall not exceed ISO 5208, Rate E.

I.9 Low-pressure Gas Seat Testing

I.9.1 Method

- I.9.1.1 The seat shall be tested as specified in 10.4 at a test pressure between 80 psi and 100 psi (5.5 bar and 6.9 bar) using air or nitrogen as the test medium.
- I.9.1.2 The valve shall be drained of hydrostatic test fluid.
- I.9.1.3 The inner parts shall be fully purged with air prior to the start of the low-pressure gas testing.
- I.9.1.4 Pressure shall be identified as stabilized when the rate of change is no more than 5 % of the test pressure within 5 minutes.

I.9.2 Acceptance Criteria

- I.9.2.1 The acceptable leakage rate for low-pressure gas seat testing shall be:
 - a) ISO 5208, Rate A (no visible leakage) for soft-seated valves;
 - b) ISO 5208, two times Rate C for metal-seated valves, except metal-seated check valves;
 - c) ISO 5208, Rate E for metal-seated check valves.

I.10 Documentation

- I.10.1 The manufacturer shall maintain documentation as specified in Table I.6 for equipment that satisfies QSL1, QSL1G, QSL2 and QSL2G.

Table I.6—Documentation Requirements for Each QSL

Item	Documentation
1	Certificate of conformance to this annex and QSL
2	Pressure test report (including pressure, test duration, test medium, and acceptance criteria) used on pressure test

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

3	Calibration certificates on pressure test equipment used (e.g., pressure gauges, transducers, and chart recorders)
4	Heat-treatment records on all pressure-containing and pressure-controlling parts, including times and temperatures, e.g., charts
5	Material test reports on all pressure-containing and pressure-controlling parts
6	For sour service valves, certificate of conformance to NACE MR0175/ISO 15156
7	General arrangement drawings
8	NDE records
9	Cross-sectional assembly drawings with parts list and materials list, including design code for pressure-containing parts and pressure-boundary bolting
10	Installation, operation, and maintenance instructions/manuals



This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex J
(informative)

Actuator—Gearbox Requirements

J.1 General

J.1.1 This annex specifies requirements for supplementary operator, which shall be performed by the manufacturer if specified by the purchaser.

J.2 Valve Operator Interface

J2.1 The interface between the operator and valve bonnet shall be pressure-balanced to the environment, filled with an appropriate pressure compensating fluid and provided with inlet and outlet pressure-relief valves.

J2.2 The compensating system design shall include the following;

- a) volume changes,
- b) temperature changes,
- c) removal or installation of operator subsea.

Caution—Permanent deformation or failure of drive-train components can occur if they are exposed to thrust or torque exceeding these stress limits.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex K
(normative)

Purchaser-specified Customization—Permissible Deviations to Specified Design and Manufacturing Requirements

K.1 General

- K.1.1 This annex identifies permissible deviations to specified design and manufacturing requirements allowing for customized valves conforming to this document, when specified by the purchaser.

K.2 Intermediate Pressures and Temperature Ratings

- K.2.1 If intermediate pressures and temperature ratings that do not conform to 4.3.1 are required, the pressure-temperature rating may be determined using an industry-accepted design standard according to 5.1.
- K.2.2 Valves with ASME flanged ends shall not be designed to an intermediate rating due to the risk of the valve being transferred to a different application, which may use the full flange rating.
- K.2.3 If the purchaser specifies an intermediate pressure rating, the valve shall be marked with the specified intermediate pressure rating on the body and nameplate (see Table 11 and Table 13).
- K.2.4 Valves with an intermediate pressure-temperature rating shall have a bore size by agreement.

NOTE Conformance to Table 1 is not required.

- K.2.5 The nameplate shall be marked with the agreed bore size.

K.3 Valve Bore

K.3.1 Nominal Size

- K.3.1.1 When specified by the purchaser, a valve bore size not identified in Table 1 (see 4.4.1) shall be permitted.
- K.3.1.2 Valves with an intermediate pressure-temperature rating shall have a bore size as specified.

K.3.2 Non-standard Opening and Reduced-opening Valves

- K.3.2.1 When specified by the purchaser, non-standard opening or reduced-opening valve sizes that do not conform to 4.4.3 or 4.4.4 shall be permitted.
- K.3.2.2 The manufacturer shall stamp the size and bore on the nameplate.

K.4 Non-standard Face-to face and End-to-end Dimensions

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- K.4.1 When specified by the purchaser, face-to-face and end-to-end dimensions that are not shown or do not conform to 5.2.1 shall be permitted.

K.5 End Connectors

- K.5.1 When specified by the purchaser, end connectors that do not conform to 5.2.3.1.1 shall be permitted.
- K.5.2 When specified by the purchaser, weld end connectors that do not conform to 5.2.3.2 shall be permitted.
- K.5.3 When specified by the purchaser, any other end connector that does not conform to 5.2.3 shall be permitted.

EXAMPLE Clamp, compact flange, hub, swivel, special weld ends, etc.

K.6 Flange Bolting for Studded-outlet End Connectors

- K.6.1 When specified by the purchaser, bolting for studded-outlet end connectors in metric dimensions shall be permitted.
- K.6.2 When specified by the purchaser, valve end flanges shall be provided with tapped holes for engaging flange bolting.
- K.6.3 Tapped bolt hole sizes shall be equal to bolt sizes used for the flange.

K.7 Chemical Composition

- K.7.1 When specified by the purchaser, the chemical composition of pressure-containing and pressure-controlling materials that do not conform to 6.3 shall be permitted.

K.8 Charpy Impact Testing

- K.8.1 When specified by the purchaser, charpy impact values for materials not listed in 6.5 shall be permitted.

K.9 Welding Overlay Iron Dilution

- K.9.1 When specified by the purchaser, an iron dilution Class Fe 5 (iron mass fraction 5.0 % maximum) shall be used as part of the CRA weld overlay with nickel-based alloy UNS N06625 as an alternative to 7.5.3.1.

K.10 Weld-overlay Thickness

- K.10.1 When specified by the purchaser, the minimum thickness of the finished corrosion-resistant weld overlay on all surfaces other than that specified in 7.5.3.1 shall be permitted.

K.11 Weld Repair of Forgings and Plate Material

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

K.11.1 When specified by the purchaser, weld repair of forgings and plates shall be acceptable to correct material defects, in conformance with 7.11.4.

K.12 Use of Assembly Lubricant

K.12.1 When specified, no lubricant shall be used on valves during assembly in conformance with 9.7.

K.13 Hydrostatic Shell Testing of One-piece Bodies

K.13.1 Hydrostatic shell testing shall be performed in the non-assembled condition for one-piece bodies with no body penetrations if specified.

K.14 Alternate Seat Test

K.14.1 When specified by the purchaser, performing a high-pressure gas seat test conforming to I.8.3 as an alternative to the hydrostatic seat test of 10.5.1 shall be permitted.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Annex L

(informative)

Specified Customization—Supplemental Options to Specified Design and Manufacturing Requirements

L.1 General

- L.1.1 This annex specifies supplemental requirements that shall be performed by the manufacturer when specified by the purchaser.

L.2 Bending Test

- L.2.1 Bending moment value shall be defined by the purchaser.
- L.2.2 This test shall confirm the valve capability to seal under bending moment.
- L.2.3 Seat test with bending moment applied shall be performed as per 10.5
- L.2.4 Gas seat test with bending moment applied shall be performed per 10.9
- L.2.5 A documented procedure shall be prepared by the manufacturer.

L.3 Reduced-opening Valves with Circular Openings

- L.3.1 Reduced-opening valve sizes less than NPS 4 (DN 100) or greater than NPS 24 (DN 600) shall be specified (see 4.4.3).

L.4 Extended Stem and Shaft Assemblies

- L.4.1 A valve with an extended stem shall be specified.
- L.4.2 Extended stems and shaft assembly service shall conform to 5.3 and 5.4.5.
- L.4.3 Extended stem and shaft assemblies shall be protected by an extension casing (housing).

L.5 Antistatic Testing

- L.5.1 If specified, antistatic testing shall be performed.
- L.5.2 The electrical resistance shall be tested with a power source not exceeding 12 V to have continuity between the parts listed in 5.8 when tested on a dry valve before pressure testing.

L.6 Service Compatibility

- L.6.1 All process-wetted parts, metallic and nonmetallic, and lubricants shall be suitable for

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

the commissioning fluids and service when specified.

L.6.2 Qualification testing of elastomers and thermoplastics shall be performed in accordance with one of the following:

- a) NORSOK M-710; or
- b) ISO 23936 Parts 1 and 2; or
- c) a purchaser-agreed specification; or
- d) a combination of these.

L.7 Pressure Balance Hole

L.7.1 If specified, the closure member in ball or gate valves shall be provided with or without a pressure balance hole; see 14.2.1.

NOTE 1 Typical locations of pressure balance holes are shown in Figure L.1 and Figure L.2.

NOTE 2 Plugging the hole in fouling service may increase the risk of not being able to start or complete the valve stroke when a small-sized operator is used. The absence of a pressure balance hole can allow the body cavity to be vented from the main pipe in the open position and restrict outflow of potential stem leakage or body leakage.

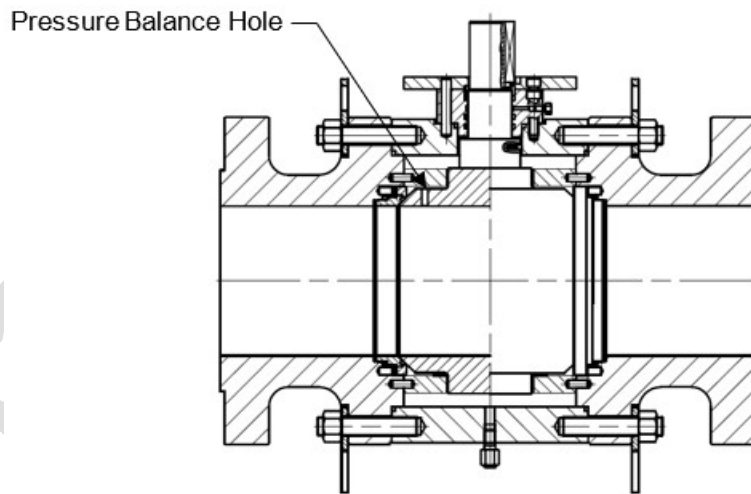


Figure L.1—Pressure Balance Hole for Ball Valve (Typical)

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

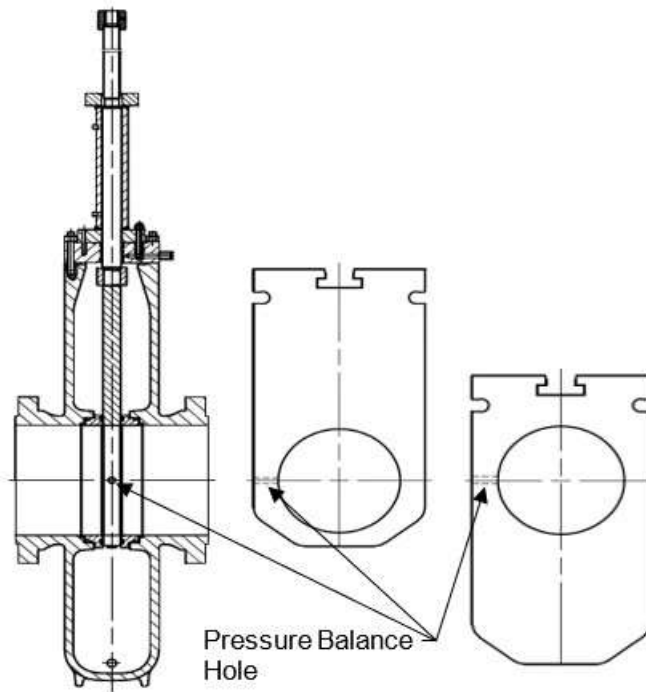


Figure L.2—Pressure Balance Hole for Gate Valve (Typical)

L.8 NDE of Weld End Connector

- L.8.1 If specified, weld end connectors shall be subjected to surface or volumetric NDE or both.
- L.8.2 Volumetric NDE examination of weld end connectors shall be performed for a minimum length equal to 1.5 times the mating pipe wall thickness or 2 in. (50 mm), whichever is greater, using one of the following:
- a) Radiographic testing on weld end connectors of castings shall conform to ASME B16.34, Appendix I. Acceptance shall conform to ASME B16.34, Appendix I.
 - b) Ultrasonic testing on weld end connectors of castings shall conform to ASME B16.34, Appendix IV. Acceptance shall conform to ASME B16.34, Appendix IV.
 - c) Ultrasonic testing on weld end connectors of forgings and plates shall conform to ASME B16.34, Appendix IV. Acceptance shall conform to ASME B16.34, Appendix IV.
- L.8.3 Surface NDE shall be performed on the machined ends of the valve-weld bevel using one of the following:
- a) Magnetic particle testing on weld bevels of weld ends after machining shall conform to ASME BPVC, Section V, Article 7. Acceptance shall conform to ASME BPVC, Section VIII, Division 1, Appendix 6.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

- b) Penetrant testing on weld bevels of weld ends after machining shall conform to ASME BPVC, Section V, Article 6. Acceptance shall conform to ASME BPVC, Section VIII, Division 1, Appendix 8.

L.9 Double Block and Bleed (DBB) Valves

L.9.1 If specified, double block and bleed (DBB) valves shall undergo additional testing.

L.9.2 The testing shall be performed as follows:

- a) With the valve unseated and partially open, the valve and its cavity shall be filled with test fluid.
- b) The valve shall then be closed, and the valve body vent valve opened to allow excess test fluid to overflow from the valve-cavity test connection.
- c) The test pressure shall be applied simultaneously from both valve ends.
- d) Seat tightness shall be monitored via overflow through the valve cavity connection.
- e) Acceptance criteria shall be per the requirements of 10.4.1, except that for the metal-to-metal seat test, the leakage rate shall not be more than two times ISO 5208, Rate C.

L.9.3 Requirements of L.9 shall be performed by the manufacturer and shall not be outsourced.

L.10 Double Isolation and Bleed DIB-1 (Both Seats Bidirectional)

L.10.1 If specified, each seat in a double isolation and bleed (DIB-1) valve shall be tested in both directions.

L.10.2 The testing shall be performed as follows:

- a) Cavity-relief valves shall be removed, if fitted.
- b) The valve and cavity shall be filled with test fluid, with the valve unseated and partially open, until the test fluid overflows through the cavity-relief connectors.
- c) To test for seat leakage in the direction of the cavity, the valve shall be closed.
- d) The test pressure shall be applied successively to each valve end to test each seat separately from the upstream side. Leakage shall be monitored via the valve cavity pressure-relief connectors.
- e) Thereafter, each seat shall be tested as a downstream seat. Both ends of the valve shall have the ends open to atmosphere and the valve cavity filled with test fluid.
- f) Pressure shall then be applied while monitoring leakage through each seat at both ends of the valve.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

NOTE Some valve types (e.g., slab gate valves) can require the balancing of the upstream and valve cavity pressure during the downstream seat test, in which case only one end of the valve shall be open to atmosphere.

- g) Acceptance criteria shall be per the requirements of 10.4.1, except that for the metal-to-metal seat test, the leakage rate shall not be more than two times ISO 5208, Rate C.

L.10.3 Requirements of L.10 shall be performed by the manufacturer and shall not be outsourced.

L.11 Double Isolation and Bleed DIB-2 (One Unidirectional and One Bidirectional Seat)

L.11.1 If specified, the bidirectional seat in a double isolation and bleed (DIB-2) valve shall be tested in both directions.

L.11.2 The testing shall be performed as follows:

- a) Cavity-relief valves shall be removed, if fitted.
- b) The valve and cavity shall be filled with test fluid, with the valve unseated and partially half-open, until the test fluid overflows through the cavity-relief connectors.
- c) To test for seat leakage in the direction of the cavity, the valve shall be closed.
- d) The test pressure shall be applied successively to each valve end to test each seat separately from the upstream side. Leakage shall be monitored via the valve cavity pressure-relief connectors.
- e) To test the bidirectional seat from the cavity test, pressure shall be applied simultaneously to the valve cavity and upstream end. Monitor leakage at the downstream end of the valve.
- f) Acceptance criteria shall be per the requirements of 10.4.1, except that for the metal-to-metal seat test, the leakage rate shall not be more than two times ISO 5208, Rate C.

L.11.3 Requirements of L.11 shall be performed by the manufacturer and shall not be outsourced.

L.12 Operations Testing—Valves Required for Double Isolation and Bleed (DIB-1 or DIB-2)

L.12.1 If specified, valves required for double isolation and bleed (DIB) operations shall be tested.

L.12.2 The testing shall be performed as follows:

- a) Test fluid shall be hydrostatic test fluid that conforms to 10.1.2 or nitrogen gas,

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
as specified.

- b) The following steps shall be performed. For DIB-1 valves, follow steps 1 through 9. For DIB-2 valves, follow steps 1 through 8.
 - 1) With the valve partly open, fill the valve with test medium and pressurize to valve MAWP.
 - 2) Close the valve.
 - 3) Reduce pressure on the downstream side of the valve to zero and monitor cavity pressure.
 - 4) Monitor leakage between the cavity and downstream side.
 - 5) Reduce pressure in the cavity to zero and monitor upstream pressure and monitor leakage to the downstream side.

NOTE For steps 5, 6, and 7, the pressure changes are done at a rate that minimizes the likelihood of rapid seat movement.

 - 6) Reintroduce pressure into the cavity up to 145 psi (10 bar) and monitor leakage to the downstream side.
 - 7) Reduce pressure in the cavity to zero and monitor leakage to the downstream side.
 - 8) With the cavity and downstream side vented to zero, measure upstream seat performance by monitoring leakage at the cavity port.
 - 9) Repeat steps 1 through 8 on the opposite side of the valve.
- c) Leakage for soft-seated valves shall not exceed ISO 5208, Rate A (no visible detectable leakage for the duration of the test at test pressure).
- d) For metal-seated valves, the leakage rate shall not exceed ISO 5208, Rate C; however, for valves tested with gas, the leakage rate shall not exceed ISO 5208, Rate D.

L.12.3 Requirements of L.12 shall be performed by the manufacturer and shall not be outsourced.

L.13 High-pressure Stem Seal Integrity Testing

L.13.1 General

L.13.1.1 Valves shall have a high-pressure gas stem seal integrity test performed by using one of the following methods:

- a) Method 1: Test shall be performed using 100 % nitrogen measured using a bubble

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

counter/soap solution, or

b) Method 2: Test shall be performed using 100 % nitrogen submerged in a water bath.

L.13.1.2 The minimum test pressure for all methods shall be 1.1 times the pressure rating determined in accordance with 5.2 for the material at 100 °F (38 °C).

L.13.1.3 The test duration for all methods shall be a minimum of 15 minutes.

L.13.2 Acceptance Criteria

L.13.2.1 Acceptance criteria shall be no visible leakage allowed.

L.14 Drive Train Strength Test

L.14.1 If specified, the drive train strength test for axial, ball, gate, or plug valves shall be performed and the results recorded. The test torque shall be the greater of:

a) two times the manufacturer's predicted breakaway torque/thrust; or

b) two times the measured breakaway torque/thrust.

L.14.2 The test torque shall be applied with the closure member blocked for a minimum time of 1 minute.

NOTE For gate valves, the thrust can be tensile or compressive, whichever is the most stringent condition. The test shall not cause any permanent visible deformation of the train.

L.14.3 For ball valves, the total torsional deflection of the extended drive train when delivering the design torque shall not exceed the overlap contact angle between the seat and closure member.

L.15 Valve Orientation

L.15.1 The required operating orientation of the valve shall be specified when other than stem-vertical, pipeline- horizontal.

L.15.2 When the operating orientation has been specified, the manufacturer shall provide installation, operation, and maintenance instructions for the valve.

L.15.3 Pressure testing per Section 10 shall be performed on one valve at the specified orientation unless otherwise specified by the purchaser.

L.16 Disassembly/Maintenance Tools

L.16.1 The manufacturer shall inform the purchaser if special (designed by the manufacturer) tools are required for disassembly or maintenance.

L.16.2 If specified, special tools shall be supplied with the valves.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

L.16.3 The manufacturer shall provide instructions for use of the special tools.

L.16.4 If specified, special tools shall be tested to demonstrate functionality.

L.17 Corrosion-resistant Metallic Surfaces

L17.1 If specified, corrosion-resistant metallic surfaces shall be required on lip seal or V-packing sealing surfaces.

L.18 Hardness Testing - Production Parts for Sour Service

L.18.1 If specified, a production material hardness test on all metallic pressure-containing and pressure- controlling parts for sour service shall be performed.

L.18.2 The maximum hardness shall be per NACE MR0175/ ISO 15156 requirements.

L.18.3 The method of hardness testing shall be performed in accordance with the following:

- a) For HBW hardness measurements testing shall be performed in accordance with ASTM E10 or ISO 6506-1.
- b) For HRC hardness measurements, testing shall be performed in accordance with ASTM E18 or ISO 6508-1.

L.18.4 Portable hardness measurements shall be performed in accordance with ASTM E110.

L.18.5 Hardness testing shall not be performed on the sealing surfaces of finished machined parts.

L.18.6 Results of the production hardness testing shall be reported and records maintained (see 14.1).

NOTE This hardness test may be performed by the supplier on the material provided and reported on the material test report.

L.19 Low-pressure Gas Seat Testing

L.19.1 Low-pressure Gas Seat Testing—Type I

L.19.1.1 Method

L.19.1.1.1 The valve shall be seat tested as specified in 10.4 and repeated at a test pressure between 5 psi and 14.5 psi (0.34 barg and 1 bar), using air or nitrogen as the test medium.

L.19.1.1.2 The closure member and leakage measurement connection port shall be purged with air with the valve half open.

L.19.1.1.3 Following pressurization and prior to commencing seat leakage measurement, the valve

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved
shall be fully stabilized.

- L.19.1.1.4 The valve stabilization period shall not begin until the test pressure in the valve remains constant for at least 2 minutes.
- L.19.1.1.5 During the stabilization period, the outlet port from where leakage is to be measured shall remain connected to the leak detection device (e.g., flow meter or water-filled bubble counter vessel) and shall be monitored for the duration.
- L.19.1.1.6 The stabilization period duration shall not be less than as specified in Table L.1.

Note The duration can be extended in case stabilization is not achieved.

Table L.1—Stabilization Period Duration

Size	Duration (minutes)
DN 100 (NPS 4) and below	5
DN 150 (NPS 6) to DN 250 (NPS 10)	10
DN 300 (NPS 12) to DN 450 (NPS 18)	15
DN 500 (NPS 20) and above	30

- L.19.1.1.7 Following stabilization, the seat leakage test shall begin.

L.19.1.2 Acceptance Criteria

- L.19.1.2.1 The acceptable leakage rate for low-pressure gas seat testing shall be:
 - a) ISO 5208, Rate A (no visible leakage) for soft-seated valves and lubricated-plug valves;
 - b) ISO 5208, two times Rate C for metal-seated valves, except metal-seated check valves;
 - c) ISO 5208, Rate E for metal-seated check valves.

L.19.2 Low Pressure Gas Seat Testing—Type II

L.19.2.1 Method

- L.19.2.1.1 The valve shall be seat tested as specified in 10.4 and repeated at a test pressure between 80 psi and 100 psi (5.5 bar and 6.9 bar) using air or nitrogen as the test medium.
- L.19.2.1.2 The valve shall be drained of hydrostatic test fluid and the inner parts shall be fully purged with air prior to the start of the low-pressure gas testing.
- L.19.2.1.3 Pressure shall be identified as stabilized when the rate of change is no more than 5 % of

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

the test pressure within 5 minutes.

L.19.2.2 Acceptance Criteria

L.19.2.2.1 The acceptable leakage rate for low-pressure gas seat testing shall be:

- a) ISO 5208, Rate A (no visible leakage) for soft-seated valves and lubricated-plug valves;
- b) ISO 5208, two times Rate C for metal-seated valves, except metal-seated check valves;
- c) ISO 5208, Rate E for metal-seated check valves.

L.20 High-pressure Gas Testing

L.20.1 General

L.20.1.1 If specified, high-pressure gas testing shall be performed.

L.20.1.2 The valve shall be drained of hydrostatic test fluid and the inner parts shall be fully purged with air prior to the start of the high-pressure gas testing.

L.20.2 High-pressure Gas Shell Test

L.20.2.1 Method

Warning—High-pressure gas testing involves potential hazards. Safety precautions must be taken.

L.20.2.1.1 All gas shell tests specified shall be performed with the valve unseated and partially open, and may be performed with the valve fully open, provided the body cavity is simultaneously filled and pressurized through a cavity connection.

L.20.2.1.2 Test methods used shall be one of the following:

- a) Method 1: Valves shall have a high-pressure gas shell test performed using air or nitrogen, with the valve submerged in a water bath during testing.
- b) Method 2: Valves shall have a high-pressure gas shell test performed using nitrogen with a minimum of 1 % helium tracer measured using a mass spectrometer.

NOTE By agreement, when the appropriate safety precautions are taken, the high-pressure gas shell test may be performed in a test cell and not submerged in a water bath.

L.20.2.1.3 The minimum test pressure shall be 1.1 times the pressure rating determined in conformance with 4.3 for the material at 100 °F (38 °C).

L.20.2.1.4 The test duration shall conform to Table L.2.

Table L.2—Minimum Duration of Gas Shell Tests

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Valve Size		Test Duration (minutes)
NPS	DN	
18	450	15
20 and larger	500 and larger	30

L.20.2.2 Acceptance Criteria

L.20.2.2.1 Acceptance criteria shall satisfy one of the following:

- a) Method 1: When the valve is tested by submerged method, no visible leakage shall be permitted.
- b) Method 2: When using a mass spectrometer, a maximum of 0.27 cc/min of nitrogen + helium gas mixture shall be permitted when measured at each mechanical joint.

EXAMPLE For 1 % helium gas mixture, the allowable leakage is 0.27 cc/min. For 3 % helium gas mixture, the allowable leakage is 0.81 cc/min. For 10 % helium gas mixture, the allowable leakage is 2.7 cc/min.

L.20.3 High-pressure Gas Seat Test

L.20.3.1 Method

L.20.3.1.1 Valves shall have a high-pressure gas seat test performed using inert gas (such as nitrogen, helium, etc.) as the test medium.

L.20.3.1.2 The minimum test pressure shall be 1.1 times the pressure rating determined in conformance with 4.3 for the material at 100 °F (38 °C).

L.20.3.1.3 The test duration shall conform to Table 10.

L.20.3.2 Acceptance Criteria

L.20.3.2.1 Leakage for soft-seated valves and lubricated plug valves shall not exceed ISO 5208, Rate A (no visible leakage).

L.20.3.2.2 For metal-seated valves, except check valves, the leakage rate shall not be more than two times ISO 5208, Rate C.

L.20.3.2.3 For metal-seated check valves, the leakage rate shall not exceed ISO 5208, Rate E.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Bibliography

- [1] ASNT ACCP-CP-1, ASNT Central Certification Program
- [2] API Specification 20A, Carbon Steel, Alloy Steel, Stainless Steel, and Nickel Base Alloy Castings for Use in the Petroleum and Natural Gas Industry
- [3] API Specification 20B, Open Die Shaped Forgings for Use in the Petroleum and Natural Gas Industry
- [4] API Specification 20C, Closed Die Forgings for Use in the Petroleum and Natural Gas Industry
- [5] API Standard 20D, Qualification of Nondestructive Examination Services for Equipment Used in the Petroleum and Natural Gas Industry
- [6] API Standard 20G, Qualification of Suppliers of Welding Services for Use in the Petroleum and Natural Gas Industry
- [7] API Standard 20H, Heat Treatment Services-Batch Type for Equipment Used in the Petroleum and Natural Gas Industry
- [8] API Standard 20J, Qualification of Distributors of Metallic Materials for Use in the Petroleum and Natural Gas Industry
- [9] API Standard 20L, Qualification of Polymeric Seal Manufacturers for Use in the Petroleum and Natural Gas Industry
- [10] API Standard 20M, Qualification of Suppliers of Machining Services for Use in the Petroleum and Natural Gas Industry
- [11] API Standard 20N, Heat Treatment Services –Continuous Line for Equipment Used in the Petroleum and Natural Gas Industry
- [12] API Specification Q1, Specification for Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry
- [13] API Specification 17D, Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment, Second Edition, May 2011
- [14] API Recommended Practice 17H, Remotely Operated Tools and Interfaces on Subsea Production Systems
- [15] API Recommended Practice 6HT, Heat Treatment and Testing of Carbon and Low Alloy Steel Large Cross Section and Critical Section Components
- [16] API Specification 6A, Specification for Wellhead and Christmas Tree Equipment
- [17] API Technical Report 21TR1, Selection for Bolting Materials
- [18] ASTM E8, Standard Test Methods for Tension Testing of Metallic Materials

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

[19] ASTM E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

[20] ASTM A577, Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates

[21] ASTM A923 ¹⁰, Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels

[22] DNVGL-ST-F101, Submarine Pipeline Systems – rules and standards

[23] DNVGL-RP-F112 ¹¹, Duplex stainless steel – design against hydrogen induced stress cracking

[24] ASME BTH-1, Design of Below-the-Hook Lifting Devices

[25] EN 12516-1 ¹², Industrial valves—Shell design strength—Part 1: Tabulation method for steel valve shells

[26] EN 12516-2, Industrial valves—Shell design strength—Part 2: Calculation method for steel valve shells

[27] EN 13445-3, Unfired pressure vessels—Part 3: Design

[28] ISO 5210 ¹³, Industrial valves—Multi-turn valve actuator attachments

[29] ISO 5211, Industrial valves—Part-turn actuator attachments

[30] ISO 9001, Quality management systems—Requirements

[31] MSS SP-25 ¹⁴, Standard Marking System for Valves, Fittings, Flanges, and Unions

[32] MSS SP-44, Steel Pipeline Flanges

¹⁰ ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.

¹¹ DNV GL, Veritasveien 1, 1363 Hovik, Norway, www.dnvgl.com.

¹² European Committee for Standardization, Avenue Marnix 17, B-1000 Brussels, Belgium, www.cen.eu.

¹³ International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, www.iso.org.

¹⁴ Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, NE, Vienna, Virginia 22180-4602, www.mss-hq.com.

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved

Ballot Draft

This document is not an API Standard; it is under consideration within an API technical committee but has not received all approvals required to become an API Standard. It shall not be reproduced or circulated or quoted, in whole or in part, outside of API committee activities except with the approval of the Chairman of the committee having jurisdiction and staff of the API Standards Dept. Copyright API. All rights reserved



AMERICAN PETROLEUM INSTITUTE

200 Massachusetts Avenue, NW Suite 1100
Washington, DC 20001-5571 USA

202-682-8000

Additional copies are available online at www.api.org/pubs

Phone	1-800-854-	(Toll-free in the U.S. and
	303-397-	(Local and International)
Fax	303-397-	

Information about API publications, programs and services is available on the web at www.api.org.

Product No. G6DSS3