Repair and Remanufacture of Drill-through Equipment

API STANDARD 16AR
SECOND EDITION, JANUARY 2025



Special Notes

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

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

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to ensure 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 used. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer, remanufacturer, or repairer 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 and for otherwise ensuring the quality and safety of the marked product. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard or otherwise endorse such products' quality or safety. Nor does API undertake any duties that the licensed manufacturer, repairer, or remanufacturer owes to third parties.

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 20001-5571.

Copyright © 2025 American Petroleum Institute

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 to conform to the standard.

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

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

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

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

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

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

Contents

Page

1 Scope 1

2 Normative References 3

3 Terms, Definitions, Acronyms, and Abbreviations 6
3.1 Terms and Definitions 6
3.2 Acronyms and Abbreviations 14

4 Quality Control Requirements 15
4.1 General 15
4.2 Measuring and Testing Equipment 16
4.3 Quality Control Personnel Qualifications 16
4.4 Quality Control Requirements for Equipment and Parts 18
4.5 Quality Control Requirements for Specific Equipment and Parts 20
4.6 Quality Control Records 30
4.7 Repair and Remanufacture Specification Levels 31

5 Quality Management System Requirements 34
5.1 General 34
5.2 Control of Documents 34
5.3 Training and Awareness 34
5.4 Control of Testing, Measuring, and Monitoring Equipment 35
5.5 Contract Review 35
5.6 Purchasing Control 35
5.7 Design and Development 36
5.8 Control of Nonconforming Product 37

6 Responsibilities 38
6.1 General 38
6.2 Manufacturer 38
6.3 Remanufacturer 38
6.4 Equipment Owner Input 39

7 Repair/Remanufacture Specification Level Minimum Requirements 39
7.1 General 39
7.2 Factory Acceptance Testing 39
7.3 Dimensional Check 44
7.4 NDE—Initial Inspection 44
7.5 Inspection of Closure Bolting 45
7.6 Visual Inspection at Disassembly 45
7.7 Replacement Parts 45
7.8 General Equipment Specifications 46
7.9 Documentation 46
7.10 Failure Reporting 46

8 Materials 46
8.1 General 46
8.2 Metallic Parts 46
8.3 Nonmetallic Parts 47
8.4 Base Metal Material Identification 47
8.5 Pressure-containing Members 49

Contents

Page

9 Welding Requirements 53
9.1 General 53
9.2 Weld Maps 53
9.3 Weldment Design and Configuration 54
9.4 Welding Controls 56
9.5 Welding Procedure and Performance Qualifications 59
9.6 Other Welding Qualification Requirements 61
9.7 Other Requirements 70
9.8 Documentation Requirements 70

10 Marking Requirements 71
10.1 General 71
10.2 Metallic Components Marking 74
10.3 Corrosion-resistant Overlay 74
10.4 Wellbore Nonmetallic Components 74
10.5 Non-wellbore Nonmetallic Components 74
10.6 Specific Codification Requirements of Equipment 74

11 Storing and Shipping 74
11.1 Storing Periods Greater than 30 Days 74
11.2 Shipping 75

12 Certification 75
12.1 General 75
12.2 Certificate of Conformance 75
12.3 Certificate of Service 76
12.4 Statement of Fact 76

Annex A (normative) General Equipment Specifications 77

Annex B (normative) Manufacturing Data Book Requirements 79

Annex C (normative) Product History File Requirements 81

Annex D (normative) Design Ownership 83

Annex E (normative) Minimum Requirements for Certificate of Conformance 84

Annex F (informative) Recommended Weld Preparation Design Dimensions 88

Annex G (normative) Qualification of Heat-Treating Equipment 91

Annex H (informative) RSL Designation for Systems and Assemblies 94

Annex I (normative) Charpy V-notch Impact Tests Location for Weld Qualification 95

Annex J (normative) Minimum Requirements for Certificate of Service 97

Annex K (normative) Minimum Requirements for Statement of Fact 99

Annex L (normative) PAUT for Bolts and Shafts 101

Contents

Page

Bibliography 117

Figures

1 Simplified Example of Surface Drill-through Equipment 2
2 Simplified Example of Subsea Drill-through Equipment 3
3 Logic for Classification as Corrosion Resistant 55
4 Rockwell Hardness Test Locations 63
5 Vickers Hardness Test Locations 65
6 Hardness Test Locations for Weld Overlay 66
7 Typical Mechanical Specimen Removal for Welding Procedure Qualification 70
D.1 Design Ownership Flow Diagram 83
E.1a Certificate of Conformance (Part 1) 86
E.1b Certificate of Conformance (Part 2) 87
F.1 Typical Weld Grooves for Pipe Butt Joints 88
F.2 Typical Attachment Welds 89
F.3 Typical Repair Welds 90
F.4 Repairs 90
G.1 Thermocouple Locations—Rectangular Furnace (Working Zone) 93
G.2 Thermocouple Locations—Cylindrical Furnace (Working Zone) 93
H.1 Flow Diagram for Remanufactured and Replacement Parts 94
I.1 Location of Charpy V-notch Impact Test 96
L.1 Simulator Bolt 103
L.2 Simulator Stud 104
L.3 Simulator Threaded Bar 104
L.4 Primary Reference Level Zones 111

Tables

1 Weld Inclusion Criteria 24
2 Minimum Hardness Requirements 27
3 Quality Control Requirements 32
4 Material Property Requirements for Pressure-containing Members 49
5 Material Applications for Pressure-containing Members 49
6 Acceptance Criteria for Charpy V-notch Impact Tests 51
7 Chemical Composition of Austenitic or 300-series Stainless Steels 68
8 Chemical Composition of the Nickel-based Alloy UNS06625 68
9 Marking Requirements and Location 72
B.1 Manufacturing Data Book 79
C.1 Product History File 81
L.1 Reflector Dimensions 102
L.2 Requirements of Phased Array Linear Scanning Examination Procedures 107

Repair and Remanufacture of Drill-through Equipment

1 Scope

This standard specifies requirements for repair and remanufacture of drill-through equipment built under API 16A.

This standard also covers the testing, inspection, welding, marking, certification, handling, storing, and shipping of equipment repaired or remanufactured per this standard.

This standard is applicable to and establishes requirements for the repair and remanufacture of the following specific equipment:

a) ram blowout preventers (BOPs);

b) ram blocks; operators;

c) annular BOPs;

d) hydraulic connectors;

e) drilling spools;

f) spacer spools;

g) adapters;

h) loose connections;

i) clamps;

j) other end connections (OECs).

Dimensional interchangeability is limited to end and outlet connections. Simplified examples of surface and subsea equipment defined by this standard are shown in Figure 1 and Figure 2 which may or may not include all items noted in the scope.

Maintenance activities are not governed by this document, but the documentation of those activities when part of the contracted workscope is included in the scope.

Repair activities performed by the equipment owner are not governed by this document, but the documentation of those activities when part of the contracted workscope is included in the scope.

This standard defines various repair/remanufacture specification levels (RSLs) for the equipment identified below as well as the mandatory equipment traceability that is required to prove conformance.