

Electrical and Electronic Components for Use in Downhole Completion Equipment

API SPECIFICATION 19E
FIRST EDITION, SEPTEMBER 2024



American
Petroleum
Institute

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

All rights reserved. No part of this work may be reproduced, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001-5571.

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.

Currently in preview, click buy full version

Contents

	Page
1 Scope.....	1
2 Normative References	2
3 Terms, Definitions, Acronyms, and Abbreviations	2
3.1 Terms and Definitions	3
3.2 Acronyms and Abbreviations	7
4 Functional Specification	8
4.1 Functional Requirements	8
4.2 Product type and configuration	9
4.3 Well Parameters	10
4.4 Operational Parameters	10
4.5 Environmental Compatibility	11
4.6 System Architecture	12
4.7 Compatibility with Related Equipment	12
4.8 Installation Considerations	12
4.9 Design Validation	13
4.10 Quality Control	13
5 Technical Specification	13
5.1 General	13
5.2 Electrical and Electronic Terms	14
5.3 Structure of Electrical/Electronic Equipment.....	14
5.4 General Functions	15
5.5 Telemetry Function	35
5.6 Actuation Function	36
5.7 Sensing Function	40
5.8 Energy Storage Function	44
5.9 Design Changes	50
6 Supplier/Manufacturer Requirements	52
6.1 General	52
6.2 Documentation and Data Control	52
6.3 Product Identification	55
6.4 Quality Requirements	55
6.5 Functional Acceptance Test	61
6.6 Obsolescence Management Plan	62
7 Redress and Repair	62
8 Shipment and Storage	62
Annex A (informative) Actuators	64
Annex B (informative) Reliability.....	69
Annex C (normative) Standalone Sensing Devices Functional Acceptance Testing	80
Annex D (informative) System Integration Testing	83

Contents

	Page
Bibliography.....	85

Figures

1	Example of Well Equipment and Associated Specifications.....	9
2	Structure of Electrical/Electronic Equipment.....	15
3	Example Pressure Chamber Configurations.....	17
4	Standalone Electronics Chamber.....	21
5	Electronics Chamber Connected to Another Assembly (e.g. pressure sensor) via a Presst. Bulkhead..	21
6	Electronics Chamber Connected to Another Assembly (e.g. actuator) with Pressure Compensation.....	21
7	Example of Pressure and Temperature Cycles.....	23
8	Acceleration Spectral Density Over Frequency Range.....	27
A.1	General Overview of an Actuation Module.....	64
A.2	Main Components of an Electromechanical Actuation System.....	65
A.3	Main Components of an Electrically Powered Solenoid Actuation System.....	65
A.4	Main Components of an Electrohydraulic Actuation System.....	65
B.1	Bathtub Curve Derived from Multiple Weibull Curves.....	70
B.2	Impact of Confidence Limits.....	71

Tables

1	Summary of API Recommended Practice 19E Annex.....	13
2	Summary of Testing Requirements and Associated Sections.....	20
3	Example Effect of Temperature on Acceleration Factor.....	30
4	Example of RDT Qualification Times for Various Operating and Test Conditions.....	32
5	Summary of Reliability Statement Default Values.....	32
6	Example of Reliability Statement Based on RDT Derived from 4 DUTs at 160 °C for 26 Weeks.....	33
7	Summary of Minimum Actuation Cycles Validation Requirements.....	39
8	Summary of Battery Pack Specific Testing.....	46
9	Rated Energy Storage Life's Test Duration.....	48
A.1	Examples of Design Parameters for Actuators.....	68
B.1	Examples of Acceleration Factor.....	72
B.2	Symbols Used in Equations.....	72
B.3a	ALT Worked Example Failures.....	75
B.3b	ALT Worked Example Failures.....	75
B.4	Reliability Statement for ALT Worked Example.....	75
B.5	Example Impact of Failure on Test Duration.....	77
B.6	Reliability Statement for RDT Worked Example.....	78
B.7	Comparison of Worked Examples.....	78
C.1	Summary of Functional Acceptance Testing for Stand-alone Sensing Devices.....	80

Electrical and Electronic Components for Use in Downhole Completion Equipment

1 Scope

This specification provides the requirements for electrical/electronic components and assemblies used in downhole completion equipment as they are defined herein for use in the petroleum and natural gas industries.

Electrical/electronic components and assemblies related to equipment covered under API specifications such as API 11D1, API 14A, API 19AC, API 19CI, API 19ICV, API 19G1, API 19G2 and API 19V are included. This specification is intended to be complimentary to other API specifications. When other API specifications require that any included electrical/electronic components or assemblies meet the requirements of this specification, the requirements defined in this specification are in addition to any other requirements specified by these other API specifications. Included are the minimum requirements for a functional specification, design verification, design validation of performance ratings, manufacturing quality assurance, functional acceptance testing, shipping, handling, and storage.

This specification covers electrical/electronic downhole completions equipment and assemblies including:

- Sensing devices such as permanent downhole and wireless gauge systems position sensors.
- Actuation devices intended for use in applications such as safety valves, interval control valves, chemical injection valves, gas lift valves, built-in setting devices.
- In-well control devices used for control of a single device or consolidation of multiple gauge/sensing, or actuation devices.
- Telemetry devices.
- Electrical energy storage devices (including batteries). Any non-electrical storage devices such as springs, gases, hydraulic devices are not in scope of this specification.
- Other downhole equipment containing electrical/electronic components, as applicable, such as wireless couplers (inductive, capacitive), solenoids, motors, relays, transducers.

Testing/equipment not covered by this specification are:

- Electric submersible pumps (ESP).
- Optical downhole gauges where electrical/electronic components are above the tubing hanger.
- Perforating tools.
- Service tools and electrical/electronic systems used during deployment/recovery and logging such as measurement-while-drilling (MWD) systems.
- Through-tubing setting or service tools.
- Well head and other related equipment.
- Subsea control systems.
- Tubing encased conductor (TEC), tubing encased fiber (TEF), associated mechanical splices, mechanical connectors (dry-mates, in-well wet-mates) and clamps.