

Evaluation of Well Performors

API RECOMMENDED PRACTICE 19B
THIRD EDITION, JULY 2021

ADDENDUM 1, MARCH 2023



Special Notes

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

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

Users of this Recommended Practice should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

Work sites and equipment operations may differ. Users are solely responsible for assessing their specific equipment and premises in determining the appropriateness of applying the Recommended Practice. At all times users should employ sound business, scientific, engineering, and judgment safety when using this Recommended Practice.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks

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.

Contents

	Page
1	Scope..... 1
2	Normative References 1
3	Terms, Definitions, and Abbreviations..... 2
3.1	Terms and Definitions 2
3.2	Abbreviations 2
4	Evaluation of Perforating Systems..... 3
4.1	Evaluation of Perforating Systems under Surface Conditions, Concrete Targets (Section I Test)..... 3
4.2	Evaluation of Perforators using Stressed Rock Targets (Section II Test)..... 9
4.3	Evaluation of Perforator Systems at Elevated Temperature Conditions, Steel Targets (Section III Test) ... 20
4.4	Evaluation of Perforation Flow Performance Under Simulated Downhole Conditions (Section IV Test) ... 25
4.5	Debris Collection Procedure for Perforating Guns (Section V Test) 50
4.6	Evaluation of Perforator Systems to Determine Swell (Section VI Test)..... 56
	Annex A (informative) Test Target and Equipment—Section IV Testing 59
	Annex B (informative) Permeability Measurement—Section IV Testing..... 62
	Annex C (informative) Data Reduction; Expected Flow Rates—Section IV Testing..... 65
	Annex D (informative) API 19B Perforator Witness and Registered Design Program..... 67
	Bibliography..... 68

Figures

1	Example Concrete Target 3
2	Diagram 1 in. × 2 in. Test Sample Post Failure; Demonstrating Shear Failure Angle Required for a Valid UCS Test..... 12
3	Diagram 1 in. × 2 in. Test Sample Post Failure; Failed to Demonstrate a Shear Failure Model for a Valid UCS Test..... 13
4	Suggested Position of Cutter Scratch vs. Bedding Planes 14
5	Test Set Up Schematic 16
6	Schematic Illustration of Steel Target for Elevated Temperature Test..... 21
7	Typical Axial-Flow Permeability Equipment 28
8	Typical Diametral Flow Permeability Equipment..... 30
9	Schematic of Typical Testing Equipment 32
10	Typical Radial-flow Geometry 36
11	Typical Axial-flow Geometry..... 37
12	Productivity Index Data Reduction Graph..... 42
13	Example Gas Flow Curve Fit to Determine a_1 and a_2 46
14	Post-Shot Radial Flow for a Gas Saturated Core 47
15	Section IV Standard Test Data Recording Sheet..... 49
16	Drift Gage Drawing 58
A.1	Typical Radial-flow Geometry 60
A.2	Typical Axial-flow Geometry..... 61

Contents

	Page
A.3 Schematic of Typical Testing Equipment	61
B.1 Typical Axial-flow Permeability Equipment	63
B.2 Typical Diametral-flow Permeability Equipment.....	64

Tables

1 Permissible Variations of Specimen Mold.....	5
2 Casing and Tubing for Use in Test Target.....	6
3 Casing Selection Requirements	57

Evaluation of Well Perforators

1 Scope

This recommended practice describes standard procedures for evaluating the performance of perforating equipment so that representations of this performance may be made to the industry under a standard practice.

[Section 4](#) provides methods for evaluating perforator or system performance, or both, in four ways:

- a) performance under ambient temperature and atmospheric pressure test conditions into standard casing and concrete targets (4.1);
- b) individual shots into Berea sandstone targets at various defined stressed conditions, with wellbore and pore pressures at nominally ambient conditions (4.2);
- c) how performance can be changed after exposure to elevated temperature conditions (4.3);
- d) flow performance of a perforation under specific stressed test conditions (4.4).

[Section 4.5](#) provides a procedure to quantify the amount of debris that comes out of a perforating gun during detonation, and during conveyance out of the well. [Section 4.6](#) provides a procedure to measure the swell of a perforating gun.

The purpose of this recommended practice is to specify the materials and methods used to evaluate objectively the performance of perforating systems or perforators.

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 Specification 10A, *Specification for Cements and Materials for Well Cementing*

API Standard 19C, *Measurement of and Specifications for Proppants Used in Hydraulic Fracturing and Gravel-packing Operations*

API Specification 19PT, *Downhole Perforating Tools*

ASTM A29, *Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought*

ASTM C109, *Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)*

ASTM C150, *Standard Specification for Portland Cement*

ASTM D3740, *Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction*

ASTM D4543, *Practices for Preparing Rock Core as Cylindrical Test Specimens and Verifying Conformance to Dimensional and Shape Tolerance*

ASTM D7012-14e1, *Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures*