

# **Manual of Petroleum Measurement Standards Chapter 20.5**

## **Recommended Practice for Application of Production Well Testing in Measurement and Allocation**

FIRST EDITION, DECEMBER 2017

ERRATA 1, AUGUST 2023



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.

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 representative 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.

Copyright © 2017 American Petroleum Institute. 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, Washington, DC 20001.

## Foreword

This edition of API Manual of *Petroleum Measurement Standards (MPMS)* Chapter 20.5 supersedes the below listed sections of API *MPMS* Chapter 20.1, *Allocation Measurement*, First Edition, 1993:

- 1.7.2.2.2 Test Separator;
- 1.11.1 Well Tests;
- 1.16.3.2 Field Test Separators;
- 1.16.3.3 Portable Test Separators;
- 1.16.5.1 Full-Scale Separator Test Report;
- Appendix J.

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, 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, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Washington, DC 20001, [standards@api.org](mailto:standards@api.org).

Currently in preview, click buy full version

## Contents

	Page
<b>1</b>	<b>Scope</b> . . . . . <b>1</b>
<b>2</b>	<b>Normative References</b> . . . . . <b>1</b>
<b>3</b>	<b>Terms, Definitions, Acronyms, Abbreviations, and Symbols</b> . . . . . <b>2</b>
<b>3.1</b>	<b>Terms and Definitions</b> . . . . . <b>2</b>
<b>3.2</b>	<b>Acronyms, Abbreviations, and Symbols</b> . . . . . <b>5</b>
<b>4</b>	<b>Production Well Testing in Upstream Measurement and Allocation</b> . . . . . <b>6</b>
<b>4.1</b>	<b>Introduction</b> . . . . . <b>6</b>
<b>4.2</b>	<b>Reasons for Production Well Testing</b> . . . . . <b>6</b>
<b>4.3</b>	<b>Production Well Testing and Additional Methods for Determining Well Rates</b> . . . . . <b>7</b>
<b>5</b>	<b>Conducting a Production Well Test</b> . . . . . <b>9</b>
<b>5.1</b>	<b>Preparation</b> . . . . . <b>9</b>
<b>5.2</b>	<b>Initiation and Measurement</b> . . . . . <b>11</b>
<b>5.3</b>	<b>Validation</b> . . . . . <b>23</b>
<b>5.4</b>	<b>Special Case: Continuous Measurement</b> . . . . . <b>25</b>
<b>5.5</b>	<b>Special Case: Production Well Test By-difference</b> . . . . . <b>26</b>
<b>6</b>	<b>Calculating Production Well Test Volumes and Rates</b> . . . . . <b>27</b>
<b>6.1</b>	<b>General</b> . . . . . <b>27</b>
<b>6.2</b>	<b>Phase Behavior (Production Well Testing PVT Application)</b> . . . . . <b>28</b>
<b>6.3</b>	<b>Separator Measurement Systems</b> . . . . . <b>32</b>
<b>6.4</b>	<b>Multiphase Measurement Systems</b> . . . . . <b>40</b>
<b>6.5</b>	<b>Tank Measurement Systems</b> . . . . . <b>45</b>
<b>7</b>	<b>Applying Production Well Test Data for Use in Allocation</b> . . . . . <b>54</b>
<b>7.1</b>	<b>General</b> . . . . . <b>54</b>
<b>7.2</b>	<b>Production Well Test Rate Assumed Constant</b> . . . . . <b>54</b>
<b>7.3</b>	<b>Production Well Test Rate with Applied Downtime</b> . . . . . <b>55</b>
<b>7.4</b>	<b>Production Well Test Rate Validation and Updating of Well Flow Models and Virtual Flow Meters</b> . . . . . <b>56</b>
<b>7.5</b>	<b>Production Well Test Volume Adjustment of Gas Well Continuous Measurement with Single-phase Meters</b> . . . . . <b>60</b>
<b>7.6</b>	<b>Special Case: Continuous Measurement</b> . . . . . <b>63</b>
	<b>Annex A (informative) Types of Oil and Gas Well Tests</b> . . . . . <b>64</b>
	<b>Annex B (informative) Description of the Production Well Test System</b> . . . . . <b>67</b>
	<b>Annex C (informative) Example Analysis for Establishing Production Well Test Duration During Nonstable Flow Conditions</b> . . . . . <b>85</b>
	<b>Annex D (informative) Example Production Well Test Report</b> . . . . . <b>89</b>
	<b>Annex E (informative) Field Determination of Oil Volume Correction Factor</b> . . . . . <b>91</b>
	<b>Annex F (informative) Calculation of Water Volume Correction Factor</b> . . . . . <b>92</b>
	<b>Annex G (informative) Example Calculations of Production Well Test Rates</b> . . . . . <b>93</b>
	<b>Annex H (informative) Example Calculations of Production Well Test Use in Allocation</b> . . . . . <b>109</b>
	<b>Bibliography</b> . . . . . <b>114</b>

## Contents

Page

### Figures

1	Well Rate Determination Tree	1
2	Production Well Test Initiation and Measurement Workflow	7
3	Summary of Production Well Test Elements and Workflow	22
4	Two-phase and Three-phase Separator Measurement System Process Flow Diagram	33
5	Multiphase Measurement System Process Flow Diagram	41
6	Tank Measurement System Process Flow Diagram	46
7	Gas Wells Continuously Measured with Single-phase Meters with the Ability to Align with a Production Well Test System	60
B.1	The Complete Production Well Test System	67
B.2	Reservoir Fluid Types	68
B.3	Example Hydrocarbon Phase Envelope	71
B.4	Solution-gas Drive	73
B.5	Gas-cap Drive	73
B.6	Water Drive	74
B.7	Gravity Drainage	75
B.8	Example Phase Envelope for Separator Operations	82
C.1	Production Well Test Data Showing Flow Variability at the Measurement Points	86

### Tables

1	Summary of Suggested Fluid Verification Activities	14
2	Summary of Suggested Production Verification Activities	16
3	Summary of Suggested Equipment Verification Activities	17
C.1	Uncertainty Result for 2-hour Production Well Test	87
C.2	Combined Uncertainty Results for 2-, 4-, 6- and 8-hour Production Well Tests	88

## Introduction

This document establishes a framework to conduct and apply production well testing for well rate determination in measurement and allocation. Production well testing addressed in this document refers to measurement of gas, oil, and water quantities from a single well during a specified length of time under controlled operational conditions. The intent of this document is to provide operators with a consistent and transparent approach for conducting, applying, and managing production well testing within an upstream measurement and allocation system. It is not intended to prescribe a particular production well test method, or particular application of production well test data use in allocation. Allocation methodologies are addressed in API *MPMS* Ch. 20.1.

# Recommended Practice for Application of Production Well Testing in Measurement and Allocation

## 1 Scope

This document provides recommendations and guidelines for the application of production well testing in production measurement and allocation. The recommendations and guidelines apply to conducting a production well test, calculating production well test volumes and rates, and the application of production well test data for use in measurement and allocation. This includes production well testing preparation, initiation, measurement, validation, and volume and rate calculations for separator, multiphase flow meter, and tank production well test systems. Additionally, this document addresses the proration of production well test results for use in allocation, the application of production well tests for validation and update of well flow models and virtual flow metering, and the adjustment of gas well continuous measurement results with production well test data.

This document also provides recommendations and guidelines for the application of well flow modeling and virtual flow metering in production measurement and allocation.

## 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 (including any amendments) applies.

API Draft Standard *Application of Hydrocarbon Phase Behavior Modeling in Upstream Measurement and Allocation Systems*

API Manual of Petroleum Measurement Standards (MPMS), Chapter 3.1A, *Standard Practice for the Manual Gauging of Petroleum and Petroleum Products*

API MPMS Chapter 3.1B, *Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging*

API MPMS Chapter 3.3, *Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Pressurized Storage Tanks by Automatic Tank Gauging*

API MPMS Chapter 3.6, *Measurement of Liquid Hydrocarbons by Hybrid Tank Measurement Systems*

API MPMS Chapter 8.1, *Standard Practice for Manual Sampling of Petroleum and Petroleum Products*

API MPMS Chapter 8.2, *Standard Practice for Automatic Sampling of Liquid Petroleum and Petroleum Products*

API MPMS Chapter 11.1, *Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils*

API MPMS Chapter 14.1, *Collecting and Handling of Natural Gas Samples for Custody Transfer*

API MPMS Chapter 18.1, *Measurement Procedures for Crude Oil Gathered from Small Tanks by Truck*

API MPMS Chapter 20.1, *Production Measurement and Allocation Systems*

API MPMS Chapter 20.2, *Production Allocation Measurement Using Single-phase Devices*

API MPMS Chapter 20.3, *Measurement of Multiphase Flow*