

Manual of Petroleum Measurement Standards Chapter 20—Allocation Measurement

Section 1—Allocation Measurement

FIRST EDITION, SEPTEMBER 1993

ADDENDUM 1, JANUARY 2013

ADDENDUM 2, NOVEMBER 2016

ADDENDUM 3, DECEMBER 2017

REAFFIRMED, JUNE 2024



American
Petroleum
Institute

SPECIAL NOTES

1. API PUBLICATIONS NECESSARILY ADDRESS PROBLEMS OF A GENERAL NATURE. WITH RESPECT TO PARTICULAR CIRCUMSTANCES, LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS SHOULD BE REVIEWED.

2. 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 AND PRECAUTIONS, NOR UNDERTAKING THEIR OBLIGATIONS UNDER LOCAL, STATE OR FEDERAL LAWS.

3. INFORMATION CONCERNING SAFETY AND HEALTH RISKS AND PROPER PRECAUTIONS WITH RESPECT TO PARTICULAR MATERIALS AND CONDITIONS SHOULD BE OBTAINED FROM THE EMPLOYER, THE MANUFACTURER OR SUPPLIER OF THAT MATERIAL, OR THE MATERIAL SAFETY DATA SHEET.

4. 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 ANY ONE AGAINST LIABILITY FOR INFRINGEMENT OF LETTERS PATENT.

5. GENERALLY, API STANDARDS ARE REVIEWED AND REVISED, REAFFIRMED OR WITHDRAWN AT LEAST EVERY FIVE YEARS. SOMETIMES A ONETIME EXTENSION OF UP TO TWO YEARS WILL BE ADDED TO THIS REVIEW CYCLE. THIS PUBLICATION WILL NO LONGER BE IN EFFECT FIVE YEARS AFTER ITS PUBLICATION DATE AS AN OPERATIVE API STANDARD OR, WHERE AN EXTENSION HAS BEEN GRANTED, UPON REPUBLICATION. STATUS OF THE PUBLICATION CAN BE ASCERTAINED FROM THE API PUBLICATIONS DEPARTMENT [TELEPHONE (202) 682-8000]. A CATALOG OF API PUBLICATIONS AND MATERIALS IS PUBLISHED ANNUALLY AND UPDATED QUARTERLY BY API, 200 MASSACHUSETTS AVENUE, NW, WASHINGTON, DC 20001.

FOREWORD

The Allocation Measurement Standard, *API Manual of Petroleum Measurement Standards*, Chapter 20.1, was developed in response to an indicated desire by federal and state regulatory agencies to reference API measurement standards. In 1986 various regulatory agencies began requiring the petroleum industry to use the *API Manual of Petroleum Measurement Standards* for allocation measurement on federal and state leased lands. The edition of the manual in place then was written specifically for custody transfer measurement, which was inappropriate for allocation measurement. Although the petroleum industry does a substantial amount of allocation measurement, the industry was being required to use a standard that did not apply.

The API Committee on Petroleum Measurement responded in the spring of 1987 by commissioning a task group to survey the industry and determine if an allocation standard was necessary. After determining that the need did actually exist, an API working group was commissioned in the fall of 1987 to develop the scope and the field of application for such a standard.

A second survey in the fall of 1987 was conducted to verify the types of equipment used, the typical design of measurement facilities, and the typical operating procedures used for allocation measurement. This document, Chapter 20.1 of the *API Manual of Petroleum Measurement Standards*, is the result of that industry survey and the efforts of the working group.

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 federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to Measurement Coordination, Industry Services Department, American Petroleum Institute, 200 Massachusetts Avenue, NW, Washington, DC 20001.

Currently in preview, click buy full version

CONTENTS

	Page
SECTION 1—ALLOCATION MEASUREMENT	
1.1 Introduction	1
1.2 Scope	2
1.3 Terms	2
1.3.1 Definitions	2
1.3.2 Abbreviations	3
1.4 Referenced Publications	3
1.5 Liquid Quantity Measurement	5
1.5.1 General Design Considerations	5
1.5.2 Measurement Equipment Considerations	5
1.6 Liquid Sampling Procedures	7
1.6.1 Spot Sampling Systems	7
1.6.2 Automatic Sampling Systems	9
1.7 Liquid Quality Measurement	9
1.7.1 Introduction	9
1.7.2 Water Cut Analyzers	9
1.7.3 Tank Gauging Methods	14
1.7.4 Shrinkage Factor	15
1.8 Liquid Proving and Calibration Techniques	19
1.8.1 Proving a Master Meter	19
1.8.2 On-Site Proving of Allocation Meters	20
1.8.3 Off-Site (Transfer) Proving of Allocation Meters	24
1.9 Liquid Calculation Procedures	25
1.9.1 Introduction	25
1.9.2 Shrinkage Factor	26
1.9.3 Sediment and Water (S&W) Factors	26
1.9.4 Temperature Correction	26
1.9.5 Theoretical Production Calculation	26
1.9.6 Water Cut Determination	28
1.9.7 Corrected Production Calculation	28
1.9.8 Closing Inventory (Stock) Determination	29
1.9.9 Allocation Procedures	29
1.9.10 Liquid Petroleum Quantity Measurement by Mass Flow Meters	29
1.10 Gas Quantity Measurement	31
1.10.1 General Design Considerations	31
1.10.2 Measurement Equipment Considerations	31
1.11 Frequency of Proving and Calibration	33
1.11.1 Well Tests	33
1.11.2 Meter Proving	33
1.11.3 Sampling	33
1.11.4 Meter Calibration	33
1.12 Gas Sampling Procedures	33
1.12.1 Spot Sampling	33
1.12.2 Automatic/Composite Sampling System	34
1.12.3 Sample Probe	34
1.12.4 Sample Cylinders	34
1.13 Gas Quality Measurements	34
1.13.1 Dew Point	34
1.13.2 Energy Content, Btu (kJ)	35

	Page
1.13.3 Recoverable Hydrocarbon Liquids (GPM or m ³ _{liq} /m ³ _{gas})	35
1.13.4 Composition	35
1.14 Gas Calibration and Proving Techniques	36
1.14.1 On-Site Calibrations	36
1.14.2 Off-Site Calibrations	38
1.15 Gas Allocation Calculation Procedures	38
1.15.1 Overview	38
1.15.2 Calculation Procedure	38
1.15.3 Other Variables	38
1.15.4 Auditing	38
1.16 Multiphase Quantity Measurement	39
1.16.1 Flow Measurement Systems	39
1.16.2 Sampling	39
1.16.3 Proving and Calibrating Techniques and Equipment	39
1.16.4 Multiphase Sample Calculation Procedures	41
1.16.5 Report Considerations	41
APPENDIX A—VOLUME CORRECTION FACTOR FOR THE EFFECT OF TEMPERATURE ON PRODUCED WATER	45
APPENDIX B—SAMPLE CALCULATION FOR PROCEDURE B STATIC SAMPLING—VOLUMETRIC MEASUREMENT (CUSTOMARY UNITS)	47
APPENDIX C—SAMPLE CALCULATION FOR PROCEDURE B STATIC SAMPLING—VOLUMETRIC MEASUREMENT (SI UNITS).....	49
APPENDIX D—SAMPLE CALCULATION FOR PROCEDURE C DYNAMIC SAMPLING—VOLUMETRIC MEASUREMENT (CUSTOMARY UNITS).....	51
APPENDIX E—SAMPLE CALCULATION FOR PROCEDURE B DYNAMIC SAMPLING—VOLUMETRIC MEASUREMENT (SI UNITS).....	53
APPENDIX F—SAMPLE CALCULATION FOR PROCEDURE A DYNAMIC SAMPLING—MASS MEASUREMENT (CUSTOMARY UNITS)	55
APPENDIX G—SAMPLE CALCULATION FOR PROCEDURE A DYNAMIC SAMPLING—MASS MEASUREMENT (SI UNITS).....	57
APPENDIX H—SAMPLE CALCULATION FOR PROCEDURE B STATIC SAMPLING—MASS MEASUREMENT (CUSTOMARY UNITS)	59
APPENDIX I—SAMPLE CALCULATION FOR PROCEDURE B STATIC SAMPLING—MASS MEASUREMENT (SI UNITS).....	61
APPENDIX J— FULL SCALE FIELD SEPARATOR TESTING SAMPLE REPORT FORM	63
SAMPLE SUMMARY FORM	64
APPENDIX K— FULL WELL STREAM RECOMBINATION REPORT	65
Figures	
1—Flow Meter System	8
2—Sampling Cylinders	16
3—Sampling Assembly	17

Chapter 20—Allocation Measurement

SECTION 1—ALLOCATION MEASUREMENT

1.1 Introduction

A purpose of industry standards and procedures is to ensure that all parties are treated fairly in a transaction. Another is to ensure uniformity, that is, to provide a fixed method of solving a problem or completing a task that will be repeatable by anyone with the necessary skills or experience. Allocation measurement, properly applied, can ensure fair treatment. Reference to industry standards as the underlying basis of allocation measurement assures uniformity of procedures and practices.

Although allocation measurement may not meet the requirements for custody transfer measurement in all cases, it is still possible to refer to existing custody transfer industry standards for the basis of measurement. Where this allocation standard does not specifically address a measurement related issue, it should be assumed that custody transfer standards apply.

If industry standards were not used as the basis of measurement, contracts would have to include volumes of technical details or the parties would have to refer to their individual company policies. By utilizing the industry standards, we can measure tolerances, design metering systems, determine if an orifice plate is flat, gauge a tank level, and so forth without having to address all the issues separately.

Allocation measurement was developed to reduce capital and operating costs without sacrificing the objective of treating all parties fairly and equally. The individual allocation meters determine what fraction of the total production or income from a system is attributable to an individual lease or well. The total production or payments are determined with custody transfer quality systems and procedures, but the associated allocation system may not fully meet industry standards for custody transfer. For example, in an allocation system it may be necessary to meter multiple phase streams rather than require separation equipment at each lease. Allocation metering systems may assume constant flowing temperatures to eliminate the need for temperature recording systems. Other compromises may be made, but they must be applied uniformly throughout the system.

In some fields the streams are very similar in temperature, pressure, flow rate and composition, but may have wide variability in one or more of these areas. For example, to be sure that a lease with lean gas is treated fairly with respect to another lease in the allocation system with rich gas, periodic testing to help better define both the quality and quantity of the stream must be established with either portable or stationary sampling, calibration, separation, and/or proving systems. The net effect of such measures is to greatly reduce capital expenses and operating expenses while still defining a representative quantity and quality for the stream.

The quality and quantity determinations in an allocation system must represent the individual lease contributions.

Allocation measurement provides a sound basis for distributing production or income and is a common practice, contractually agreed to by many different companies and interests. It may allow leases and fields with marginal economics to exist, since requiring custody transfer quality systems and measurements would require more expense than could be supported.

The purpose of this standard is to set appropriate guidelines for implementing allocation measurement.

1.2 Scope

This document provides design and operating guidelines for liquid and gas allocation measurement systems. Included are recommendations for metering, static measurement, sampling, proving, calibrating, and calculating procedures.

1.3 Terms

1.3.1 DEFINITIONS

- a. *Allocation measurement* is measurement using metering systems for individual producing leases or wells and specific procedures to determine the percentage of hydrocarbon and associated fluids or energy contents to attribute to a lease, well, or working interest owner, when compared to the total production from the entire affected reservoir, production system or gathering system.
- b. *Beta ratio* is the ratio of the orifice bore to the internal diameter of the meter tube.
- c. *Commingle* means to combine the hydrocarbon streams from two or more wells or production facilities into a common tank or pipeline.
- d. *Full well stream* is the total amount of produced fluids from a hydrocarbon producing well.
- e. *Indicated volume* is the difference between opening and closing meter readings.
- f. *K Factor* relates the output signal or registration of a meter to a unit of quantity (mass, volume, energy).
- g. *Multiphase* is the term used to describe the fluid from a well that is composed of any combination of hydrocarbon gases, hydrocarbon liquids, or produced water.
- h. *Oil-continuous emulsion* is an oil and water mixture in which the oil is the major component and the water is in suspension.
- i. *Pipeline condensate* is the liquid formed in a pipeline by a phase change from gas to liquid resulting from a change in temperature and/or pressure. Pipeline condensate is occasionally referred to as retrograde condensation in some segments of the industry.
- j. *Raw composite volume* is the uncorrected, indicated, multiphase volume determined by a full well stream metering system.
- k. *Recoverable liquid hydrocarbon content (GPM)* is the amount of theoretical or actual liquid component products recoverable from a stream.
- l. *Residual atmospheric liquid* is the fluid remaining in a stock tank after weathering at atmospheric pressure and ambient temperature.
- m. *Shrinkage factor* is the ratio of a liquid volume at stock tank or some defined intermediate conditions to that liquid volume at metering conditions.
- n. *Stabilized liquid* is hydrocarbon liquid which has reached equilibrium.
- o. *Stock tank* is an atmospheric tank used to store hydrocarbon liquids.
- p. *Stock tank conditions* are atmospheric pressure and 60 °F.
- q. *Theoretical production* is the volume of crude oil corrected to stock tank conditions.
- r. *Three-phase* is the term used to describe the fluid from a well composed of hydrocarbon liquid, gas, and produced water.
- s. *Uncorrected totalized volume* is that volume registered on a totalizer to which no adjustments for temperature and pressure have been applied.
- t. *Water-continuous emulsion* is a water and oil mixture in which the water is the major component and the oil is in suspension.
- u. *Water cut* is the volume percentage of water in a combined hydrocarbon and water stream.