Recommended Practice for the Design, Testing, and Operation of Subsea Multiphase Flow Meters

API RECOMMENDED PRACTICE 17S
SECOND EDITION, MAY 2022

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 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.

Users of this standard assume all responsibility for ensuring safe handling and compliance with all applicable laws regarding radioactive materials.

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.

Classified areas may vary depending on the location, conditions, equipment, and substances involved in any given situation. Users of this Recommended Practice should consult with the appropriate authorities having jurisdiction.

Users of this standard assume all responsibility for ensuring safe handling and compliance with all applicable laws regarding radioactive materials.

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.

Shall: As used in a standard, “shall” denotes a minimum requirement to conform to the specification.

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

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

Contents

Figures

Tables

Introduction

Multiphase flow is a complex fluid phenomenon presenting many observable and distinctly different spatial patterns. These flow regimes are a function of fluid composition, velocity, flow orientation, geometry, and operating conditions. This creates a greater number of variables requiring measurement than single phase flow. Multiphase flow meters (MPFMs) use a combination of measurement principles and software models to delineate component parameters of the specific flow condition being measured. These elements are further combined to simultaneously resolve the total flow state and inform the user of the flow rate of each phase.

This document is intended for use by persons familiar with the principles of multiphase flow and the technologies used to measure its constituent parts. This Recommended Practice (RP) outlines a strategy for the correct sizing, specification, integration, and testing of MPFMs to maximize their performance for a specific application. Measurement techniques used in MPFMs are complex and only brief descriptions are included herein. It is recommended that the reader be acquainted with API *MPMS* Chapter 20.3 which describes in detail the technologies of multiphase metering, calibration, measurement uncertainty, and operation. API *MPMS* Chapter 20.3 is referred to in this document wherein the reader should seek further information or best practice. API *MPMS* Chapter 20.3 is not specific to subsea applications.

Various expertise is required throughout the life cycle of the MPFM to achieve optimal performance. Due to the number of interfaces and design parameters a strategy is required to ensure the meter is appropriate for its specific application. This RP acts as a guide outlining key parameters of the strategy that quantifies meter performance based on application, sizing data, technology constraints, and performance checks through manufacturer, independent facilities, and in-situ tests.

There is a distinct separation in ownership between MPFM specification, testing, and installation versus commissioning and operation. This RP addresses equipment design in Section 4 through Section 7 and commissioning/operational issues in Section 8 and Section 9. To ensure accuracy and functionality of the MPFM, a coherent handover between equipment design and long-term operations is required. Several operational issues are managed in this RP, as well as metering methodologies, but these are only intended as suggested interfaces to be addressed. This RP should be used in combination with appropriate measurement and operational standards to develop a comprehensive strategy for the design, installation, and long-term operation of an MPFM.

Recommended Practice for the Design, Testing, and Operation of Subsea Multiphase Flow Meters

1 Scope

This document provides recommendations for the sizing, specification, system integration, testing and operation of in-line subsea multiphase flow meters (MPFMs) for measurement of full stream, multiphase flow for well testing, allocation measurement, fiscal measurement, well management, and in flow assurance applications. This Recommended Practice (RP) includes wet gas flow meters as a subset of MPFMs.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

API *Manual of Petroleum Measurement Standards (MPMS*), Chapter 20.3—*Measurement of Multiphase Flow*

API Specification 6A, *Specification for Wellhead and Tree Equipment*

API Specification 17D, *Design and Operation of Subsea Production Systems—Subsea Wellhead and Tree Equipment*

API Standard 17F, *Standard for Subsea Production Control Systems*

API Recommended Practice 17H, *Remotely Operated Tools and Interfaces on Subsea Production Systems*

API Recommended Practice 17N, *Recommended Practice for Subsea Production System Reliability and Technical Risk Management*

API Recommended Practice 17P, *Recommended Practice for Subsea Structures and Manifolds*

API Recommended Practice 17Q, *Recommended Practice on Subsea Equipment Qualification*

3 Terms, Definitions, Acronyms, and Abbreviations

3.1 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
accuracy
The degree of conformity of a measurement to a known standard for the unit of measurement.

3.1.2
actual conditions
measurement conditions
line conditions
flowing conditions
Conditions of pressure and temperature of the fluid at the point where fluid properties or flows are measured.