PD ISO/TR 12748:2015

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Natural Gas — Wet gas flow measurement in natural gas operations

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The UK committee, advises users to reference to ISO/TR 11583:2012 when applying this PD, in particular to the equations for wet-gas measurement using Venturi tubes found in Clause 6 of ISO/TR 11583:2012, since their use reduces the bias found at low liquid levels using other commonly used correction factors.

The UK participation in its preparation was entrusted by Technical Committee CPI/30, Measurement of fluid flow in closed conduits, to Subcommittee CPI/30/2, Differential pressure methods.

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Gaz naturel — Mesurage du débit de gaz humide dans les opérations de gaz naturel

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 193, *Natural Gas*, Subcommitte SC 3, *Upstream Area*.

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Introduction

Oil and gas companies started developing Wet Gas Flow Meters (WGFMs) and Multiphase Flow Meters (MPFMs) through extensive R&D activities in the late 1980s. During this period, WGFMs and MPFMs were typically perceived as two distinct technologies for different applications: MPFMs were designed for liquid continuous flow conditions and WGFMs were designed for gas continuous flow conditions. In recent years, however, the operating range of these two technologies has increasingly overlapped, blurring the distinction between a WGFM and MPFM. As wet gas flow is presently considered a subset of multiphase flow, a WGFM is an MPFM that specializes in gas-dominant multiphase flow conditions. In this Technical Report, such technologies will be referred to as WGFMs.

There are many factors that contributed in the decision to replace a separator with a WGFM, with each application warranting careful consideration. A well-designed and maintained separator working within an appropriate flow condition range should produce accurate flow measurements. A primary concern for oil and gas companies was to reduce costs by replacing complex and bulky test separators, as well as to further simplify the upstream infrastructure, in particular for offshore and subsea projects. WGFMs typically require lower capital[1)] and operational[2)] expenditures than fully equipped test separators. More savings in CapEx may be achieved by omitting dedicated test lines in satellite developments. In addition, there is a significant benefit for offshore developments, in terms of weight and space conservation, by using the much smaller footprint of WGFMs.

Due to various operational problems, a conventional test separator does not continuously provide accurate and reliable well test data, giving only relevant information when the well is switched to the test separator. With the use of WGFMs testing well production more frequently or even continuously becomes possible. WGFM developments and extensive testing over the last two decades have resulted in WGFM technology that is a viable alternative to a test separator. Modern WGFMs now offer continuous well monitoring (per installation on individual wells).

WGFM technology is an attractive option for multiphase wet gas flow measurement. Over the last two decades, some WGFMs have been developed from prototypes into very mature, robust, advanced, and field-proven measurement devices, increasing their application scope. Although originally intended for use mainly in reservoir and well production allocations, WGFMs have evolved into a technology that spans even fiscal product allocation. In the latter case, the output of a WGFM is used to determine money transactions between operating companies or between an operating company and a host government.

This Technical Report focuses on the measurement of wet gas flow, i.e. terminology, models, and principles, and the design, implementation, testing, and operation of WGFMs.

1) Capital expenditure (CapEx) or costs for purchasing and installing a WGFM/MPFM includes all hardware to operate the WGFM (data transmission, verification facilities, sampling arrangements, etc.)

2) Operating expenditure (OpEx) or costs to operate a WGFM/MPFM (maintenance, verification processes, sampling for fluid properties, etc.)

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Natural Gas — Wet gas flow measurement in natural gas operations

1 Scope

This Technical Report describes production flow measurement of wet natural gas streams with WGFMs in surface and subsea facilities. Wet natural gas streams are gas-dominated flows with liquids like water and/or hydrocarbon liquids[3)] (see 2.67 for a detailed definition). This Technical Report defines terms/symbols, explains the various concepts, and describes best practices of wet gas flow meter design and operation. It addresses metering techniques, testing, installation, commissioning, and operation practices such as maintenance, calibration, and verification. It also provides a theoretical background of this comprehensive, challenging and still evolving measurement technology.

There are four general methods in measuring wet natural gas flow. Each approach is detailed below.

— Single-phase gas flow meter with correction factor: Uses a single-phase gas flow meter (often a conventional gas flow metering device) with a correction factor for the effect of liquid on the metering system. In these cases, the liquid flow rate required to determine the correction factor, should be estimated from an external source.

— Two-phase WGFM: The gas and liquid (both water and hydrocarbon liquid combined) flow rates are predicted with no additional external information regarding the liquid flow rate required. This is generally known as a two-phase WGFM and will be referred to in this Technical Report simply as WGFM.

— WGFM: A flow meter that measures the gas and liquid flow rates, and also the gas, water and hydrocarbon liquid ratios (or "phase fractions") with no external information required regarding the liquid flow rate.

— Phase separation/Measurement after phase separation: This traditional and conventional method of wet gas flow metering uses a two- or three-phase separator with single-phase flow meters measuring the outgoing single-phase flows.

The first three of these methods, which emerged in the last two decades, may be described as in-line wet gas flow metering, i.e. wet gas flow measurement is executed with WGFMs without separating the gas and liquid phases. This Technical Report discusses in detail these first three methods. Several best practice documents have already been issued to describe, among other topics, wet gas flow measurement[9][10][11][12].

The last method is more conventional and describes wet gas flow measurement after the gas and liquid phases have been separated. Wet gas meters can be used in multiphase flow metering systems that utilize partial separation technologies. This method is only briefly discussed in this Technical Report.

2 Terms and Definitions

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

2.1
adjustment
act of altering an instrument's performance in any way, e.g. software, mechanical or electrical modifications, in order for the instrument's indication to match the reference values indicated by a test stand

3) In this Technical Report, the term hydrocarbon liquid includes both oil and condensed hydrocarbons.

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