Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids—Concentric, Square-edged Orifice Meters

Part 3: Natural Gas Applications

American Gas Association

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Contents

Contents

Introduction

API *MPMS* Chapter 14.3.3/AGA Report No. 3, Part 3 is organized as follows: Symbols and units are first defined, the basic flow equation is presented, then key equation components are defined, and finally the gas properties applicable to orifice metering of natural gas are developed. Factors to compensate for meter calibration and location are included in Annex A. The factor approach to orifice measurement is included in Annex B. Annex F covers derivation of constants. The user is cautioned that the symbols may be different from those used in previous orifice metering standards.

Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids—Concentric, Square-edged Orifice Meters Part 3: Natural Gas Applications

1 Scope

1.1 General

This part of API *MPMS* Ch. 14.3/AGA Report No. 3 has been developed as an application guide for the calculation of natural gas flow through a flange-tapped, concentric orifice meter, using the U.S. customary (USC) inch-pound system of units.

For applications involving international system (SI) of units, a conversion factor can be applied to the results (Q_m, Q_v, or Q_b) determined from the equations in 4.3. Intermediate conversion of units will not necessarily produce consistent results. As an alternative, the more universal approach specified in API *MPMS* Ch. 14.3.1/AGA Report No. 3, Part 1 can be used. The meter has to be constructed and installed in accordance with API *MPMS* Ch. 14.3.2/AGA Report No. 3, Part 2.

1.2 Definition of Natural Gas

As used in this document, the term natural gas applies to fluids that for all practical purposes are considered to include both pipeline and production quality gas with single-phase flow and mole percentage ranges of components as given in Table 1 of API *MPMS* Ch. 14.2/AGA Report No. 8. For other hydrocarbon mixtures, the more universal approach specified in API *MPMS* Ch. 14.3.1/AGA Report No. 3, Part 1 may be more applicable. Diluents or mixtures other than those stipulated in API *MPMS* Ch. 14.2/AGA Report No. 8 may increase the flow measurement uncertainty.

1.3 Basis for Equations

The computation methods used in this document are consistent with those developed in API *MPMS* Ch. 14.3.1/AGA Report No. 3, Part 1 and include the Reader-Harris/Gallagher (RG) equation for flange-tapped orifice meter discharge coefficient. The equation has been modified to reflect the more common units of the USC inch-pound system.

1.4 Expansion Factor Application

For all existing installations, the decision as to which expansion factor equation to use is at the discretion of the parties involved. However, the parties should be cognizant of the following:

1) If the calculated difference between previous revision (1990) Buckingham and Bean expansion factor equation (refer to Annex G) and the new revised expansion factor equation (refer to 5.6) is less than or equal to 0.25 %, then the expansion factor values produced by either expansion factor equation will be within the uncertainty of the new expansion factor database and the existence of any flow bias is uncertain.

2) However, if the calculated difference between expansion factor equations exceeds 0.25 %, then a variable flow bias, which is a function of diameter ratio (β), isentropic exponent (κ), and $\Delta P / P_{f_1}$ ratio (x_1), will be experienced unless the new expansion factor equation is utilized.

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 *MPMS* Ch. 14.2/AGA Report No. 8, *Compressibility Factors of Natural Gas and Other Related Hydrocarbon Gases*