
# AGA Report No. 3

# ORIFICE METERING OF NATURAL GAS AND OTHER RELATED HYDROCARBON FLUIDS

## PART 3
## Natural Gas Applications



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# FOREWORD

AGA Report No. 3, *Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids,* consists of four parts. **This one is Part 3 – *Natural Gas Applications*.** Other parts are:

Part 1 – *General Equations and Uncertainty Guidelines*

Part 2 – *Specification and Installation Requirements*

Part 4 – *Background, Development, Implementation Procedure, and Subroutine Documentation for Empirical Flange-Tapped Discharge Coefficient Equation*

Each of the four parts is published separately to facilitate future changes, allow immediate use, and reduce the size of the applicable part needed by most users. Although for many applications each part can be used independently, users with natural gas applications are advised to obtain Parts 1, 2 and 4.

This report applies to fluids that, for all practical purposes, are considered to be clean, single phase, homogeneous, and Newtonian, and the Part 3 of the report provides practical guidelines for applying Parts 1 and 2 for the measurement of natural gas. Mass flow rate and base (or standard) volumetric flow rate methods are presented in conformance with the North American industry practices.

This report has been developed through the cooperative efforts of many individuals from industry under the sponsorship of the American Gas Association, the American Petroleum Institute, and the Gas Processors Association, with contributions from the Chemical Manufacturers Association, the Canadian Gas Association, the European Community, Norway, Japan and others.

It may become necessary to make revisions to this document in the future. Whenever any revisions are advisable, recommendations should be forwarded to the Operations and Engineering Section, **American Gas Association**, 400 N. Capitol Street, NW, 4$^{th}$ Floor, Washington, DC 20001, U.S.A. A form has been included at the end of this report for that purpose.

# ACKNOWLEDGMENTS

From the initial data-collection phase through the final publication of this revision of the AGA Report No. 3, *Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids,* many individuals have devoted time and technical expertise. However, a small group of individuals has been very active for much of the project life. This group includes the following people:

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## ATTENTION

## ERRATA AT THE END

**See four pages at the end for errata in this report.**

# PART 3 –NATURAL GAS APPLICATION

## 3.1 Introduction

### 3.1.1 APPLICATION

#### 3.1.1.1 General

This part of 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 inch-pound system of units. For applications involving SI units, a conversion factor may be applied to the results ($Q_m$, $Q_v$, or $Q_b$) determined from the equations in 3.3. Intermediate conversion of units will not necessarily produce consistent results. As an alternative, the more universal approach specified in AGA Report No.3, Part 1, should be used. The meter must be constructed and installed in accordance with AGA Report No.3, Part 2.

#### 3.1.1.2 Definition of Natural Gas

As used in this part, 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 American Gas Association (AGA) Transmission Measurement Committee Report No.8, "Compressibility and Supercompressibility for Natural Gas and Other Hydrocarbon Gases." For other hydrocarbon mixtures, the more universal approach specified in Part 1 may be more applicable. Diluents or mixtures other than those stipulated in AGA Transmission Measurement Committee Re-port No.8 may increase the flow measurement uncertainty.

### 3.1.2 BASIS FOR EQUATIONS

The computation methods used in this part are consistent with those developed in Part 1 and include the Reader-Harris/Gallagher equation for flange-tapped orifice meter discharge coefficient. The equation has been modified to reflect the more common units of the inch-pound system. Since the new coefficient of discharge equation does not address pipe tap meters, the pipe tap methodology of the 1985 edition of AGA Report No.3 has been retained for reference in Appendix 3-D.

### 3.1.3 ORGANIZATION OF PART 3

AGA Report No.3, Part 3, is organized as follows: Symbols and units are defined in 3.2, the basic flow equation is presented in 3.3, the key equation components are defined in 3.4, and the gas properties applicable to orifice metering of natural gas are developed in 3.5. All values are assumed to be absolute. Factors to compensate for meter calibration and location are included in Appendix 3-A. The factor approach to orifice measurement is included in Appendix 3-B. Appendix 3-C covers examples to assist the user in interpreting this part. Appendix 3-D covers pipe tap meters. Appendix 3-E covers SI conversions, Appendix 3-F covers heating value calculation, and Appendix 3-G covers derivation of constants. The user is cautioned that the symbols as defined in 3.2 may be different from those used in previous orifice metering standards.

## 3.2 Symbols, Units, and Terminology

### 3.2.1 GENERAL

The symbols and units used are specific to AGA Report No.3, Part 3, and were developed based on the customary inch-pound system of units. Regular conversion factors can