



American Gas Association

# **AGA Report No. 3**

## **ORIFICE METERING OF NATURAL GAS AND OTHER RELATED HYDROCARBON FLUIDS**

### **PART 2**

## **Specification and Installation Requirements**

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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 2 – Specification and Installation Requirements.** Other parts are:

Part 1 – *General Equations and Uncertainty Guidelines*

Part 3 – *Natural Gas Applications*

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, 3 and 4.

This report applies to fluids that, for all practical purposes, are considered to be clean, single phase, homogeneous, and Newtonian, measured using concentric, square-edged, flange-tapped orifice meters; and the Part 2 of the report furnishes specifications and installation requirements, and provides specifications for the construction and installation of orifice plates, meter tubes, and associated fittings. Users of pipe tap orifice meters are referred to AGA Report No. 3, Part 3, for specifications relevant to those meters.

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 Gas Research Institute, the Chemical Manufacturers Association, the Canadian Gas Association, and the Commission of the European Communities, Norway, Japan, and others.

The methods and criteria used to analyze data applied for April 2000 revision are described in the relevant white papers and in the Gas Research Institute research reports (see references in Appendix 2-A)

Further revisions to this report may become necessary from time to time. Whenever any revisions are deemed advisable, recommendations should be forwarded to the Operations and Engineering Section, **American Gas Association**, 400 N. Capitol Street, NW, 4th Floor, Washington, DC 20001, U.S.A. A form is included for that purpose at the end of this report.

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## PART 2—SPECIFICATION AND INSTALLATION REQUIREMENTS

### 2.1 Construction and Installation Requirements

This document outlines the various design parameters that must be considered when designing metering facilities using orifice meters. The mechanical tolerances found in this document encompass a wide range of orifice diameter ratios for which experimental results are available. In several sections of this document, tolerances for the mechanical specifications have been changed relative to previous editions. In particular, this revision includes a change to the installation requirements (meter tube lengths). This change reduces the uncertainty attributable to installation effects to a magnitude smaller than the uncertainty of the database supporting the Reader-Harris/Gallagher (RG) equation and, therefore, should not affect the uncertainty previously defined for that equation.

*This document does not require upgrading existing installations. If the meter installations are not upgraded to meet this current standard, however, measurement bias errors may exist due to inadequate flow conditioning and insufficient straight pipe lengths. The decision to upgrade an existing installation shall be at the discretion of the parties involved.*

Use of the calculation procedures and techniques shown in the AGA Report No.3, Parts 1 and 3 with existing equipment is recommended, since these represent significant improvements over the previous methods. However, the uncertainty levels for flow measurement using existing equipment may be different from those quoted in Part 1.

Use of orifice meters at the extremes of their diameter ratio ( $\beta_r$ ) ranges should be avoided whenever possible. Good metering design and practice tend to be somewhat conservative. This means that the use of the tightest tolerances in the mid-diameter ratio ( $\beta_r$ ) ranges would have the highest probability of producing the best measurement. An indication of this is found in the section on uncertainty in Part 1.

This standard is based on  $\beta_r$  between 0.10 and 0.75. Minimum uncertainty of the orifice plate coefficient of discharge ( $C_d$ ) is achieved with  $\beta_r$  between 0.2 and 0.6 and orifice bore diameters greater than or equal to 0.45 inch. Diameter ratios and orifice bore diameters outside of this range may be used; however, the user should consult the uncertainty section in Part 1 for limitations.

Achieving the best level of measurement uncertainty begins with, but is not limited to, proper design. Two other aspects of the measurement process must accompany the design effort; otherwise it is of little value. These aspects are the application of the metering system and the maintenance of the meters, neither of which is considered directly in this standard. These aspects cannot be governed by a single standard as they cover metering applications that can differ widely in flow rate, fluid type, and operational requirements. Therefore, the user must determine the best meter selection for the application and the level of maintenance for the measurement system under consideration.

### 2.2 Symbols/Nomenclature

This standard reflects orifice meter application to fluid flow measurement with symbols in general technical use.

Symbol	Represented Quantity
$a$	Speed of sound
$C_d$	Orifice plate coefficient of discharge
$C_d(FT)$	Flange tap orifice plate coefficient of discharge
$\square C_d(FT)/C_d$	Percent difference between baseline $C_d$ and installation effect $C_d$
$d$	Orifice plate bore diameter calculated at flowing temperature, $T_f$
$dm$	Orifice plate bore diameter measured at temperature, $T_m$
$dr$	Orifice plate bore diameter calculated at reference temperature, $T_r$
$D$	Meter tube internal diameter calculated at flowing temperature, $T_f$
$D_i$	Published meter tube internal pipe diameter
$D_L$	Meter tube length downstream of orifice plate in multiples of published internal pipe diameters (see Figure 2-6)
$D_m$	Meter tube internal diameter measured at $T_m$
$D_n$	Nominal pipe diameter