



American Gas Association

# **AGA Report No. 3**

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

### **PART I**

## **General Equations and Uncertainty Guidelines**

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**American Gas Association  
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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 1 – General Equations and Uncertainty Guidelines.** Other parts are:

- Part 2 – *Specification and Installation Requirements*
- 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 should obtain Parts 2, 3 and 4 before implementing Part 1.

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 1 of the report provides equations for computing the flow through orifice meters and offers guidelines for uncertainty determination. Users of pipe tap orifice meters are referred to AGA Report No. 3 Part 3, for some equations and guidelines 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 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<sup>th</sup> Floor, Washington, DC 20001, U.S.A. A form has been included at the end of this report for that purpose.

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H. Bean, EL Paso Natural Gas Company (Retired)  
R. Beaty, Amoco Production Company, *Committee Chairman*  
D. Bell, NOVA Corporation  
T. Coker, Phillips Petroleum Company  
W. Fling, OXY USA Inc. (Retired), *Project Manager*  
J. Gallagher, Shell Pipe Line Corporation  
L. Hillburn, Phillips Petroleum Company (Retired)  
P. Hoglund, Washington Natural Gas Company (Retired)  
P. LaNasa, CPL & Associates  
G. Less, Natural Gas Pipeline Company of America (Retired)  
J. Messmer, Chevron U.S.A. Inc. (Retired)  
R. Teyssandier, Texaco Inc.  
E. Upp  
K. West, Mobil Research and Development Corporation

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D. Gould, Commission of the European Communities  
F. Kinghorn, National Engineering Laboratory  
M. Reader-Harris, National Engineering Laboratory  
J. Sattary, National Engineering Laboratory  
E. Spencer, Consultant  
J. Stolz, Consultant  
P. van der Kam, Gasunie

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R. Adamski, Exxon Chemical Americas – BOP  
R. Bass  
M. Bayliss, Occidental Petroleum (Caledonia) Ltd.  
R. Beaty, Amoco Production Company  
D. Bell, NOVA Company  
B. Berry  
J. Bosio, Statoil

J. Brennan, National Institute of Standards and Technology  
E. Buxton  
S. Caldwell  
R. Chittim, American Petroleum Institute  
T. Coker, Phillips Petroleum Company  
H. Colvard, Exxon Company, U.S.A.  
L. Datta-Barua, United Gas Pipeline Company  
D. Embry, Phillips Petroleum Company  
W. Fling  
J. Gallagher, Shell Pipe Line Corporation  
V. Gebben, Kerr-McGee Corporation  
B. George, Amoco Production Company  
G. Givens, CNG Transmission Corporation  
T. Glazebrook, Tenneco Gas Transportation Company  
D. Goedde, Texas Gas Transmission Corporation  
D. Gould, Commission of the European Communities  
K. Gray, Phillips Petroleum Company  
R. Hankinson, Phillips 66 Natural Gas Company  
R. Haworth  
E. Hickl, Union Carbide Corporation  
L. Hillburn  
P. Hogle, Washington Natural Gas Company  
J. Hord, National Institute of Standards and Technology  
E. Jones, Jr., Chevron Oil Field Research Company  
M. Keady  
K. Kothari, Gas Research Institute  
P. LaNasa  
G. Less  
G. Lynn, Oklahoma Natural Gas Company  
R. Maddox  
G. Mattingly, National Institute of Standards and Technology  
B. McConaghy, NOVA Corporation  
C. Mentz  
L. Norris, Exxon Production Research Company  
K. Olson, Chemical Manufacturers Association  
A. Raether, Gas Company of New Mexico  
E. Rapoport, OGE USA, Inc.  
W. Ryan, El Paso Natural Gas Company  
R. Sege  
J. Shumfield  
S. Stark, Williams Natural Gas Company  
K. Starling  
J. Stolz  
J. Stuart, Pacific Gas and Electric Company  
W. Studzinski, NOVA/Husky Research Company  
M. Sutton, Gas Processors Association  
R. Teysandier, Texaco Inc.  
V. Ting, Chevron Oil Field Research Company  
L. Traweck, American Gas Association  
E. Upp  
F. Van Orsdol, Chevron U.S.A. Inc.  
N. Watanabe, National Research Laboratory of Metrology, Japan  
K. West, Mobil Research and Development Corporation  
P. Wilcox, Total of France

J. Williams, Oryx Energy Company  
M. Williams, Amoco Production Company  
E. Woomer, United Gas Pipeline Company  
C. Worrell, OXY USA, Inc.

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## **PART 1 – GENERAL EQUATIONS AND UNCERTAINTY GUIDELINES**

### **1.1 Introduction**

#### **1.1.1 SCOPE**

This standard provides a single reference for engineering equations, uncertainty limitations, construction and installation requirements, and standardized implementation recommendations for the calculation of flow rate through concentric, square-edged, flange-tapped orifice meters. U.S. customary [Inch-Pound (IP)] and International System of Units (SI) are included.

#### **1.1.2 ORGANIZATION OF STANDARD**

The standard is organized into four parts. Parts 1, 2, and 4 apply to the measurement of any Newtonian fluid in the petroleum and chemical industries. Part 3 focuses on the application of Parts 1, 2, and 4 to the measurement of natural gas.

##### **1.1.2.1 Part 1 – General Equations and Uncertainty Guidelines**

The mass flow rate and base (or standard) volumetric flow rate equations are discussed, along with the terms required for solution of the flow equation.

The empirical equations for the coefficient of discharge and expansion factor are presented. However, the bases for the empirical equations are contained in other sections of this standard or the appropriate reference document.

For the proper use of this standard, a discussion is presented on the prediction (or determination) of the fluid's properties at flowing conditions. The fluid's physical properties shall be determined by direct measurements, appropriate technical standards, or equations of state.

Uncertainty guidelines are presented for determining the possible error associated with the use of this standard for any fluid application. User-defined uncertainties for the fluid's physical properties and auxiliary (secondary) devices are required to solve the practical working formula for the estimated uncertainty.

##### **1.1.2.2 Part 2 – Specification and Installation Requirements**

Specifications are presented for orifice meters, in particular, orifice plates, orifice plate holders, sensing taps, meter tubes, and flow conditioners.

Installation requirements for orifice plates, meter tubes, thermometer wells, flow conditioners, and upstream/downstream meter tube lengths are presented.

##### **1.1.2.3 Part 3 – Natural Gas Applications**

The application of this standard to natural gas is presented, along with practical guidelines. Mass flow rate and base (or standard) volumetric flow rate methods are presented in conformance with North American industry practices.