AGA Report No. 3

ORIFICE METERING OF NATURAL GAS AND OTHER RELATED HYDROCARBON FLUIDS

PART 1

General Equations and Uncertainty Guidelines

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, 4th 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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D. Gould, Commission of the European Communities
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Over the years many individuals have been a part of the Chapter 14.3 Working Group and its many task forces. The list below is the roster of the working group and its task forces at the time of publication but is by no means a complete list of the individuals who participated in the development of this document.

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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 estimations, 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.