AN AMERICAN NATIONAL STANDARD

Measurement of Gas Flow by Turbine Meters

ANSI/ASME MFC-4M–1986

REAFFIRMED 2016

SPONSORED AND PUBLISHED BY

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

United Engineering Center 345 East 47th Street New York, N. Y. 10017

Date of Issuance: July 15, 1986

This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this Edition.

FOREWORD

(This Foreword is not part of ANSI/ASME MFC-4M–1986.)

The purpose of this Standard is to provide guidance and recommendation in the application of turbine meters for gas measurement.

This Standard was prepared by Subcommittee No. 8 — Turbine Meters, of the ASME Standards Committee on Measurement of Fluid Flow in Closed Conduits. It represents current practice.

This Standard on gas turbine meters complements the following two published American National Standards on liquid turbine meters:

(*a*) ANSI Z11.299-1971 (API Standard 2534), Measurement of Liquid Hydrocarbons by Turbine Meter Systems

(*b*) ANSI/ISA-RP31.1-1977, Recommended Practice — Specification, Installation, and Calibration of Turbine Flowmeters

This Standard was approved as an American National Standard on April 14, 1986.

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INTRODUCTION

The axial flow type turbine meter is a velocity measuring device in which the flow is parallel to the rotor axis and the speed of rotation is proportional to the rate of flow. The volume of gas measured is determined by counting the revolutions of the rotor.

The gas turbine meter is used in all phases of natural gas operations: production, transmission, and distribution. It has also been used on a variety of industrial and commercial gases.

This Standard is produced to provide guidance to the designer, the operator, and others concerned with the use of the turbine meter for gas measurement.

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MEASUREMENT OF GAS FLOW BY TURBINE METERS

1 SCOPE

(*a*) This Standard applies to:

(*1*) axial full-flow turbine meters with mechanical and/or electrical outputs whose rotating member is driven by a compressible fluid;

(*2*) the measurement of gas by a turbine meter; the meter's construction, installation, operation, performance characteristics, data computation and presentation, calibration, field checking, and other related considerations of the meter.

(*b*) This Standard does not apply to:

(*1*) accessory equipment used to measure pressure and temperature, and/or density for the accurate determination of mass or base volumes, or those accessories used to automatically compute mass or base volumes;

(*2*) steam metering or two-phase flow measurement;

(*3*) applications involving pulsating flow or fluctuating flows where adverse effects on meter accuracy can be anticipated.

2 SYMBOLS AND DEFINITIONS

Much of the vocabulary and many of the symbols used in this Standard are defined in ANSI/ASME MFC-1M–1979, Glossary of Terms Used in the Measurement of Fluid Flow in Pipes. Others that are unique in the field under consideration or with special technical meanings are given in Table 1, and in para. 2.1. Where a term has been adequately defined in the main text, reference is made to the appropriate clause or paragraph.

2.1 Definitions

base flow rate — flow rate calculated from flowing conditions to base conditions of pressure and temperature

base pressure — a specified reference pressure to which a gas volume at flowing conditions is reduced for the purpose of billing and transfer accounting. It is generally taken as 14.73 psia (101.560 kPa) by the gas industry in the USA.

base temperature — a specified reference temperature to which a gas volume at flowing conditions is reduced for the purpose of billing and transfer accounting. It is generally taken as 60°F (15.56°C) by the gas industry in the USA.

base volume — volume of the fluid at base pressure and temperature

flowing pressure — static pressure of the fluid at the turbine rotor in actual operation

flowing temperature — the temperature of the fluid when passing through the turbine rotor in actual operation

meter pressure tap — the pressure tap provided and identified by the manufacturer on the meter body to enable the metering static pressure at the turbine rotor to be measured

rated conditions — conditions of pressure, temperature, and gas composition as specified by manufacturer that rates the meter

Reynolds number — a dimensionless parameter expressing the ratio between inertia and viscous forces. It is given by the formula

$$Re = \frac{V\ell}{\upsilon}$$

where

V = the average spatial fluid velocity
ℓ = a characteristic dimension of the system in which the flow occurs
υ = the kinematic viscosity of the fluid

pipe Reynolds number — expressed by the formula

$$Re_p = \frac{V_p D}{\upsilon}$$

where

D = diameter of the inlet pipe which is of the same nominal size as the meter
V_p = average fluid velocity in the inlet pipe