AGA Report No. 7

Measurement of Natural Gas by Turbine Meters

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Prepared by

Transmission Measurement Committee

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FOREWORD

This report is published in the form of a performance-based specification for turbine meter for natural gas flow measurement. It is the result of collaborative effort of natural gas users, turbine meter manufacturers, flow measurement research organizations and independent consultants forming Task Group R-7 of AGA's Transmission Measurement Committee (TMC). In addition, comments to this report were made by the Committee on Gas Flow Measurement (COGFM) of the American Petroleum Institute (API).

Research conducted in support of this report and cited herein has demonstrated that turbine meters can accurately measure natural gas and, therefore, should be able to meet or exceed the requirements specified in this report when calibrated and installed according to the recommendations contained herein. Users should follow appropriate installation, use and maintenance of turbine meter as applicable in each case.

This version of AGA Report No. 7 is intended to supersede all prior versions of this document. However, this document does not reference existing turbine meter installations. The decision to apply this document to existing installations shall be at the discretion of the parties involved.

Appendix B of this report contains the equations needed to convert volume measured at actual (line) conditions to equivalent volume at base conditions, or to mass. These equations may be used to perform such calculations with any type of positive displacement or inferential meter that registers in units of volume.

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MEASUREMENT OF NATURAL GAS BY TURBINE METERS

1. Introduction

1.1 Scope

These specifications apply to axial-flow turbine flow meters for measurement of natural gas, typically 2-inch and larger bore diameter, in which the entire gas stream flows through the meter rotor. Typical applications include measuring single-phase gas flow found in production, process, transmission, storage, and distribution and end-use gas measurement systems. Typical use is the measurement of fuel grade natural gas and associated hydrocarbon gases either as pure hydrocarbons or as a mixture of pure hydrocarbons and diluents. Although not within the scope of this document, turbine meters are used to measure a broad range of fluids other than natural gas.

This report does not address the characteristics of electronic pulse signal generating devices within or attached to the meter, although it does address the use of their outputs.

Also not addressed are the characteristics of mechanical or electronic instruments that convert meter outputs from line conditions to base conditions. However, Appendix B does contain the equations establishing the mathematical basis for the conversion process. Although these equations appear in this report, they may be used to convert volume registered by any type of meter.

1.2 Principle of Measurement

Turbine meters are inferential meters that measure flow by counting the revolutions of a rotor, with blades, which turns in proportion to the gas flow velocity. From the geometry and dimensions of the rotor blades and flow channel, for a particular turbine meter size and model, the gas volume at line conditions can be inferred from counting the number of rotor revolutions. The revolutions are transferred into digital readout or electronic signals by some combination of mechanical gearing, generated electronic or optical pulses, or frequency. The accumulated line volume can be converted to base volume at standard or contract conditions by accessory devices. Turbine meters can operate over a wide range of gas and ambient conditions. Their upper flow capacities are established and limited by maximum local internal gas velocities, noise generation, erosion, rotor speed, shaft bearing wear and pressure losses. The maximum flow capacity at line conditions is fixed for a particular turbine meter regardless of the operating pressure and temperature. The maximum base flow capacity increases in accordance with Boyle's and Charles' laws. Minimum flow capacities are limited by fluid and non-fluid drags (i.e., windage and mechanical friction losses, respectively) that cause a particular turbine meter design to exceed the desired or prescribed performance limits.