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**SINGLE PATH ULTRASONIC GAS
METERS**
(Under 1400 Cubic Feet Per Hour Capacity)

Secretariat



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PREFACE

This publication represents a basic standard for safe operation and substantial and durable construction for single path ultrasonic gas meters having a gas flow rating of under 1400 cubic feet per hour (39.6 m³/h) at 0.5 inch water column (125 Pa) differential pressure at base conditions. This work is the result of years of experience, supplemented by extensive research. The standard is designed to ensure efficient performance and substantial construction of equipment.

It is recognized that during any transition period to the metric system, sizes and dimensions need to be expressed in either the metric system or the inch-pound system or in both. In this document, both systems are used, with the inch-pound units given preference. A soft conversion from existing inch-pound values is shown. Soft conversion implies a change in nomenclature only; in this document, the alternative nomenclature (metric) is shown by using parentheses.

Nothing in this standard is to be considered as in any way indicating a measure of quality beyond compliance with the provisions it contains. It is designed to allow the construction and performance of single path ultrasonic gas meters that may exceed the various provisions specified in any respect. In its preparation, recognition was intended to be given to the possibility of improvement through ingenuity of design. As progress takes place, revisions may become necessary. When they are believed desirable, recommendations should be forwarded to: American Gas Association, ATTN: Secretariat B109, 400 North Capitol Street, NW, SUITE 450, Washington, DC 20001, U.S.A.

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HISTORY OF THE DEVELOPMENT OF STANDARDS FOR SINGLE PATH ULTRASONIC GAS METERS

In 1966, the American Gas Association and its members requested the establishment of a project within the American National Standards Institute for the development of suitable standards for displacement-type gas meters. The B109 Committee was formed in Jan 1967 and was endorsed by the Mechanical Standards Board of ANSI.

In 1982, ANSI revised its procedures and established committees to become “separate” accredited standards committees with procedures approved by the Audit and Accreditation Board of ANSI.

The ANSI B109 Committee is responsible for development of standards for gas displacement meters, gas service regulators, and related devices. The following meter and regulator standards have since been approved under the guidance of this committee:

ANSI B109.1 – Diaphragm-Type Gas Displacement Meters (Under 500 Cubic Feet Per Hour Capacity)
(initially approved 1973)

ANSI B109.2 - Diaphragm-Type Gas Displacement Meters (500 Cubic Feet Per Hour Capacity and Over)
(initially approved 1980)

ANSI B109.3 – Rotary-Type Gas Displacement Meters (initially approved 1980)

ANSI B109.4 – Self-Operated Diaphragm-Type Natural Gas Service Regulators (initially approved in 1997)

The ANSI procedures require a review of standards every five years. The standards have been kept active via reaffirmation and/or updates.

In 2020 the B109 Committee began discussion of the need for a new standard for ultrasonic meters. In November 2021 the Committee submitted a Project Initiation Notification (PINS) to begin development of a new standard project to address single path ultrasonic gas meters having a flow rating of less than 1400 cubic feet per hour. This new standard would be designated as B109.6 Standard.

The B109 Committee established the B109.6 Task Group at their Fall 2021 meeting. This new B109.6 Task Group began meeting virtually in early-2022 and continued development throughout 2022 and 2023.

The B109 Committee approved the standard for submittal to ANSI for endorsement as an American National Standard on August 2, 2023. The first edition was approved on January 9, 2024.

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SCOPE

This standard applies to single path ultrasonic gas meters, designed for revenue measurement of fuel gas, having a flow rating of less than 1400 cubic feet per hour (39.64 m³/h) capacity at 0.5 inch water column (125 Pa) differential pressure at base conditions.

Part I comprises a list of definitions and terms used throughout the standard.

Part II covers the construction requirements for qualifying new-type meters in the designated flow-rate ranges.

Part III covers the performance requirements for qualifying new-type meters in the designated flow-rate ranges.

Part IV covers the “in-service” performance requirements for meters in the designated flow-rate ranges.

Part V addresses installation requirements for these meters.

Part VI pertains to auxiliary devices used with gas meters covered by this standard.

Part VII covers test methods and equipment.

PART I

DEFINITIONS

- 1.1 **ACCURACY, METER.** The degree to which a meter correctly measures the volume of gas passing through it, determined by comparing the volume registered by the meter with that registered by the prover. (See Appendix D for methods of expressing meter accuracy.)
- 1.2 **REMOTE READING DEVICES.** Devices used with a meter to provide an adjustment of the meter reading, to permit obtaining special information, or to transmit information to a remote location.
- 1.3 **BADGE.** A permanent plate, affixed in a conspicuous place on a meter, containing basic meter information.
- 1.4 **BASE CONDITIONS.** The standard or base conditions of pressure and temperature for the volumetric measurement of natural gas. As used in this standard 14.73 psi (101.56 kPa) and 60°F (15.6°C) are established as the base pressure and temperature respectively to which all volumes are commonly referred. (Also known as STANDARD CONDITIONS)
- 1.5 **BOTTLE, CUBIC-FOOT.** A specially constructed and calibrated bottle, usually immersion type, complete with an immersion tank containing a light oil of low vapor pressure, with the bottle suspended over the tank by means of a suitable cord and pulley so that the bottle may be immersed in the oil between two graduations, top and bottom. The bottle is constructed so that exactly 1 cubic foot of air is displaced when the bottle is immersed between the two marks. The calibration of the bottle must be traceable to the National Institute of Standards and Technology.
- 1.6 **CAPACITY, RATED.** The flow rate in cubic feet per hour of 0.6 specific gravity gas delivered through the meter at an absolute pressure of 14.73 psi (101.56 kPa) and at 60°F (15.6°C) that results in an average differential pressure across the meter connections of 0.5 inch water column (125 Pa).
- 1.7 **CONNECTIONS, METER.** The integral parts of the meter designed for attachment to meter swivels, pipe, or other piping components.
- 1.8 **FLOW RATE.** The actual quantity of gas passing through the gas meter divided by the time taken for this quantity to pass through the gas meter.
 - 1.8.1.1 **Low Flow Cutoff rate (Qlfc):** Flow output is set to zero until the measured flow exceeds the cutoff value. Flow rate when exceeded begins the measurement of gas
- 1.9 **CUBIC FOOT, METERED.** The quantity of gas that occupies 1 cubic foot when under pressure and temperature conditions existing in the meter.
- 1.10 **CUBIC FOOT, STANDARD.** That quantity of gas at base conditions occupies a volume of 1 cubic foot. (See BASE CONDITION)
- 1.11 **CUBIC METER, STANDARD.** That quantity of gas at base conditions occupies a volume of 1 cubic meter. (See BASE CONDITION)
- 1.12 **FLOW RATE, PILOT.** A minimum flow rate that a meter is required to register with a prescribed accuracy.
- 1.13 **HUBS, METER.** Same as 1.10, CONNECTIONS, METER.
- 1.14 **INDEX, METER.** The device that displays the volume of gas that has passed through the meter.
- 1.15 **INDEX RATE.** The uncorrected flow rate calculated by dividing the registration by time.
- 1.16 **INDEX, TEMPERATURE COMPENSATING.** A meter index used to display corrected volume under flowing gas conditions to a base temperature, commonly 60°F (15.6°C).
- 1.17 **LIFE TEST, ACCELERATED.** A test under controlled conditions simulating long-term operation designed to determine long-term maintenance and performance characteristics within a relatively short period of time.
- 1.18 **LOGS, EVENT.** Electronic means for a standard, centralized way for applications (and the operating system) to record important software and hardware events.

- 1.19 **LOGS, SECURITY.** Electronic means to capture information associated with security events and metrological parameter changes.
- 1.20 **LOGS, INTERVAL DATA.** Electronic means to capture data that pertains to interval consumption and billing relevant information
- 1.21 **MAOP.** Maximum Allowable Operating Pressure equivalent to manufacturer's maximum working pressure.
- 1.22 **METER CAPACITY CLASS.** A capacity rated group designation for meters within different ranges of meter capacity. Rated capacity must equal or exceed the capacity class designation, but be less than the next higher meter capacity class.
- 1.23 **METER, GAS.** A device for measuring the volume of flowing gas.
- 1.24 **METER, NEW.** A meter of all new materials as received from the manufacturer; never used in service.
- 1.25 **METER, NEW TYPE.** A gas meter sufficiently different in design or materials of construction so affecting performance as to require qualification as a new-type meter under this standard.
- 1.26 **MILEAGE.** See 1.41, REGISTRATION.
- 1.27 **PERCENT ACCURACY.** The volume indicated by the meter (V_m) divided by the volume indicated by the standard (V_s) taken as a percentage.

$$= \frac{V_m}{V_s} \times 100$$

- 1.28 **PERCENT REGISTRATION.** See 1.1, ACCURACY, METER and Appendix D. Same as 1.29 PERCENT ACCURACY.
- 1.29 **PRESSURE, ABSOLUTE.** Atmospheric pressure plus gauge pressure. Abbreviated as psia.
- 1.30 **PRESSURE, BASE.** An absolute pressure value to which measured gas volumes are corrected. If a purchase contract applies, the term is referred to as a contract base pressure. See 1.4 Base Conditions.
- 1.31 **PRESSURE DIFFERENTIAL.** The difference in pressure between two points in a flowing gas system.
- 1.32 **PRESSURE, GAUGE.** Pressure measured relative to atmospheric pressure. Abbreviated as psig.
- 1.33 **PRESSURE, METER.** The pressure in a meter under operating conditions. (Usually considered to be the meter's inlet pressure.)
- 1.34 **PROVER.** Device for measuring the accuracy of gas meter registration.
- 1.35 **PROVER, BELL.** Device for measuring the accuracy of gas meter registration. A calibrated cylindrical bell in which a quantity of air is collected over an oil seal. See ANSI B109.1 Appendix E.
- 1.36 **PROVER, LOW PRESSURE FLOW.** An apparatus utilizing an orifice for testing meters at low pressures by passing gas or air through both the orifice and meter and finally discharging it to the atmosphere. The time for a given quantity of gas to pass through the meter compared to the orifice standard time corrected for test conditions provides a measure of meter accuracy.
- 1.37 **PROVER, SONIC FLOW.** Also referred to as SONIC FLOW PROVER or CRITICAL FLOW PROVER. A device employing either venturi, orifices or sonic nozzles as restrictions that is used for testing meters, usually at elevated pressures, by passing gas or air through both the meter and restriction and finally discharging it at a lower pressure that maintains sonic velocity (critical flow) through the restriction. The time for a given quantity of gas or air to pass through the meter compared to the restriction standard time corrected for test conditions provides a measure of meter accuracy.
- 1.38 **PROVER, TRANSFER.** A device for determining the accuracy of a meter under test by comparing its reading against the reading obtained from a calibrated reference meter connected in series with the meter under test.
- 1.39 **REGISTRATION.** The indicated volume of gas passed through a meter.
- 1.40 **SEAL.** A device designed to give evidence of tampering with a meter.

- 1.41 **SINGLE PATH ULTRASONIC METER.** A type of flow meter that measures the velocity of a fluid with ultrasound to calculate volume flow. Using a single pair of ultrasonic transducers, the flow meter can measure the average velocity along the path of an emitted beam of ultrasound. This velocity measurement is then transformed into a volumetric measurement.
- 1.42 **STANDARD CONDITIONS.** See 1.4, BASE CONDITIONS.
- 1.43 **COMPRESSIBILITY.** Deviation of a real gas from the ideal gas laws relative to changes in pressure and temperature.
- 1.44 **TEMPERATURE, ABSOLUTE.** That temperature obtained in degrees Rankine by adding 459.67 degrees to a reading of a Fahrenheit thermometer or in degrees Kelvin by adding 273.15 degrees to that of a Celsius thermometer reading.
- 1.45 **TEMPERATURE, BASE.** A reference temperature to which measured gas volumes are corrected. See 1.4 BASE CONDITIONS
- 1.46 **TEMPERATURE, FLOWING.** The temperature of the gas at flowing conditions.
- 1.47 **TEMPERATURE, METERING.** The temperature of the gas in a meter at operating conditions. (Defined as the meter's outlet temperature.)

PART II

CONSTRUCTION REQUIREMENTS FOR QUALIFYING NEW-TYPE METERS

2.1 SCOPE

This part establishes construction requirements for qualification of a new-type meter.

2.2 CONNECTION DIMENSIONS

The following standard specifications are included to provide for practical mounting and connecting interchangeability, consistent with accepted manufacturing procedures.

2.2.1 Meter Capacity Class Connections. Standard, top mount, meter capacity class connections are listed in Table I. Dimensions for connections listed below as standard, and other commonly used connections, are defined in Appendix A and Appendix B.

TABLE I
TOP-CONNECTED METERS

Meter Capacity Class	Connection Designation		Center-to-Center Dimensions [reference only] (Dim. A., Fig.1)
	Male Customary (SI)	Female Customary (SI)	
175	20 Lt	NA	6" (152.4 mm)
250	20 Lt	NA	6" (152.4 mm)
400	30 Lt	NA	8 ¼" (209.6 mm)
500	45Lt-1½" NPT (DN 40)	1½" NPT (DN 40)	11" (279.4 mm)
900	45Lt-1½" NPT (DN 40)	1½" NPT (DN 40)	11" (279.4 mm)

2.2.2 Top-Mounted Connections.

Meters with top-mounted connections shall conform to the dimensions and specifications illustrated in Figure 1. Center-to-Center Dimensions are recommended in Figure 1.

2.2.2.1 The tolerance limits on dimension "A" (center-to-center) of the connections are specified in Table II

TABLE II
CENTER-TO-CENTER CONNECTION TOLERANCE

Dimension "A", Figure 1		Tolerance	
Imperial	Metric	Imperial	Metric
6" and less	152.4 mm and less	± 1/32"	0.8 mm
> 6" up to 12"	>152.4 mm up to 304.8 mm	± 1/16"	1.6 mm
>12"	>304.8 mm	± 3/32"	2.4 mm

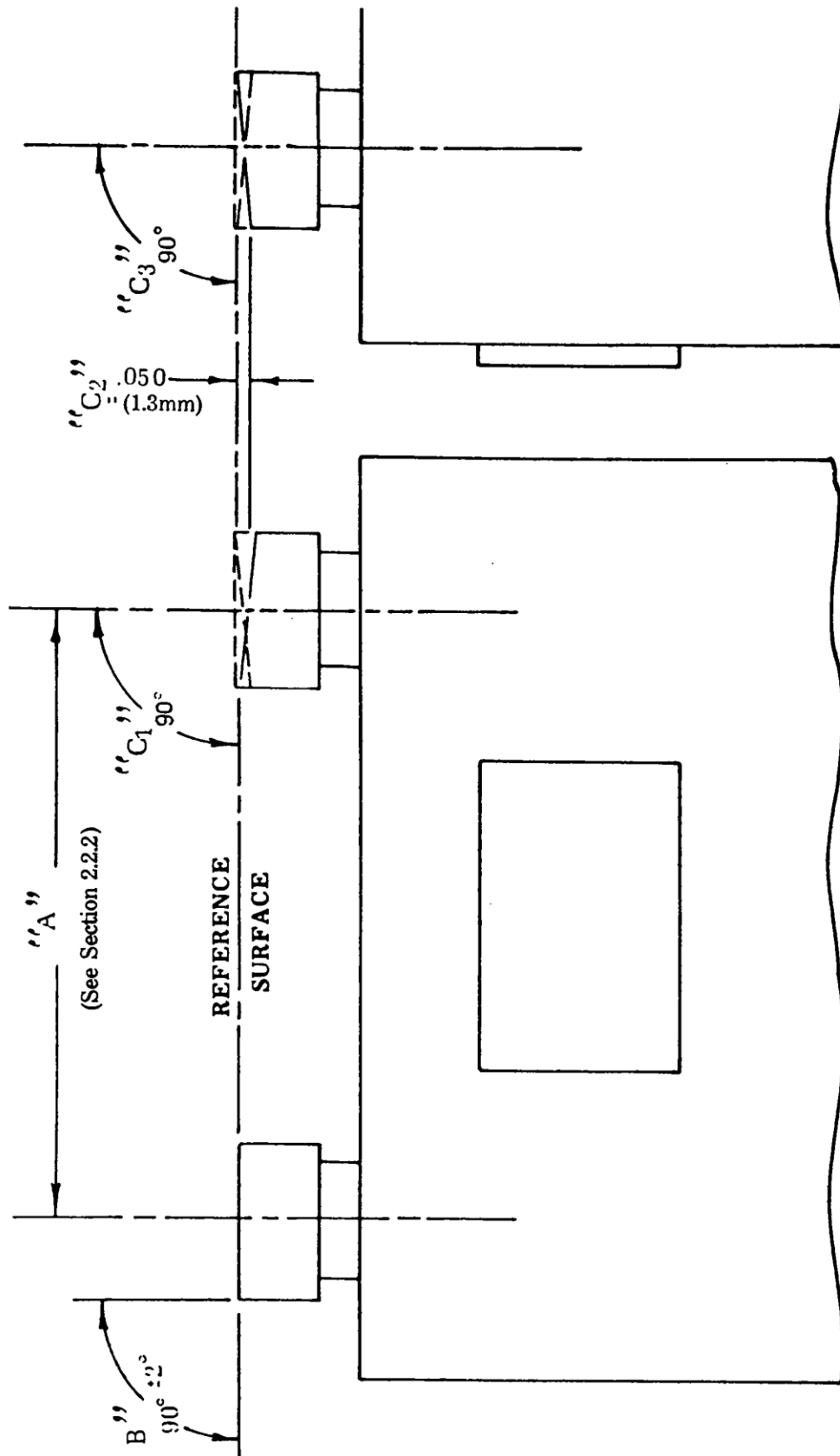


Figure 1. Top-mounted hub tolerances.