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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 18604-2023

Replacing GB/T 18604-2014

Measurement of natural gas flow by gas ultrasonic flow meters

用气体超声流量计测量天然气流量

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1 Scope

GB/T 18604-2023 is the Chinese national standard on measurement of natural gas flow by gas ultrasonic flow meters, in the field of petroleum and related technologies. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 23 May 2023 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 December 2023. Classification: ICS 75.180.30, CCS E98. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document specifies the measurement performance, flow meter body, installation and

maintenance, field verification test requirements, as well as flow calculation method and measurement uncertainty estimation of insertion-type gas ultrasonic flow meters using transit-time difference method (hereinafter referred to as "flow meters"). This document applies to measurement of natural gas flow in gathering and transmission equipment, gas transmission pipelines, storage facilities, gas distribution systems, user metering systems, measuring standard devices and other application places.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 2624.2 Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1 transit-time difference method A gas flow measurement method by using the transit-time difference of two ultrasonic signals propagating downstream and upstream to determine the average gas flow along the acoustic path within the same stroke in the flowing gas.

3.2 ultrasonic transducer A component that converts acoustic energy into electrical signals and converts electrical signals into acoustic energy.

3.3 signal processing unit; SPU An electronic device composed of electronic components and a microprocessor system, which has the functions of receiving ultrasonic transducer signals, processing measurement signals, displaying, outputting and recording measurement results.

3.4 meter body A pipe section through which the measured gas passes, which is equipped with components such as ultrasonic transducers and pressure measuring joints, and is specially manufactured to meet the requirements of relevant standards in all aspects.

3.5 acoustic path Actual path that an ultrasonic signal travels between a pair of transmitting and receiving ultrasonic transducers.

4 Measurement principle

4.1 Basic principle A gas ultrasonic flow meter using transit-time difference method is a velocity flow meter that measures the transit-time of high-frequency sound pulses to obtain the gas flow. The transit-time is measured by the sound pulses transmitted and received between paired transducers outside or inside the pipeline. The sound pulse propagates in

the oblique direction (see Figure 1).

4.2 Factors affecting measurement accuracy

4.2.1 The internal factors affecting measurement accuracy are mainly.

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5 Working conditions

5.1 Natural gas quality The natural gas composition measured by the flow meter shall be within the range specified in GB/T 17747 (all parts), and the relative density of natural gas is 0.55 ~ 0.80.

5.2 Pressure The minimum working pressure of ultrasonic transducers shall ensure that the sound pulse can propagate normally in natural gas.

5.3 Temperature The manufacturer shall provide flow meters that meet the temperature range requirements according to the actual working conditions of the user, including specified working and ambient temperature range of flow meter body, field-installed electronic devices, and its related external equipment, cable connections and ultrasonic transducers.

5.4 Flow range and flow direction The flow measurement range of flow meters is determined by the actual flow velocity of the gas. The typical flow velocity range of the measured natural gas should be (0.3 ~ 30) m/s.

5.5 Velocity distribution Under ideal conditions, the natural gas flow entering the flow meter shall be a symmetrical and fully developed turbulent velocity distribution.

6 Measurement performance requirements

6.1 General requirements This Clause specifies a set of minimum measurement performance requirements that flow meters shall meet. Before adjusting the real flow calibration coefficient, the flow meter shall meet these performance requirements to ensure that the flow meter's own problems and defects are not covered up by the calibration coefficient adjustment.

6.2 Measurement performance requirements for multi-acoustic-path gas ultrasonic flow meters

6.2.1 General Before adjusting the calibration coefficient, the general measurement performance of all multi-acoustic-path gas ultrasonic flow meters shall meet the following requirements.

6.2.2 Accuracy of large-diameter flow meters Before adjusting the calibration coefficient, multi-acoustic-path gas ultrasonic flow meters with a diameter equal to or greater than 300

mm shall meet the measurement accuracy requirements shown in Figure 2 and the following.

6.2.3 Accuracy of small-diameter flow meters Before adjusting the calibration coefficient, multi-acoustic-path gas ultrasonic flow meters with a diameter less than 300 mm shall meet the measurement accuracy requirements shown in Figure 2 and the following.

6.3 Measurement performance requirements for single-acoustic-path gas ultrasonic flow meters

6.4 Effect of working conditions on measurement performance Under the working conditions specified in Clause 5, the flow meter shall meet the measurement performance requirements specified in

6.1 And

6.2 without any manual adjustment.

7.1 Composition and basic regulations

7.1.1 Composition A flow meter mainly consists of the following two parts.

7.2 Meter body

7.2.1 Maximum working pressure The maximum design working pressure of a flow meter shall be the minimum value of the maximum working pressure of the flow meter body, flange, ultrasonic transducer components and their mounting parts.

7.2.8 Appearance quality requirements The appearance quality shall meet the following requirements.

7.2.9 Other requirements The flow meter shall not roll when placed on a smooth surface with a slope of 10 % to prevent damage to the protruding ultrasonic transducer and signal processing unit when it is temporarily placed on the ground during installation or maintenance.

7.3 Ultrasonic transducer

7.3.1 Technical requirements The manufacturer shall provide the general technical indicators of ultrasonic transducers, such as. key dimensions, maximum allowable working pressure, working pressure range, working temperature range, gas composition limit, transducer working frequency, etc.

7.5 Flow computer

7.5.1 Hardware The computer code used for flow meter control and operation shall be stored in non- volatile memory, and all flow calculation constants and manually entered