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شرکت ملی گاز ایران

مدیریت پژوهش و فنآوری

امور تدوین استانداردها

IGS

مشخصات فنی



# کنتورگاز آلتراسونیک چند مسیره

# Multipath Ultrasonic Gas Flow Meter

# ابلاغ مصوبه هیأت مدیره

## مدیر محترم پژوهش و فناوری

باسلام،

به استحضار می‌رساند در جلسه ۱۹۲۷ مورخ ۱۴۰۰/۰۳/۲۳ هیات مدیره، نامه شماره گ۳۲۸۰۷/۰۰۰/۹ مورخ ۱۴۰۰/۰۳/۱۷ آن مدیریت درمورد تصویب نهایی مقررات فنی شرکت ملی گاز ایران به شرح زیر مطرح و مورد تصویب قرار گرفت.

۱-مشخصات فنی کنتور گاز آلتراسونیک چند مسیره IGS-M-IN-104(3)

۲-دستور العمل عمل کننده هیدرولیکی شیرآلات IGS-M-IN-304(2)

۳-مشخصات فنی کیفیت سامانه قطع گاز در ایستگاه های TBS/DRS در مقابل زلزله IGS-M-IN-306(1)

۴-مشخصات فنی فلنج های مهار (Anchor Flang) IGS-M-PL-027(1)

این مصوبه در حکم مصوبه مجمع عمومی شرکت‌های تابعه محسوب و برای کلیه شرکت‌های تابعه لازم الاجرا می‌باشد .

**الهام ملکی**
**دبیر هیات مدیره**

**رونوشت** : مدیرعامل محترم شرکت ملی گاز ایران و رئیس هیات مدیره
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رئیس محترم حسابرسی داخلی
رئیس محترم امور مجامع

## Foreword

This standard specification is intended to be mainly used by N.I.G.C. and contractors, and has been prepared base on interpretation of recognized standards and technical documents, as well as knowledge, backgrounds and experiences in gas industries at national and international levels.

Iranian Gas Specification (IGS) are prepared, reviewed and amended by technical standard committees within NIGC standardization division of research and technology management and submitted to "the standards council of NIGC" for approval.

IGSs are subjected to revision, amendment or withdrawal, if required, and thus the latest edition of IGS shall be checked / inquired by NIGC'S users.

This standard must not be modified or altered by NIGC employees or its contractors. Any deviation or conflicts between this specification and other applicable standards, codes, procedure or well-known manufacturer's specifications must be resolved in writing by the user or its representative through Manager, Engineering Department or standardization division of NIGC.

The technical standard committee welcomes comments and feedbacks from concerned or interested corporate and individuals about this standard, and may revise this document accordingly based on the received feedbacks.



## General Definitions

Throughout this standard the following definitions, where applicable, should be followed:

1- "STANDARDIZATION DIV." is organized to deal with all aspects of industry standards in NIGC. Therefore, all enquiries for clarification or amendments are requested to be directed to mentioned division.

2- "COMPANY": refers to National Iranian Gas Company (NIGC).

3- "SUPPLIER": refers to a firm who will supply the service, equipment or material to IGS specification whether as the prime producer or manufacturer or a trading firm.

4- "SHALL ": is used where a provision is mandatory.

5- "SHOULD": is used where a provision is advised only.

6- "MAY": is used where a provision is completely discretionary.

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## Contents

## 1. SCOPE

This specification together with the data sheet there to covers the minimum requirements for design, material , testing, inspection, painting, marking, packing and documentation of "Multi path ultrasonic transit-time flow meter (USM) according to AGA report No.9 but with following requirements which have been mentioned at this specification.

This specification is only used for in line USM with ANSI Class rating 600and not applicable to clamp-on externally mounted meters.

## 2. REFERENCES

Throughout this standard specification the following standards, codes and reports are referred to. The editions of these standards and codes that are in effect at the time of publication of this standard specification (Latest edition) shall, to the extent specified herein, form a part of this standard specification. The applicability of changes in standards and codes that occur after the date of this standard specification shall be mutually agreed upon by the purchaser and supplier and/or manufacturer.

AGA REPORT No.9 “Measurement of Gas by Multipath Ultrasonic Meter”

OIML R 137-1 & 2, Gas Meters

IGS-CH-033 (1) “Specification for Iranian Natural Gas Quality”

ISO 17089-1 “Measurement of Fluid in Closed Conduits-ultrasonic for gas – Part 1:

Meters for Custody Transfer and Allocation Measurement”

IGS –O-CH-042(0) “Painting Procedure for Gas Industry “

IPS-G-GN-210 “Packing & Packages “

ANSI/ASMEB16.5 “Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24”

## 3. DEFINITIONS

For the purposes of this standard, the terminology, definitions, and units apply According to AGA Report No. 9.

## 4. REQUIEMENTS

### 4.1 Design and Service Conditions

**4.1.1** Multi path ultrasonic meters shall have at least four independent pairs of measuring transducers (acoustic path).

**4.1.2** For specific requirements see data sheet (normative Appendix). In case of any exception to the specification, it shall be clearly stated on the technical quotation submitted by suppliers.

**4.1.3** The USM shall be constructed of quality materials in a workmanlike manner in order to attain gas tightness, stability of performance and sustained accurate meter in govern a period of time and over the range of operating conditions with minimum of maintenance, when metering natural gas.

**4.1.4** The USM shall be tamper proof, gas tight and capable to sustain accuracy under the whole range of service conditions.

**4.1.5** The natural gas which is used for the measurement by the USM, shall be according to IGS-CH-033(1). The USM shall, as a minimum requirement, operate with any of the “normal range" natural gas composition mixtures specified in that standard.

**4.1.6** Standard volume measured at 101.325 k Pa (14.696 psia) Standard Pressure and 15.56 ºC (60 ºF) = 288.71 K Standard Temperature.

**4.1.7** For each meter design and size, the minimum, transition and maximum gas flowrate (qt, qmin and qmax) passing through the USM should be specified by the manufacturer.

**4.1.8** The USM's output is typically an uncorrected volume, either per unit of time or accumulated. Therefore, an associated flow computer must be installed by the manufacturer/supplier to correct for pressure, temperature, compressibility, and accumulated uncorrected and corrected volumes, and to provide the necessary date retention and audit trail.

Optionally, the flow computer functions could be integrated into the USM's SPU by the manufacturer.

**4.1.9** Erosion, corrosion and dirt build up on internal meter surfaces, etc. may be adversely influenced by operational degradation of the USM over time and the manufacture shall be coated with nickel plate or suitable material on internal meter surfaces.

**4.1.10** USM flange shall be according to ANSI B16.5 up to 24 inches and ANSI B16.47for above 24 inches.

**4.1.11** According to data sheet for bi-directional applications, the USM should be treated as two separate meters, associated with two "meter runs" in a single flow computer or with two separate flow computers.

**4.1.12** The ability to replace transducers, cables, electronic parts and firmware is a requirement. Such replacement shall not cause a change in the meter's performance greater than the manufacturer's published repeatability of the meter. Additionally, component replacement shall not change the meter package performance from the original calibration results by more than the long-term uncertainty of the flow calibration test facility. The manufacturer shall provide proven procedures for the user and sufficient data to demonstrate compliance with this requirement. If the manufacturer cannot meet this requirement, flow calibration may be necessary.

**4.1.13** When flow computer is not provided by meter manufacturer/supplier the specification of Power supply of SPU shall be filled in the data sheet.

**4.1.14** The manufacturer shall establish and follow a written comprehensive quality assurance program for the production, assembly and testing of the meter and its Electronic system (e.g., ISO, EC-Type Examination, etc.). A written description of the quality assurance program shall be made available upon request.

**4.1.15** Filtration of the flowing gas is necessary for UM Application for avoiding the accumulation of deposits to a mixture of dirt, mill scale, condensates, lubricating oil and construction debris.

## 4.2 Materials

**4.2.1** Because natural gas may contain some impurities (e.g., light oils, glycols, amines, inhibitors or condensates), transducer ports should be designed in a way that reduces the possibility of liquids or solids accumulating in the transducer ports.

**4.2.2** Cable jackets, rubber, plastics and other exposed parts shall be resistant to ultraviolet light, water, oil and grease.

**4.2.3** USM flange material shall be according to ASTM A105"Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24".

**4.2.4** USM body material shall be carbon steel according to API 5L or cast carbon steel according to ASTM A 216 Gr. WCB/WCC.

# 5. INSPECTION, FLOW CALIBRATION AND CERTIFICATIONS

### 5.1 inspections, tests and certifications

All inspections, tests and certifications shall be done on each USM according to AGA report No. 9 together with the following additional requirements.

### 5.1.1 Visual inspection

Visual inspection includes checking of color, flanges, nameplate, etc. In visual inspection, the meter bore and transducer ports should be inspected for accumulation of solids, erosion or other damage that would affect meter performance.

### 5.1.2 Hydrostatic test

The USM body shall be designed to withstand the internal pressure using an appropriate safety factor for the body material at maximum inlet pressure ($P_{max}$). It shall be tested to ensure it has sufficient strength to operate safety.

### 5.1.3 Individual Meter-Manufacturing Tests and Checks

Prior to the flow calibration and/or field operation of each USM package, the meter manufacturer shall perform the following tests and checks. The results of all tests and checks performed shall be documented and provided in a report to the designer or operator, and retained by the manufacturer for a minimum of 10years.



#### 5.1.3.1 Dimensional Measurements

The manufacturer shall measure and document the average internal diameter of the meter, the length of each acoustic path between transducer faces and the axial (flow meter body axis) distance between transducer pairs (or angle of each acoustic path).

The average internal diameter should be calculated from a total of 12 internal diameter measurements. Four internal diameter measurements (one in the vertical plane, another in the horizontal plane and two in planes approximately 45o from the vertical plane) shall be made at three meter cross-sections: 1) near the set of upstream ultrasonic transducers, 2) near the set of downstream transducers and 3) half way between the two transducer sets. If the acoustic path lengths or the axial distances between ultrasonic transducer pairs cannot be directly measured, then the unknown distances shall be calculated using trigonometry and distances that can be measured directly. Where the measurement of angles is difficult and the result is imprecise, such measurements shall not be used to calculate the required distances.

The flow meter body temperature shall be measured and documented at the time these dimensional measurements are made. The measured lengths shall be corrected to an
equivalent length at a meter body temperature of 68o F (20o C) by applying the applicable coefficient of thermal expansion for the flow meter body material.

All instruments used to perform these measurements shall have valid calibrations traceable to national standards; e.g., National Institute of Standards and Technology (NIST) in the U.S.A.
These measurements and calculations shall be documented on a certificate, along with the name of the meter manufacturer, meter model, meter serial number, flow meter body temperature at the time dimensional measurements were made, date, name of the individual who made the measurements and name of the inspector, if present.

**5.1.3.2 Leakage Test**

Every USM, complete with transducers and transducer isolation valves (if used), shall be leak-tested by the manufacturer after final assembly and prior to shipment to the designer, fabricator or flow calibration facility. The test medium should be an inert gas such as nitrogen. The leak test pressure shall be a minimum of 200 psig (1380 KPa), or the meter's maximum pressure rating, whichever is less. This pressure shall be maintained for a minimum of 15 minutes, with no leaks detectable with a noncorrosive liquid solution or an ultrasonic leak detector as described in ASTM E1002 (latest revision).
This leak test does not preclude the requirements to perform a hydrostatic test.

**5.1.3.3 Zero-Flow and SOS Verification Test**

The manufacturer shall perform a zero-flow verification test to obtain and document the zero-flow reading. The manufacturer shall follow a detailed test procedure that includes the following elements, at a minimum: 1 7

• If zero-flow verification is performed at elevated pressure, blind flanges shall be attached to the ends of the flow meter body. The selection of the reference gas shall be the responsibility of the manufacturer. Air at atmospheric pressure and room temperature can be used as a reference gas if the USM performs under such conditions. The acoustic properties of any reference gas shall be well known and documented.

• The gas pressure and temperature shall be allowed to stabilize at the outset of the test. The gas velocities for each acoustic path shall be recorded for at least 30 seconds. The mean gas velocity and standard deviation for each acoustic path shall then be calculated.

• Adjustments to the meter shall be made as necessary to bring the meter performance into compliance with the manufacturer's specifications and the specifications stated in this report.

The measured speed-of-sound values shall be compared with the theoretical value computed using a complete compositional analysis of the reference gas, measurements of the reference gas pressure and temperature, and the equation of state used in AGA Report No. 8, Part 1: DETAILED Equation of Stator Part 2: GERG-2008 Equation of State.
As part of the test procedure, the manufacturer shall document the ultrasonic transducer serial numbers and their relative locations in the flow meter body. The manufacturer shall also document all parameters used by the meter, e.g., transducer/electronic transit-time delays, zero-flow reading for each acoustic path, incremental timing corrections, and all acoustic path lengths, angles, diameters and other parameters used in the calculation of the gas velocity for each acoustic path. The manufacturer shall note if the constants are dependent on specific transducer pairs.

The zero-flow verification test shall meet the following requirements:

• The individual path gas velocity no greater than ±0.02 ft/sec (0.006 m/sec)
• The speed of sound per path within ±0.2% of the theoretical value
• Percentage of accepted pulses for each acoustic path are 100%
• All gain levels are within the nominal limits provided by the manufacturer
• Maximum SOS path spread not greater than 1 .5 ft/s (0.5 m/s)

Any per-path zero-flow issues outside the above specification shall be corrected at the path level. The manufacturer may not implement a bulk zero-flow offset factor based on the zero-flow calibration.
Once all of the above conditions are satisfied, the flow calibration of a meter with the metering package may commence at an operator-approved flow calibration facility.

The test equipment shall not subject the meter to externally applied stress which may significantly affect the result of this tests. At the discretion of the test facility the tests can be carried out with water, kerosene or any other suitable liquid having a viscosity of not greater than that of water, or with gas (air or any other suitable gas).

The meter shall be free of entrapped air when testing with a liquid.

The test shall be performed on a meter without external painting of coating at a Minimum internal pressure of 1.5 times the maximum working pressure with a minimum of 2 bar.

The test shall be performed by applying pressure inside the assembled meter body with the connections closed.

Detectable leakage through the casing is not acceptable. Test duration shall be for a minimum 5 min.

If pressure tests in the presence of a representative of the purchaser are specified, painted meters from stock may be retested without removal of paint.

**5.1.4 Document review**

Records of all design calculations shall be available for inspection to insure that the materials and design of the meter casing comply with a recognized standard. The design calculation shall fulfil the strength requirements at a minimum temperature of -29 ºC and at a maximum temperature of 60 ºC.

**5.1.5 Paint test**

The external surface of the USM shall be thoroughly painted according IGS-O-CH-042.

**5.2 Inspection and Certificates**

The manufactured USM will be inspected and the inspection shall cover the following stages as specified in this specification and according to terms and conditions of purchase order.
5% of each item and lot (minimum one sample) ready for presentation (unless otherwise specified by mutually agreed inspection procedure based on capacity and quantity of each lot) shall be selected randomly by identified NIGC inspector.
Manufacturer shall provide and present to NIGC inspector test results for different examinations correlated to serial number and material test certificates according to requirements of NIGC specification:

**1- Visual inspection**

**2- Hydrostatic test**

**3- Leakage test**

**4- Dimensional test**

**5- Zero flow verification test (Zero test)**

**6- Flow calibration test**

**7-Electronic design test**

**8- Paint test**

**9-Type test**

## 6. PAINTING

The external surface of the USM shall be thoroughly painted according to IGS-O-CH-042.

## 7. MARKINGS

The marking of each USM shall be according to AGA report No. 9 and each transducer and SPU shall be permanently marked with a unique designation for easy reference.

## 8. PACKING AND PACKAGING

A- Each USM shall be put in a plastic bag with all openings such as inlet, outlet covered, by plastic caps.

B- Each plastic bag shall be housed in wooden support.

C- The wooden supports shall be housed in wooden cases according to NIGC packing instructions under protection, packing, marking and dispatching.



## 9. DOCUMENTATION

The Documentation with technical quotation, after receipt of order and before shipment shall be according to AGA report No.9 including (all documentation shall be dated and be named the manufacture):

**1.** The customer/ designer submits to USM manufacturer the initial metering station plan. Then manufacturer shall be provided the detailed installation drawings including upstream & downstream pipe length, flow conditioner, etc. according to flow calibration/type approval certificate.

**2.** Description of the meter giving the technical characteristics and the principle of its operation.

**3.** Dimensioned drawing of the meter

**4.** Nomenclature of parts with adscription of constituent materials of such parts.

**5.** Description of the available output signals and any adjustment mechanisms a list of the documents submitted.

**6.** A recommended spare parts list.

**7.** Certified dimensional meter drawing, including but not limited to overall process connection dimensions, ratings, maintenance space clearances, conduit connection points, and estimated weight.

**8.** Meter-specific electrical drawings showing the custom/er wiring termination points.

**9.** Instructions for installation, operation, periodic maintenance and troubleshooting.

**10.** Description of software function and configuration parameters at the time of shipment.

**11.** Documentation that the design and construction comply with applicable safety codes and regulations.

**12.** A field verification test procedure as described According to AGA Report No.9 in section 7.2 "Field Verification."

**13.** Drawing showing the location of verification marks and seals if applicable.

**14.** Drawing or picture of the data plate or face plate and of the arrangements for inscriptions.

**15.** Drawing of any auxiliary devices.

**16.** Copies of hydrostatic test certificates, material certificates, weld radiographic reports, and other quality test as specified by the designer.

**17.** Results of the zero-flow verification test.

**18.** Type test certificate

**19.** Flow / wet calibration certificate

# Data Sheet

| Item | Subject | To be filled by NIGC | To be filled by manufacturer/supplier |
|---|---|---|---|
| General | Tag No. | .... | .... |
| | Flow direction | Uni – directional □<br>Bi-directional□ | Uni – directional □<br>Bi-directional□ |
| | Line size ( IN ) | .... | |
| | Pipe thick | .... | |
| | Piping material | API 5 L- GRADE... | |
| | Manufacturer / supplier | | .... |
| | Model No. | | .... |
| Process data | Process fluid | Natural gas | ... |
| | Flow rate (CM/H) | Max./ Min.: ------ | Max. / Min.: ... |
| | design pressure (barg) | ... | ... |
| | Gas inlet pressure(barg) | Max./ Min.: ------ | Max. / Min.: ... |
| | Gas inlet temperature( $^{\circ}C$ ) | Min :-10 Max:+55<br>Otherwise please specify: | Min : Max: |
| | design temperature( $^{\circ}C$ ) | ... | |
| | Ambient temperature ( $^{\circ}C$ ) | Min :-29 Max:+60 | Min : Max: |
| | Specific gravity | ... | ... |
| | Standard conditions | 1.01325 bara & 15.56 $^{\circ}C$<br>(14.696 PSIA & 60 $^{\circ}F$ ) | Yes □ No □ |

| Item | Subject | To be filled by designer | To be filled by manufacturer/supplier |
|---|---|---|---|
| Meter Data | Type | Transit Time | .... |
| | USM Size ( IN) | .... | .... |
| | USM Class Rating | ANSI Class 600 | ANSI Class 600 |
| | USM Connection Type | Flanged End | Flanged End |
| | USM Flange Material | Carbon Steel Acc.to ASTM A105 | .... |
| | USM Body Material | Carbon Steel Acc.to API-5L Gr. Cast Carbon Steel Acc. To ASTM A216 WCB/WCC | .... |
| | USM Face to Face Length | | .... |
| | Upstream/Downstream | …. | …. |
| | USM Mounting | Horizontal | Horizontal |
| | Flow Conditioner | Yes □ No □ | Yes □ No □ |
| | USM Equipped With | Flow Computer | Flow Computer |
| Transducer (or) sensor | Number of Paths / Channels | At least four pairs | .... |
| | Transmitting &Receiving Type | | Head to Head □<br>Reflection □<br>**others□ |
| | Transducer Replaceable In Operation | required | |
| | Transducer Mounting | | .... |
| | Transducer Type/Model | | .... |
| | Transducer Material | | .... |
| | Transducer Housing Material | | .... |
| | Transducer Power Supply | | .... |
| | Transducer Enclosure Protection | At least IP65 | .. |
| ransducer or) sensor | Transducer Manufacture | | .... |
| | Transducer Model No. | | .... |

| | | | |
|---|---|---|---|
| | Transducer Enclosure Certification | *required* | .... |
| | Transducer Electronic Connection | | … |
| | Transducer Cable Type | | … |
| | Transduce Signal Cable Length | | … |
| | Transducer Critical Dimensions | | … |
| | Transducer Max. Allowable Operating Pressure | | … |
| | Transducer Operating Pressure Range | | … |
| | Transducer Operating Temperature Range | | … |
| | Gas Composition Limitations | | … |