



**HELLENIC GAS
TRANSMISSION
SYSTEM OPERATOR**

357-359, MESSOGION AVE.,
15231 ATHENS, GREECE
Tel.: 210 6501258
Fax : 210 6501551

**TECHNICAL JOB
SPECIFICATION**

612/2

REVISION 0

DATE 05/04/2011

HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

ULTRASONIC METERS

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QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

Rev. No	Rev. Date	REASON FOR CHANGE	PQ DPT. Made By	VG Approved By
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- Job Spec. No. 500/5
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- Job Spec. No. 830/1
[External Painting]
- Job Spec. No. 970/2
[Shop Inspection of Equipment and Materials for NGT Project]
- EU DIRECTIVE 2004/108/EEC EMC
[Electromagnetic Compatibility Directive]
- EU DIRECTIVE 94/9/EC ATEX
[Equipment Explosive Atmospheres Directive]
- EU DIRECTIVE 97/23/EC - PED
[Pressure Equipment Directive]
- MINISTERIAL DECISION No. Δ1/1227
Governmental Gazette 135B/05.02.2007
- ELOT EN 583-1
[Non-destructive testing - Ultrasonic examination - Part 1: General principles]
- ELOT EN 1092-1
[Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges]
- ELOT EN 1290
[Non-destructive testing of welds - Magnetic particle testing of welds]
- ELOT EN 1369
[Founding - Magnetic particle inspection]
- ELOT EN 1435
[Non-destructive testing of welds - Radiographic testing of welded joints]
- ELOT EN 1776
[Gas supply systems - Natural gas measuring stations - Functional requirements]
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ELOT EN 10297-1

[Seamless circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes]

ELOT EN 12261

[Gas meters - Turbine gas meters]

ELOT EN 60529

[Degrees of Protection provided by Enclosures (IP Code)]

ISO 9951

[Measurement of Gas Flow in Closed Conduits - Turbine Meters]

ISO/DIS 17089 -1

[Measurement of fluid flow in closed conduits - Ultrasonic meters for gas - Part 1: Meters for custody transfer and allocation measurement]

AGA Report No. 9

[Measurement of Gas by Multipath Ultrasonic Meters]



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1.0 SCOPE

1.1 ITEM

Spool piece ultrasonic meters.

1.2 SERVICE

Natural gas metering systems.

1.3 APPLICATION

Used for measuring actual volumetric gas flow rates.

2.0 GENERAL REQUIREMENTS

2.1 LEGISLATION AND STANDARDS

- EU Directive 2004/108/EC EMC
- EU Directive 94/9/EC ATEX
- EU Directive 97/23/EC PED
- MINISTERIAL DECISION No. Δ1/1227 Governmental Gazette 135B/05.02.2007
- ELOT EN 1776
- ISO/DIS 17089-1
- AGA 9

2.2 UNITS

Metric.

2.3 OPERATING TEMPERATURE RANGE

Accurate function is required at process temperatures as defined in basic design documents.

2.4 CONSTRUCTION

2.4.1 GENERAL

The principal components of an ultrasonic meter, is the meter body with the ultrasonic transducers, and a control unit with appropriate electronics in order to operate the transducers and calculate the actual volume flow rate from the measured transit times, along with the interconnecting cables.

2.4.2 DESIGN TYPE

A design comprising multi-path arrangement and direct transmission, according to AGA 9 and ISO/DIS 17089-1, immune to the effects from dirt deposits on the pipe wall, shall be used for custody transfer applications.



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2.4.3 ULTRASONIC TRANSDUCERS

The ultrasonic signals required for the flow measurement shall be generated and received by ultrasonic transducers, using piezoelectric crystals, according to **AGA 9** and **ISO/DIS 17089-1**. The transducers shall be of the retractable type under pressure only if redundancy is less than 100%.

2.4.4 CONTROL UNIT

A control unit with appropriate electronics shall be used in order to operate the transducers and calculate the averaged flow velocity across the cross section of the pipe, and consequently the actual volume flow rate, from the measured transit times. The calculations shall be for multi-path arrangement according to **AGA 9** and **ISO/DIS 17089-1**.

The control unit shall be capable of rejecting invalid measurements and noise, and provide a high frequency pulse output to a flow computer, proportional to the calculated actual volumetric flow rate, so that the calculated actual volume flow can be converted to standard conditions. A digital common alarm output shall be also available.

The control unit shall include display and diagnostics facilities (self diagnostics capability). A totalized and current flow indication is required among the display facilities.

The control unit might be splitted into separate subunits, the signal processing and the flow computation ones. In a multi-path arrangement usually there is a signal processing subunit per a set of transducers of a particular plane. Each signal processing subunit operates its own set of transducers in the multi-path arrangement, measures the corresponding transit times and calculates the averaged flow velocities in the relevant plane.

The flow computation subunit collects the calculated results from all signal processing subunits and calculates in turn the flow velocity averaged across the pipe diameter, as well as the actual volume flow rate. This subunit is also used to facilitate the display and diagnostic functions.

In case of a split control unit, the flow computation subunit might be installed remotely in a safe area, e.g. in a local control room. The signal processing subunits should be located at the ultrasonic meter, so that measured transit times are not influenced from the consequences of long length interconnecting cables.

2.4.5 METROLOGICAL PERFORMANCE

Accuracy below +/- 0.7% of the measured value is required for custody transfer applications, with a minimum turndown ratio of 1:50. Repeatability shall be better than 0.1%.

2.4.6 MATERIALS

Only materials conforming to recognized material European standards shall be used. Attention is drawn to **Job Spec. No. 970/2** where the material certification requirements are specified.



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Cast or forged steel of low alloyed or unalloyed steel pipe material shall be according to recognized material standards [e.g. **ELOT EN 10222, ELOT EN 10213 and EN 10297-1**].

The ultrasonic transducers retraction tool with the isolation valves shall be made of stainless steel. The piezoelectric elements shall be fully encapsulated in titanium housing.

2.4.7 FLANGES

Inlet / outlet flanges shall conform to the relevant piping specifications (**Job Specification No. 500/5, e.g. ELOT EN 1092-1, Raised Face**).

2.4.8 ELECTRICAL PARTS

The meter shall be suitable for use in a hazardous area and in accordance with its classification study which must comply the requirements of the **EU Directive 94/9/EC ATEX**. As an exception might be the case of a split control unit where the flow computation subunit can be installed remotely in a safe area, e.g. in a local control room.

Connections and enclosures of all electrical parts shall have a minimum protection class of **IP 65 (ELOT EN 60529)**, as far as outdoor installations are concerned. For indoor installations, IP 54 protection class can be accepted.

2.4.9 SURFACE TREATMENT

Refer to **Job Specification No. 830/1**.

2.5 NON DESTRUCTIVE EXAMINATION

2.5.1 CASTINGS AND FORCINGS

All exterior and accessible interior surfaces shall be magnetic particle examined to **ELOT EN 1369**.

2.5.2 STEEL PIPE MATERIAL

Low alloyed or unalloyed steel pipe material shall be subject to a NDE test according to **ELOT EN 10297-1**.

2.5.3 WELDS (IF ANY)

All welded joints shall be radiographed and found acceptable in accordance with **ELOT EN 1435**.

However, where radiography is unfit for detection of defects, joints shall be ultrasonically examined according to **ELOT EN 583-1**.

Where both radiography and ultrasonic examinations are unfit for detection, then magnetic particle examination may be used in accordance with **ELOT EN 1290**.



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2.6 TYPE TEST

The ultrasonic meter including all accessories shall be subject to a type test and shall obtain a CE design test certificate.

The design shall be approved by a Notified Body.

2.7 FACTORY TESTING

2.7.1 FACTORY TESTING

As per section 6.2.2 of **ELOT EN 12261** for turbine meter bodies.

2.7.2 TIGHTNESS TESTING

As per section 6.2.3 of **ELOT EN 12261** for turbine meter bodies.

2.7.3 PERFORMANCE TESTING

Each ultrasonic meter shall undergo a performance and a first time calibration test in accordance with **ELOT EN 1776, AGA 9 and ISO/DIS 17089-1**.

The measured deviations must comply with the requirements of **ISO 9951**.

The test certificates shall be issued by a Notified Body.

Calibration certificates at atmospheric and high pressure (operating pressure) are required. High pressure certificates shall have one (1) error curve of seven (7) percentage points of Qmax, covering the whole operating pressure range.

2.8 DELIVERY

The meters shall be packed for safe transportation (e.g. in a wooden crate) and indoor storage for up to 3 years.

All outlets shall be capped and flange faces shall be protected against corrosion.

2.9 INSPECTION AND CERTIFICATION

Inspection will be performed by an Accredited Inspection Body appointed by Owner.

Inspection requirements are defined in the following documents:

- a. Material Requisition.
- b. **Job Spec. No. 970/2.**
- c. Relevant project specifications.
- d. Inspection clauses of applicable Standards.



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2.10 COMPLIANCE WITH THE EU DIRECTIVES

All parts and/or assemblies that comply with the "New Approach" directives shall be provided with:

- a. A physical CE marking and other information as required by the relevant directives.
- b. A declaration of conformity which lists all the directives with which the product complies.
- c. Any other information specified by the directive, e.g. user instructions.