



**HELLENIC GAS  
TRANSMISSION  
SYSTEM OPERATOR**

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**TECHNICAL JOB  
SPECIFICATION**

**612/1**

**REVISION 0**

**DATE 05/04/2011**

# **HIGH PRESSURE (HP) TRANSMISSION SYSTEMS**

## **TURBINE METERS**



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**QUALITY ASSURANCE PAGE**

**CHANGES LOG**

**REVISIONS LOG**

0	05-04-2011	FIRST ISSUE	PQDPT	V.G.
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**REFERENCE DOCUMENTS**

Job Spec. 500/5  
[Piping Material]

Job Spec. 830/1  
[External Painting]

Job Spec. 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]

EU DIRECTIVE 2006/95/EEC LVD  
[Low Voltage Directive]

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]

ELOT EN 10213  
[Technical delivery conditions for steel castings for pressure purposes]

ELOT EN 10222  
[Steel forgings for pressure purposes]

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)]

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ELOT EN 60947-5-6

[Low-voltage switchgear and control gear Part 5-6 : Control circuit devices and switching elements DC Interface for proximity sensors and switching amplifiers]

**1.0** SCOPE

**1.1** ITEM  
Turbine Meters

**1.2** SERVICE  
Natural gas piping systems.

**1.3** APPLICATION  
Used for measuring actual volumetric gas flow.

**2.0** GENERAL REQUIREMENTS

**2.1** LEGISLATION AND STANDARDS

- EU Directive 97/23/EC PED
- EU Directive 94/9/EC ATEX
- EU Directive 2004/108/EC EMC
- EU Directive 2006/95/EC LVD
- ELOT EN 1776
- ELOT EN 12261

**2.2** UNITS  
Metric

**2.3** OPERATING TEMPERATURE RANGE  
Accurate function is required at process temperatures defined in the basic design documents. The meter shall not be damaged at process temperatures down to -25°C.

**2.4** CONSTRUCTION

**2.4.1** GENERAL

The principal components of a turbine meter is a meter body with a turbine rotor, a transmission shaft, a meter head with a mechanical counter for uncorrected gas flow, an oil pump and two high frequency pulse generators.

**2.4.2** FREQUENCY PULSE GENERATORS

The meter shall be equipped with at least two non-contact inductive proximity sensors for generation of high frequency pulses directly proportional to the turbine rotor angular velocity, but having a phase difference (180°).

The proximity sensors shall be mounted, one at the turbine rotor and the other at a follower cam wheel (reference wheel), which is not exposed to the gas flow. The two sensors shall be used for:

- a) flow measurement and
- b) monitoring the turbine rotor integrity, respectively.

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The proximity sensors/pulse generators shall be suitable for use in a hazardous area and in accordance with the relevant classification study. The intrinsically safe approach shall be selected.

**2.4.3**      **FLOW CONDITIONER**

The meter shall have a built-in flow conditioner that shall condition the flow profile and increase the gas velocity. Unwanted vortices, turbulences and asymmetries shall be eliminated or reduced.

**2.4.4**      **MECHANICAL COUNTER**

The meter shall be equipped with an 8-digit mechanical counter for indication of the totalized flow in actual cubic meters. It shall be possible to turn the counter and its housing 180° without breaking any seals.

**2.4.5**      **PRESSURE TAP**

The meter shall have at least one pressure tap to enable measurement of the static pressure that equals the static pressure at the turbine wheel of the meter at metering conditions.

**2.4.6**      **OIL PUMP**

Meters shall be equipped with an oil pump for lubricating the bearings, when under pressure.

**2.4.7**      **ELECTRICAL PARTS**

The pulse generators shall be in accordance with **ELOT EN 60947-5-6**.

Connections and enclosure of the meter head 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.

The meter shall be suitable for use in a hazardous area and in accordance with its classification study.

They must comply with the requirements of the **EU Directive 94/9/EC-ATEX 100a**

**2.4.8**      **FLANGES**

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

**2.4.9**      **RANGEABILITY**

The rangeability shall be at least 1:20 at atmospheric pressure. Lower rangeability may be accepted for smaller meter sizes (G 160 or less).

Rangeability is defined as being the maximum approved flow divided by the minimum allowable flow.

Minimum allowable flow is the flow where the inaccuracy exceeds +/- 2%.

**2.4.10**     **MEASURING ACCURACY**

The measuring accuracy, at any pressure, shall be better than +/- 2% in the range  $Q_{min}$  to 0.2  $Q_{max}$ , and better than +/- 1% in the range 0.2  $Q_{max}$  to  $Q_{max}$ .

In case the turbine meter is intended to be used for custody transfer measurement the relevant accuracy should be better than  $\pm 0.5\%$ , while when installed in Metering Stations with maximum capacity up to 6.000 MWh/day its accuracy

should be better than  $\pm 1\%$ .

The measuring accuracy of the meter is determined by the measurement at the mechanical counter and not by the electronic output from the meter.

**2.4.11 OVERLOAD**

The turbine meter shall not be damaged by a repeated short time overload up to 120% of Qmax.

**2.4.12 PRESSURE DROP**

The total pressure drop at maximum rated flow of the turbine meter may not be greater than 20 mbar measured with air with a density of 1.2 kg/m<sup>3</sup>.

**2.4.13 CONNECTIONS AND DIMENSIONS**

As per ELOT EN 12261.

The overall length of the meter between the inlet and outlet connections shall be 3 DN.

**2.5 MATERIALS**

**2.5.1 GENERAL**

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.

**2.5.2 METER BODY**

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 ELOT EN 10297-1]

**2.5.3 TURBINE ROTOR**

Aluminium or other non sparking metal.

**2.6 SURFACE TREATMENT**

Refer to Job Specification No. 830/1.

**2.7 NON DESTRUCTIVE EXAMINATION**

**2.7.1 CASTINGS AND FORGINGS**

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

**2.7.2 STEEL PIPE MATERIAL**

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

**2.7.3 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.



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

**2.8 TYPE TEST**

The turbine meter including all accessories shall be subject to a type test and shall obtain an EEC design test certificate as per **ELOT EN 12261**.

The design shall be approved by a Notified Body.

**2.9 FACTORY TESTING**

**2.9.1 STRENGTH TEST**

As per section 6.2.2 of **ELOT EN 12261**.

**2.9.2 TIGHTNESS TEST**

As per section 6.2.3 of **ELOT EN 12261**.

**2.9.3 FUNCTIONAL TEST**

Each turbine meter shall undergo a functional test and a first time calibration test in accordance with **ELOT EN 12261**.

The metrological performance requirements shall be those defined in **ELOT EN 12261**.

Each meter conforming to an approved type shall be tested individually according to Annex E of **ELOT EN 12261**.

The test certificates shall be issued by a Notified Body.

**2.10 MARKING**

Each item shall be fitted with a stainless steel marker plate indicating all relevant technical data, as per **ELOT EN 12261** section 8.

The item shall additionally be marked with the contract and item tag numbers.

**2.11 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.

**2.12 INSPECTION AND CERTIFICATION**

Inspection will be performed by an Accredited Inspection Body.

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.

**2.13 COMPLIANCE WITH THE EU DIRECTIVES**

All parts and/or assemblies that comply with the "New Approach" directives

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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.