



**HELLENIC GAS
TRANSMISSION
SYSTEM OPERATOR**

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**TECHNICAL JOB
SPECIFICATION**

552/3

REVISION 0

DATE 05/04/2011

**HIGH PRESSURE (HP) TRANSMISSION
SYSTEMS**

HOT BENDS

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QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

Rev. No	Rev. Date	REASON FOR CHANGE	Made By	Approved By
0	05-04-2011	FIRST ISSUE	PQ DPT	V.G.

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REFERENCE DOCUMENTS

Job Spec. No. 171/1

Job Spec. No. 970/2

Job Spec. No. 970/3

ELOT EN 1594

[Gas supply systems - Pipelines for maximum operating pressure over 16 bar - Functional requirements]

ELOT EN 10208-2

[Steel pipes for pipelines for combustible fluids - Technical delivery conditions - Part 2: Pipes of requirements class B]

ELOT EN 14870-1

[Petroleum and natural gas industries - Induction bends, fittings and flanges for pipeline transportation systems - Part 1: Induction bends (ISO 15590-1:2001 modified)]

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1.0 SCOPE

1.1 ITEM

Hot-formed bends with radius of curvature $R = 5 \times DN$ or $10 \times DN$.

1.2 SERVICE

Sweet, natural gas with sporadic passage of water and glycol.

1.3 ADDITIONAL INFORMATION

Additional information may be given in the DATA SHEETS and Material Requisition, and these documents should be read in conjunction with this material specification.

2.0 GENERAL REQUIREMENTS

2.1 SPECIFICATION

Refer to DESFA specification doc. No. **Job Spec. No. 171/1** for pipe (base material) specification, otherwise in accordance with the requirements herein.

2.2 UNITS

Metric.

2.3 DESIGN

2.3.1 CALCULATIONS

Since the wall thickness reduction due to the bending is critical, sizing shall be in accordance with **ELOT EN 1594** with allowances for manufacturing tolerances such as wall thickness reduction, yield strength reduction, under grinding etc.

Maximum allowable stress value for calculations is $SMYS \times \text{Design Factor}$.

Manufacturer will control the bending process such that the wall thickness reduction to be in the adequate limits.

In any case, the minimum wall thickness of the bend after bending fabricated at any point shall not be less than the specified minimum allowable wall thickness of the Abutting straight line pipe.

2.3.2 DESIGN PRESSURE

Refer to DATA SHEET.

2.3.3 DESIGN FACTOR

Refer to DATA SHEET.

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2.3.4 ABUTTING PIPE

Refer to DATA SHEET for details of type, material and size.

2.4 MANUFACTURE

2.4.1 PROCESS

Bends shall be manufactured by inductively heating and bending a pipe, previously manufactured in accordance with the DESFA specification advised under **clause 2.1**.

2.4.2 LONGITUDINAL WELDED PIPE

Bends manufactured from longitudinal welded pipe shall have the weld seam placed in the tensile zone between 10 and 45 degrees from the neutral axis.

2.4.3 SPIRAL WELDED PIPE

Bends manufactured from spiral welded pipe shall not contain skelp-end welds.

2.4.4 DEFECTS

Minor defects may be removed by grinding provided that the minimum wall thickness is maintained and the grinding does not exceed 300 mm in any direction.

2.4.5 BUTT WELDING ENDS

Unless otherwise stated, the welding ends shall be delivered beveled in accordance with **ELOT 10208-2** to match the abutting pipe.

2.4.6 WELDING END LENGTH

Each end of the bend shall have a straight tangential length equal to the nominal diameter dimension.

2.4.7 WELDING END TOLERANCE

±1.6 mm on the inside diameter derived from circumferential measurement.

Out of roundness shall comply with the base material specification.

2.4.8 BEND RADIUS

Refer to DATASHEET.

2.4.9 BEND ANGLE

Refer to DATASHEET.

The deviation from the stated angle shall not exceed 0.5 degrees.

The end faces shall be perpendicular to the centre axis of the bend.

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2.5 TESTING

2.5.1 VISUAL

The bends shall be free of any surface defect.

2.5.2 BORE

The free passage through the bend shall be verified with a sphere or calibration plate equal in length and diameter to 0.96 of the nominal inside diameter.

Dimensional checking of straight pipe ends shall be applied for at least 50 mm into each end of tangential section, as per **Job Specification 171/1**.

Refer to DATA SHEET for calibration dimension.

2.5.3 WALL THICKNESS

The wall thickness along the longest arc shall be measured together with any area where defects have been ground out to ensure that the minimum wall thickness has been maintained.

2.5.4 MECHANICAL TESTING

Control of the mechanical properties shall be carried out on test specimens taken after the last heat treatment. Bends shall be divided into groups containing items from the same charge, with the same heat treatment and the same dimensions. Several heat treatments can be considered as one, if uniform time versus temperature plots can be produced.

If test specimens cannot be taken from the bent section of a completed bend, an additional test bend shall be manufactured for this purpose. This test bend shall be from the same charge and shall undergo the same or an identical heat treatment.

For each group the yield strength, ultimate tensile strength, elongation, V-Charpy impact test, drop weight tear test and weld seam hardness etc., shall be determined and shall meet the requirements of the base material specification in all respects.

2.5.5 NON DESTRUCTIVE EXAMINATION

The finished bends shall be examined by magnetic particle or dye penetrant for cracks, any evidence shall be cause for rejection.

Requirements of **Job Specification** for steel pipes **No 171/1**, paragraph 2.5.6 regarding UT shall be applied.

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2.6 SURFACE TREATMENT

Refer to DATA SHEET for requirement.

Uncoated bends shall be protected for rusting in transit.

2.7 MARKING

The following marking shall be die stamped with a minimum of 4 mm high round dies on one end of the bend and within 100 mm of the end and not on the weld seam:

- Outside diameter, wall thickness (or schedule number) and Material Grade.
- Bend number (individual and selected consecutively, no two bends shall have the same number regardless of size or angles). The bend number shall ensure full traceability to test reports.
- Angle of bend.
- Independent Accredited Inspection Body's mark.

All of the foregoing die stamped marking shall be framed with a white reflective paint.

Vendor's mark and Owner contract identification number shall be paint stenciled.

2.8 DELIVERY

Welding bevels shall be protected during transit.

3.0 SUPPLEMENTARY REQUIREMENTS

Further requirements, if specifically mentioned in the Material Requisition or on the DATA SHEETS, shall be valid.

In case of conflict between such requirements and the requirements contained herein, the former shall prevail.

4.0 TECHNICAL DOCUMENTATION

4.1 QUANTITY

Four copies of each, inclusive original, for all Documents and Certificates.

Also electronic files of all Documents, Drawings and Certificates must be submitted by Contractor to the Owner.

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4.2 DOCUMENT REQUIREMENTS

4.2.1 WITH TENDER

Vendor's DATA SHEETS etc., giving details of proposed surface treatment.

Statements regarding (base) pipe material document requirements as listed under "with tender" in the pipe specification.

4.2.2 AFTER AWARD OF CONTRACT

A detailed design description complete with dimensional drawing and calculations.

Description of heat treatment and bending process.

Vendor's detailed Test and Inspection plan, approved by an Independent Accredited Inspection Body. The plan shall additionally show the control points at which the independent inspector's witnessing /approval is required as per **Section 5** herein.

4.2.3 ON DELIVERY

Bend Certification package as listed above.

5.0 INSPECTION AND CERTIFICATION

Inspection will be performed by a Third Party Accredited Inspection Body.

Inspection requirements are defined in the following documents:

- a) Material requisition
- b) DESFA Specification doc. No. **970/2** "Shop inspection of equipment and materials for NGT project"
- c) Relevant project specifications
- d) Inspection clauses of Applicable Codes

Inspection procedures to be followed are detailed in **Job Spec. No. 970/3** "Inspection and Test instructions".

6.0 SHIPMENT

Equipment shall be suitably prepared for the type of shipment specified one piece hot bends shall be completely with all external/internal attachments, if any, before shipment, unless otherwise specified.

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In order to avoid strains of the hot bends during transportation, it is suggested to use wooden pallets or saddles on which the bends shall be firmly fixed with metallic straps or wooden anchors. In addition the all package shall be covered with suitable rainproof nylon.

The preparation for shipment shall make the equipment suitable for six months of outdoor storage from the time of shipment. If storage for a longer period is assumed, the Purchaser will consult with the Vendor regarding the recommended procedures to be followed.

The Vendor shall provide the Purchaser with the instructions necessary to preserve the integrity of the storage preparation after the hot bends arrive at the job site and before installation.

The hot bends shall be prepared for shipment after all inspection activities and the items have been released to the Purchaser.

The interior of the hot bends shall be clean and free from scale and foreign objects. The selection and application of preservatives or rust preventives shall be mutually agreed upon the Purchaser and the Vendor.

Openings that have been beveled for welding shall be provided with end caps designed to prevent entrance of foreign materials and damage to the bevel.

Lifting points and lifting lugs shall be clearly identified on the hot bend.

Hot elbows, where necessary, shall be supported by temporary stiffeners to avoid distortion and damage during transportation and erection.

All exposed machined surfaces shall be coated with rust preventive.