



**HELLENIC GAS
TRANSMISSION
SYSTEM OPERATOR**

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**TECHNICAL JOB
SPECIFICATION**

599/2

REVISION 0

DATE 05/04/2011

HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

WELDING OF PIPING FOR M/R STATIONS

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QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

Rev. No	Rev. Date	REASON FOR CHANGE	Made By	Approved By
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REFERENCE DOCUMENTS

Job Spec. No. 199/4
[Welding]

Job Spec. No. 500/8
[Welding Inspection of Piping M/R Stations]

ELOT EN 1594
[Gas supply systems - Pipelines for maximum operating pressure over 16 bar - Functional requirements]

ELOT EN 12732
[Gas supply systems - Welding steel pipework - Functional requirements]

ELOT EN 287-1
[Qualification test of welders - Fusion welding - Part 1: Steels]

ELOT EN 473
[Non destructive testing - Qualification and certification of NDT personnel - General principles]

ELOT EN 583-1
[Non-destructive testing - Ultrasonic examination - Part 1: General principles]

ELOT EN 1290
[Non-destructive testing of welds - Magnetic particle testing of welds]

ELOT EN 1435
[Non-destructive testing of welds - Radiographic testing of welded joints]

ELOT EN 10208-2
[Steel pipes for pipelines for combustible fluids - Technical delivery conditions - Part 2: Pipes of requirements class B]

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1.0 INTRODUCTION

1.1 SCOPE

This Specification covers welding of piping in natural gas and piping systems within Metering and Regulating Station including tie-in welds.

1.2 STANDARDS

For the performance of welding, the requirements of the following shall be fulfilled:

- This Specification.
- Documents to which reference is made in the following.
- **ELOT EN 1594**
- **ELOT EN 12732**
- **Job Spec. No. 500/8**

1.3 INSPECTION

The welding work will be inspected by an Accredited Inspection Body appointed by the Owner. The inspection shall be carried out according to the specification **Job Spec. No. 500/8** "Welding Inspection of Piping for M/R Stations".

1.4 PERSONNEL AND EQUIPMENT

The Contractor shall provide all necessary personnel and equipment.

In preparing the schedule for the welding program, the Contractor shall include the necessary time for the welding inspection.

The Contractor shall supervise the site, the welders and their work during the entire working period. For this purpose, he shall use a foreman or an engineer, with adequate theoretical knowledge and practical experience in the performance and evaluation of the welding work.

The equipment shall, at least, include the following:

- welding equipment and power supply, suitable for the procedure to be used.
- preheating equipment, which ensures uniform preheating around the whole circumference of the ends.
- heated containers, to keep the electrodes dry at each site or workshop and at each welder's position.
- temperature sensitive crayons.
- line-up clamps.
- protective canopies.
- high temperature insulation mats for the thermal insulation.
- grinding machines,
- cutting machines.
- other equipment necessary to ensure a satisfactory quality of the welding work.

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If personnel or equipment are replaced during the execution of the contract, an approval shall be obtained from the Owner's Representative.

2.0 WELDING PROCEDURE AND WELDERS

2.1 WELDER QUALIFICATION

At all times during welding work, all welders shall have a valid certificate, according to **ELOT EN 12732, ELOT EN 287-1 & ELOT EN 473** applicable for the materials to be used and the welding procedure to be applied.

All the above-mentioned certificates shall be kept on site during the whole working period.

Welders without certificates or with expired certificates shall not perform any welding work at all.

The Owner's Representative and/or the inspector will demand that weld seams which have been made by unqualified personnel shall be cut out.

All costs shall be paid by the Contractor.

2.2 WELDING PROCEDURE SPECIFICATION (WPS)

The WPS shall cover details which are important to the production of sound welds.

The WPS shall contain those of the following items that are relevant, and for each material group, the qualification test (Procedure Qualification Record (PQR)) shall be made on the highest specified minimum yield strength material which is expected to be used.

The WPS information may be presented in any format, written or tabular, to fit the needs of each Manufacturer or Contractor as long as every essential and non-essential variable indicated below is included:

2.2.1 WELDING METHOD:

- Process used.

2.2.2 PARENT MATERIAL:

- Standard.
- Grade.
- Thickness.
- Diameter.

2.2.3 FILLER MATERIAL:

- Manufacturer and designation.
- Classification.
- Electrode and thread diameter.
- Shield gas, type and flow rate.
- Back shielding gas.

2.2.4 WELDING PARAMETERS :

- Dimensioned sketch of joint, including beveling.
- Welding position and direction.
- Number of passes.
- Bead technique (string, weave, etc.).
- Backing ring.
- Type of current (AC or DC).
- Polarity.
- Voltage.

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- Current range.
- Stretch or speed of travel, indicating mm per minute for each pass.
- Preheating temperature.
- Working temperature.
- Heat treatment after welding.
- Max. lapse-time between the passes.

2.2.5 DESTRUCTIVE TESTING:

- Required testing of qualification test coupons.

Any other parameters of relevance to the welding procedure shall also be specified.

2.3 **CHANGES THAT REQUIRE A NEW WPS**

- Change in pipe material group.
 - a. Specified minimum yield strength of 290 N/mm² or less.
 - b. Specified minimum yield strength of more than 290 N/mm² but less than 448 N/mm².
 - c. For specified minimum strength of 448 N/mm² or more each grade shall require a separate qualification test.
- Change in welding process or method of application.
- Change in wall thickness group.
 - a. Under 4.78 mm.
 - b. 4.78 mm to 19.05 mm, incl.
 - c. Over 19.05 mm.
- Change from two-sided to one-sided welding.
- Change from single pass to multi-pass.
- Change from welding with backing ring to welding without backing ring (back-up).
- Change to a more demanding welding position.
- Change from uphill to downhill or vice-versa.
- Change to a bead width greater than 3 times the electrode diameter.
- Changes in parent material giving an increase of Carbon Equivalent (C + Mn/6) greater than 0.03, for Carbon Equivalents above 0.40.
- Change of shield gas.
- Electrode change or change of filler material classification.
- Change of parameters that give a change of heat input per unit length, greater than 15%.
 - Change of current type, AC to DC or vice-versa, or change of polarity unless electrode is recommended by the manufacturer for both polarities or current types.
- Reduction in preheating temperature.
- Change of post-weld heat-treatment specification.
- Change from short-arc to spary-arc (gas shielded arc welding).
- Change from forehand to backhand and vice-versa (gas welding).

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2.4 WELDING PROCEDURE TESTS AND WELDER QUALIFICATION TESTS

The tests shall be carried out in accordance with the applicable requirements of:

- ELOT EN 12732, ELOT EN 583-1, ELOT EN 1290, ELOT EN 1435
- ELOT EN 287-1 & ELOT EN 473

Test specimens from the welding procedures in question shall be available to the Owner.

For pipes with external diameter $D > 60.3$ mm, arc welding shall be used.

All girth welds shall be "V" bevel butt joints.

Downhill welding or gas welding shall only be used if specially approved by the Owner or his Representative.

3.0 PREPARATIONS FOR WELDING

3.1 PREPARATION OF MATERIALS

All pipes shall be internally cleaned of any dirt, millscale, rust, or other foreign matter.

Dents shall be removed by other suitable methods, following approval by the Owner's Representative.

3.2 WELD ENDS

All weld ends shall be cleaned mechanically with a wire brush or mechanical grinder. The cleaned area shall extent at least 10 mm from the end.

All burrs, serrations, notches, millscale, rust and dirt shall be removed.

The ends shall be prepared by grinding to comply with the designs indicated in **ELOT EN 1594**.

Surface defects and weld end defects, which cannot be repaired, shall be removed by cutting away the damaged section, preferably with a cutting disc.

After the cutting operation, the pipe ends shall be beveled carefully.

Beveling by flame-cutting is not permitted. If smaller diameter girth welds are not accessible from the inside, a short section may be cut from the pipe to be connected and used as a cross-over and fitting (see **FIGURE 2 DESFA Job Spec. No. 199/4**).

If the cutting operation is carried out with a flame cutter, the surfaces shall be ground to remove bums and burnt material from both inside and outside.

If the cutting out of defects cannot be performed without removing, marking on a pipe or fitting, the Contractor shall, before cutting, place a new set of marks on the remaining section, in the presence of the Owner's Representative. Failure to do this will result the material being charged to the Contractor.

Weld-ends produced locally shall be examined by the Contractor's foreman or engineer for any laminations.

Laminations shall be cut off as specified for surface and weld-end defects. Cutting out of laminations will be paid by the Owner. Furthermore, each pipe or fitting shall be examined to discover any visible internal or external defects. Hereafter the Contractor is responsible for the usability of these items. Any defects shall be evaluated in consultation with the Owner's Representative.

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3.3 LINING UP

Immediately prior to lining up, the pipe shall be reinspected to ensure that no damages have occurred during handling and storing of the pipe.

The welding of pipes, fittings, e.t.c. on site shall, as far as possible, be performed outside the pipe-trench. Lining up and welding of pipe sections shall be carried out alongside the pipe-trench, the pipeline being placed min. 0.40 m above the ground level.

With longitudinally welded pipes, the seam shall, as far as possible, be placed in the upper quadrant of the pipe circumference (exceptions may be made with factory bends, tees, e.t.c). Longitudinal seams shall, at girth welds, be offset at least 100 mm from each other. With electrical resistance welded pipes, this requirement only applies if the seams can be seen.

Branch-connections, weldolets, e.t.c, shall never be connected to longitudinal or girth seams.

Weld seams for branch-connections shall be offset at least 100 mm from longitudinal and girth seams. Mitre joints are not permitted.

Line-up clamps shall be used for all girth welds.

Wherever possible internal clamps should be used.

Where it is necessary to use external clamps (tie-ins, installation of fittings, e.t.c.) uphill welding shall be used.

The offset of the pipe ends may never exceed 1.6 mm for pipes with the same wall the same wall thickness.

Where offset is caused by the pipe's ovality, the pipe may be turned to reduce the offset. The width of the root gap shall be $2.0 \text{ mm} \pm 0.5 \text{ mm}$.

Joints which cannot be lined-up with either internal or external line-up clamps may be tack-welded. These tackwelds, however, shall be completely ground out before the root bead is completed.

Only those weld seams which are necessary to join pipes or install those auxiliary fittings that are specified in the construction plan, are permitted.

No temporary welds on the surface of the pipe are permitted.

Pipe-fittings, flanges, tees, bends etc shall be supported during welding so that any inadmissible stresses in the connected pipe are avoided.

3.4 MATERIAL IDENTIFICATION

The contractor shall control that the quality and wall thickness of items to be welded together are in accordance with the project material and shall ensure that the marked operating pressure of fittings is in accordance with the operating pressure of the pipeline. Any materials which do not bear the relevant control authority's mark may not be used.

If, for construction purposes, a pipe has to be cut up into sections, new sets of marking shall, before cutting, be placed on the un-marked sections in the presence of the Owner's Representative.

3.5 TYPES OF WELDING ELECTRODES

The welding electrodes shall be approved by the Owner or his Representative before the procedure test.

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The welding electrodes shall be stored by the contractor according to the manufacturer's instructions or after instructions from the Owner's Representative.

3.6

PREHEATING

If, in the welding procedure, no indication of preheating is given, the following requirements should be satisfied:

- At temperature below 0°C the weld-zone shall be preheated to approx. 80°C when laying the root bead and hot pass.
- At temperature between -5°C and -10°C permission of welding shall be obtained from the Owner's representative.
- At temperatures below, -10°C welding is not permitted.
- The weld-zone shall be kept free of condensation.
- When welding items of steel with a specified minimum yield strength (S.M.Y.S.) corresponding to L360 (ELOT EN 10208-2) or higher, preheating shall always be used.
The preheating temperature shall not exceed 150°C and the working temperature shall not fall below 80°C.

In case of bad weather conditions, all protective measures should be taken in order to protect the quality of welding. All these measures have to be in compliance with Owner's requirements. His written approval is also required.

If necessary, heated canopies may be used in cold weather conditions.

The preheated zone shall extend min. 100 mm to each side of the seam. If necessary, any insulation must be cut back 150 mm. Only equipment giving an evenly distributed heat around the whole circumference may be used. Acetylene burners may not be used.

The temperature shall be controlled with temperature sensitive crayons or other equivalent means and the correct temperature shall be reached at the moment welding starts. Tack welds and root beads must be staggered 180°.

4.0

WELDING

4.1

GENERAL

Prior to welding, the opposite ends of the pipes shall be capped so that no draught occurs through the piping.

The striking of arcs outside the beveled ends is not permitted. Should arcs be struck outside his area, it shall be brought to the Owner's attention or the representative who may require any resulting damaged section to be repaired at the contractor's expense.

Welding earth electrodes shall always be placed one at each side of the joint when laying root and cap beads, so that the current flows to each side of the joint.

4.2

ROOT BEAD

For pipes with external diameter DN > 500 two welders shall weld at the same time on each side of the circumference.

The line-up clamps may not be removed until at least 70% of the root bead has been laid.

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The root bead shall be ground down before making the hot pass and checked visually for defects.

All other beads shall be brushed before making the next pass, and checked visually for defects.

Hammers may not be used.

4.3 HOT PASS

This shall be made by at least two welders, working simultaneously, for pipe diameters DN > 500. It shall be ensured that the hot pass is done immediately after the root bead has been laid, and preferably by the same welders.

4.4 FILLER AND CAP BEADS

Filler and cap beads shall be laid in "one heat". If this condition is not satisfied, the Owner or his Representative may require the joints in question to be 100% ultrasonically tested at the Contractor's expense. Each pass shall be completed around the whole circumference before the next pass is started.

The cap bead may not extend more than 1.6mm above the pipe surface.

On completion of the cap bead, the uncoated part of the pipe shall be cleaned of weld spatter and other deposits by brushing and shall, for outdoor welding, be wrapped with a dry high temperature insulation mat to ensure a slow cooling of the weld zone and protection against rain.

4.5 WELDING OF STRUCTURAL ELEMENTS TO PIPELINE COMPONENTS

For these applications, a separate procedure test, and subsequent destructive testing, will be required.

Structural elements shall as far as possible be welded with uninterrupted girth welds of at least two passes. Items of steel with a S.M.Y.S. corresponding to L360 (ELOT EN 10208-2) or higher shall be preheated up to 150°C before start of welding.

4.6 WELDING OF FITTINGS, TEES, ETC.

The fittings shall be welded stress-free. Joints shall be made girth welds. Any limits of preheating temperature indicated on butt-welding ends shall be followed. Where allowable within these limits, items of steel with S.M.Y.S. corresponding to L360 (ELOT EN 10208-2) or higher shall be preheated up to 150°C (minimum working temperature: 100°C).

4.7 WELDING OF HALF SHELLS

For these applications a separate procedure test, and subsequent destructive testing, will be required.

4.8 BACKWELDING

For pipes with external diameter DN > 300 backwelding is permitted with internal offsets not exceeding 2.4 mm. Instead of backwelding, however, it is recommended to lay the root bead uphill from the inside and then to complete the seam from the outside. If the offset exceeds 2.4 mm, extra material shall be removed (see **FIGURE 1, Job Spec. No. 199/4**).

4.9 CLOSING OF PIPE ENDS

At interruptions in the pipe construction, the Contractor shall close the ends of the pipe sections with a plug or plastic cap. The closure shall be tight enough to prevent the entry of any foreign bodies. Plugs or caps may not be fixed by

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welding or by any other method which damages the pipe. They shall be securely attached to the pipe and shall remain in place until the sections are connected.

5.0 IDENTIFICATION OF WELD SEAMS

5.1 GENERAL

Any girth weld shall be numbered by the Contractor according to a system which has been agreed with the Owner's Representative. This number shall be painted on the pipe surface or the pipe insulation to one side of the joint, together with pipe number and any other relevant identification, to facilitate completion of the pipe record.

Repair welds have to be marked with the same identification number and an index A, B or C according to repair sequence.

Tie-in seams shall be identified by their number.

The pipe record shall also identify the welders, who have made the root and hot pass. The welder identification system shall be approved by the Owner's Representative and no identification number may be re-used.

For each pressure test section, the Contractor shall fill out pre-printed Pipe Record Forms (prepared by the Owner) and enter these in a pipe record. The Contractor forms shall be submitted to the Owner's Representative.

Before the start of the pressure test, the completed pipe record for the section in question shall be handed over to the Owner's representative.

6.0 WELD QUALITY CONTROL

6.1 SUPERVISION AND TESTING

The Contractor has to supervise the welders and their work during the entire work period.

6.2 TEST EVALUATION

As basis for the test evaluation and repair of defects the specification Job Spec. No. 500/8 shall apply.

6.3 TEST REPAIR OF DEFECTS

Girth welds with defects may be repaired if agreed between the Owner's Representative and the inspector.

Defects in the seam shall be ground out before repair welding is commenced, and the repair shall be made with uphill welding with electrodes of a suitable type.

The repair groove shall be examined by dye penetrant testing or by magnetic particle examination, to ensure complete removal of the defects.

The area to be repaired shall be preheated according to the requirements of para 3.6.

All repair welds and rewelds shall be paid by the Contractor.

Weld seams with cracks shall be cut out, i.e. the entire seam shall be removed. If a welder is aware of a fault during the laying of the root bead, he may repair it immediately. Other repairs of root defects from the outside are not normally permitted. On small diameter pipelines of steel with a S.M.Y.S.

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corresponding to L360 (ELOT EN 10208-2) or lower, such repairs may, however, be permitted with the consent of the Owner's Representative.

It is not permitted to make two repair welds in the same place.

Repair weld shall be carried out in accordance with the relevant approved repair welding procedure.

After the repair, the welds have to be re-tested.

All welds which have been repaired shall be classified "repair welds" in the pipe record - and be re-tested according to the specification **Job Spec. No. 500/8**. Repair cost and costs for re-testing shall be paid by the Contractor.