



**HELLENIC GAS
TRANSMISSION
SYSTEM OPERATOR**

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

**TECHNICAL JOB
SPECIFICATION**

180/1

REVISION 0

DATE 05/04/2011

HIGH PRESSURE (HP) TRANSMISSION SYSTEMS

WELDING INSPECTION

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 2/29

QUALITY ASSURANCE PAGE

CHANGES LOG

REVISIONS LOG

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

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 3/29

CONTENTS

REFERENCE DOCUMENTS

- 1.0 SCOPE
- 2.0 GENERAL
- 3.0 TEST METHODS
- 4.0 NDE PROCEDURES
- 5.0 EXTENT OF TESTING
- 6.0 THE OWNER SUPERVISION
- 7.0 QUALIFICATION OF PERSONNEL
- 8.0 QUALIFICATION OF PROCEDURES
- 9.0 RADIOGRAPHIC EXAMINATION
- 10.0 ULTRASONIC EXAMINATION
- 11.0 MAGNETIC PARTICLE EXAMINATION
- 12.0 LIQUID PENETRANT EXAMINATION
- 13.0 OCCURRENCE OF CRACKS
- 14.0 DESTRUCTIVE TESTING

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 4/29

REFERENCE DOCUMENTS

Job Spec. No. 199/4 [Welding]

ELOT EN 462-3 "Non-destructive testing - Image quality of radiographs - Part 3: Image quality classes for ferrous metals"

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 583-4 "Non-destructive testing – Ultrasonic examination – Part 4: Examination of discontinuities perpendicular to the surface"

ELOT EN 583-6 "Non – destructive testing – Ultrasonic examination Part 6: Time – of – flight diffraction technique as a method for detection and sizing of discontinuities"

ELOT EN 571-1 "Non-destructive testing - Penetrant testing - Part 1: General principles"

Υ.Α. 1014 (ΦΟΡ) 94/2001, ΦΕΚ 216/Β/01 "HELLENIC REGULATION FOR PROTECTION AGAINST RADIATION «ΕΓΚΡΙΣΗ ΚΑΝΟΝΙΣΜΩΝ ΑΚΤΙΝΟΠΡΟΣΤΑΣΙΑΣ»"

ELOT EN 1435 "Non-destructive examination of welds - Radiographic examination of weld joint"

ELOT EN 1290 "Non destructive examination of welds Magnetic particle examination of welds"

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 12732 "Gas supply systems – Welding steel pipework- Functional requirements"

EN 15617 " Non-destructive testing of welds - Time-of-flight diffraction technique (TOFD) - Acceptance levels"

ISO 2504 "Radiography of Welds and Viewing Conditions for films - Utilization of Recommended Patterns of Image Quality Indicators"

CEN/TS14751:2004 "Welding use of time of flight diffraction technique (TOFD) for examination of weld

ASTM E-1961-2006 "Mechanized Ultrasonic Examination of Girth Welds using Zonal Discrimination with Focused Search Units"

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 5/29

1.0 SCOPE

This specification covers inspection of welding work in natural gas pipelines and M/R Stations.

For this inspection, the requirements of the following, in order of precedence, shall be fulfilled:

-This specification.

-ELOT EN 12732

-ELOT EN 1594

-Documents to which reference is made to the following.

2.0 GENERAL

All completed welding work shall be subject to series of examinations to control the quality of the work. The performance of examinations is to be allowed for in the work program. Examinations shall be rated with the same capacity as the welding work. Weld seams shall not be insulated or surface treated in any way before examinations have been made and weld clearance has been given by the Owner representative.

The Contractor shall plan, prepare, qualify, perform, evaluate, supervise and document all non-destructive examination (NDE).

All NDE will be performed by using written procedures that have been approved by a Level III Inspector as per **ELOT EN 473**, appointed in writing by the Contractor and declared to the Owner.

The procedures shall be detailed enough to provide the technique to be used to meet all codes requirements, and must be approved by Owner.

Personnel performing and evaluating the above examinations shall be qualified in accordance with provisions of **ELOT EN 473**. All NDE reports, radiographic films and qualification records shall be available for Owner's Representative review.

All material equipment, personnel, procedures, documents and facilities necessary for NDE shall be provided by the Contractor and are in the scope of work of his contract with the Owner.

3.0 TEST METHODS

The following test methods shall be used:

- Radiography for all butt welds in the pipeline.
- Ultrasonic for butt welds in pipe with wall thickness exceeding 6.0 mm.
- Magnetic particle examination for welds which cannot be examined with radiography or ultrasonic. For checking that defects have been totally removed when repair welding is done and for testing of surfaces.
- Dye penetrant examination instead of magnetic particle examination, where

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 6/29

this
is not practicable.

- Destructive testing for certain girth welds to be specified by the Client Representative.

4.0 **NDE PROCEDURES**

4.1 **GENERAL**

Six weeks before the start of any welding the Contractor shall submit to Owner for approval written detailed NDE-procedure specifications, including samples of reporting forms for each of the methods to be applied.

Indicative reporting forms are here attached, containing information to be provided.

4.2 **RADIOGRAPHIC EXAMINATION PROCEDURE**

The procedure shall conform to the requirements of this Specification and **ELOT EN 12732 and ELOT EN 1435** for each technique used. Also included shall be complete equipment descriptions.

4.3 **ULTRASONIC EXAMINATION PROCEDURE**

The procedure shall conform to the requirements of **ELOT EN 12732, ELOT EN 583-1** and this Specification.

4.4 **MAGNETIC PARTICLE EXAMINATION PROCEDURE**

The procedure shall conform to the requirements of **ELOT EN 12732, ELOT EN 1290** and this Specification.

4.5 **LIQUID PENETRANT EXAMINATION PROCEDURE**

The procedure shall conform to the requirements of **ELOT EN 12732, ELOT EN 571-1** and this Specification.

Type of cleaner, penetrant and developer shall be stated.

4.6 **NON DESTRUCTIVE EVALUATION BY AUTOMATIC ULTRASONIC TESTING (AUT)**

Automatic Ultrasonic examination of welds may be applied as alternative to the radiographic technique under the terms that will be agreed in the contract. The Automatic Ultrasonic Testing (AUT) shall cover the requirements set in Appendix A of the present specification.

Automatic Ultrasonic Testing (AUT) shall be applied only if wall thickness is greater than 6 mm.

The Contractor shall provide a detailed technical description of the equipment, testing methods, ultrasonic testing procedure set up and calibration methods.

The Contractor shall engage the services of an independent automatic ultrasonic specialist to undertake assessment of the suitability of the equipment, system, testing methods and training/qualification/experience of the operators and interpreters proposed. Before the automatic ultrasonic testing is approved for use

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 7/29

it shall be demonstrated to the complete satisfaction of the Company that the system and operators can reliably achieve detection, location, characterization and sizing of all anticipated flaws in welds, heat affected zones and weld repairs

The Contractor shall qualify the procedure using the requirements set in Appendix A of the present specification. The Contractor shall supply the necessary reference and calibration blocks for the qualification procedure.

The Contractor shall provide a quality assurance system, covering all aspects of development and automatic ultrasonic testing for company approval.

The Contractor shall prepare and submit a plan which provides details of contingency plan for periods when automatic ultrasonic testing systems do not perform properly. The plan shall provide for numbers of spare scanners and systems, spare parts to be retained at the jobsite and provision for replacement of equipment when systems must be shipped off-site for service or repair.

5.0 EXTENT OF TESTING

Butt Welds in Gas Pipes

5.1 RADIOGRAPHY

100%

5.2 ULTRASONIC

5.2.1 INITIALLY

As a minimum the first 50 welds, shall be ultrasonically tested (100%) per each spread. Thereafter, the extent of US testing for line-up welds and tie-ins will be selected by the client representative based upon the welding quality. In general ultrasonic shall be used as back up for the radiography in case of interpretation/verification problems. However, guarantee welds shall always be ultrasonically tested. Guarantee welds are the welds which cannot be pressure tested for technical reasons (e.g. tie-ins between two pressure test sections).

Ultrasonic testing shall be performed full length, except for resolving interpretation problems in specific areas on radiographic films and for testing of repair welding where the testing shall extend 100 mm to each side of the repair.

5.2.2 BUTT WELDS IN CASING PIPES

Where casing pipes are installed under railways, the extent of testing shall be 100% RT and approx. 10% UT. In all other cases the extent of testing shall be 10% ultrasonic.

5.3 MAGNETIC PARTICLE

All fillet welds.

If it is necessary to extent the control on account of poor welding quality, the additional costs shall be paid by the Contractor. The costs of testing repair welding shall also be paid by the Contractor.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 8/29

6.0 THE OWNER SUPERVISION

The Owner Representative and the Greek Authorities shall have free access to witness or verify all NDE, visit all working areas and review all documents pertinent to NDE.

The Owner Representative has the right to increase the amount of NDE to be performed by the Contractor.

The Contractor shall notify the Owner Representative before NDE is to be carried out. Notification time shall be agreed upon between the Owner Representative and the Contractor.

The Owner Representative has the final approval or rejection of all examinations.

7.0 QUALIFICATION OF PERSONNEL

NDE company must be accredited as per EN ISO 17020.

Personnel responsible for performing or evaluating NDE shall be qualified and certified in accordance with **ELOT EN 473** requirements and as stated below.

Personnel responsible for supervising or evaluating NDE shall hold a current **ELOT EN 473 Level II**. Manual ultrasonic examination operator shall hold a current **ELOT EN 473 Level II**.

TOFD examination operator and the personnel responsible for supervising or evaluating TOFD shall hold a current **ELOT EN 473 Level III**.

Records of the qualification supporting certificates shall be reviewed by the Owner Representative and retained on file by the Contractor.

All personnel shall be approved by the Owner Representative before commencement of work.

8.0 QUALIFICATION OF PROCEDURES

Qualification of welding procedures shall be as per **ELOT EN 12732** and the relevant **ELOT EN ISOs**.

Each approved NDE-procedure technique shall be qualified and documented by the Contractor under site conditions in the presence of the Owner Representative before the technique is applied.

The qualification tests of NDE procedures shall be carried out on welds produced during qualification test welding or initial production welding (first 50 welds).

The ultrasonic qualification test shall demonstrate that the technique is capable of detecting planar defects and cracks to same extent as radiography. During qualification testing the operator shall be without knowledge of defects found by radiography. Failure to detect marginal defects shall not disqualify the technique. In order to verify defects detected, specimens shall be cut out, and the size of defects, if any, shall be found by sectional cutting and polishing.

Thereafter the specimens from the test joints shall be destructively tested in accordance with **ELOT EN 10208-2** by an Accredited test laboratory at

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 9/29

the Contractor's expense. Furthermore Charpy - V test as required in **ELOT EN 12732** shall be executed, according to **ELOT EN 10208-2** and as per **Job Spec. No. 171/1**.

Qualification shall be approved by Owner before any welds can be released.

9.0 **RADIOGRAPHIC EXAMINATION**

9.1 **SAFETY AND PROTECTION**

All necessary safety precautions shall be fulfilled by the Contractor according to the requirements and Owner Representative instructions.

The X-ray and Gamma-ray radioactive sources shall comply with the requirements of (**ΦΕΚ** (National Governmental journals) **216/B/01**).

9.2 **SURFACE PREPARATION**

The surface shall be free of all irregularities that may cause spurious images on the film or difficulties in the interpretation.

9.3 **LOCATION OF WELD ON RADIOGRAPHS**

Where weld reinforcement does not exist, lead markers shall be used to identify the weld location.

9.4 **IDENTIFICATION OF RADIOGRAPHS**

Lead or barium figures shall be used for radiographic identification. Each film shall as a minimum be identified with the following information:

- Serial No. or Heat No.
- Weld identification number.
- Field location.
- The Owner contract number.
- The date.

The identification system shall not interfere with the weld interpretation.

For pipe diameters greater than 50 mm a lead number belt shall be used to verify circumferential weld coverage and to identify defect areas.

If the film has scratches in the area under examination, the radiography must be repeated.

For diameters less than 50 mm lead letters or numbers shall be used to show exposure coverage.

Repair films shall be identified with a lead "R" as a suffix to the weld-identification number.

The Owner reserves the right to introduce and utilize a permanent weld identification system.

9.5 **OVERLAP OF FILMS**

If a continuous length of weld is radiographed using several films, an overlap of at

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 10/29

least 25 mm on each film shall be observed to ensure full weld coverage.

9.6 TECHNIQUE

The requirements of **ELOT EN 12732** and **ELOT EN 1435** shall be fulfilled.

9.6.1 IMAGE QUALITY INDICATORS (PENETRAMETER)

An image quality indicator (IQI) of mild steel shall be used as specified in **ELOT EN 1435** and shall be placed where possible on the surface of the weld on the source side.

The sensitivity shall be 2% or higher.

For pipes of wall thickness up to 6.35 mm equivalent sensitivity may be 4% or higher.

9.6.2 RADIATION SOURCE

X-ray shall be the preferred source used.

However, where access or conditions are prohibitive for X-ray, a Gamma-ray technique with IR-192 may be used if approved by the Owner Representative. In such case the reduction of contrast due to the use of Gamma Source shall be compensate by a finer film sec film screen and cassettes.

9.6.3 SOURCE TO FILM DISTANCE

Radiography shall be performed with a geometrical unsharpness of a maximum of 0.2 mm.

9.6.4 POSITION OF FILM AND X-RAY TUBE

For radiography one of the following techniques shall be used : Technique

II) film outside, source inside centrally placed (panoramic). Technique

III) film outside, source outside (double wall, double image). Technique

IV) film outside, source outside (double wall, single image).

Technique II is the required technique used for the main construction welds with an X-ray crawler.

Technique III shall be applied only on pipe diameters less than 2".

Technique IV shall be applied where the X-ray crawler cannot be used or no access to the inside of the pipe is possible.

9.6.5 FILM SCREENS AND CASSETTES

Film used shall be fine grained, corresponding to fi ex Agfa Gevaert type D5 or better.

Film type Gevaert D4 or similar is required for use with IR-192 as per paragraph. 9.6 of this Specification.

Lead foil intensifying screens shall be used with a front screen thickness between 0.02 mm and 0.15 mm.

Use of prepacked film for tie-ins repairs will be permitted only when technique III is

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 11/29

applied.

Fluor -metallic screens shall not be used.

9.6.6 FILM DENSITY

The density of the radiograph of the sound weld metal in the area under examination, including fog density shall be between 1.8 and 3.8. Higher densities may be used with advantage where the viewing light is sufficiently bright to permit adequate interpretation.

If the density anywhere throughout the area of interest varies by more than -15% +30% from the density throughout the body of the penetrameter then an additional penetrameter shall be used for each exceptional.

The unexposed density (fog density) of any film shall not exceed 0.30.

9.6.7 FILM PROCESSING

Films may be processed by manual or automatic methods.

Manual processing shall be in accordance with the manufacturer's recommendations.

Chemical temperatures shall be maintained according to the manufacturer's requirements.

A change log shall be maintained for chemicals used.

For handling of films a "dry" and "wet" film bench area shall be available in the dark room to prevent contamination.

Automatic processing equipment shall be operated and maintained in accordance with the manufacturer's recommendations.

Finished radiographs shall be processed to allow for an archival life without discoloration for a period of at least 10 years after the line has been handed over.

All radiographs shall be free from artifacts, blemishes, scratches etc. which might hinder future interpretations.

After processing the radiographs shall not contain a greater concentration of residual thiosulphate than specified in **ELOT EN 1435**.

The Contractor shall perform a residual thiosulphate analysis on 5% of all production radiographs.

The data and test results shall be recorded in a logbook.

9.7 **VIEWING OF RADIOGRAPHS**

The radiographs shall be viewed in accordance with **ELOT EN 462-3** (in a darkened room on an illuminated diffusing screen with the illuminated area masked to the minimum required for viewing the radiograph image).

The brightness of the viewing screen shall be adjustable so as to allow satisfactory reading of the radiographs up to and including the specified maximum density.

9.8 **STANDARDS OF ACCEPTABILITY**

Standards of acceptability shall be as specified in **Job Spec. No. 199/4**.

9.9 **REPORTING**

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 12/29

All report forms and reporting shall be accepted by the Owner Representative. A sample form used for previous phases of construction is shown in **FIGURE 1**.

Each working day a test report shall be completed, covering the examination work performed.

The radiographer shall record the location(s) and type of all rejectable discontinuities in this report.

Films and test reports shall be presented if required to the Owner Representative for evaluation.

9.10 DOCUMENTATION AND STORAGE

Documentation shall be prepared, fixed and stored so that access and traceability can be achieved.

Films shall be stored individually and placed in suitable storage boxes. All documentation shall be stored under controlled conditions for humidity etc including safe protection.

Documentation system and storage shall be approved by the Owner Representative. All documentation shall be handed over to the Owner Representative before the hydrostatic testing of examined welds. The documentation shall be legible, indexed and filed according to consecutive weld identification numbers.

10.0 ULTRASONIC EXAMINATION

10.1 EQUIPMENT

Ultrasonic equipment used for the weld examination shall be of a pulse-echo, CRT, A Scan type e.g. USL 32 or equivalent, capable of generating ultrasonic frequencies over a range of 2 MHz to 5 MHz.

Records of calibration, annual maintenance and adjustments, of the equipment shall be kept on file by the Contractor.

Probes shall range from 0□ to 80□ in steel, frequencies from 2 MHz to 10 MHz and sizes (crystal diameter) 6 mm to 12.7 mm. For wall thickness exceeding 15 mm larger probe sizes may be used.

Calibration blocks shall be IIW V1 and V2.

Reference blocks shall be plate of similar dimensions; material and surface finish as the actual pipe. The reference standard shall be a side-drilled hole.

Couplant shall be of a water, glycerin, jelly or paste which will not cause any contamination of the material being examined, or problems of adherence the coating field joints.

TOFD equipment shall comply with the requirements of CEN/TS 14751:2004, paragraph 7.2.

10.2 SURFACE PREPARATION

The scanning surface of the pipe on each side of the weld shall be free of weld spatter, scale or dirt that could restrict the evaluation.

10.3 TECHNIQUE

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 13/29

10.3.1 CALIBRATION

A necessary warming-up period for the ultrasonic instrument shall precede any calibration operation.

Probe index and angle of refraction shall be checked on the IIW calibration block V1 or V2.

Sensitivity setting shall be established on a reference block provided with a 3 mm cylindrical side-drilled hole. A distance amplitude correction (DAC) curve based on the 3 mm hole shall be used. The indication from the reference hole shall be adjusted to reach the DAC curve.

All defect indications shall be compared with the level of the DAC curve.

The equipment shall be calibrated at least once per shift in which it is being used, and whenever change of probe or other parameter changes occur. If the instrument is found to be functioning not satisfactorily, all welds examined since last calibration shall be re-examined.

Each calibration shall be recorded with reference to the number of the next weld to be examined.

10.3.2 LAMINATION EXAMINATION

An ultrasonic lamination examination of parent material adjacent to weld shall be performed and recorded before any shear wave examination.

10.3.3 SCANNING

Transfer correction and attenuation correction shall be carried out on all inspections, and gain shall be adjusted accordingly before establishing scanning level.

Scanning sensitivity shall be at least 6 dB higher than the reference level.

10.4 **TIME LAPSE**

For steel items with a yield strength corresponding to **ELOT EN 10208-2 Grade L360** or higher no ultrasonic examination shall be made until 24 hours after the completion of the seam, unless an exception has been granted by the Owner Representative.

10.5 **DEFECT EVALUATION**

All indications that equal 25% of DAC shall be evaluated and recorded.

Additional NDE may be employed to resolve questions of interpretation of ultrasonic indications.

10.6 **STANDARDS OF ACCEPTABILITY**

Standards of acceptability shall be as specified in **Job Spec. No. 199/4**.

10.7 **CLEANING OF SURFACES**

The steel surface shall be cleaned of couplant on completion of examination.

10.8 **REPORTING**

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 14/29

All report forms and reporting shall be accepted by the Owner Representative. A sample form used for previous phases of construction is shown in FIGURE 2.

Each working day a test report shall be completed, covering the examination work performed, and the report shall be presented if required to the Owner Representative for evaluation.

For each weld there must be clear statement whether the quality requirements are fulfilled or not. In case that are not fulfilled, the following details are to be reported:

- Defect location from the marked zero point.
- Defect length.
- Defect location in depth and side position.
- Echo height.

A sketch shall be produced and attached to the report.

- a. In case of TOFD technique, preparation for testing, testing of base material, range and sensitivity settings, interpretation and analysis of TOFD images shall comply in all the respects to CEN/TS 14751:2004 paragraphs 8-12.
- b. The report form and reporting shall be issued in accordance to paragraph 13 of CEN/TS 14751:2004. Before issuing the report form, it shall be submitted to Owner representative for approval.

11.0 MAGNETIC PARTICLE EXAMINATION

11.1 SAFETY AND PROTECTION

Care must be taken to avoid direct contact with the testing medium and to ensure that electric cables are safely positioned.

11.2 SURFACE PREPARATION

"As-welded" surfaces shall be power buffed and free of all surface debris before test.

11.3 EQUIPMENT

According to **ELOT EN 1290**, with a minimum lifting power of 4.5 kg using alternating current.

11.4 MAGNETIC PARTICLE MATERIALS

Only water-suspended wet types may be used.

11.5 MAGNETIC TECHNIQUE

According to **ELOT EN 1290**.

11.5.1 OTHER METHODS

Other magnetizing methods may also be used, such as the coil or the central conductor method.

In these cases it shall be verified that the magnetic field strength is at least 30 Oersted in the area to be tested.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 15/29

11.5.2 DIRECTION OF MAGNETIZATION

At least two separate examinations shall be carried out on each area.

The second examination shall be with the lines of magnetic flux perpendicular to those of the first examination.

A different means of magnetization may be used for the second examination.

Examination shall be conducted with sufficient overlap to assure 100 percent coverage at the established test sensitivity.

11.5.3 WET METHOD

The suspension shall be applied by spraying during the magnetization.

The suspension shall be constantly agitated to prevent fall-out before application.

11.6 EVALUATION OF INDICATIONS

Discontinuities and defects will be identified by retention of the magnetic particles. All such indications shall be investigated.

11.7 DEMAGNETIZATION

Demagnetization following examination is required where residual magnetism interferes with subsequent processes or usage.

11.8 STANDARDS OF ACCEPTABILITY

Standards of acceptability shall be as specified in **Job Spec. No. 199/4**.

11.9 REPORTING

All report forms and reporting shall be accepted by the Owner representative. A sample form used for previous phase of construction is shown in **FIGURE 3**.

Every examination shall be followed by a report containing the following details:

- Description of the examined object, including location, identification, dimensions, surface conditions and extent of examination.
- Equipment, including apparatus data, magnetizing method, magnetic field strength.
- Examination procedure, including examination pattern, directions of magnetization, examination during and after repair.
- Examination results, each surface crack shall be reported with location and length. Depth shall be determined during removal of the crack.

For each weld or area, there shall be a clear statement whether or not the quality requirements are fulfilled.

Non-acceptable discontinuities shall be described with location and size and, if required, illustrated with a sketch.

The report shall be presented if required to the Owner Representative for evaluation.

12.0 LIQUID PENETRANT EXAMINATION

12.1 SAFETY AND PROTECTION

As penetrant inspection techniques may require the use of toxic, flammable and volatile materials, certain precautions have to be considered. Working areas shall be sufficiently ventilated and clear of heat sources, open fires and flames.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 16/29

12.2 SURFACE PREPARATION

Surfaces to be examined and the adjacent area within at least 25 mm shall be free from scale, slag, burrs, oil, grease and adhering or embedded sand and other extraneous matter that would obscure surface openings or otherwise interfere with the examination.

12.3 EQUIPMENT

Visible dye penetrant system, solvent removable shall be used. Certification of penetrant materials and cleaning solvents are required to show sulphur/halogen/chlorides content less than 1% of weight.

12.4 TECHNIQUE

Penetrant examination shall meet the recommendations of **ELOT EN 571-1 and ELOT EN 12732** with the following additions:

- The excess penetrant shall be removed in such a manner as to ensure retention of penetrant in any discontinuity open to the surface, excluding washing directly with solvent.

It should be noted that testing at temperatures other than those specified for the liquid penetrant materials may lead to erroneous results.

Details of above operations shall be in accordance, with the penetrant system manufacturers recommendations.

12.4.1 EXAMINATION

When developing time has elapsed, examination of the test surface shall be made under the appropriate viewing conditions. If the background is such that the interpretation of indications is impaired, the surface shall be completely retested. The location of indications shall be marked and associated discontinuities shall be evaluated.

12.5 STANDARDS OF ACCEPTABILITY

Standards of acceptability shall be as specified in **Job Spec. No. 199/4**.

12.6 REPORTING

All report forms and reporting shall be accepted by the Owner representative. A sample form used for previous phases of construction is shown in **FIGURE 4**.

Every examination shall be followed by a report containing all relevant information, including - but not limited to - the following details:

- Description of the examined object, including location, identification, dimensions, surface conditions, and extent of examination.
- Penetrant system.
- Examination procedure, including examination pattern, soaking time, development time, etc.

For each weld or area examined, there shall be a clear statement whether the quality requirements are fulfilled or not.

In case they are not fulfilled the following details are to be reported:

- Defect location from the marked zero point.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 17/29

- Defect length.
- Defect location in depth and side position.

A sketch shall be produced and attached to the report.

The report shall be presented if required to the client representative for evaluation.

13.0 OCCURRENCE OF CRACKS

If cracks occur repeatedly, the reason for the occurrence of cracks shall be investigated and disclosed.

The investigations shall include additional ultrasonic testing of at least 10 seams performed by each of the welder(s) having worked on the seams containing cracks (notwithstanding that the seam may previously have been radiographically tested and accepted).

The specific welder's adaptation to the procedure shall be examined in order to disclose the origin of the occurrence of cracks. Should this not be determined as a welder's fault, the approved welding procedure or other factors shall be thoroughly examined, if necessary involving renewed procedure qualification tests or work procedure to ascertain whether the procedure can be used to produce sound welds.

14.0 DESTRUCTIVE TESTING

Owner's Representative is entitled to select some weld seams for destructive testing. He will also select the company that will perform these tests on behalf of the Contractor.

Contractor is responsible for cutting out the seams, beveling of the pipe ends, as well as to reweld the joint, preparing the test samples, and transporting the samples to the testing company / laboratory.

Contractor's Engineer and Owner's Representative shall be present during the testing of the specimen.

1

Destructive tests of production welds shall satisfy all the pipe mechanical properties including impact. The frequency of the production tests shall be at least:

- One production test during the first two days. Afterwards one production weld shall be selected by the Owner's representative for every 500 welds of line up including tie-ins.
- Two days after any change of welding crew.

If the destructive test results are not acceptable then the Owner's Representative may select another joint for testing from the same date and of the same welder.

1

In case that the results are still not acceptable the Owner Representative shall decide for the extension of the destructive testing (which is Contractor's obligation), with the aim of establishing the extent and cause of the problem.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 18/29

FIGURE 1 FIELD REPORT, RADIOGRAPHY OF WELDS

Journal No	Enclosure No	(Inspector init.)	Certificate (type No)	(Assistant init.)	Certificate (type No)	Report No							
Client				Contractor									
Owner				Location									
Object (Dim. ident. number)				Drawing No		Rev No							
Weld preparation				Material		Undercut depth							
<input type="checkbox"/> X	<input type="checkbox"/> Y	<input type="checkbox"/> U	<input type="checkbox"/> V	<input type="checkbox"/> K	<input type="checkbox"/> L	mm							
Welding process				Reinforcement		Filler metal							
<input type="checkbox"/> MMA <input type="checkbox"/> Sub Arc				<input type="checkbox"/> Flat <input type="checkbox"/> Normal <input type="checkbox"/> High									
<input type="checkbox"/> TIG <input type="checkbox"/> MAG				Other									
Heat treated				Surface condition		Time of inspection							
<input type="checkbox"/> Yes <input type="checkbox"/> No				<input type="checkbox"/> Ground <input type="checkbox"/> Smooth <input type="checkbox"/> Coarse		Hours after welding							
Examination procedure-class				Other		Class							
ELOT EN 1435													
Exp. technique A-E				ellipse									
<input type="checkbox"/> A. <input type="checkbox"/> B. <input type="checkbox"/> C. ___ Eksp./weld				<input type="checkbox"/> D. ___ Eksp./weld <input type="checkbox"/> E. ___ Eksp./weld									
X-ray R-192		Equipment No		Focal spot x mm Exp. KVP fFD cm mACr Min.		Exp. KVP fFD cm mACr Min.							
				Source dim x mm data I / / /		data II / / /							
Place of IQI				Film make Type Class Size		Screen type Thickness front / back							
				/ / / x cm		/ mm / mm							
Development				Developer type		Temp. Densitometer Range							
<input type="checkbox"/> Manual <input type="checkbox"/> Automat.						min °C Type No. D =							
Quality requirements (Standard)				Other		Extend							
ELOT EN 1435						Examined %							
Film No	Box No	Seam posit	Tube No	Tube row	Welders mark	Technique A-E	Exp data I-II	Density	Image qual. 1)	Dominating defects 3)	KW degree 2)	Defect location	Repair on film No 4)
Film Location													
Repairs marked		Check on		Prelim evaluation		Enclosures		Inspector (signature, date)					
<input type="checkbox"/> On object <input type="checkbox"/> On sketch		<input type="checkbox"/> Grinding <input type="checkbox"/> Repair		<input type="checkbox"/> Final evaluation <input type="checkbox"/> Stamped		<input type="checkbox"/> None <input type="checkbox"/> sheets							
Appr. by Client		Copy delivered to		Appr. by Owner represent.		Copy delivered to		Appr. by certification auth.		Copy delivered to			
Signature date [1) - 4) see explanation]				Signature date				Signature date					

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 19/29

FIGURE 2 FIELD REPORT, ULTRASONIC INSPECTION OF WELDS

Journal No	Enclosure No	(Inspector init)	Certificate (type No)	(Assistant init.)	Certificate (type No)	Report No											
Client				Contractor													
Owner				Location													
Object (Dim. ident number)				Drawing No	Rev No												
Material																	
Weld preparation			Other	Reinforcement		Undercut depth											
<input type="checkbox"/> X	<input type="checkbox"/> Y	<input type="checkbox"/> U	<input type="checkbox"/> V	<input type="checkbox"/> K	<input type="checkbox"/> I	<input type="checkbox"/> mm											
Welding process			Other		Filler metal												
<input type="checkbox"/> MMA	<input type="checkbox"/> Sub Arc	<input type="checkbox"/> TIG	<input type="checkbox"/> MAG														
Stress relieved		Surface condition			Time of inspection												
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Ground	<input type="checkbox"/> Smooth	<input type="checkbox"/> Coarse	Hours after welding												
Examination procedure-class				Other													
<input type="checkbox"/> ELOT EN 1714																	
Equipment type				Other		Equipment No.											
<input type="checkbox"/> USM 2	<input type="checkbox"/> USL 31/32	<input type="checkbox"/> USK 6/7															
Comp. probes	Type	A:	B:	Angle probes	Type	C:	D:	E:									
	SVC No/Freq.	/ ... MHZ	/ ... MHZ		SVC No/ True angle	/	/	/									
Sensitivity Setting	Basic setting ~ ref curve	db	db	Sensitivity Setting	Basic setting ~ ref curve	db	db	db									
	Transfer Correction	db	db		Transfer Correction	db	db	db									
	Extra when scanning	db	db		Extra when scanning	db	db	db									
	Total	db	db		Total	db	db	db									
DAC: Hole dia = mm, range = mm, AVG: Disk dia. = mm, range = mm																	
Quality requirements						Other											
<input type="checkbox"/> DS/R 325 class, <input type="checkbox"/> DS 412 class, <input type="checkbox"/> ELOT EN 1714																	
Scanning for longitudinal defects and laminations					Scanning for transverse defects												
Position	1	2	3	4	5	6	7	8	9	10	Position	11	12	13	14	15	16
Probe											Probe						
Extend of inspection																	
Result of inspection																	
Repairs marked		Grinding Checked		Enclosures				Inspector (signature, date)									
<input type="checkbox"/>	On object	<input type="checkbox"/>	Repair Checked	<input type="checkbox"/>	None												
<input type="checkbox"/>	On sketch	<input type="checkbox"/>	Stamped	sheets													
Appr by Client								Appr. by Owner Representative				Appr. by certification authority					
Signature date								Signature date				Signature date					

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 20/29

FIGURE 3 FIELD REPORT, MAGNETIC PARTICLE EXAMINATION

Journal No	Enclosure No	(Inspector init.)	Certificate (type No)	(Assistant init.)	Certificate (type No)	Report No
Client				Contractor		
Owner				Location		
Object (Dim ident. number)				Drawing No		Rev No
Weld preparation				Material		Undercut depth
<input type="checkbox"/> X	<input type="checkbox"/> Y	<input type="checkbox"/> U	<input type="checkbox"/> V	<input type="checkbox"/> K	<input type="checkbox"/> I	<input type="checkbox"/> mm
Welding process				Reinforcement		Other
<input type="checkbox"/> MMA <input type="checkbox"/> Sub. Arc <input type="checkbox"/> TIG <input type="checkbox"/> MAG				<input type="checkbox"/> Flat <input type="checkbox"/> Normal <input type="checkbox"/> High		mm
Stress relieved				Surface condition		Time of inspection
<input type="checkbox"/> Yes <input type="checkbox"/> No				<input type="checkbox"/> Ground <input type="checkbox"/> Smooth		Hours after welding
Examination procedure-class				Other		
ELOT EN 1290						
Current magnetizing		Electromagnet		Cost magnetizing		Magnet
 S = mm I = Amp Equipment No:		 Type = Smax = Equipment No. Lifting Power:		 Current Number of turns I = Amp Equipment No. AC DC		 S = mm Magnet No. _____ Lifting Power
Test		Longit. _____ Amp		Circular _____ Amp x turns		
Type of probe		Other		groundcut		Demagnetize
<input type="checkbox"/> Steel <input type="checkbox"/> Copper		<input type="checkbox"/> Yes <input type="checkbox"/> No		<input type="checkbox"/> Yes <input type="checkbox"/> No		
Magnetic		Petroleum / black		Background		
<input type="checkbox"/> Water/black <input type="checkbox"/> Water/fluor		<input type="checkbox"/> Petroleum / fluores <input type="checkbox"/> Dry powder		<input type="checkbox"/> White <input type="checkbox"/> Polished <input type="checkbox"/> Non-treated		
Field strength _____ kA/m				Viewing		
Oerstedmeter value _____ Ce				<input type="checkbox"/> Field indicator <input type="checkbox"/> White <input type="checkbox"/> UV - lamp No		
Magnetized				<input type="checkbox"/> Longitudinal defects <input type="checkbox"/> Transverse defects <input type="checkbox"/> Any direction		
ELOT EN 1290				Other		
Extend of examination						
Result of examination						
Repairs marked		Grnding Checked		Enclosures		Inspector (signature, date)
<input type="checkbox"/> On object <input type="checkbox"/> On sketch		<input type="checkbox"/> Repair Checked <input type="checkbox"/> Stamped		<input type="checkbox"/> None sheets		
Appr. by Client		Appr. by Owner Representative		Appr. by certification authority		
Signature date		Signature date		Signature date		

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 21/29

FIGURE 4 FIELD REPORT, LIQUID PENETRANT EXAMINATION

Journal No	Enclosure No	(Inspector init.)	Certificate (type No)	(Assistant init.)	Certificate (type No)	Report No
Client			Contractor			
Owner			Location			
Object (Dim. ident. number)			Drawing No	Rev No		
Weld preparation			Material		Undercut depth	
<input type="checkbox"/> X	<input type="checkbox"/> Y	<input type="checkbox"/> U	<input type="checkbox"/> V	<input type="checkbox"/> K	<input type="checkbox"/> I	<input type="checkbox"/>
Welding process			Reinforcement		Filler metal	
<input type="checkbox"/> MMA	<input type="checkbox"/> Sub. Arc	<input type="checkbox"/> TIG	<input type="checkbox"/> MAG	<input type="checkbox"/> Flat	<input type="checkbox"/> Normal	<input type="checkbox"/> High
Heat treated		Surface condition			Time of inspection	
<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Ground	<input type="checkbox"/> Smooth	<input type="checkbox"/> Coarse	Hours after welding	
Pre-cleaning			Type of bath			
<input type="checkbox"/> None	<input type="checkbox"/> Cleaner applied	<input type="checkbox"/> Cleaning by dipping (Bath)				
Penetrant			Method			
Manufacturer			Type	<input type="checkbox"/> A. Fluoresc.	<input type="checkbox"/> B. Visible	<input type="checkbox"/> C. Dual purpose
Penetrant remover						
<input type="checkbox"/> 1. Water-wash	<input type="checkbox"/> 2. Emulsifier + water	<input type="checkbox"/> 3. Solvent				
Developer						
<input type="checkbox"/> 1. Dry powder	<input type="checkbox"/> 2. Suspension in water	<input type="checkbox"/> 3. Powder in volatile solvent				
Penetration time			Object temperature			
min.	min.	min.	°C			
White Light		UV - Light		Lamp. No		
Quality requirements		Other				
<input type="checkbox"/> ELOT EN 571-1		<input type="checkbox"/>				
Extend of inspection						
Result of inspection						
Repairs marked		Grinding Checked		Enclosures		Inspector (signature, date)
<input type="checkbox"/> On object	<input type="checkbox"/>	Repair Checked		<input type="checkbox"/> None		
<input type="checkbox"/> On sketch	<input type="checkbox"/>	Stamped		<input type="checkbox"/> sheets		
Appr by Client			Appr by Owner Representative			Appr. by certification authority
Signature date			Signature date			

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 22/29

APPENDIX A

**REQUIREMENTS FOR AUTOMATIC ULTRASONIC TESTING
(AUT)**

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 23/29

A.1 Scope

This appendix provides recommendation for the automatic ultrasonic testing (AUT) of pipeline girth welds. It includes requirements for the AUT system, transducer configuration, reference blocks, sensitivity and system qualification.

Operator qualification for AUT is also addressed. This standard is applicable for a wall thickness range from 6mm up to 25mm (maximum wall thickness tolerance of +/- 1.5mm) with a pipe diameter ranging from 2" to 60".

Other wall thicknesses and wall thickness tolerance may apply when it can be demonstrated that requirements for zonal discrimination and weld volume coverage can be met.

A.2 General Requirements

This Appendix establishes the minimum requirements for the ultrasonic inspection of pipeline girth welds related to the system setup (ultrasonic equipment and transducers and recording system), calibration standards and field inspection performance. Phased array equipment shall meet the requirements of ASTM E 1961 and ToFD of prEN12723:2009 and CEN/TS 14751

The AUT system used shall provide an adequate number of inspection channels to ensure the complete volumetric inspection of the weld and heat affected zone in one (1) circumferential scan. This requirement may be deviated from in cases where full coverage in one scan cannot be obtained.

The inspection techniques, employed for the transmission of ultrasound, can be utilized using either multi probe / fixed angle or phased array probes. ToFD inspection shall be used as a supplementary technique to enhance the determination of imperfection dimensions and position.

An operating Quality Assurance system shall be in place documenting the AUT system in use in sufficient detail to ensure that the system is designed, assembled and operated to meet ISO 13487 standard requirements

A.2.1 Inspection Configuration

The weld shall be divided into vertical examination sections (zones) taking into account the specific weld bevel configuration and welding process. The height of each inspection zone is primarily dictated by vertical content of the weld bevel geometry, for instance in case of specific bevel orientation related to Root, Hot passes and/or LCP.

Remaining vertical bevel (Fill area) shall be divided into approximately equal vertical zones with heights between 2 and 4mm, taking into account the over trace requirements for adjacent zones.

It is advised to create synergy, to the extent possible, between the inspection setup configuration and the welding process, for instance the number and height of used welding passes.

A.2.2 System Functionality

The system shall be capable of locating/detecting and accurately measuring the through wall height and circumferential length of imperfections that permits the use of the relevant acceptance criteria. System functionality shall be in accordance with ASTM E1961, Section 6, CEN/TS 14751 and the following requirements:

A.2.2.1 TOFD Channel

The AUT system shall incorporate a Time of Flight (TOFD) configuration. With the TOFD technique, the

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 24/29

entire weld volume is covered. A single TOFD configuration shall be used for wall thickness $\leq 25\text{mm}$, whereas a dual TOFD configuration shall be used for wall thickness $>25\text{mm}$. The TOFD technique provides additional information to assist in the evaluation of the overall AUT inspection result and offers the enhanced ability to determine the through-thickness dimension and the depth position of imperfections within the weld volume.

A.2.2.2 Transverse channels

The AUT system shall incorporate inspection techniques for the detection of transverse imperfections when the welding process, base material, application and environmental conditions identify a potential risk for transverse defects and when required by the Client

A.2.2.3 Digitization rate

The digitization rate shall be at least 4 times the nominal transducer frequency

A.2.3 Ultrasonic System Set up

Ultrasonic equipment set-up shall be in accordance with ASTM 1961 Sections 7, 8 and 9 and CEN/TS 14751 with the following additional requirements

A.2.3.1. TOFD

The TOFD frequency shall be between 6 and 10 MHz. TOFD transducers shall be optimised for the wall thickness to be tested and the refracted angle shall be the same for transmitter and receiver. Damping and incident angle shall be chosen to limit the dead zone formed by the lateral wave

For single TOFD channels, the transducer spacing shall be selected to place the theoretical crossing of beam centres at the weld centreline at 66 to 95% of the wall thickness. For double TOFD channels (recommended for wall thickness $>50\text{mm}$) the theoretical crossing of beam centres at the weld centreline shall be at 66 to 95% of the wall thickness for one channel and approximately 33% of the wall thickness for the other channel.

The time gate start should be at least $1 \mu\text{s}$ prior to the time of arrival of the lateral wave, and shall at least extend up to the first back wall echo. Because mode converted echoes can be of use in identifying defects, it is recommended that the time gate also includes the time of arrival of the first mode converted back wall echo.

The amplitude of the lateral wave shall be between 40 and 80% of full screen height (FSH). In cases when use of the lateral wave is not applicable, e.g. surface conditions and steep beam angles, the amplitude of the back wall signal shall be set at between 12 to 24 dB above FSH. When use of neither the lateral wave nor the back wall signal is applicable, the sensitivity should be set such that the noise level is between 5 and 10% of FSH.

A.2.3.2 Phased Array

Phased Array transducers shall be certified as meeting the performance requirements of the applicable standard.

Each phased array probe shall be marked to identify the manufacturer's name and frequency

Phased array systems will simulate the conventional probe array system function for weld volume inspection. Phased array transducers shall have a minimum of 64 elements. Due to the large

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 25/29

wedge footprint and therefore sensitivity to surface waviness, care must be taken to ensure the contact surface of the transducer is properly dressed to match the contour of the pipe surface.

Phased array transducers shall contain shaped elements in the passive none steered direction, radius of curvature 75 to 125 mm. Alternatively phased array transducers shall contain a suitable lens in the passive none steered direction.

Each focal law will provide for the maximum sound pressure at the target defined in the inspection design. The focus shall occur at the target ± 10 mm of steel path and the beam height shall be within $\pm 25\%$ of that required by the inspection design. A system preventing any unqualified alterations to agreed focal laws shall be implemented for the phased array AUT system.

A.2.3.4 Temperature

For AUT inspection at extreme temperatures, in very hot or very cold conditions, the calibration block may need to be heated or cooled so that the array is maintained within a 10 Celsius degrees variance when completing calibration in, weld scan, and calibration out cycles. The need for heating or cooling of the calibration standard shall be documented on all the hard copy calibration and weld printouts

A.2.5 Reference Block Standards

A.2.5.1 General

Reference standards shall be used to establish sensitivity qualify the system for field inspection and to monitor ongoing system performance. They shall be in accordance with ASTM E1961 Annex 3 and/or CEN/TS 14751 Annex A.

The principal calibration reflectors for fusion defects shall be 3 mm diameter flat bottom holes (FBH) and 1 mm deep surface notches. The central axis of each FBH calibration reflector shall coincide with the central axis of the sound-beam interrogating it. Where transverrequired two transverse notches are required, each measuring 10 mm long and 2 mm deep, with one on the ID and one on the OD surface. The principal reflector for porosity detection shall be a 1.5 mm FBH

TOFD notches shall not be deeper than 2 mm for the inside surface and 3 mm for the outside surface.

Besides the reference blocks mentioned above the Contractor shall prepare two circumferential joints with the same dimensions, material and welding process he is going to use on site, which will contain seven flaws at, or near the limit of the acceptance criteria. These joints shall be used during the AUT qualification procedure.

Other reference reflectors dimensions may be used to achieve the necessary probability of detection as determined by the smallest allowable imperfection height derived from the agreed acceptance criteria.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 26/29

A.2.6 Procedure (General and Specific)

A.2.6.1 General

A detailed AUT Procedure shall be prepared for each weld joint geometry to be examined prior to the start of any welding. It is advised to establish a *General procedure* which describes the functionality of the AUT inspection system in use whereas the *Specific AUT procedure(s)* are to complement the general AUT procedure addressing the actual system configuration, set-up parameters and acceptance criteria for each pipe size, wall thickness and weld configuration. The general and specific procedures cover the use of Automatic Ultrasonic Testing (AUT) only. The AUT procedure(s) shall be submitted for acceptance.

A.2.6.2 General procedure

The purpose of the general procedure is to detail the methodology used for the Automatic Ultrasonic Testing (AUT) of circumferential pipeline girth welds (including repair welding)

- functional description of equipment
- reference standards and guidelines controlling equipment maintenance
- instructions for scanning device, ultrasonic instrument, ultrasonic electronics, hard- and software for recording, processing, display, presentation and storage of inspection data
- methodology for sensitivity setting and for fusion zone transducers; over trace (signal amplitude from adjacent zones) requirements consistent with the over trace used as basis for establishing height sizing corrections for amplitude sizing
- description/drawings of calibration block(s), including type, size and location of all calibration reflectors
- method for scanner alignment and maintenance of alignment
- verification of reference line and guide band positioning
- maximum allowed temperature range
- control of temperature differentials (pipe and calibrationblock)

A.2.6.3 Specific procedure

- number of examination zones for each wall thickness to be examined, as relevant
- transducer configuration(s), characteristics, types, coverage and/or focal law details
- gate settings
- equipment settings
- threshold settings
- acceptance criteria, or reference
- instructions for reporting including example of recorder chart and forms to be used

A.2.7 Operator Qualification

Ultrasonic operators shall be qualified and certified as a Level II in the "Ultrasonic" method in accordance with EN 473 and /or ISO 9712 and shall submit their current records of certification. In addition, operators shall have completed a minimum of 100 hours training in automatic testing, including practical and theoretical aspects pertinent to the equipment and general configurations to be examined. This training shall be documented and the records shall be provided on request

When requested the competency of the AUT system operators shall be demonstrated showing their ability to detect and characterize typical weld indications and determine their acceptance.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 27/29

A.3 Specific Requirements – Acceptance Criteria

A.3.1 Scope

This section defines the specific requirements for system qualification, system verification and calibration for ultrasonic systems where flaw acceptance is based on the response amplitude and length of the indication.

A.3.2 System qualification

Qualification of the system and procedure shall be by demonstration that an acceptable response is obtained for all reflectors in a reference standard block as specified in Section A.2.5

In addition further verification of the performance of the system shall be demonstrated by the examination of at least two welded circumferential joints containing approximately seven flaws at, or near the limit of the acceptance criteria. The indications given by the system shall be compared with the results of radiography, manual ultrasonic examination and any other method required by the Client. Discrepancies between the indications given by the system and by the other methods shall be resolved by sectioning the weld at the location of the indication and metallographic examination.

A.3.3 Acceptance criteria

A.3.3.1 Classification

Relevant indication: any indication related to a welding anomaly (imperfection / discontinuity / inclusion).

Not relevant indication: any indication not related to weld quality.

Imperfection: any welding anomaly.

Defects: imperfection exceeding the given acceptance criteria.

A.3.3.2 General

The reference level shall be based on 3mm flat bottomed hole and 1mm deep surface notches (Sect. A.2.5) All UT signals which produce a response over 40% of the reference level shall be evaluated to determine their cause. Based on this evaluation all relevant indications are considered imperfections. When doubt exists about indication being relevant or non-relevant verification may be obtained by using other non-destructive testing methods.

A.3.3.3 Flaw acceptance criteria

A.3.3.3 Cracks

Imperfections determined to be cracks (C) shall be considered defects

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 28/29

A.3.3.4 Linear surface (LS)

Linear surface (LS) imperfections (other than cracks) interpreted to be open to the I.D. or O.D. surface shall be considered defects should any of the following conditions exist:

- a. The length of an individual indication exceeds 10 mm.
- b. The aggregate length of indications exceeds 25 mm in any continuous 300 mm length of weld.
- c. The aggregate length of indications exceeds 8 % of the weld length in any weld less than 300 mm in length.

A.3.3.5 Linear buried (LB)

Linear buried (LB) indications (other than cracks) interpreted to be subsurface within the weld and not I.D. or O.D. surface-connected shall be considered defects should any of the following conditions exist:

- a. The length of an individual indication exceeds 25 mm.
- b. The aggregate length of indications exceeds 25 mm in any continuous 300 mm length of weld.
- c. The aggregate length of indications exceeds 8 % of the weld length.

A.3.3.6 Transverse (T)

Transverse (T) indications (other than cracks) shall be considered volumetric and evaluated using the criteria for volumetric indications. The letter T shall be used to designate all reported transverse indications.

A.3.3.7 Volumetric cluster (VC)

Volumetric cluster (VC) indications shall be considered defects when the maximum dimension of VC indications exceeds 1/2 in. (13 mm).

A.3.3.8 Volumetric individual (VI)

Volumetric individual (VI) indications shall be considered defects when the maximum dimension of VI indications exceeds 1/8 in. (3 mm).

A.3.3.9 Volumetric Root (VR)

Volumetric root (VR) indications interpreted to be open to the I.D. surface shall be considered defects should any of the following conditions exist:

- a. The maximum dimension of VR indications exceeds 1/4 in. (6 mm) or the nominal wall thickness, whichever is less.
- b. The total length of VR indications exceeds 1/2 in. (13 mm) in any continuous 300 mm length.

HELLENIC GAS TRANSMISSION SYSTEM OPERATOR



Job Spec. No 180/1
Revision 0
Date 05-04-2011
Page 29/29

A.3.3.10 Accumulation of imperfections (AR)

Any accumulation of relevant indications (AR) shall be considered a defect when any of the following conditions exist:

- a. The aggregate length of indications above evaluation level exceeds 50 mm in any 300mm length of weld.
- b. The aggregate length of indications above evaluation level exceeds 8% of the weld length.