



Exploration & Production

GENERAL SPECIFICATION

PIPELINES - RISERS

GS PLR 430

Automated Ultrasonic Testing (AUT) of Pipeline Girth Welds

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Contents

1. Scope	5
1.1 General	5
2. Purpose of scanning.....	5
3. Reference documents	5
4. General.....	7
4.1 Definitions	7
4.2 Quality Assurance/Quality Control	8
4.3 SUBCONTRACTOR approval	9
4.4 Development of AUT procedure	9
4.5 Pipes with large tolerance on wall thickness	9
5. Equipment.....	10
5.1 Generality	10
5.2 Power supply	10
5.3 Ultrasonic equipment	10
6. Personnel qualification.....	14
6.1 Operator.....	14
6.2 Interpreter	14
7. Calibration	15
7.1 Calibration blocks	15
7.2 Ultrasonic examination set-up (static calibration)	17
8. Qualification of UT procedures.....	20
8.1 Generality	20
8.2 Preliminary statements	20
8.3 Qualification of the system efficiency.....	20
8.4 Qualification of equipment particular arrangement/scanning procedure for each pipe size	21
8.5 Description of tests	21
9. Field examination – Production scanning	25
9.1 General requirements	25

9.2	Qualified equipment.....	26
9.3	Static calibration	26
9.4	Dynamic calibration	26
9.5	Preliminary verification of scanning system calibration	26
9.6	Setting of parameters for production scanning	27
9.7	Reference line.....	27
9.8	Surface condition and drop of Coupling.....	27
9.9	Pipe surface temperature	27
9.10	Accelerated cooling of welds	27
9.11	Traceability - Weld identification and scanning marking	28
9.12	Dynamic calibration frequency in production scanning.....	28
9.13	Interpretation of scanning results.....	28
9.14	Inspector survey	28
9.15	Re-examination.....	29
10.	Examination of welding repairs	29
11.	Philosophy of weld quality and Imperfection Acceptance Criteria.....	29
11.1	Workmanship of good standard.....	29
11.2	Conditions to the implementation of ECA based AC (EC) in production	29
11.3	Engineering Critical Assessment.....	30
12.	Inspection by the COMPANY	31
12.1	General.....	31
12.2	Inspector's training.....	32
13.	Third Party	32
14.	Documentation	32
14.1	At the bid stage.....	32
14.2	Reporting in production.....	32
14.3	Upon completion of pipe production	34
Appendix 1	Development of AUT procedure definition.....	35
Appendix 2	Additional requirements for pipes with a Wall Thickness Range "WTR" over 1.5 mm and sound path difference over 3 mm	36
Appendix 3	Joint assembled as per WPS specification (Before machining of shrinkage).....	39



Appendix 4	JIG for reference line scribing	40
Appendix 5	Evaluation of defect length	41
Appendix 6	Test “T5” tack welded joint design	42
Appendix 7	Recommendation for “C3” coupling monitoring (phased array system)...	43
Appendix 8	Qualification stage - Synopsis of qualification and Inspector scope	44
Appendix 9	Production stage – COMPANY inspector scope.....	55
Appendix 10	Reserve form	57

1. Scope

1.1 General

COMPANY reminds that specifications **GS PLR 420 and **GS PLR 421** require inspection of pipeline girth welds by x-ray. Inspection by automatic UT (AUT), when so proposed by Contractor, is subject to derogation request. COMPANY may accept provided that the conditions and the requirements specified herein are fully met.**

This specification defines the COMPANY requirements for the Automated Ultrasonic Testing (AUT) of any girth (field butt) welds of onshore or offshore transmission pipelines operating in sweet or sour service.

It applies to carbon steel pipelines of wall thickness 7 mm minimum, OD 4.5" minimum, and to pipes made from rolled plates or rolled coils.

It does not apply to seamless pipes or to welded pipes that have a Wall Thickness Range (WTR) which exceeds 1.5 mm or which affects the sound path in any channel of more than 3 mm. However, COMPANY may accept derogation where AUT procedure is found to be specially designed for and really suitable. Refer to the relevant paragraph 4.5 and Appendix 2.

This specification covers multiple probe technique or phased array probe technique or a combination of these.

This specification shall be used in conjunction with a Project Particular Specification (PPS), if any, detailing the additional tests and requirements or the possible modifications to the present specification, based on the particular design conditions of the pipeline project.

The automatic UT procedure proposed by CONTRACTOR shall conform to the present specification. It shall remind the here-included requirements, qualification tests and the acceptance criteria. It shall specify clearly the procedure of flaw evaluation, in such a way that COMPANY Representative can understand and can counter check the UT interpretation. It shall be approved by the Third Party approved by COMPANY and then, submitted to COMPANY final approval. Procedure qualifications shall not begin until COMPANY has accepted the procedure(s). The procedure validations are submitted to the hereafter qualifications.

2. Purpose of scanning

The system shall be capable to detect, to identify, to locate and to size in the through thickness and in the circumferential direction, and to size any longitudinal or transverse, planar or volumetric discontinuity.

It is CONTRACTOR responsibility to specify the equipment and the procedures so as to achieve such a capability.

3. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

The order of precedence of the applicable documents shall be:

- The Contract
- The Particular Specification if any



- The present Specification
- The codes and standards in reference.

Applicable Codes and Standards that are to be used in conjunction with this specification are stated in paragraphs hereafter.

Unless otherwise specifically indicated in writing by the COMPANY, the CONTRACTOR shall work in accordance with the requirements specified herein and the applicable requirements of the latest editions at date of CONTRACT award of the referenced Codes and Standards, whenever asked in the present specification.

Where this specification states no overriding requirements, the referenced Codes and Standards shall apply in full.

Standards equivalent to those referred to herein shall not be substituted without written approval from the COMPANY. Approval of equivalent standards will not, in any way, remove responsibility from CONTRACTOR to meet the requirements of the Standards referred to and amended herein, in the event of conflict.

The CONTRACTOR shall equip himself with copies of all the reference specifications referred to in this specification and shall make them readily available to all fabrication, testing and inspection personnel involved on the work.

Standards

Reference	Title
API 5L	Specification for line pipe
API 1104	Welding of pipelines and related facilities
DNV OS-F101	Submarine pipeline systems - 2000
ASTM A 578	Straight-beam ultrasonic examination of plain and clad steel plates of special application
ASTM E 317	Practice for evaluating performance characteristics of ultrasonic Pulse-echo testing system without the used of electronic measurement instruments
ASTM E 1961-98	Standard practice for mechanised ultrasonic examination of girth welds using zonal discrimination with focused search units
ISO 9002	Quality systems - Model for quality assurance in production and installation
ENV 583-6 Part 6	Non-destructive testing – Ultrasonic examination – Part 6: Time-of-flight diffraction technique as a method for detection and sizing of discontinuities
BS 7910	Guide on methods for accessing the acceptability of flaws on metallic structures

Professional Documents

Reference	Title
EN 473	Qualification and certification of NDT personnel – General principles
COFREND	Comité français des essais non-destructifs (French Committee of non-destructive testing)

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
ASME B 31-4	Liquid transportation systems for hydrocarbons, liquid petroleum gas, anhydrous ammonia, and alcohols
ASME B 31-8	Gas transmission and distribution piping systems

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS PLR 420	Site welding of carbon steel pipelines to API 1104 (sweet and mild sour service)
GS PLR 421	Site welding of carbon steel pipelines to API 1104 (intermediate and severe sour service)

4. General

4.1 Definitions

COMPANY

TOTAL or agents acting on its behalf, shall be referred to herein as the "COMPANY".

CONTRACTOR

Shall be the COMPANY appointed by the COMPANY to carry out the work but shall also include his SUBCONTRACTORS and VENDORS.

Third Party (TP)	Shall be any recognised authority appointed by CONTRACTOR, as defined in chapter 13 of this specification.
Inspector	The COMPANY's representatives or members from a COMPANY's elected Inspection Agency for the time being or from time to time duly appointed in writing by the COMPANY to act as its representatives for the purpose of the Contract shall be referred to herein as the "Inspector".
Operator	Is a CONTRACTOR's technician who is qualified and trained to manipulate in practice the AUT equipment.
Interpreter	Is a CONTRACTOR's technician qualified and trained and whose expertise is deemed sufficient to apply properly the AUT procedure in regard of the present specification requirements.
Contract	All documents such as requisitions, specifications, etc. issued by COMPANY and attached to the contract or the purchase order are referred to herein as the "Contract".
Approval	Authorisation in writing given by the COMPANY to the CONTRACTOR on a procedure or to proceed with the performance of a specific part of the work without releasing in any way the SUPPLIER from any of his obligations to conform with the technical specifications, requisitions, etc. "approve", "approved" and "approval" shall be construed accordingly.
Search units	Means also Transducers or Probes .
Indication	Evidence of an imperfection obtained by non-destructive testing.
Mapping	An image of weld cross section where indication(s) may be localised along the weld.
TOFD	Time Of Flight Diffraction techniques
Imperfection	A discontinuity or irregularity that is detectable by methods outlined in this specification.
Defect	An imperfection or discontinuity of sufficient magnitude to warrant rejection based on the stipulations of the present specification.
Repair	Any rework on a weld that is required to correct a weld defect. The defect is beyond this specification's limits of acceptability.
To Detect	To make evidence of an imperfection on weld examination chart.
PUS	Probability of under-sizing.
May	Used to indicate that a provision is optional.
Shall	Used to indicate that a provision is mandatory.
Should	Used to indicate that a provision is not mandatory but is recommended as good practice.

4.2 Quality Assurance/Quality Control

The SUPPLIER shall operate a Quality Assurance system in accordance with [ISO 9002](#), or equivalent, approved by a recognised authority.

Three months prior to commencement of weld inspection, the SUPPLIER shall prepare and submit to the COMPANY a written Quality Control Plan (or otherwise called Inspection and Test

Plan) which describes all the required information hereafter. The Quality Control Plan shall set forth "Witness", "Hold", "Review" and "Monitor" points.

Moreover, the interface between weld inspection and welding quality monitoring shall be described in the Contractor Quality plan. It shall ensure the transmission of scanning results to the welding line in terms of corrective actions to keep a good quality standard.

4.3 SUBCONTRACTOR approval

The following SUBCONTRACTORS shall be submitted to COMPANY for approval:

- The laboratories selected to perform the ECA associated tests
- The supplier of ECA calculation
- The AUT SUBCONTRACTOR
- Contractor's Third Party.

4.4 Development of AUT procedure

The AUT procedure shall be specifically developed for the Project job. It shall be detailed on the basis of technical specificity and of purpose/requirements to meet.

Consequently, as a minimum, the following data shall be provided to the AUT SUBCONTRACTOR early enough to allow him to define and issue adequately his procedure:

- Profile and dimensions of weld preparation, together with its tolerances
- Welding process
- Thickness standard deviation of pipes
- Weld shrinkage
- Acceptance criteria of defects issued from the ECA, when so accepted by COMPANY.

COMPANY keep its rights to amend or modify the requirements stated in the present specification, in view of the above data.

CONTRACTOR shall strictly conform his development to the Appendix 1 of the present specification.

4.5 Pipes with large tolerance on wall thickness

As stated in the paragraph 1, the AUT inspection of pipeline girth welds of which wall thickness range (WTR) exceeds 1.5 mm is not allowed.

However, it may be accepted under the following conditions:

- The effect of tolerance on the thickness, considering $\pm$ "WTR/3", does not affect the ultrasonic path of more than 3 mm in any pulse echo/tandem channel (e.g. V bevel where tandem is not applied). In such conditions, the AUT scanning of girth welds is acceptable and the above requirements shall apply for equipment, calibration block, qualification and production scanning.
- The effect of tolerance on the thickness, considering $\pm$ "WTR/3", affects the ultrasonic path of more than 3 mm in any pulse echo/tandem channel. Then, X-ray radiography and the requirements of the relevant specification **GS PLR 420** or **GS PLR 421** shall apply.

However, if CONTRACTOR maintains his request to perform AUT on girth welds, the additional requirements of the Appendix 2 shall apply.

5. Equipment

5.1 Generality

The system shall be capable to identify and to size (height and length) all imperfections identified herein and in the [API 1104](#) Chapter 9.6, and shall clearly identify the specific zone in which they are located.

5.2 Power supply

The ultrasonic system shall have its own power supply. There shall be provisions for an alternative power supply in case of failure in the main power supply. There shall be no loss of inspection data as a result of a power failure.

5.3 Ultrasonic equipment

5.3.1 General

The system shall provide an adequate number of examination channels to cover the examination of the complete volume of the weld through thickness and heat-affected zone in a single circumferential scan. The system shall be designed such that the weld volume is divided into elementary examination zones of height in the through thickness direction not exceeding 3 mm in the fill region.

In case phased array equipment is used and work as multi-probes equipment, each individual ultrasonic channel produced by the phased array transducer shall have a predefined focal law.

5.3.2 A-Scan

The instrument shall provide a linear A-scan presentation for each channel selected.

5.3.3 B-scan

The instrument shall provide a TOFD and a B-scan image. TOFD shall complete pulse-echo techniques but shall not replace pulse-echo techniques.

B-scan display will be used for volumetric imperfection detection and characterisation.

5.3.4 Scanner

The details of the probes required to inspect the weld will be defined for the specific application in a technique described in the CONTRACTOR procedure.

The system shall allow to carry out properly the static calibration, i.e. the UT scanning frame shall have an approach speed slow enough (or declutchable) to allow a perfect positioning of probes on the relevant reflector(s) and the computer display shall allow to show individually each channel.

5.3.5 Transducers

5.3.5.1 Generality

A single pair or multiple pair of phased array probes or a combination of phased array and conventional ultrasonic transducers may be used. Each weld configuration shall require the development of a unique inspection procedure based on the parameters of weld bevel and expected possible imperfection position and orientation. Acceptable performance of the probes used for the zonal discrimination will be demonstrated by signals from adjacent zones being at least 6 dB and not more than 12 dB lower than the zone a probe or array is calibrated for. All transducer wedges shall be contoured to match the curvature of the pipe surface.

The system shall be equipped of a transducer wedge temperature monitoring. A difference of wedge temperature between calibration scanning and production scanning exceeding 10° C shall be automatically warned by the system.

5.3.5.2 Actual characteristics

As a minimum, the following parameters for each transducer shall be reported:

- Identification
- Beam angle
- Wedge characteristics
- Beam size
- Pulse shape
- Frequency
- Pulse length
- Signal to noise
- Focus point and length in case focused beams are used
- Focus laws in case phased arrays are used.

The whole of these parameters is not always applicable to phased array transducers.

The transducers with array design shall be indicated at the bid stage.

5.3.6 Actual arrangement of the system

After AUT SUBCONTRACTOR has carried out his "in house" adjustments for the system optimisation, the following data shall be duly reported before qualification starting:

- "Actual characteristics" as stated above
- Number of transducers
- Arrangement of transducers.

After qualification test(s) has been found satisfactory, Inspector and Third Party shall sign this report. This report shall be attached to AUT procedure as the actual qualified configuration.

Prior to start any calibration, qualification or production examination, the actual configuration shall be checked and reported. Once qualified, there shall not be any change made without prior agreement of COMPANY.

5.3.7 Acoustic Coupling

Two types of coupling control shall be available on the system:

- Transmission type between probes symmetrical from the weld centre line (C1).
- Level coupling control type (surface condition control) (C2) shall consist of a scanning zero degree on both upstream and downstream, on the circumferential area of the farthest receiver probe. The probe area shall be of similar size as the weld scanning probes. The reference level shall be the back wall signal on calibration block.
- For Phased Array system, a coupling control (C3), of "C2" type, may be sufficient, providing that the full scanning area is covered as shown on the attached sketch.

5.3.8 Software

The software and the particular executable programs (sequenced focal laws) from the software to be used for each scanning procedure shall be identified by a unique version number which will be specified in the procedure. These specific numbers shall be clearly indicated on all displays and printouts of calibration and production scanings.

All recording, data handling, software and weld examination chart system shall be covered by the Quality Assurance system.

The specific programs of the software shall be exactly the same for dynamic calibrations as for production scanning. Software, programs, etc. shall not display information on indications or reflectors from theoretical pre-set data. The display shall be such as found really by the UT scanning, based on the commonly used method of UT interpretation. E.g. a planar indication at root shall not be displayed automatically at the pre set theoretical root face location but it shall be shown at the actual location it is.

5.3.9 Recording system

The scanning direction shall be clockwise as regard to the fluid direction through the pipe. "Upstream" and "downstream" side shall refer to the flow fluid direction. The AUT procedure shall include a sketch of site laying, showing the flow(s) direction(s) and the scanning direction(s). The "0" datum shall always be referenced on the top of the pipe (12 O'clock in 5G scanning position).

The recording system shall clearly indicate the locations of imperfections from 12 O'clock position with a + 10 mm accuracy along weld length.

Each transducer (or symmetrical couple of transducers) shall exhibit a separate recording channel for imperfection evaluation and confirmation of acoustic coupling.

Distance markers shall be provided on the recording at intervals not exceeding 100 mm of circumferential weld length.

For TOFD technique, the recording system shall be capable of a 64 level greyscale display and be capable of recording full R-F waveforms for the TOFD transducer pairs.

5.3.10 Reporting and data storage

5.3.10.1 Weld examination chart

The examination data produced as a permanent record should consist of a complete strip chart type showing the weld number, the reference point "O", the direction of scanning, date and time

of examination, and the name of operator and interpreter. The examination zone identified in each channel should also be recorded.

Colour palettes or grey scales used for B-scan mapping channels shall be set to display all pertinent signals. It shall provide a rapid mean to identify the concerned areas and to aid the characterisation of flaws.

5.3.10.2 Electronic data storage

All weld inspections shall be stored automatically at the end of each inspection cycle (each production weld) on two hard drives in the inspection computer. Calibration parameters (gains, threshold levels...) shall be recorded and stored as well, prior to start each production shift and every time when any parameter is changed.

Periodic data back up will be made to back up data master.

5.3.10.3 Graphical print-out

Calibration parameters (gains, threshold levels, etc.) shall be printed out prior to start each production shift and every time when any parameter is changed. Strip chart of any weld showing defect shall be prints out.

5.3.11 Spares

There shall be a sufficient number of spare parts available at the place of examination to ensure that the work can proceed without interruptions. Type and number of spares shall be agreed with COMPANY. The AUT Contractor shall evaluate the necessity to provide spare calibration blocks in regard of the quantity of joints to be scanned in production.

5.3.12 Display for COMPANY supervision

The CONTRACTOR shall include in the system, slave equipment computer/monitor/software which will allow, in real time, Inspector to carry out inspection at his own convenience:

- The display of production and calibration scanning
- The return back to any previous scanning
- The verification of any pre-set parameters
- The supervising of any indication evaluation in terms of size, signal amplitude, location in weld cross section and position on the circumference.

All facilities, computer software tools, available for AUT interpreter shall be available as well on Inspector slave equipment without any restriction.

5.3.13 JIG for scribing the reference line

For an accurate positioning of UT probe holder, a specific jig shall be used. The device shall allow scribing a positioning reference line on pipe external surfaces, the jig being tacked against the **bevel root face, which shall be the reference plan.**

Jig shall be qualified at the stage of procedure qualification and then shall be used for production scanning. The AUT procedure shall specify at which pipe end (upstream or downstream with respect to the flow direction) of the joint, the reference line must be scribed.

The tolerance on UT head positioning shall not exceed + 0.5 mm against the bevel root face. However, because of the difficult conditions on site/barge, the scanning system shall remain

fully efficient with a deviation of ± 2 mm from the stated theoretical position, unless CONTRACTOR can demonstrate that better accuracy of band positioning can be achieved.

The procedure shall include instructions to AUT operator:

- To place the band on minimum 3 points at 120° each other around the circumference
- To verify on the scanning display that UT head is well centred
- When the band is incorrectly centred, to instruct the technicians responsible to “reposition the band” for a rescanning
- To check periodically (at least twice a shift), the scribe line proper position
- To call for a corrective action when recurrent deviation is found.

6. Personnel qualification

The credentials of each AUT operator and interpreter shall be submitted to COMPANY acceptance 3 weeks minimum prior to start of weld examination.

COMPANY shall have the right to verify the operators and interpreters qualifications before final approval.

Operators and interpreters who are not accepted by COMPANY shall not work on the project.

The CONTRACTOR shall designate one of them to be the lead operator and interpreter and also the responsible of the ultrasonic personnel, the good order of equipment, spare parts availability, and inspection work, including reports and records. The interpreters shall have technical support from an “AUT-expert-interpreter” at any time during execution of the examination work.

6.1 Operator

The operator, who operates the scanner mechanism shall be trained in using mechanised UT manipulator.

6.2 Interpreter

AUT interpreters shall have at least one previous experience of AUT on pipe laying. This previous experience as AUT interpreters shall include the use of the same AUT system and same AUT software.

Interpreters shall be qualified for manual UT to level 2 minimum by a recognised independent authority, EN 473 or equivalent.

They shall be able to demonstrate their capabilities with regard to calibrating the equipment, performing an operational test under field conditions and evaluating type, size, nature and location of imperfections.

7. Calibration

7.1 Calibration blocks

7.1.1 Specificity

Pipe section for calibration blocks shall be taken from the Project pipes. The pipe shall be selected to have a wall thickness corresponding to the average $[(W_{tmax} + W_{tmin})/2]$ of values found by pipe mill inspection or by plate/coil rolling mill. The pipe number and the pipe section shall be selected based on the manufacturing mill data, as stated in the Appendix 2 of the present specification. However, the selected pipe and section shall be taken off for calibration block sampling, only after the blasting at coating stage.

One calibration block shall be required for each pipe size.

A specific calibration block shall be required for any difference in the Essential Variables hereunder listed:

- Pipe diameter
- Wall thickness
- Steel source
- Plates (or coils) sources and/or manufacturing process
- Steel grade
- As delivery condition of base material
- Heat treatment condition of weld
- Welding Procedure Specification (WPS)
- Welding Procedure Qualification Test (WPQ)
- Bevel profile and dimensions (including root face)
- Preparation root gap.

In case of doubt concerning the base material acoustic characteristics, acoustic velocity and attenuation measurements shall be performed to compare the behaviour of the various materials. These measurements shall be performed according to [DNV OS-F101-Appendix E-Annexe B](#) or [ASTM E 1961-Annexe A1](#). If significant differences in acoustic velocity are found, then specific calibration blocks shall be made.

7.1.2 Design

Calibration blocks shall be used to calibrate, qualify the inspection equipment and procedure, and to monitor the production scanning calibration.

The drawings of the calibration blocks used shall be appended to the CONTRACTOR procedure. Calibration reflectors shall be checked by the CONTRACTOR for conformance to design drawings. Results of prints or metrology will be kept in file for each calibration block and submitted to COMPANY on request.

Reference Standards or calibration blocks shall be in accordance with “[DNV OS-F101-Appendix E-Chapter B §412 to §422](#)” or “[ASTM E 1961-Annexe A3](#) (block types A3-1 and A3-2)” and the hereafter requirements.

The calibration block shall be designed with sufficient length and width so that total number of transducers including array system will run across the target areas in a single pass.

The calibration block shall be identified and hard stamped using a unique serial number. Records of the serial number, wall thickness, diameter, item, batch, bevel design, welding procedure and ultrasound velocity shall be kept and be made available to Inspector review.

CONTRACTOR shall submit also to COMPANY the details and sketches of:

- The specific weld geometry
- The ultrasonic path associated to each reflector.

For the inspection of SAW welds (e.g. double jointing), a welded joint shall be used for the manufacture of calibration blocks. Weld reinforcements shall be let as they are after welding.

7.1.3 Reflectors

The type and the position of each reflector shall be the most suitable to simulate the expected imperfections in the relevant zone, in regard of the joint preparation (bevels) and of the welding process.

At the bevel opposite to the reference line scribed at pipe end (refer to 5.3.13), the positioning of reflectors shall take into account the transverse weld shrinkage expected or previously measured by the CONTRACTOR. This parameter (i.e. the expected weld shrinkage) shall be specified in the AUT procedure.

The following shall be required, as a minimum, for calibration:

- Height of scanning zones in weld fill: 3 mm max.
- Flat Bottom Hole (FBH) reflectors shall be 2 mm max in diameter.
- Reflectors for longitudinal scanning calibration shall consist of notches with depth between 0.8 mm and 1 mm, with maximum length of 15 mm. For TOFD, the CONTRACTOR shall specify the dimensions of reflectors.
- Reflectors for transverse scanning calibration shall consist of one transverse notch, 1 mm deep and 5 mm width, on external and internal surfaces. Each couple of probes shall detect, at the minimum, 80% FSH for the dedicated notch and 30% FSH for the opposite surface notch. Otherwise, alternative calibration could be based on one FBH, diameter 3 mm, drilled at both block ends, designated as (Ht), longitudinally to the weld direction, at mid thickness. These calibrations will allow demonstrating that full through thickness scanning is achieved.
- For volumetric defects (such as porosity), on upstream (US) and downstream (DS), one FBH diameter 1.5 mm designated as (Hp), 45° from the vertical, every 7 mm of thickness.
- Through thickness longitudinal slot, located either side, at weld centre line for gate positioning.
- Reflectors simulating high-low of 1 mm max (low side alternatively at Upstream and at Downstream).

The machining tolerances shall be in accordance with [ASTM E 1961](#), Chapter A3.8. However, where ASTM specifies a tolerance of 0.1 mm, 0.2 mm will be acceptable.

Lateral positioning of the reflectors should be such as to allow for independent signals. The beam of each transducer shall include the reflector without any part of the beam encountering adjacent reflector.

The calibration block may be inserted and only tack-welded on the circumference of the calibration pipe.

Any modification to the above requirements shall be duly justified and submitted to COMPANY prior approval.

7.1.4 Storage of calibration blocks

The CONTRACTOR shall ensure preservation and storage of calibration blocks.

They shall be stored and made available to the COMPANY for 30 days minimum after the inspection completion.

7.2 Ultrasonic examination set-up (static calibration)

The system shall be optimised for any inspection and particularly for qualification and for field inspection using the relevant calibration block (s).

7.2.1 TOFD

To the extent that is applicable, [ENV 583-6 Part 6](#) will be used as a guide for setting up the TOFD arrangement.

The TOFD emitter-receiver elements shall be optimised for the wall thickness to be tested using the same refracted angle for emitter and receiver. Probe centre spacing will be selected so as to allow the theoretical crossing point of the beam centres to occur on the weld centreline at approximately 66% to 95% of the wall thickness. Probe parameters of frequency, damping, filtering and incident angle will be selected so as to limit the dead-zone formed by the lateral wave.

When a phased array equipment is used and the pair of arrays is not able to produce an acceptable signal, a dedicated TOFD transducer pair shall be used.

The amplitude of the lateral wave shall be between 40% and 80% full screen height (FSH). In cases where the use of the lateral wave is not appropriate (e.g. inappropriate surface conditions, use of steep beam-angles), the sensitivity shall be set such that the amplitude of the back wall signal is between 18 dB and 30 dB above FSH. When the use of neither a lateral wave, nor a back wall signal is appropriate, sensitivity should be set such that the material grain noise is between 5% and 10% FSH. In any case, the sensitivity shall be verified by the use of an appropriate reference block.

The time start of gate shall be at least 1 μ 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 used 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 time gate shall cover at least the depth of region of interest.

For TOFD, the recording threshold shall be the calibration threshold. It is normally not recommended to change it. However, a change of threshold may be specified in the procedure in post processing mode but it shall not exceed +/- 6 dB.

7.2.2 Mapping Channels

In addition to the strip chart (linear C-scan) channels, digitised waveforms will be used to generate B-scan mapping channels. Dedicated separate transducers or focal laws or a re-firing of dual purpose probes (e.g. root probe for amplitude on one firing and mapping on another firing) will be used to generate volumetric/mapping channels for both the weld fill area and the root area.

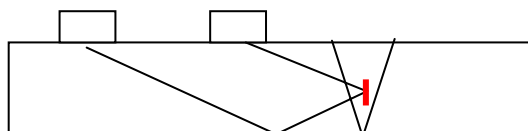
The mapping sensitivity shall allow to detect a spherical porosity of diameter 20% x w.t. and 3 mm max, wherever its location in the weld. As a minimum, gain will be approximately 6 -10 dB over that required achieving an 80% FSH signal from a 1.5 mm FBH (Hp) but should not be so great as to cause electrical interfering or geometric noise.

Colour palettes used in the B-scan mapping channels shall be set to display all pertinent signals over the noise level and indicate signal amplitude with respect to threshold and reference levels.

Using the calibration block, each mapping gate shall be set to cover a sound path distance which starts at least 7 mm before the weld preparation (in HAZ) and long enough to encompass 3 mm after the weld axis bevel on opposite side of weld centreline.

7.2.3 Pulse Echo and Tandem mode

TANDEM MODE



Note: The tandem mode technique is used to detect imperfections perpendicular to the scanning surface. Both probes are set on the same side of the weld, one working as emitter and the other as receiver.

7.2.3.1 Static Calibration

Gate widths: Gates shall be set 5 mm min before the fusion line (in HAZ), and 3 mm minimum after the weld axis (except at root where 1 mm minimum is required). Moreover, gate adjustment shall take into account the extent of possible signal position due to the difference between the minimum and the maximum of ultrasonic time flight. This difference shall be relating to a band positioning error of 1 mm and to a difference of wall thickness equal to 2 times the standard deviation.

Reference signal from reflectors shall be set 80% FSH min.

Detection thresholds: Threshold shall be set at 20% FSH. Any imperfection which send a signal higher than 20% FSH shall be considered as a defect. Its length shall be that corresponding to the part of signal over 10% FSH (the 6 dB drop method). No indication of "go/no go" type will be displayed on screen. Only colour/signal height type is allowed.

Coupling: A coupling control by transmission shall exist between symmetric probes. The warning thresholds may be set down to a drop of 10 dB, the reference being the coupling signals on calibration block.

A level coupling control for surface condition (C2 or C3) shall also be installed. It shall consist of a scanning with zero degree probes and shall be based on the back wall signal height. The warning shall be set to a drop of 2 dB maximum, the reference being the signal height from back wall, in static condition, on calibration block.

7.2.3.2 Dynamic calibration

7.2.3.2.1 Circumferential scanning velocity

The circumferential scanning velocity V_c shall be determined by:

$$V_c < 1/3 \times W_c \times PRF$$

Where:

W_c = The narrowest beam width –6 dB at the appropriate operating distance(s) of the all transducers,

PRF = Effective Pulse Repetition Frequency of transducer.

The scanning velocity shall never exceed 200 mm/sec.

7.2.3.2.2 Position of calibration block on the circumference

Calibration and qualification tests shall be performed in the position of production scanning, with regard to the vertical.

For dynamic calibration in positions 5G and 6G, the calibration block shall be located:

- For procedure qualification, and for further verification on production barge/site, successively at 12, 3, 6, 9 O'clock
- For calibrations during production, at 6 o'clock.

7.2.3.2.3 Acceptance criteria

Whatever the position of calibration block on the scanned circumference, the following requirements shall be met:

- In each pulse echo/tandem channel, the signal from the specific reflector shall be 70% FSH min.
- TOFD notches shall be detected in the pulse echo channels dedicated to capping and to root scanning.
- In channels of transverse scanning, transverse notches and FBH (Ht) shall be detected with a signal 70% FSH min. Alternatively, transverse notches in dedicated channel shall be detected with a signal 70% FSH and 30% in channel dedicated to notch at opposite surface, refer to chapter 7.1.3 (Reflectors).
- (Hp) shall be detected on pulse echo relevant channels and on mapping. They shall be sizeable within a tolerance of + 0.5 mm.
- Notches dedicated to TOFD shall be detected and located on the TOFD display.
- The circumferential positional accuracy of the recorded reflectors relative to each other shall be within + 2 mm, and with respect to the zero start within 10 mm. Gate setting shall not deviate more than 0.5 mm from their reference positions, based on the location of the peak signal from reflectors.
- Longitudinal notch, in weld axis shall be found within the gates for any pulse echo/tandem channel.

The procedure shall include a table for the acceptance criteria of dynamic scanning. It shall specify, for each channel which specific reflector(s) must be detected.

Then, after dynamic calibration is valid, a calibration chart shall be printed out to be use as a reference of acceptance criteria for subsequent calibration acceptability. This recording shall be kept in the logbook.

8. Qualification of UT procedures.

8.1 Generality

The qualification purposes are to demonstrate, through the here-after listed tests, the efficiency of the system:

- “T1” to detect planar and volumetric imperfections
- “T2” to detect small size discontinuities (sensitivity)
- “T3” to size the height of planar flaws, the diameter of porosity, their length, their location in the through thickness and along the circumference, with a suitable accuracy
- “T4” to detect and size imperfections with the same accuracy, whatever their position around the circumference
- “T5” to check the proper locations and orientations of reflectors used for calibration
- “T6” to check that the calibration conditions can be maintained in production
- “T7” to check the repeatability of the scanning reliability.

8.2 Preliminary statements

Auto UT procedures shall have been approved by Third Party and COMPANY prior to any qualification test.

Qualifications shall be witnessed by Third Party and by Inspector.

Equipment characteristics: calibration block identification (hard stamped on block), probe identifications, reference/identification of the software installed, reference/identification of the particular programs to be used (e.g. with focal laws), the location of reference line on pipe ends...shall be duly specified in the procedure and checked just before the start of qualification.

All parameters set and results obtained in static and in dynamic condition shall be reported: gains, signal heights, thresholds and gate positions, etc.

For each scanning procedure, a jig identified by a unique number shall allow to scribe, with accuracy, from bevel root face, the reference line for AUT headband.

The good functioning of coupling shall be checked prior to the start of qualification.

8.3 Qualification of the system efficiency

8.3.1 Statistical efficiency of the system

The AUT system shall have been previously qualified according to [DNV OS-F101](#), for similar AUT arrangement. The results of this qualification shall meet the following, as a minimum:

- A probability of detection (POD) of 0.90 at a confidence level of 95% for defects 1.5 mm in height, based on threshold at 20% and considering defects with length > 10 mm
- A probability of 0.90, of under-sizing (PUS) 1 mm maximum, considering defects > 1.5 mm in height and > 10 mm in length,

Qualification test report and records shall be submitted to COMPANY for approval.

8.3.2 Verification of the system efficiency with regard to the specification requirements

Providing that UT scanning process, procedures, equipment and software are similar, subject to COMPANY evaluation, above tests for above purpose "T2" and "T3" shall apply to the thickest and to the thinner pipe size. When pipe wall thickness range is within 30% of the thickest wall, the required tests may apply to the thickest pipe only.

COMPANY will review all the test results and will state on the system acceptability.

Note: This part of qualification may be accepted for further Project inspection as far as COMPANY can consider the tests valid in view of the new proposed procedures.

8.4 Qualification of equipment particular arrangement/scanning procedure for each pipe size

The above tests "T1", "T4", "T5", "T6" and "T7" shall apply to each pipe size.

A new qualification shall be required for any difference in the Essential Variables listed in paragraph 7.1.1 with addition of "scanning procedure".

COMPANY shall review the test results and shall give approval on the procedure qualification.

8.5 Description of tests

After AUT parameters have been set and satisfy the static and dynamic calibration "T4" acceptance criteria, the same parameters shall be used for all qualification tests specified hereafter. Should any parameter need to be changed, all the already performed qualification tests shall be invalid and shall be redone.

8.5.1 Capability to detect planar and volumetric imperfections "T1 & T4 tests"

After static calibration, a dynamic calibration shall be carried out on the calibration block as per requirements of paragraph 7.2.3.2.2

Acceptance criteria: all reflectors shall be detected as per requirements of paragraph 7.2.3.2.3

The signal heights from each reflector in each position 12/3/6/9 o'clock, shall be compared. They shall not show a difference of more than 10% FSH.

8.5.2 Verification of the system efficiency with regard to the specification requirements "T2 & T3 tests"

8.5.2.1 Test welds for evaluation

For "T2" and "T3" tests, sufficient welded joints shall be carried out (on pipes of thickest and thinnest wall).

8.5.2.1.1 Natural reflectors

The prepared joints shall have the same bevel profiles as those to be used in production. Welds will be run with intentionally selected wrong parameters in such a way that various natural reflectors (planar and volumetric) are present. The purpose being to demonstrate the sensitivity for the detection of planar reflectors, porosity and the capability to detect defects of various types, sizes and locations. The number of test welds to be made will depend on the type, location and size of imperfections found in the weld(s) for a satisfactory evaluation (to the Inspector's satisfaction).

In one of the welds, copper will be included intentionally:

- In root pass
- In one pass of hot pass region
- In one pass of fill (mid thickness) region.

After completion of each of the concerned region, the welding will be stopped. After cooling, a Liquid Penetrant Test shall be carried out to reveal a typical hot cracking. If cracking does not occur, the trial will be redone until satisfactory cracking is revealed.

8.5.2.1.2 Artificial defects

In one weld minimum, artificial reflectors (using refractory or any other efficient method) shall be placed at root, on bevel faces of fill and cap (weld toe) and transverse to weld axis (as close as possible to root), in order to obtain, in weld, height defects of:

- Root: 1 mm, (3 locations surface breaking)
- Bevels (fill): 2 mm, 3 mm, and 4 mm (1 location for each height)
- Cap: 1 mm (3 locations surface breaking)
- Transverse to weld axis: 2 mm deep max, 5 mm long max, thickness/opening of defect < = 0.5 mm max, (3 locations: 1 at root surface breaking, one at mid thickness, one at cap surface breaking).

In one of the above welds, a misalignment of internal surfaces (High-Low) of 2 mm will be intentionally made.

8.5.2.1.3 Transverse shrinkage

On 3 minimum of the above test welds, the actual transverse shrinkage shall be measured with an accuracy of 0.1 mm at positions 12, 4, 8 O'clock. The average of the 9 results shall be the same as the expected value specified in the AUT procedure within +/- 0.3 mm.

The measurement shall be carried out between two marks made on pipes surface, on either weld side.

8.5.2.1.4 Reporting

CONTRACTOR shall duly report hot crack locations.

CONTRACTOR shall issue a detailed report indicating with accuracy the position along weld circumference, location in weld cross section and size of each artificial reflector.

CONTRACTOR shall issue a detailed report indicating the actual transverse shrinkage values.

All reports shall be approved stamped/signed/dated by Inspector.

8.5.2.2 AUT, X-ray and manual ultrasonic Inspection of welds

Then, welds shall be scanned (using the UT parameters recorded from "T7" test).

Reflector heights (for longitudinal ones only), location in through thickness, transverse location in weld section, depth, and position on the circumference shall be evaluated and reported, **based on the written procedure and written working instructions.**

Welds shall be scanned twice. Between two scanning, the AUT head and band shall be removed and re-installed on joints.

Welds shall be scanned also twice as specified above, with scanning in the opposite direction with corresponding re-setting of the band from one side of the weld to the other side. Reference line shall have been scribed on either pipe side before welding, with the same jig adjustment and band shall be set with accuracy at the same distance from the reference line.

In addition, each weld shall be, also inspected by X-ray and by manual UT as per the relevant COMPANY specification.

8.5.2.3 Macrography and Micrography of defects

Most significant natural reflectors will be selected on a mutual agreement between COMPANY, Third Party and CONTRACTOR.

The related weld portions shall be properly marked, identified, hard stamped by COMPANY representative and cut off for macrography and/or micrography where necessary.

However, locations found by X-ray and/or manual UT with significant defects, missed by AUT, shall be cut off for interpretation, as well.

8.5.2.4 Presentation of reports

For natural and artificial reflectors, the results of interpretation of each AUT scans, X-rays, manual UT, macrography and micrography (if any) and the actual locations and sizes of artificial reflectors, shall be presented in a table for each joint (defect type, height in through thickness, depth, location in weld section, circumferential position).

8.5.2.5 Acceptance criteria

8.5.2.5.1 Artificial reflectors

All shall be detected by pulse echo/tandem techniques.

Longitudinal reflector height of 2, 3 and 4 mm shall be evaluated separately by pulse echo and TOFD. The height evaluations by both techniques shall not deviate by more than 1.5 mm.

Length evaluation shall not deviate by more than 10 mm.

Position on circumference shall not deviate by more than 10 mm.

Depth evaluation shall not deviate by more than 3 mm.

High-low shall be clearly displayed and shall be sizeable within a tolerance of 1 mm.

All reflectors detected by TOFD will be reported for information.

8.5.2.5.2 Natural reflectors

Sensitivity: at least one Lack Of Fusion (LOF) of 0.5 mm maximum in fill passes shall be detected.

Porosity: at least one porosity 20% w.t. or 3 mm max (whichever the lesser) shall be detected,

Lack of fusion: at least: 3 (LOF) at root, 2 LOF in hot pass and 5 LOF in fill passes shall be detected and sized.

8.5.2.6 Global evaluation

Third Party and COMPANY will make an overall review of the test results regarding natural reflectors. This review will determine the ability of the system in terms of "fit for purpose".

8.5.3 Calibration block against the actual bevel profile “T5”

8.5.3.1 Description

Before scanning, the reference line for AUT head shall be scribed with accuracy on one pipe end. **A precise jig shall be used. It shall be in contact with the bevel root face** which must be the only reference basis (see the sketch on Appendix 4).

Under no circumstances, the reference line will be positioned approximately from the weld centre line.

On calibration block, In static or dynamic scanning at each position 12 and 6 O'clock, the signal heights and locations in the gates from each artificial reflector on bevels (FBH and notches) shall be reported with accuracy.

A joint, just tack-welded, shall be prepared as follows:

- Bevel shall be machined at its nominal dimensions
- A joint shall be fitted-up with clamp, as specified in the applicable WPS
- The width preparation at cap “G” (see Appendix 3) shall be measured with accuracy and reported
- Then joint shall be disassembled and each bevel root face shall be machined in order to remove at root only, half of the expected weld shrinkage value (refer to the sketch on Appendix 6). This is to simulate the joint in its final condition, after welding shrinkage
- Then the joint shall be assembled by tack welding
- The joint shall be scanned in static (or dynamic) condition at each 12 and 6 O'clock position
- Heights and locations of signals received from bevel faces shall be reported with accuracy.

8.5.3.2 Acceptance criteria of “T5” test

Signal heights from bevels shall be at least 100% FSH. The true FSH percent shall be reported.

The peak signal locations in the gates from bevels, against those obtained from reflectors, shall be located within +/- 0.5 mm.

8.5.3.3 Dynamic scanning

A dynamic scanning on tack welded joint shall also be run. The results shall be reported for information only.

8.5.3.4 Validation of calibration block

When “T5” test has satisfied the above requirements, the validation of calibration block will be as follows:

- CONTRACTOR shall manufacture a “gap-gauge” of the qualified joint bevel (see the sketch in Appendix 3)
- CONTRACTOR shall hard stamp a unique number to identify calibration block, gap-gauge and jig
- CONTRACTOR shall issue a certificate for calibration block, gap-gauge and jig

- Inspector shall stamp (hard stamping) the calibration-block, the bevel gap-gauge and the jig
- Inspector shall stamp, sign and date the certificate.

8.5.4 Efficiency can be kept in production scanning “T6” test

8.5.4.1 Coupling “T6/1”

Couplings (C1) and (C2) shall be checked. On calibration block, in static condition, in each coupling channel, the signal received will be checked. Then, the gain will be manually decreased -8 dB or -10 dB for C1 and -2 dB for C2.

Acceptance criteria: The warning shall be activated automatically.

8.5.4.2 Tolerances on the positioning of scanning head band “T6/2 test”

The “T4” test shall be repeated as follows:

- The reference line for AUT headband shall be marked with accuracy on each pipe end
- “T4” test shall be re-performed with the AUT head band placed at -2 mm and at +2 mm from the reference line (alternatively +1, -1 mm from the reference line, refer to paragraph 5.3.13).

Acceptance criteria: Signal from bevels shall be 60% FSH min.

8.5.4.3 Wedge temperature “T6/3 test”

The “T1” test shall be performed at the specified temperature range limits.

Acceptance criteria: Signal from reflectors shall be 70% FSH min.

8.5.5 Repeatability of the scanning reliability “T7” test

“T4” test shall be run 10 times minimum.

After each “T4” test, the scanning machine and the band shall be removed from the calibration pipe and re-installed.

Acceptance criteria: Signal heights from reflectors shall be between 70% and 99% FSH for all runs.

9. Field examination – Production scanning

9.1 General requirements

On site/barge, the following verifications and requirements shall apply.

The ultrasonic system used for examination during production shall be the one used for qualification.

In addition, a power failure shall be simulated. An operation of the system using an alternative power source shall be carried out. It shall be verified that previous examination data have not been lost, in part or totally.

9.2 Qualified equipment

The following equipment, qualified and identified at qualification stage, shall be available on site/barge for each scanning procedure:

- The AUT scanning head equipment (same probe identity, number and arrangement)
- The computer referenced software and the relevant programs
- The calibration (s) block (s)
- The joint bevel gap-gauge
- The jig for reference line
- A tack welded joint (with bevels machined in production condition on same machine and same site as production machining), root shall have been shorted for shrinkage simulation as describe in paragraph 8.5.3.1
- A thermometer (or optical pyrometer or infrared camera thermometer) shall be available for the temperature measurement before accelerated cooling with water.

CONTRACTOR shall check with Inspector, the availability and conformance of the above equipment. CONTRACTOR shall issue a report stamped and signed by Inspector.

9.3 Static calibration

The static calibration criteria shall conform to the requirement of above paragraph 7.2.3.1 (gate width, reference signal, detection thresholds, coupling).

The setting parameters (e.g. gains) may be slightly different from those of qualification.

The parameters "gains" and "noise and coupling thresholds" shall be recorded.

A report shall be issued.

9.4 Dynamic calibration

The dynamic calibration shall be run using the reported static parameters.

The scanning speed shall be reported. It shall not exceed the qualified speed.

The dynamic calibration acceptance criteria are those specified in the above paragraph 7.2.3.2.3.

The wedge temperatures shall be recorded during dynamic scanning.

9.5 Preliminary verification of scanning system calibration

The following verifications shall be performed using all the reported previous setting parameters of static and dynamic scanning.

After in-house adjustments and prior to any production scanning, the following preliminary verifications shall be carried out and witnessed by Inspector and Third Party:

- "T7" test
- "T5" test

- "T6/1" (coupling - surface control "C2") –2 dB
- The warning threshold(s) of coupling by transmission shall be checked and reported – 10 dB max.

9.6 Setting of parameters for production scanning

The reported setting parameters applied for preliminary verifications shall be used for production scanning. The wedge temperature recorded during the above dynamic calibration shall be set as a monitoring parameter. The setting of warning when the temperature is out of the specified and qualified range shall be checked within 10° C.

Otherwise, the Interpreter shall check and report the difference of wedge temperatures between calibration block scanning and production joint scanning, every 10 joints.

If a readjustment has to be done, the Inspector will appreciate whether a verification has to be done.

9.7 Reference line

Prior to welding, the reference line shall be scribed using the qualified jig against the bevel root face. This line shall be on inspection band side specified in the procedure. This shall be at a constant distance from the weld preparation. This reference line shall be used to ensure that the band and/or the transducer are adjusted to the same distance from the weld bevels as to duplicate the calibration block.

9.8 Surface condition and drop of Coupling

The scanning area shall be free of spatters and other irregularities, which may interfere with the movement of the transducers, the coupling or the transmission of acoustic energy into the material. The longitudinal seam welds shall be ground flush and smooth for a specific distance, normally in the range of 150 mm from the bevel face to ensure that no transducers are lift from the pipe surface on each side of the bevel.

The pipe coating shall be cut back from the original factory bevel face for a specified distance, usually 350 mm approx. for concrete coating and 150 mm approx. for corrosion coating. The actual cut back dimension requirements shall be advised by AUT SUBCONTRACTOR, based on the defined procedure probe arrangements and confirmed by CONTRACTOR to coating mill.

When the loss of coupling warning is activated, the AUT Interpreter and the Inspector will evaluate if the scanning of the concerned area may be analysed. When the warning is activated over a circumferential length more than 50 mm, the concerned area shall be cleaned and rescanned.

If loss of coupling are recurrent (or systematic), to the Inspector opinion, a cleaning by brushing of internal and external scanning areas, before welding, shall be required.

9.9 Pipe surface temperature

The scanning area temperature within the specified/qualified range (not exceeding 70° C) shall be monitored (3 checks minimum/8 hours).

9.10 Accelerated cooling of welds

The accelerated cooling of welds is allowed only when the temperature of weld at the welding end location is lower than 250° C.

A test of cooling duration down to 250° C shall be carried out at the beginning of production scanning. Then, the welding and scanning sequences shall be organised in such a way that enough time allows weld cooling in the proper conditions.

9.11 Traceability - Weld identification and scanning marking

A unique number shall identify each weld. A "0" mark and arrow, shall design start point and direction of UT head travel. The mark shall not interfere with scanning.

9.12 Dynamic calibration frequency in production scanning

"T1" test is required **after each** production joint scanning.

The position of block (reflectors) shall be **6 o'clock in 5G and 6G scanning positions**.

A production weld shall be released only when the subsequent calibration is satisfactory.

When the dynamic calibration fails, the last scanned joint must be re-scanned after the calibration is re-adjusted and found satisfactory.

9.13 Interpretation of scanning results

All evaluations shall be completed immediately after examination of the weld.

Prior to joint release, Inspector shall confirm the weld acceptability. This shall be a "HOLD point"

9.13.1 Planar indications

Any planar indication signals which exceed 20% FSH shall be considered as a defect and shall be investigated for its length: refer to sketch in Appendix 5.

Planar defects that are not sizeable because of their small height shall be considered as at least 2 mm high and regarded as defects from the first range of acceptance criteria "(0 to x mm)" and evaluated for their lengths according to the relevant criteria,

Defect length may be corrected for beam spread.

9.13.2 Volumetric indications

Volumetric indications shall be interpreted according to CONTRACTOR written procedure/instructions, and evaluated for their acceptability. Such instructions shall have been submitted to COMPANY for approval.

9.13.3 Transverse indications

CONTRACTOR shall submit to COMPANY approval a procedure of identification/sizing of transverse indications.

9.14 Inspector survey

A slave computer/screen shall be made available for Inspector survey as stated in the above paragraph 5.3.12.

9.15 Re-examination

Welds shall be re-examined whenever any of the following occurs:

- Dynamic calibration fails
- Coupling “C1” or “C2” or “C3” is activated over a length of 50 mm or more.

10. Examination of welding repairs

Requirements of COMPANY specification **GS PLR 420** or **GS PLR 421** are applicable, i.e. X-ray inspection.

However, CONTRACTOR may submit to COMPANY, an alternative AUT procedure, specific to welding repairs. In such a case, focalised ultrasonic beam shall not be used. Imperfection Acceptance Criteria shall be those specified in **GS PLR 420** or **GS PLR 421**. Height sizing shall not apply. The present specification requirements shall apply for the relevant parts.

When manual UT is to be applied, the procedure shall be qualified at qualification site and then checked at production site. The qualification shall be witnessed and approved by Inspector.

11. Philosophy of weld quality and Imperfection Acceptance Criteria

11.1 Workmanship of good standard

In principle, welds should be sound and therefore free from defects.

Criteria of acceptance for defects is a tolerance.

Welding must be perfectly mastered and managed in terms of quality assurance, in such a way that the resulting global quality is of good standard, i.e. a minimum of imperfections with a minimum of repairs.

Acceptance criteria based on an Engineering Critical Assessment, must be only used for accidental drifts in production, but on no account it could be considered as a standard for the weld soundness.

Consequently, to prevent that Engineering Critical Assessment (ECA) based Acceptance Criteria (AC) opens the door to bad workmanship, COMPANY state here-after the rules for their implementation.

11.2 Conditions to the implementation of ECA based AC (EC) in production

11.2.1 Quality survey system

CONTRACTOR is required to implement a close management of weld quality standard. CONTRACTOR shall apply a welding quality survey system in terms of welding parameters drifts, welder/operator selection and performance, recurrent defect statistic...and subsequent corrective actions, in order to eliminate the causes of imperfections, even when imperfections stay within the acceptable limits.

Welding operators &/or welders shall be sufficiently trained prior production starting so as no learning stage will take place in regard to the weld quality standard at the beginning of the production.

CONTRACTOR shall submit to COMPANY their detailed welding quality survey system as part of the Quality Control Plan. By the way, COMPANY reminds that visual and dimensional inspection of weld seam are also required.

11.2.2 Application of the AC in production

- a) Welds shall be inspected based on API Standard Workmanship AC (SC).
- b) When an indication in a weld (X) is found out of the SC, the inspection results of the previous 15 welds (X-1 to X-15) shall be reviewed. Provided that, these 15 welds have not been repaired and are acceptable based on SC and EC, then, the acceptability of the weld (X) will be based on EC.
- c) Moreover, for GMAW automatic process, when a weld is found to be evaluated based on EC as defined in b) above, then the next 2 welds (X+1 and X+2) concerned by the same welding period, will be evaluated based on EC.

A dedicated software shall be used for the application of the above rule.

Details for the application of the above rules:

- If an imperfection is found within the SC and out of the EC (e.g. important height and small length), the EC shall prevail.
- The height of indication to be considered for the SC evaluation shall be the one specified in EC for a defect with an acceptable length of one pipe diameter (OD). EC rules for the interaction of stacked indications shall apply.
- For SC evaluation, imperfections shall be considered as surface breaking if the through wall distance between imperfection and the surface is less than or equal to the through wall height of the imperfection after any grinding.

11.3 Engineering Critical Assessment

11.3.1 Sweet service pipeline

When the quality survey system is found satisfactory to maintain a good standard of weld quality, COMPANY may accept the acceptance criteria to be based on an Engineering Critical Assessment (ECA) as defined here after. Otherwise, the acceptance criteria shall be those of radiography as specified in the relevant specifications **GS PLR 420** and **GS PLR 421**.

The acceptance criteria shall be defined and calculated in accordance with **BS 7910** and separate assessments models for fatigue, if any. The CTOD value to be accounted for will be stated in the Particular Project Specification (PPS).

The requirements of the above standard shall be fully met.

A recognised laboratory, approved by COMPANY, shall carry out the necessary tests and the acceptance criteria calculation. CONTRACTOR shall provide, for stress analysis, all necessary data required by them and specified in the relevant standard. High-low at weld root, within the tolerances of COMPANY specification, shall be also taken into account in the calculation.

The acceptance criteria shall define as well the rules to be applied for the defect interaction.

These acceptance criteria shall be transposed in ultrasonic features measurable with the ultrasonic equipment used and taking into account the sizing error.

In all cases, the following shall also apply, unless the specified ECA acceptance criteria are more stringent:

- Imperfections shall be considered as surface breaking if the through wall distance between imperfection and the surface is less than or equal to the through wall height of the imperfection after any grinding.
- The acceptance criteria height shall be reduced of **1 mm** in order to take into account the inaccuracy of the system in sizing the height. The range corrections shall be revised, when the sizing accuracy is found > 1 mm at the qualification stage.
- Due to height sizing inaccuracy of small imperfections, the first height range for longitudinal planar defects shall be "0 to 2 mm" or "0 to 1 mm" when it is justified.
- Cracks and arc strikes shall not be acceptable, (as per **GS PLR 420** requirements).
- Dimensional and visual inspection, including undercuts, shall be as per **GS PLR 420** requirements.

11.3.2 Sour service pipeline

For sour service pipelines, and unless otherwise stated in a Project Particular Specification (PPS) approved by COMPANY, the following shall apply:

- The fracture mechanics testing shall be made according to **BS 7910** keeping the conditions of sweet service pipelines (i.e. the same type of testing as that stated in paragraph 11.3.1 above).
- The provisions and imperfections acceptance criteria that are stated in paragraph 11.3.1 above for sweet service pipelines shall apply in full. However, the max. acceptable defect lengths shall comply with **GS PLR 421** for any imperfection located in the weld root area, and with API 1104 Std for imperfections located outside the weld root area.

11.3.3 For reeled pipes and Steel Catenary Riser (SCR)

In case of reeled pipes and SCR, a Project Particular Specification (PPS) submitted to COMPANY approval shall specify the particular requirements and the appropriate standards to be used for the ECA.

12. Inspection by the COMPANY

12.1 General

All procedures shall have prior approval of the COMPANY. All qualification tests shall take place under the supervision of the Inspector.

The CONTRACTOR shall notify the Inspector sufficiently in advance to enable him to be present at qualification tests and at all other tests or stages in accordance with this specification.

The CONTRACTOR shall ensure that the Inspector has full and free access to all parts of the working and inspection benches during all stages.

The COMPANY reserves the right to re-check tests carried out by the CONTRACTOR. For this purpose, the COMPANY may request the delivery of calibration blocks or scan records or pup piece for analysis in an independent laboratory chosen by the COMPANY.

12.2 Inspector's training

COMPANY will commission Inspectors who have enough background and experience for the job.

Prior to start the qualifications, CONTRACTOR shall provide to Inspectors suitable training for their understanding of the AUT system, software, scanning display interpretation and indications sizing.

13. Third Party

CONTRACTOR shall appoint a Third Party (TP).

Prior to submit the AUT procedure to COMPANY for approval, the TP shall approve the proposed scanning procedure as conform to COMPANY requirements and that the AUT procedure is "fit-for-purpose".

TP shall also witness the procedure qualifications and shall confirm that the procedure is "fit for purpose". TP shall witness as well, the beginning of production scanning (50 first joints).

TP reports shall be transmitted to COMPANY.

14. Documentation

The CONTRACTOR shall deliver the following minimum documentation to the COMPANY.

14.1 At the bid stage

CONTRACTOR shall submit to COMPANY his procedure updated in accordance with the present specification.

Also, the AUT procedure shall explain the methodology of imperfection height sizing in comprehensible terms and in such a way that Inspector can monitor the methodology for interpreting the results of scans.

The AUT SUBCONTRACTOR past experience shall be provided to COMPANY for information. The documentation shall indicate the projects track record, pipe grades, diameters, wall thickness, lengths, welding process, the acceptance criteria applied, the percent of repairs in terms of number of repaired joints versus the total of welded/inspected joints, the percent of defect types found, repaired...

14.2 Reporting in production

14.2.1 Logbook

The AUT SUBCONTRACTOR shall keep a constantly updated logbook detailing the calibration parameters, the performance and characteristic data and identification of instruments, transducers and software/programs. All changes, if any, shall be reported. The logbook shall be kept at the place of inspection and shall be available for review by Inspector upon request.

14.2.2 Time of report

For examination during production welding, ultrasonic examination of the weld shall be carried out as soon as possible after the weld has been completed. The entire examination of a weld, including ultrasonic examination record and the subsequent dynamic calibration, shall not take

longer than the weld production cycle. Evaluation of a weld and the associated weld examination data shall be completed prior to commencement of the subsequent weld.

14.2.3 Weld inspection report

The AUT SUBCONTRACTOR shall issue for each inspected weld an electronic or hard copy report with the following information:

- Ultrasonic system trade Name
- Laying Contractor
- End User COMPANY
- Project reference
- Pipeline identification
- Outside diameter of pipe
- Wall thickness of pipe
- Steel grade of pipe
- Location of the operation
- Welding method and associated WPS number and revision
- Ultrasonic procedure number with associated revision
- Date of operation
- The examined zone identified in each channel
- For each weld:
 - Number
 - Location (A-scan/Pulse echo):
 - . From “o” to defect position “Start position”
 - . Defect “End position”
 - . Upstream or downstream position
 - . Depth position
 - . % of Full Screen Height
 - Size (B-scan/TOFD):
 - . Length
 - . Depth
 - . Height
 - Defect type classification
 - Acceptance status by AUT SUBCONTRACTOR
 - Area for Inspector's Approval.

14.2.4 Recording of Inspection data

The following inspection data shall be electronically recorded:

- Scan of each weld examined
- Weld inspection report (14.2.3)
- Calibration scans (start and stop of each shift, and at each modification of any parameters).

14.3 Upon completion of pipe production

Upon the completion of pipe examination of weld, the final electronic report shall include:

- All documentation and records required in the above chapter.
- The complete software for the viewing of examination displays and indication evaluation, such as specified in the above paragraph 5.3.10.2.
- All other quality control reports or acceptance certificates.
- Histograms in percentage of defect type, location in weld section and circumferential position.
- The histograms shall show also the percentage of all defects found in production per day. Percentage is understood in terms of repaired location per one hundred welded joints.
- X-ray (if any) reports.
- Manual UT (if any) reports.
- Weld visual and dimensional inspection report.
- Compilation of all concessions/deviations (if any) granted by COMPANY during all stages.

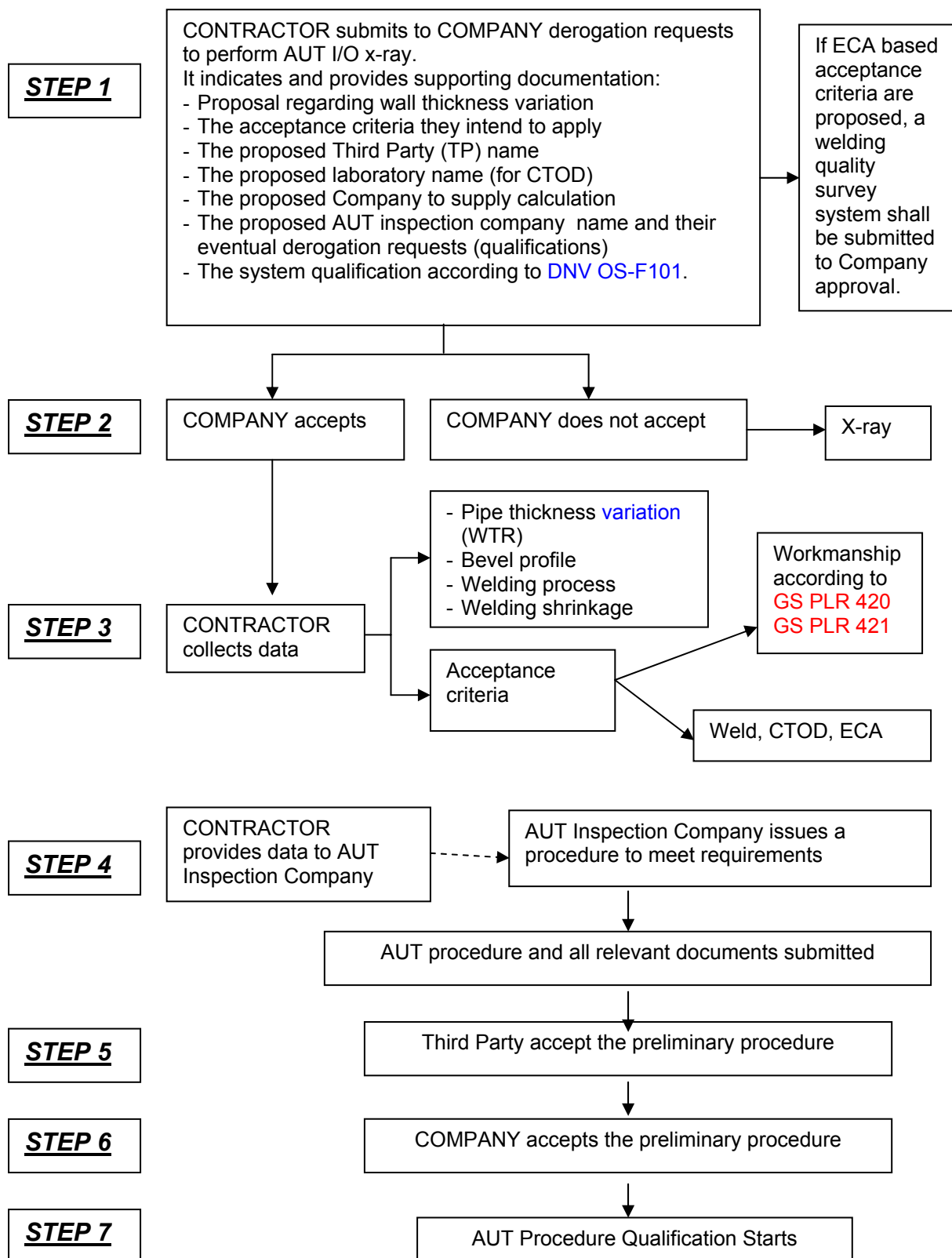
The COMPANY may approve alternate archival record formats if submitted by the CONTRACTOR at the bid stage.

Unless otherwise stated, 5 electronic copies of final electronic report shall be supplied to COMPANY.

The Inspector shall issue a certificate stating that weld inspection as been performed in full conformance with COMPANY specification requirements.

The full final electronic report shall be transmitted to the COMPANY within the week following the inspection completion.

Appendix 1 Development of AUT procedure definition



Appendix 2 Additional requirements for pipes with a Wall Thickness Range "WTR" over 1.5 mm and sound path difference over 3 mm

1. General

All requirements specified in the present specification are so called "standard requirements". Where supplementary requirements applied due to WTR, they are called here after "additional requirements".

For the scanning conditions, using multiple "shoot" beams, a simultaneous wall thickness measurement should be added as a help for the interpreter to identify the channels to be examined.

2. Definitions

2.1 "WTR" definitions

Unless otherwise agreed by COMPANY, the Wall Thickness Range (w.t. max – w.t. mi) shall be issued from the production stage data:

- For seamless by automatic w.t. measurement on pipe surface
- For welded pipes from w.t. measurement of plates/coils at rolling mill. For plates, the w.t. to be considered are the minimum and the maximum values of actual w.t. measured on each plate. (the mean w.t. values measured on each plate shall be disregarded).

2.2 WT definitions

Pipes are identified as follows regarding w.t.:

- Average W.T. "– WTR/3" are called "L"
- Average W.T. "0" are called "M"
- Average W.T. "+WTR/3" are called "H"
- The selection of pipe section for L, M and H tests rings shall be selected as described in the standard procedure, i.e. after blasting at coating stage (7.1.1).

2.3 Beam types for scanning procedure

Where focalised beams are used, the AUT procedure shall apply multiple ultrasonic pulse echo "shoots":

- To cover the cap, the root and the hot pass areas where the bevel face may be expected
- In the filling, to maintain reasonably the signal within the gates.

Where non-focalised beams are used, CONTRACTOR may propose an alternative procedure.

3. $1.5 < \text{WTR} < 2.5$ mm and sound path difference > 3 mm

Qualification tests, three tacks welded joints with WT "L", "M" and "H" shall be prepared as specified in the paragraph 8.5.3.

The "T5" test shall be performed on the three joints:

- For qualification
- On site before production starting
- During production, once a day minimum
- During production, at any time, under inspector request.

The acceptance criteria will be as follows:

- On joint "M", the criteria shall be those of the standard procedure
- On "L" and "H" joints, the peak of signals shall be within the relevant gates
- Gains in channels of "L" and "H" shall be adjusted in such a way that the signals are approximately +10% of the same height as those found on the "M" joint of corresponding channels.

However, in production, any failure or need for readjustment during the performance of T5 test, will not invalid the joints scanned during the previous run.

4. WTR > 2.5 mm and sound path difference > 3 mm

4.1 Calibration blocks

Three calibration blocks L, M, and H as described for the standard procedure, shall be made.

4.2 Tests on calibration blocks

All tests required on calibration block in the standard procedure shall be performed on the three blocks L, M, and H. All acceptance criteria of tests on calibration block specified in the standard procedure shall apply on each calibration block.

In production, the dynamic verification shall be run on L and H blocks, once every 8 hours minimum, and at any time under COMPANY inspector request.

However, in production, any failure, or need for readjustment during the performance on L and H blocks, will not invalid the joints scanned during the previous run.

4.3 Tack welded joints

Three tacks welded joints L, M and H shall be prepared as specified in the paragraph 8.5.3.

The T5 test shall be performed on the three joints:

- For qualification
- On site before production starting
- During production, once a day minimum
- During production, at any time, under inspector request.

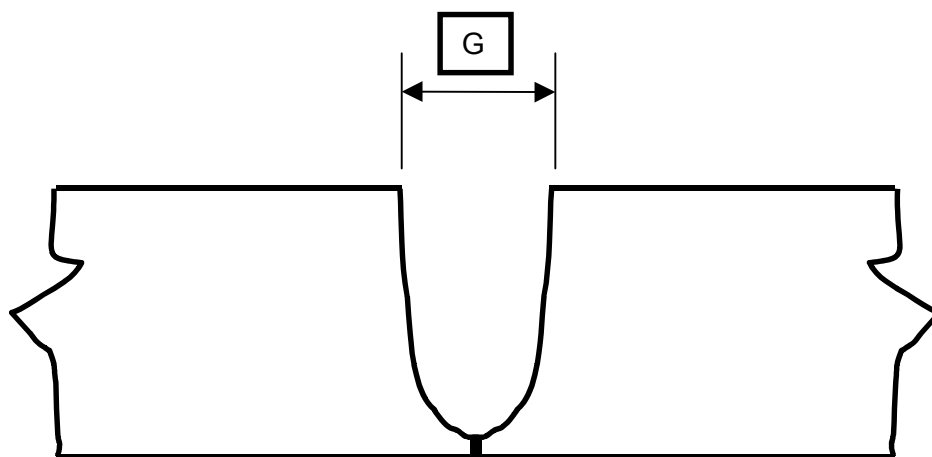


The acceptance criteria will be as follows:

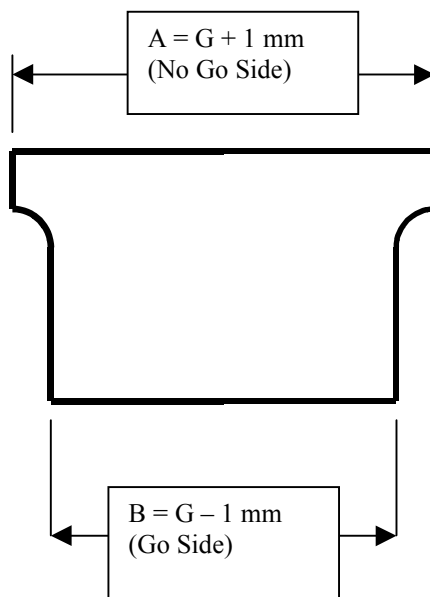
- On M joint., the criteria shall be those of the standard procedure,
- On L and H joints, the peak of signals shall be within the relevant gates
- The gains in channels of L and H shall be adjusted in such a way that the signals are approximately +10% of the same height as those found on the M joint relevant channels.

However, in production, any failure, or need for readjustment, during the performance of T5 test, will not invalid the joints scanned during the previous run.

Appendix 3 Joint assembled as per WPS specification (Before machining of shrinkage)

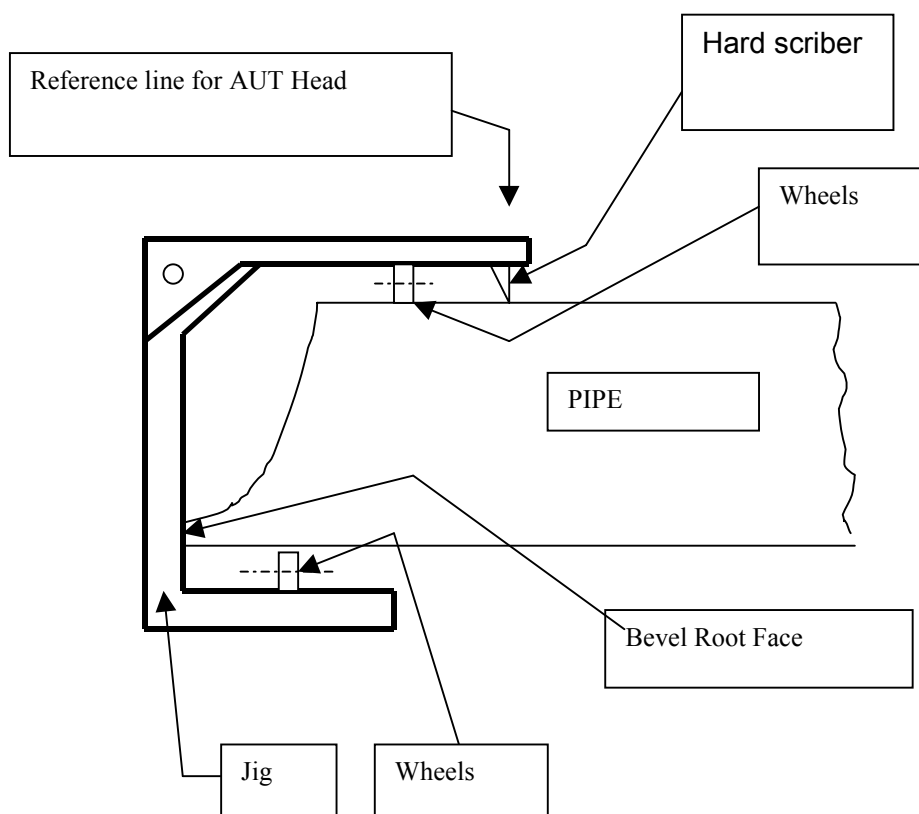


GAP GAUGE

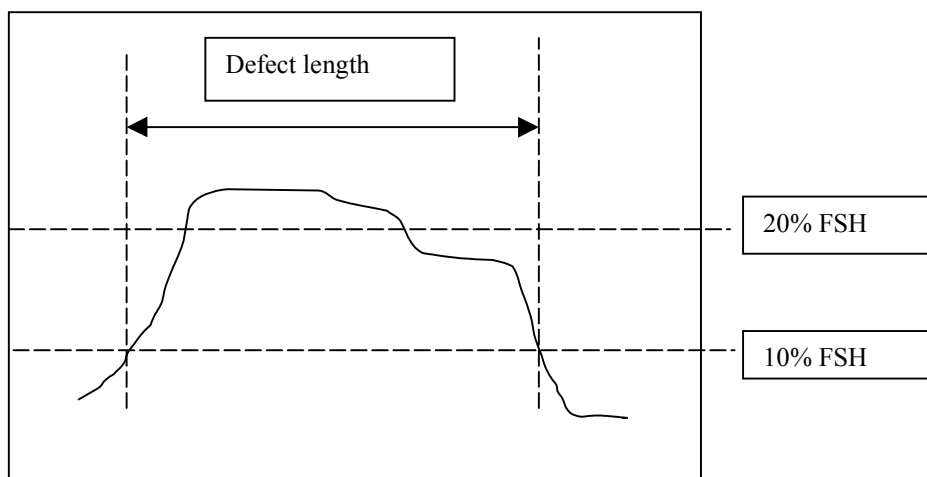


Appendix 4 JIG for reference line scribing

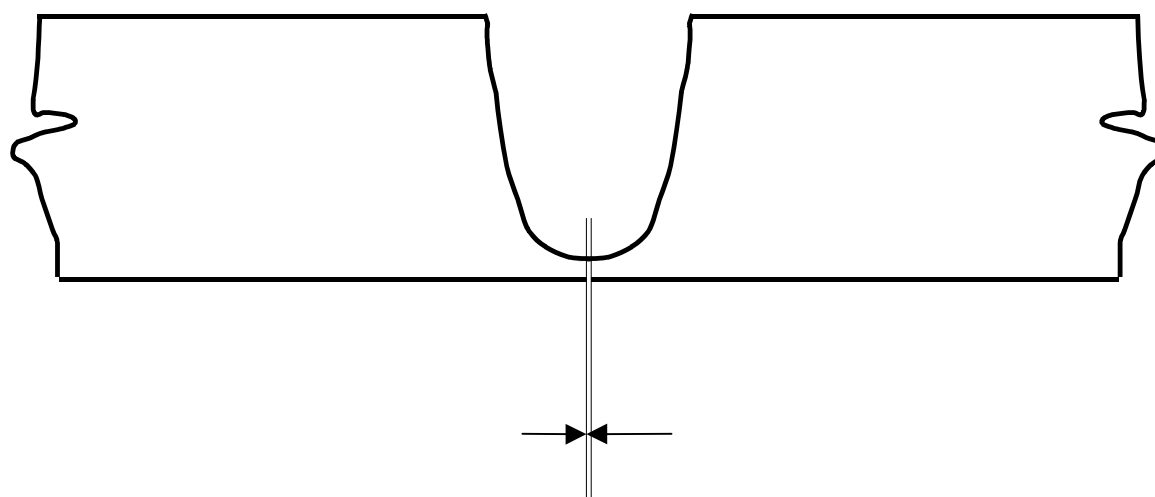
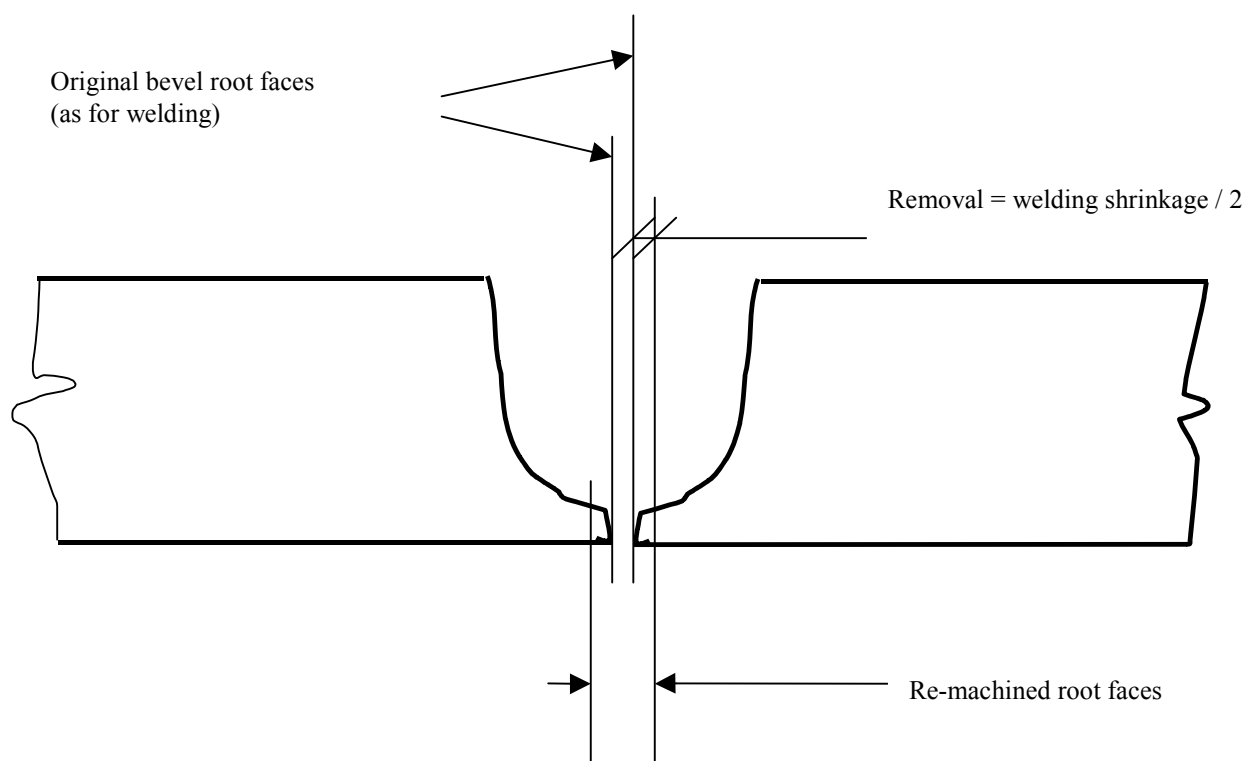
(before machining of shrinkage)



Appendix 5 Evaluation of defect length

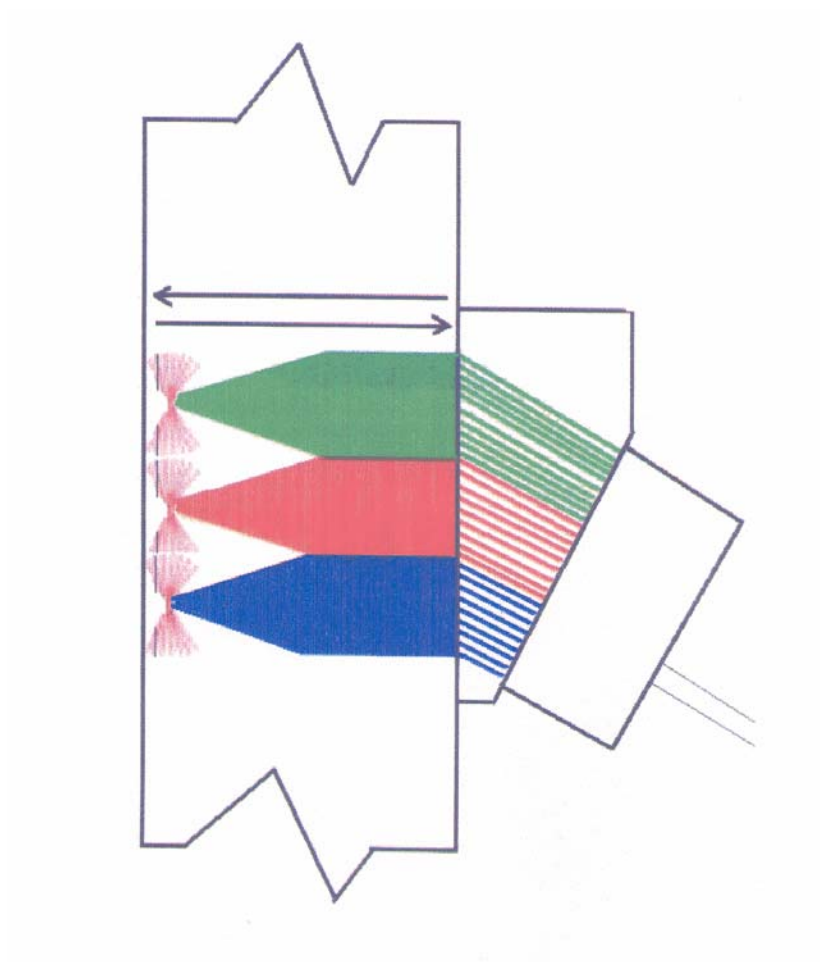


Appendix 6 Test “T5” tack welded joint design



Joint after tack welding

Appendix 7 Recommendation for “C3” coupling monitoring (phased array system)



Appendix 8 Qualification stage - Synopsis of qualification and Inspector scope

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr ≤ 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Joint to be qualified:						
Refer to the stated WTR stated in the procedure to find which type of qualification is applicable.						
- WTR ≤ 1.5 mm, standard qualification is applicable 1.5 mm < WTR ≤ 2.5 mm, standard qualification is applicable plus specification Appendix 2 "additional requirements" and scope in the present table relevant column → - WTR > 2.5 mm, standard qualification is applicable plus specification Appendix 2 "additional requirements" and scope in the present table relevant column. →						

1. Preliminary

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr ≤ 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Third Party representative is present			Y/N			X
AUT CONTRACTOR has trained CY inspector(s).		12.2	Y/N			
AUT procedure has been accepted by TP and by CY			Y/N Last revision N°			Final rev. for production

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Statistical efficiency according to DNV OS-F101 .	Report of previous qualification has been reviewed and accepted by TP and CY.	8.3.1	Y/N			
Transverse Weld shrinkage	Expected weld shrinkage has been specified by Contractor and is stated in the AUT procedure.	7.1.3	Y/N Report the value			
Jig and ruler gauge for band positioning	are available and properly adjusted according to AUT procedure.	5.3.12	Y/N - Jig adjustment (root face/scribe line) dimension. Ruler gauge identification N° and dimension scribe line/band			Same identification & adjustment as qualification
Calibration block (CB)	CB w.t, dimensional report after machining. Reflectors, conform to AUT procedure and CY spec. CB identification is hard stamped and N° is reported.	7.1 + AUT procedure	Y/N CB w.t. and identification Nr		+ L, H	Same identification as qualification + CY inspection stamp
Flaw Acceptance Criteria	Are available and have been accepted by CY.		Y/N Document reference and rev.			
Software N°/rev; programs/focal laws N°			Report			Same identification & rev. as qualification



Exploration & Production

General Specification

GS PLR 430

Date: 10/04

Rev: 01

Appendix 8

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
AUT interpreter	Check qualification levels 2 manual UT, plus previous experience documentation.	6.2	Name: Conform to CY spec.			X
Level 3 technical support	Is available.	6	Name:			X
On production site only Power failure simulation	Check scanning records are kept safe.	9.1	Y/N			On site only
On production site only Welding repair.	General: Inspection procedure of welding repairs is available on site. TP and CY have approved it. Acceptance criteria are available and approved by CY.	10	Y/N			X
	If AUT procedure has been accepted for repair inspection, the inspection scope stated in the present table also apply to it.		Procedure N° and rev.			X
	If X-ray are used for inspection of welding repair. TP and CY have approved procedure.		Procedure N° and rev			On site only
	If manual UT have been required, procedure to be qualified and accepted by CY inspector.		Procedure N° and rev			On site only
On production site only Spares	Types and quantity, as stated in the list approved by TP or CY, are available on site.		Y/N			On site only

2. Tests on calibration block(s)

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Reference signals: 80% FSH Threshold: 20% Gate widths before bevel: Gate widths after weld axis: Gains in each channel including coupling channels.	Conform to COMPANY specification and procedure Check and record.	7.2.3.1	Report all parameters		+ L, H	X X X X X
Dynamic CALIBRATION: T1, T4 and T7 tests on CB						
Scanning speed: Test with CB at 3, 6, 9, 12 O'clock, scanning always starting from 12 O'clock	Report scanning speed.	7.2.3.2.1 7.2.3.2.2	Report: Y/N		+ L, H	Not exceed the qualified speed
10 Dynamic scanning on each position	Conform to CY spec.	7.2.3.2.3 8.5.1 8.5.5	Y/N		+ L, H	X
Coupling - T6/1 test on CB						
C1 by transmission through the weld	Check coupling channel is existing between each pair of symmetric probes.	5.3.7	Y/N			X
C2 compression probe	Check one is existing on US and on DS. They are located as per CY spec.	5.3.7	Y/N			X



Exploration & Production

General Specification

GS PLR 430

Date: 10/04

Rev: 01

Appendix 8

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
C1 by transmission and C2 or C3 compression probes	In static condition, check and report dB drop for warning. They are in conformance with CY spec. (C1: - 10 dB max; C2: -2 dB max).	8.5.4.1	Y/N			X
Wedge temperature – T6/3 test on CB Repeat T1 test at wedge specified min and max temperature range. (Unless alternative procedure has been accepted).	Temperature gauge is installed in 1 wedge at least. CB shall be heated in such a way that min temperature is 50° C approx. Conform to CY spec.	8.5.4.3 7.2.3.2.3	Y/N			Temperature gauge is installed in 1 wedge.

3. Tests on tack welded joint(s)

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Verification of calibration block(s) against actual bevel T5		8.5.3				
G = Gap. Calculation of Weld Shrinkage Average: "WSA". Calculation of theoretical top gap on tack welded joints "Gtw".	Gtw = G – WSA	8.5.3.1	Report values			
Top gap on tack welded joint	Check Gtw (Gap tack welded actual). Difference between Gtw and Gtw < 0.5 mm.		Y/N			Check top gap on production joint
Scanning of tack welded joint in static or dynamic condition	Check position of band against scribed line. It is well adjusted.		Y/N	+ L, H	+ L, H	X
	Check UT gains in each channel are the same as for calibration block scanning.		Y/N			X
	Signal heights from bevels >= 100% FSH Peak signals are within +/- 0.5 mm against CB reflectors positions.	8.5.3.2	Y/N Report the true values %FSH (e.g. 160%) Y/N Report values	+ L, H	+ L, H	Check tack welded joint has been machined on site
Gap gauge for production	Check and report actual gap gauge dimensions. Inspector Stamp CB and Gap gauge.		Report dimensions			Gap gauge is available on site.



Exploration & Production

General Specification

GS PLR 430

Date: 10/04

Rev: 01

Appendix 8

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Tolerance on band positioning T 6/2 test on tack welded joint		8.5.4.2				
Move band of +/- 2 mm from the theoretical position (or 1mm)	Signals from bevels are not below 60% Report moving distance and signal heights.	8.5.4.2	.Y/N & Report	+ L, H	+ L, H	

4. Tests on welded joint(s)

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Verification of AUT procedure efficiency T2 and T3 tests on welded joints		8.3.2 8.5.2				
Welding of Joints with natural and artificial defects	Before joint fit up, reference lines have been properly scribed on pipe end with the adjusted jig.	5.3.13	Y/N			
	Before welding, check top gap on joint preparations. It is conform to welding procedure.	8.5.2.1	Report gap "G" dimension			Check "G"
	Make sure that reference hard stamped points are made at either weld side for verification of transverse weld shrinkage (WS) on two diametrically opposite lines.		Y/N Report WS values after welding. It is the one stated as expected approx.: Y/N			
	Number of welded joints.		Number of joints welded: Identification of each one:			
	Sketch with position of artificial defects, including copper cracks, is available.		Y/N			
	All required flaws (natural and artificial) have been found in joints.		Y/N			



Exploration & Production

General Specification

GS PLR 430

Date: 10/04

Rev: 01

Appendix 8

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
AUT scanning of joints: Twice at both side of joint with removal of AUT head and band.	Interpretation is carried out according to written procedure and properly reported.	8.5.2.2	Y/N			
X-ray and manual UT	X-ray and manual UT interpretation is satisfactory and properly reported.		Y/N			
After agreement with inspection CONTRACTOR and TP, defect locations are defined. Defects missed by AUT are selected also for investigation.	Locations are physically marked and hard stamped by CY inspector before cut off.	8.5.2.2	Y/N			
Macrography/Micrography	Interpretation is satisfactory.	8.5.2.3	Y/N			
Report of AUT, X-ray, manual UT, Macro/micro is issued for evaluation	Reporting is in conformance with findings and reporting form is satisfactory.		Y/N			
Acceptance criteria stated in CY spec.	Acceptance criteria are fulfilled.	8.5.2.5	Y/N			
Report is sent to CY for global evaluation		8.5.2.6	Y/N			



5. Reports and miscellaneous

Type of control/test	To be checked	COMPANY Spec. Relevant chapter	COMPANY Inspector to report	1.5 < wtr < 2.5 mm	wtr > 2.5 mm	Test/control to be performed on site also before production starts
Report all probe types, identification, arrangement/position against the axis.	Check the reporting.		Attach to Qualification Report.			Identical to qualification
Full Qualification Report to be sent to COMPANY for evaluation						CY and TP have accepted qualification
On production Site only Slave monitor and computer are available on site for CY inspector survey. All functions available on main computer are also available on slave computer.		5.3.12	Y/N			On site only
On production Site only Qualification dossier with all recorded data	Available on site.		Y/N			On site only



Note:

- "Y/N" means Yes/No.
- Where "N" is reported, a "RESERVE" must be issued and addressed to CONTRACTOR immediately by inspector, copy to TP and COMPANY.
- The reserves shall bear a serial N° (from 1 to...). The reserve N° shall be reported in the above table, last column. The reserve shall be included in the qualification file.
- CONTRACTOR shall give a response as soon as possible to TP and to COMPANY: explanation, concession request, and corrective action proposal...
- Qualification shall not be accepted as far as "reserves" will remain pending.

Appendix 9 Production stage – COMPANY inspector scope

Type of control/test by CY inspector	WTR < 1.5 m m	1.5 < WTR < 2.5 m m	WTR > 2.5 m m	Comments	Minimum Extent of inspection/s urvey
Above column "Test/control to be performed also before production starts"...				...has been fulfilled. Preliminary required tests and controls are satisfactory. Otherwise, issue a "Reserve".	
Review of Calibration block "M" scanning display after every weld. L + H every 8 hours:	X		X		30% 100%
Check interpretation of scanning display of each production weld. Inform immediately the interpreter when you disagree on his interpretation.					100%
Release/Hold joint when your interpretation is "conform"/"non conform" to acceptance criteria.				Acceptance/rejection of joint Release	100%
Check difference of wedge temperature between CB and production weld scanning.				Max 10° C	20%
Check on display that UT head is well centred on joint.					100%
Check coupling warnings have not been activated.					100%
Check level of actual coupling on C1 and C2 or C3					2 per shift
Checking of weld temperature before water cooling at UT stand				250° C max.	3 per shift
Checking of weld temperature before scanning, 1 every 8 hours				70° C	100%

Type of control/test by CY inspector	WTR < 1.5 m m	1.5 < WTR < 2.5 m m	WTR > 2.5 m m	Comments	Minimum Extent of inspection/s urvey
Check top gap of fit up joints before welding with "Go/No Go" gauge.					3 per shift
Check UT parameters				Gain in every channel, including in those of coupling. Coupling warning threshold. Scanning speed.	10 per shift
Check AUT/Radiography (if any) and manual UT on repairs.				Acceptance/rejection of joint Release	100%
Require test on tack welded joint "M" when any doubt arise. L + M + H Once a day	X	X	X	Refer to Appendix 2 "additional requirements".	100% 100%
Inform CY representative/CY inspector in charge of welding, of recurrent defects found in weld.					
Check weld number is properly entered in computer after or before scanning.					10 per shift
Check electronic scanning data are properly stored as specified in CY specification					3 per shift
Record all released, rejected and repaired joint Number Keep traceability until production end.					



Appendix 10 Reserve form

(Note: This page must be kept under “word” to allow modifications when necessary)

RESERVE N°

Issued by:

Date:

THE FOLLOWING ITEM IS ON HOLD. The qualification cannot be accepted as far as this reserve is pending. Description of the concern, deviation/non conformance (attachment: Y/N):

Name:

Signature:

Date:

Date:

CORRECTIVE ACTION PROPOSED BY CONTRACTOR

Contractor QA/QC agent name:

Signature:

Date:

CY COMMENTS:

Name:

Signature:

Date:

FINAL DECISION

A) The Corrective Action has been implemented under CY inspector witness

CY inspector has signed the corrective action report, date of report (to be attached) and corrective action is satisfactory.

B) Contractor explanation is satisfactory

CY response is attached.

C) Contractor Concession request has been accepted by CY

CY response is attached.

Closure of reserve date

Name:

Signature:

Date: