Base Load Power Hub (BLPH)

Ultrasonic Testing Procedure – Structure

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Crosswind, a Shell and Eneco joint venture, was awarded the tender to develop the offshore Hollandse Kust Noord (HKN) wind farm, located 18.5km off the coast of Netherlands near the town of Egmond aan Zee. The consortium plans to have HKN operational in 2023 with an installed capacity of 759MW generating at least 3.3TWh per year. This is sufficient renewable power to supply more than 1 million Dutch households with green electricity.

Offshore wind farms produce intermittent electricity and balancing these dips and peaks and integrating this electricity into the national energy system requires new technologies. For this reason, the offshore wind farm will include several new technologies that could be implemented at full-scale in the future. The new technologies being explored include a floating solar park, a short-duration battery storage as well as long-term storage via green hydrogen produced by water electrolysis and subsequently consumed in a fuel cell. The combination of these individual measures, herein referred to as the Base Load Power Hub (BLPH) will ensure a continuous power supply regardless of the wind situation.

1.1.1 Project Location

The Hollandse Kust Noord (HKN) wind farm is located 18.5km off the coast of the Netherlands near the town of Egmond aan Zee.

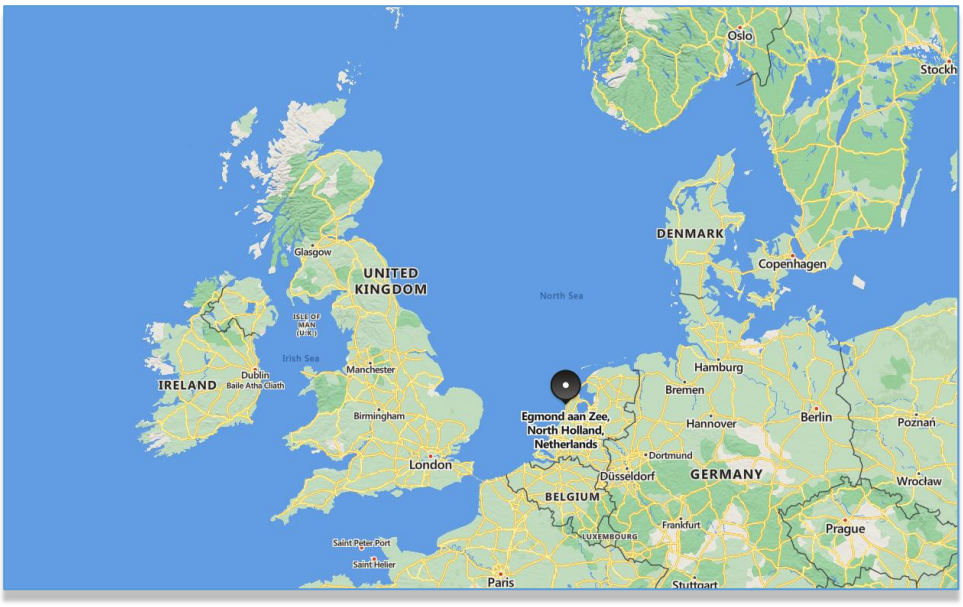


Figure 1 HOLLANDSE KUST NOORD WIND PARK Location Map

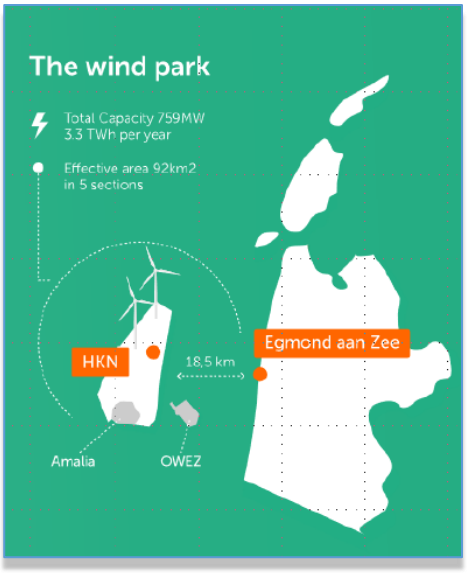


Figure 2 - Wind Park Details

The wind farm will consist of No. 69 x 11.5MW wind turbine generators each to be installed on a dedicated monopile structure. A 70th monopile located on coordinates E 590719.1, N 5841602.3 is reserved for installing the platform accommodating the BLPH. The monopile structure was designed and installed by Van Oord Offshore Wind (VooW) and therefore not part of the BLPH scope.

1.1.2 Project Concept

All components included in the BLPH will be integrated onshore on a topsides and installed in an offshore location within the boundaries of the HKN wind farm. At its simplest, the BLPH will store energy during periods of high electricity generation from renewable sources (a wind turbine generator and the floating solar PV farm) and release it during periods of low generation. In practice. It is expected that the energy stored will supplement generation from renewable sources to ensure that at least 1.0MW of power is exported to the electrical grid regardless of wind/solar availability.

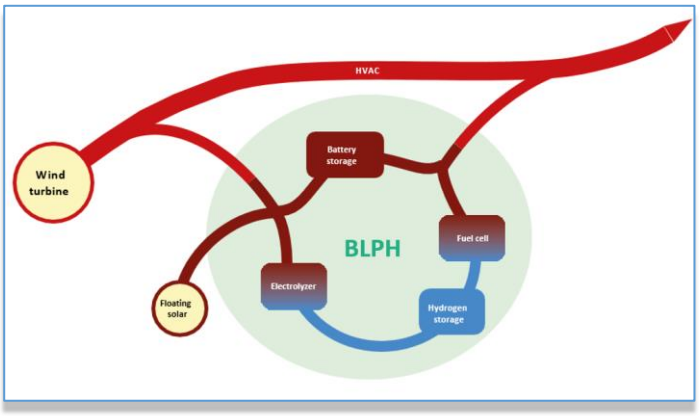


Figure 3 – BLPH Concept

Electricity in the BLPH will be stored in the form of electrons in a battery energy storage system (BESS) as well as converted into green hydrogen via water electrolysis. When the power output from the connecting wind

turbine drops to below 1 MWe, the BLPH will return its stored energy to supplement the remaining power output. This will be by discharging the BESS, while stored hydrogen will be converted back into electricity using a fuel cell to extend the discharge duration.

The purpose of the BLPH s to function as a testbed for the integration of energy storage technologies with renewable generation. It is expected that equipment installed on the BLPH will operate as Normally Unmanned Installation for at least two (2) years with no or minimal maintenance and it will have its own independent control room with the ability to communicate with Crosswind's control room.

2 DOCUMENT SCOPE

This procedure is applicable for testing full and partial penetration welds using ultrasonic testing examination by the pulse echo manual contact technique on welds of structures with thickness equal or greater than 8mm with temperature in the range between 0°C to 60°C.

The examination shall be performed not earlier than 48 hours after the completion of the weld.

2.1 REFERENCES (Applicable edition)

Doc. No.	Description
K559-2254-MT-SPE-001	Structural Fabrication Specification
EEMUA_158	Construction Specification for fixed offshore structures
UNI EN ISO 17640	Non destructive testing – Ultrasonic testing Technique, testing levels, and assessment
UNI EN ISO 11666	Non-destructive testing of welds - Ultrasonic testing – Acceptance levels
UNI EN ISO 23279	Non-destructive testing of welds. Ultrasonic testing Characterization of indications in welds
ISO 16811	Non-destructive testing – Ultrasonic testing – Sensitivity and range setting.
UNI EN ISO 5817	
UNI EN ISO 17635	Non-destructive testing OF WELDS – General rules for metallic materials.
ISO 22232-3	Non-destructive testing - Characterization and verification of ultrasonic test equipment
ISO 9712	Non-destructive testing – Qualification and certification of NDT personnel

Table 1 - Reference Documents

2.2 DEFINITIONS AND ABBREVIATIONS

COMPANY or Client (CPY):	Crosswind
CONTRACTOR (CTR):	ROSETTI MARINO S.p.A.
PROJECT:	HOLLANDSE KUST NOORD WIND PARK Project
NDT:	Non Destructive test
UT	Ultrasonic testing
SDH	Side Drilled Hole
H_O	Reference Level
DAC	Distance amplitude correction
FSH	Full Screen Height
TM	Thermo mechanically

Table 2 - Definitions and Abbreviations

3 PERSONNEL QUALIFICATION

The technicians that carry out ultrasonic examinations and evaluate the results shall be qualified at least a level 2 in the UT method in accordance with the requirements of PCN, ISO9712 in the relevant product sector or equivalent scheme after approval by Company.

The personnel shall have passed an eyesight acuity test and shall be able to read the Time New Roman character 4.5 at a distance of not less than 300mm.

Colour vision shall be sufficient that the candidate can distinguish contrast between the colours used in NDT method.

4 SURFACE PREPARATION

The surface of the materials to be examined shall be clean and free from extraneous material such as loose scale, paint, irregular surface, spatters or other foreign material that could interfere with the inspection.

Any surface condition that interferes with Ultrasonic Examination and cannot be solved by cleaning or surface dressing shall be reported.

For butt weld requiring cap to be ground flush for inspection purposes final UT examination shall be performed after cap removal and after MT examinations performed after cap removal.

The status of the weld shall be reported in UT inspection report.

The weld shall be prepared by grinding, if necessary, to assure that the examination shall be performed properly and that the surface condition of the weld is not causing misleading interpretations of the results.

5 EQUIPMENT

This examination shall be conducted with a pulse echo ultrasonic instrument capable of generating frequencies over the range of at least 1 Mhz to 6 Mhz and shall be equipped with a stepped gain control in units of 2.0 dB over a range of minimum 60 dB.

The instrument shall be able to clearly distinguish echoes with amplitude of 5% of full screen height.

The reject control shall be in the "off" position for all examinations.

Each ultrasonic apparatus shall have a calibration certificate with reference to the apparatus serial number.

The calibration is valid for a maximum of one year by an independent laboratory.

The calibration certificate shall be made available to Inspector.

The ultrasonic apparatus serial number shall be included in the examination report.

The following Ultrasonic Instruments will be used:

- Krautkramer
- Olympus
- Sonatest
- Panametrics
- USM GO

Or equivalent

5.1 SCREEN HEIGHT LINEARITY AND AMPLITUDE CONTROL LINEARITY

The ultrasonic instrument screen height linearity verification & amplitude control linearity verification shall be in compliance with ISO 22232-3.

5.2 SEARCH UNITS

The nominal frequency shall be from 2 MHz to 5 MHz unless variables, such as production material grain structure, require the use of other frequencies to assure adequate penetration or better resolution.

Search units with contoured contact wedges may be used to allow ultrasonic coupling.

Calibration shall be done with the contact wedges used during the examination.

The search units to be employed for the examination shall be of the type:

- Straight Beam
- Angle Beam.

5.2.1 STRAIGHT BEAM

Longitudinal waves search units with straight beam will have the following characteristics:

- Size: Ø3,5X10mm , Ø25mm
- Frequency: 2 - 4 MHz
- Crystal: Single – Double

The following Probes will be used:

- Krautkramer
- Img
- Eeci
- Siui
- GE

Or equivalent.

5.2.2 ANGLE BEAM

Shear waves probes with angle beams 45° ; 60° and 70° degree angles shall be used.

They may be single or double elements with size as follows:

- 4 MHz probe 8x9
- 2 MHz probe 14x14 or 8x9

The following Probes will be used:

- Krautkramer
- Img
- Eeci
- Siui
- GE

Or equivalent.

5.3 ADAPTION PROBE

The gap, g, between test surface and bottom of the probe shoe shall not be greater than 0,5 mm.

g=a^2/D

where:

- a is the dimension, in millimetres, of the probe shoe in the direction of testing;
- D is the diameter, in millimetres, of the component.

If a value for g larger than 0,5 mm results from the equation, the probe shoe shall be adapted to the surface and the sensitivity and range shall be set accordingly.

5.4 CHECKING AND CALIBRATION EQUIPMENT

Probes functioning and calibration of equipment shall be checked:

- each beginning of work-shift;
- every 4 hours and at the end of an inspection programme;
- each change of examination personnel;
- any time that malfunctioning is suspected;

All of the products that have been tested since the last valid equipment calibration shall be re-examined whenever during any check it is determined that the testing equipment is not working properly.

If deviation is found to be > 2% of time base, > 4 dB of primary gain setting or > 2° of nominal angle probe, the examinations carried out with the equipment over the previous period shall be repeated.

5.5 COUPLANT

The substances to be used for coupling are the following:

- Water with methyl cellulose

The same couplant that will be used for calibration shall be the same used during the examination

6 NDT EXTEND

The extend shall be in accordance to Spec. K559-2254-MT-SPE-001 and will reported on design drawings and inspection test plan.

7 CALIBRATION

When ultrasonic testing is performed on TM material, the calibration block shall be made in longitudinal rolling direction and perpendicular to the rolling direction.

7.1 CALIBRATION BLOCK

The calibration block for either normal or angle probes shall be used with side drilled holes Ø3mm (refer to Appendix 2) to established primary reference responses of the equipment in accordance with ISO 16811
The remaining holes shall be approximately equally spaced through the thickness.
The material from which the block is fabricated may be of the same product form, and material or equivalent specification as one of the materials being examined.
The finish on the scanning surfaces of the block shall be representative of the scanning surface finishes on the component to be examined.
The temperature difference during range and sensitivity setting and during the test shall be within 15°C.

7.2 DISTANCE RANGE CALIBRATION

Distance range calibration shall be the full skip, the calibration of the distance range is executed by utilising steel block and steel block V1, V2 by IIW (refer to Appendix 1).

7.3 VERIFICATION OF THE ULTRASONIC PROBE EMISSION

The IIW V1 or V2 block shall be used to verify the emission point of each transducer/wedge combination used as per Figure 4 and 5 shall be in accordance with ISO 2400 and ISO 7963.
The search unit shall be moved until the signal from the radius is maximized.
The point on the search unit that is in line with the line on the calibration block is indicative of beam emission point.

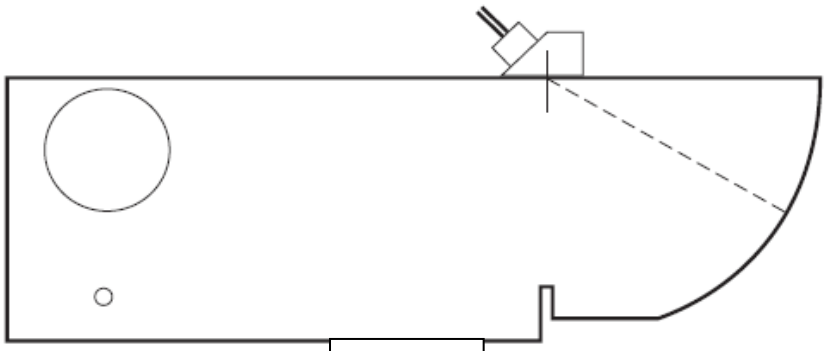


Figure 4

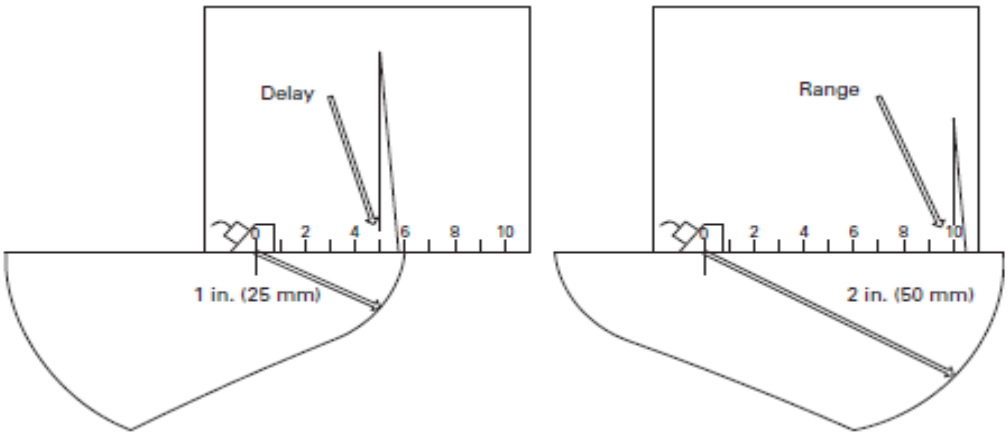
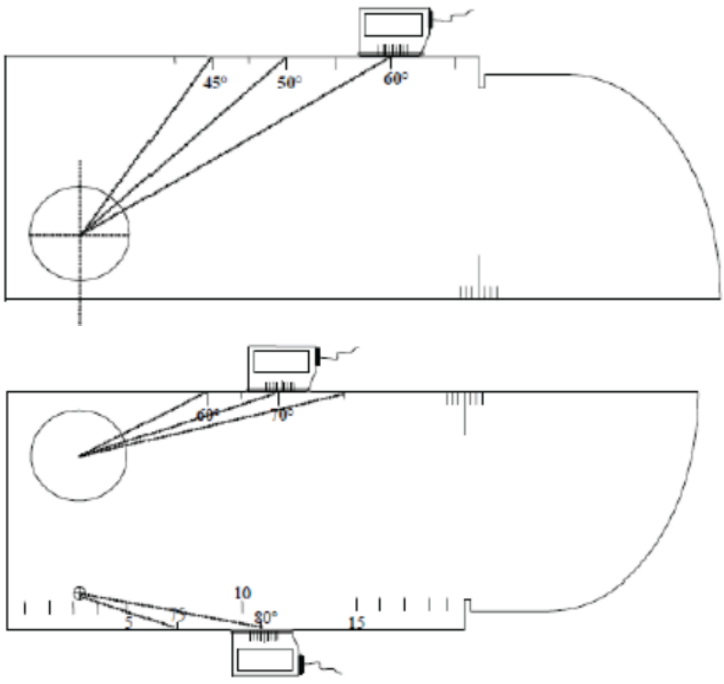


Figure 5

7.4 VERIFICATION OF THE REFRACTED ANGLE

The IIW V1 (see figure 6) block will be used to verify that the angle of the transducer and shoe combination is the same as that marked on the probe. If the angle differs by more than ± 2° from that marked on the probe the shoe will be corrected or replaced.



In alternative:

Angle search unit formula = cos -1 Depth of hole V1/ soundpath;

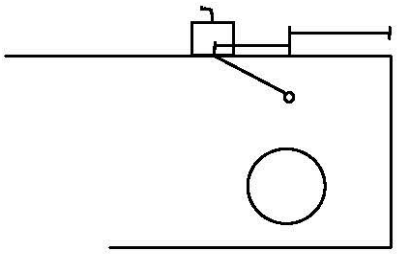


Figure 6

7.5 CONSTRUCTION OF THE D.A.C. CURVE

The angle beam shall be directed toward the first hole that yields the maximum response. The gain setting shall be set so that this response is 75% of full screen height, this shall be the primary reference level (Ho).

The search unit then shall be manipulated, without changing instrument settings, to obtain the maximum responses from the calibration reflectors at the distance increments necessary to generate a three-point distance–amplitude correction (DAC) curve.

8 TRANSFER CORRECTION

The purpose of this operation is to correct the testing system sensitivity to compensate for ultrasonic energy losses caused by differences between the reference calibration block responses to the actual testing conditions like surface roughness, coupling between probe and test surface, and material acoustic attenuation characteristics.

The following procedure is prescribed:

- Two angle beam probes (For example 60°) of the same type are required (see figure 7)
- One of the probes works as transmitter probe, whilst the other acts as receiver.
- The first echo is maximised and with the aid of the gain control it is adjusted to reach DAC.
- The gain setting is noted.
- Without altering this gain setting the probes are moved to the reference block.
- The echo is adjusted to reach DAC and the gain setting is noted.
- Any difference in echo amplitude between the two materials can now be determined with the aid of the gain control.

If the differences are less than 2 dB, correction is not required.

If the differences are equal or greater than 2 dB but smaller than 12 dB, they shall be compensated for.

If transfer losses exceed 12 dB, the reason shall be considered and further preparation of the scanning surfaces shall be carried out, if applicable.

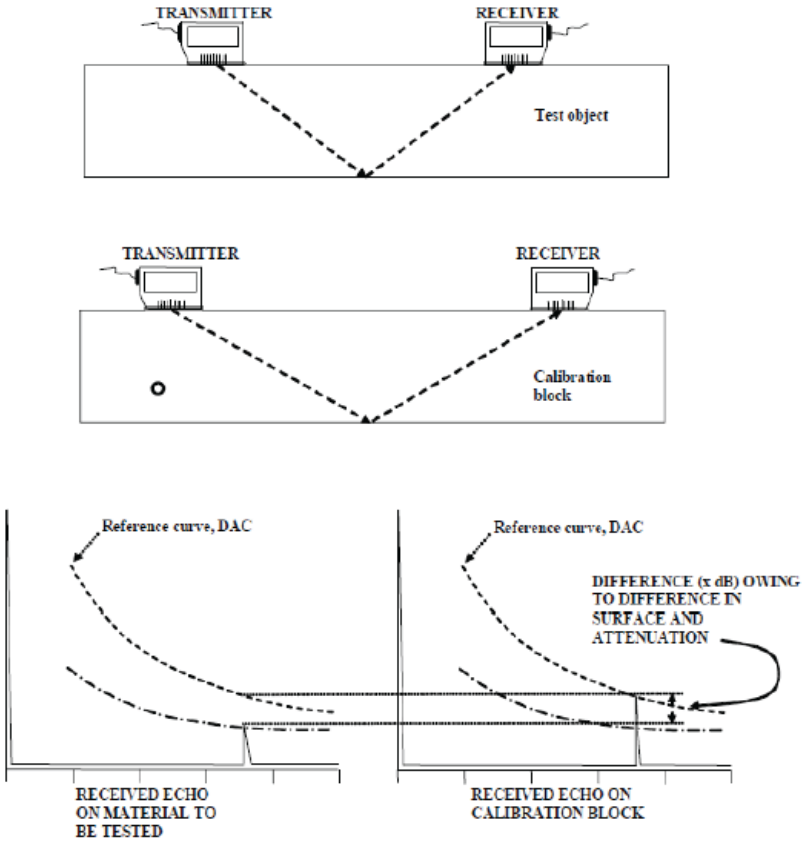


Figure 7

If Thermo Mechanically structure shall be examination, real angle shall be calculate as follow, in the vicinity of the joint:

- Two angle beam probes (i.e.60 degree probe) of the same type are required
- One of the probes works as transmitter probe, whilst the other acts as receiver
- The echo related to the wall thickness is maximised (figure 8).
- Without altering this maximised, calculate the effective angle with the algebraic formula (figure 9).
- The value will be reported on final report after examination.

The same procedure described above, shall be repeated for all others angle beam as per examination technique showed in Appendix 5

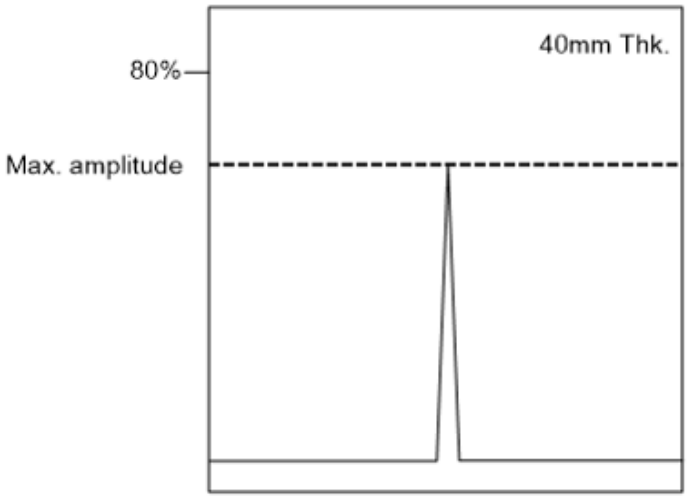


Figure 8

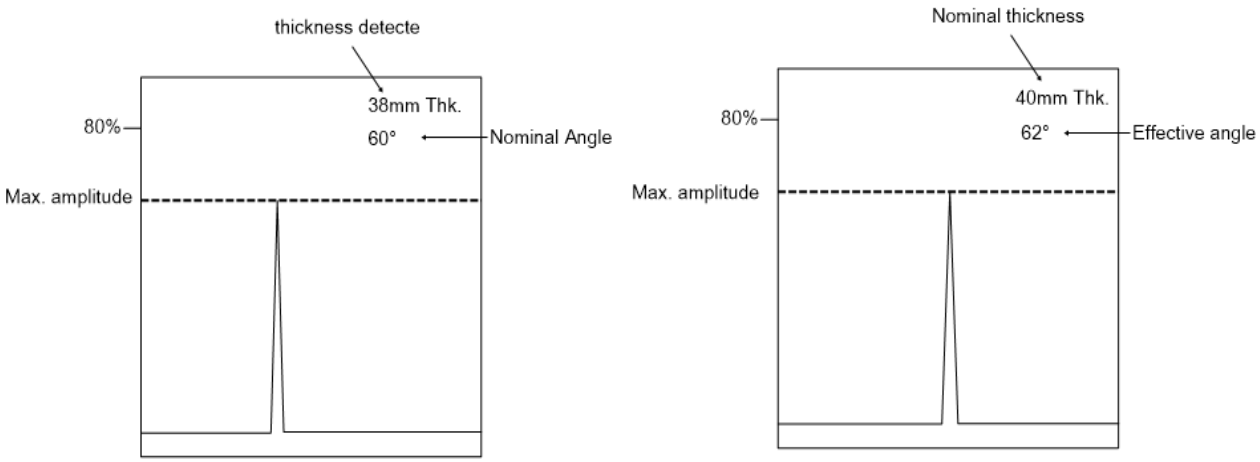


Figure 9

Angle search unit formula = Depth / soundpath * cos -1

9 EXAMINATION

All ultrasonic examination of welded joints shall be carried out in accordance with ISO 17640 Level B (refer Appendix 5).

All welds shall be 100% visually examined and accepted in accordance with the Project requirements of Visual Procedure prior to the performance of UT.

Ultrasonic examination shall be performed after completion of all mechanical activities.

The entire volume of the weld and the parent metal up to a distance of minimum 10 mm to be scanned, shall be examined by moving the search unit over the scanning surface so as to scan the entire examination volume for each required search unit.

- Each pass of the search unit shall overlap a minimum of 10% of the transducer size (piezoelectric element).
- Oscillation of the search unit is permitted if it can demonstrate that overlapping coverage is provided (Appendix 3).

Inspection shall be performed with a sensitivity of H0 + 6dB + Transfer Correction (Section 6).

Evaluation shall be performed with a sensitivity of H0 + Transfer Correction (Section 6)

The scanning rate shall not exceed 6" (150 mm) per second.

9.1 PARENT METAL EXAMINATION

Parent material adjacent to the weld (up a distance to cover full skip path of the maximum angle used in the inspection) shall be examined using a 0° probe to ensure there are no laminar type defects which may interfere with the subsequent angle scans.

Scanning sensitivity shall be set on 2nd BWE to FSH.

Reflectors evaluated as laminar reflectors in base material which interfere with the scanning of examination volumes shall require the angle beam examination technique to be modified such that the maximum feasible volume is examined and shall be noted in the record of the examination.

Scribed lines should be drawn 100 mm away from the root face on either side of the weld to assist ultrasonic examination of the completed weld.

9.2 WELD EXAMINATION

9.2.1 STRAIGHT BEAM PROBE

The scanning pattern for straight beam examination shall be to move the search unit along and across a sufficient contact area of the test specimen so as to scan the entire volume of the weld and heat affected zone.
Straight beam calibration shall be performed using the side drilled holes reflectors with Ø3mm
Straight Beam Technique shall be used to check "T"- Joints to search lamellar tears and weld defects.

9.2.2 ANGLE BEAM PROBE

For each probe, raster scanning shall be performed on both side of the weld (where accessible) and in transversal scanning (where accessible) of the bead in order to identify out those indications which are parallel or perpendicular to the weld.

9.2.3 REFLECTOR PARALLEL TO THE WELD SEAM

At least one the angle beams used shall be directed at approximate right angles to the weld axis from.
The search unit shall be manipulated so that the ultrasonic energy passes through the required volume of the weld and adjacent base material.

9.2.4 REFLECTOR TRANSVERSE TO THE WELD SEAM

The angle beam shall be directed essentially parallel to the weld axis.
The search unit shall be manipulated so that the ultrasonic energy passes through the require volume of weld and adjacent base material.
The search unit shall be rotated 180 deg. and the examination repeated. If the weld cap is not machined or ground flat, the examination shall be performed from the base metal on both sides of the weld cap in both weld axis directions (refer to Appendix 4).

10 SIZING

The technique determines the lateral dimensions of a discontinuity over which the echo is equal to or greater than the evaluation level.

To make a measurement, the beam is scanned over the discontinuities, and the probe position and beam path range, at which the echo has fallen to the evaluation level are noted (see Figure 7).

The lateral dimension "l", is then determined by the distance between the positions 1 and 2.

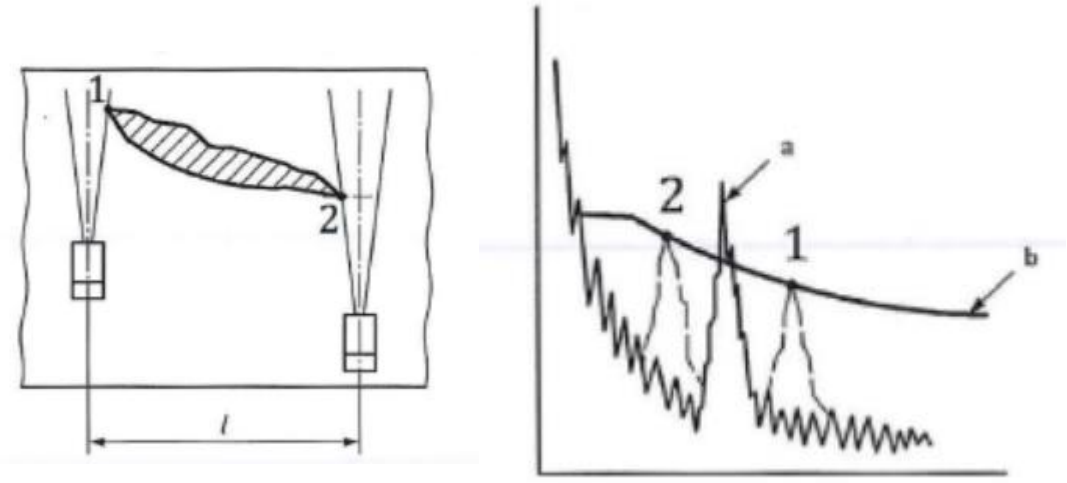


Figure 10

Where:

- l measured lateral dimension of discontinuity
- 1, 2 positions where the indication amplitudes are equal to the evaluation level
- a Maximum echo.
- B Evaluation level

11 ACCEPTANCE CRITERIA

As per company specification K559-2254-MT-SPE-001, the acceptance criteria shall be in accordance with ISO 11666 Level 2.

All indications producing a response equal to or greater than 20% DAC (-14dB) shall be investigated with respect to flaw type and position.
All indications shall be evaluated at reference level sensitivity.

All indications, that will be evaluated as planar indications according to the FLOWCHART of UNI EN ISO 23279 (refer to Appendix 7), shall be rejected regardless the length.

All non-planar indications shall be evaluated in accordance with ISO 11666 Level 2 (Appendix 7).

Any transverse imperfection detected shall be evaluated according to ISO 23279 and any transverse planar imperfection shall be considered as crack with all the associated Non-Conformance Report, root cause analysis and corrective action implementation.

Steel classification	**Inspection Category**	**Equivalent Inspection EEMUA_158**	**ISO 17640 Testing level**	**ISO 11666 Acceptance criteria**
DC1 and DC2	A	I	C	2
DC3 and DC4	C	III	B	2

11.1 GROUP OF DISCONTINUITIES

Grouping of discontinuities is based on the length and the separation of individually acceptable discontinuities providing amplitudes above the recording level.

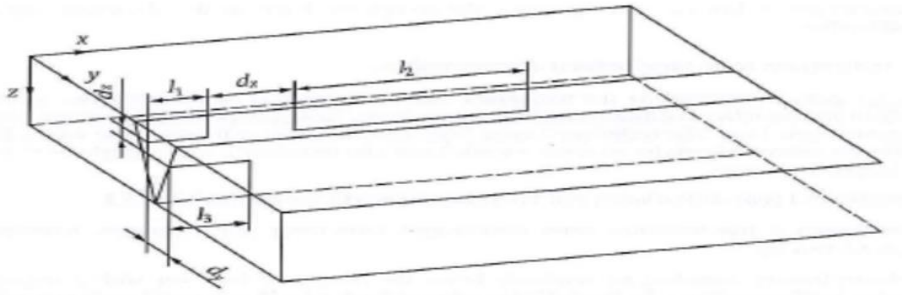
The length of a group shall not be used for further grouping.

For evaluation, a group of discontinuities shall be considered as a single one if:

a) distance, dx, between two discontinuities is less than twice the length of the longer discontinuity (see Figure 11);
b) distance, dy. between two discontinuities is less than half of the thickness but not more than 10 mm;
c) distance, dz, between two discontinuities is less than half of the thickness but not more than 10 mm.

The combined length of the group of two discontinuities is l12 = l1 + l2 + dx (see Figure 12).

The combined length, l12, and the larger maximum amplitude of the two discontinuities shall then be assessed against the applicable acceptance levels.

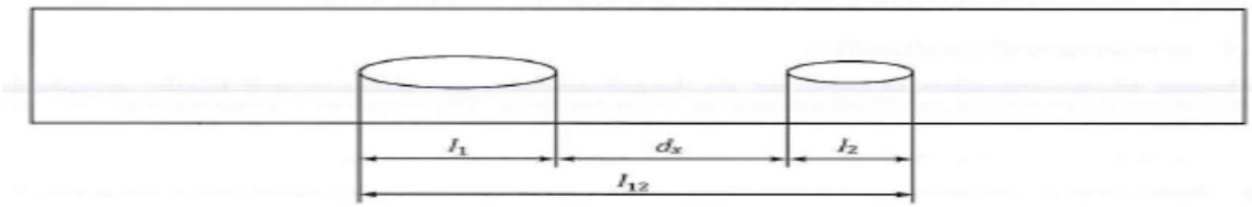


Where:

dx, dy, dz: distance in the x,y and z-direction, respectively

ln: Individual discontinuities, where n= 1,…,3

FIGURE 11 - GEOMETRIC CONFIGURATION FOR GROUPED DISCONTINUITIES



Where:

dx: distance in the x-direction

l1, l2 : Individual discontinuities

l12 combined length

FIGURE 12 – LENGTH OF A GROUP OF DISCONTINUITIES

12 WELD REPAIR

All repair welds shall be marked (start, stop, depth and side of defect) on the surface by the NDT Technician and a repair indication sheet shall be produced (attached to the UT report, as per Appendix 6).

Repaired areas shall be inspected with the same configuration that originally detected the imperfection to ensure that:

- the original imperfection is removed
- no new imperfection that exceeds the acceptance criteria have been produced in the weld.

The inspection of the repaired area shall cover all the excavation plus 50mm on each side of the excavation in each axial welding direction.

13 EXAMINATION REPORT

All NDT shall be documented, and all reports shall be generated by the database (refer to Appendix 6)
The documentation shall include as minimum the following information, where appropriate:

- weld identification
- object, examination area and quality level class
- surface status
- ultrasonic equipment - probes
- couplant
- sensitivity level
- code and standard
- results with sketch of rejectable indications
- QC personnel signature
- Judgement
- name, qualification, and technician signature
- date
- report ID number
- Flaw type (planar or non-planar)

During the inspection, if any of limitations listed below occurs:

- surface condition that cannot be solved by cleaning or surface dressing;
- geometrical limitations;

shall be reported in the second page on the final report with reference drawing, sketch or picture.

14 ATTACHMENT

Attachment 1 – IIW ultrasonic reference block

Attachment 2 – calibration blocks

Attachment 3 – scanning patterns

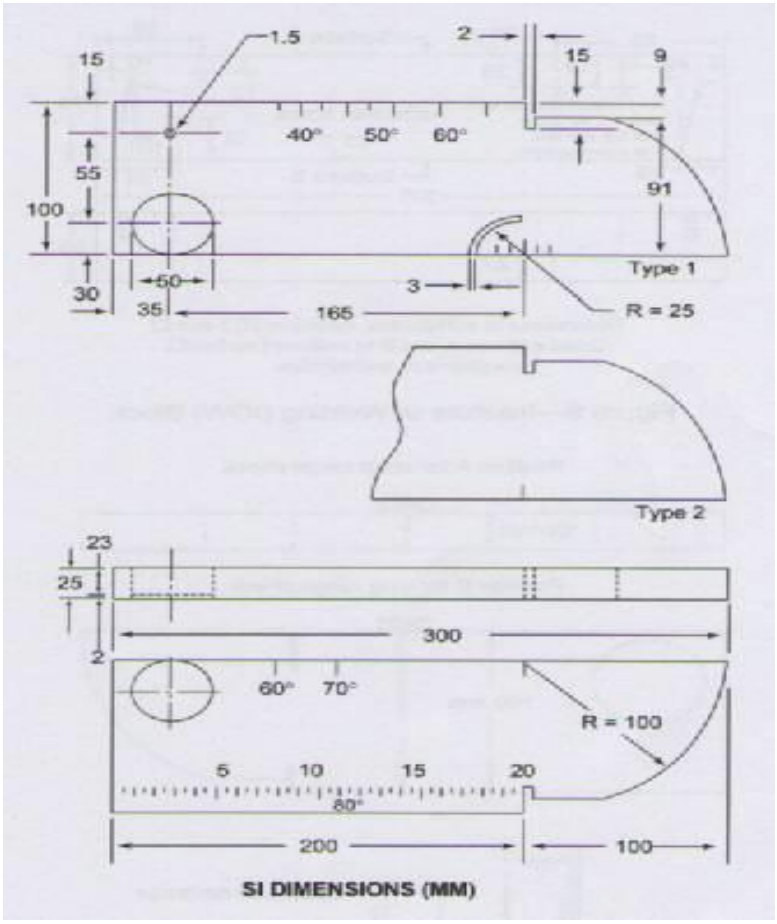
Attachment 4 – scan for transverse imperfections

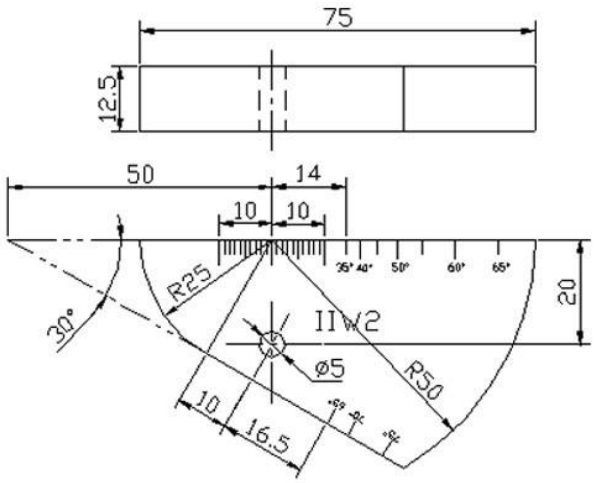
Attachment 5 – examination techniques

Attachment 6 – examination report

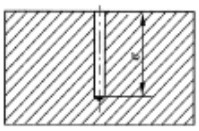
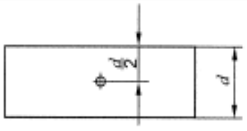
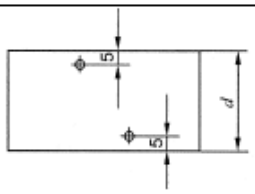
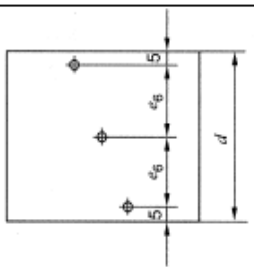
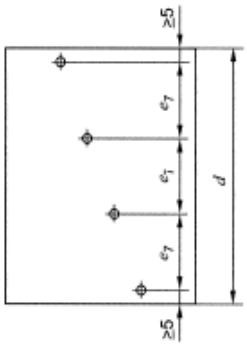
Attachment 7 – acceptance levels

Attachment 1 – iiw ultrasonic reference block

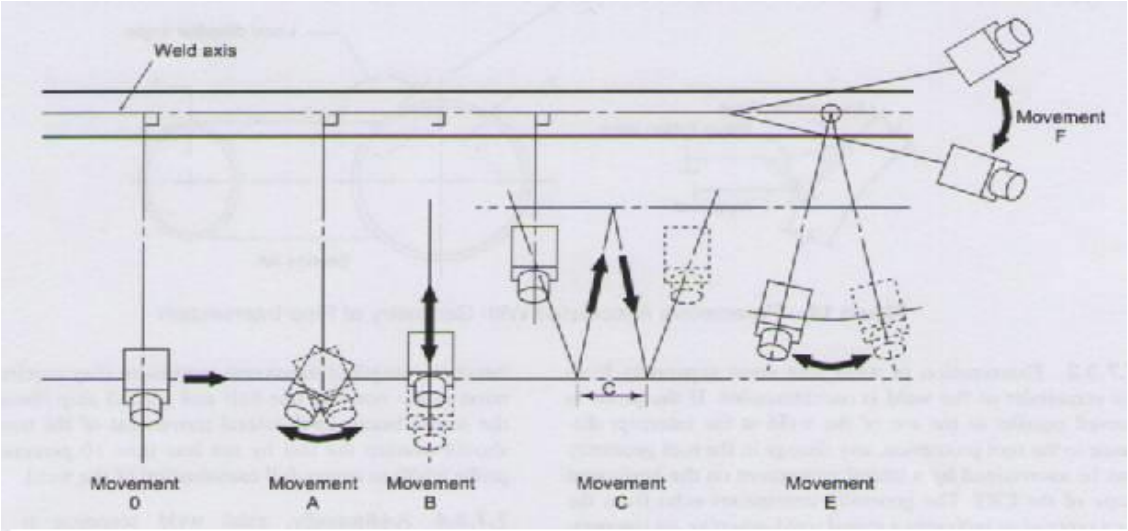


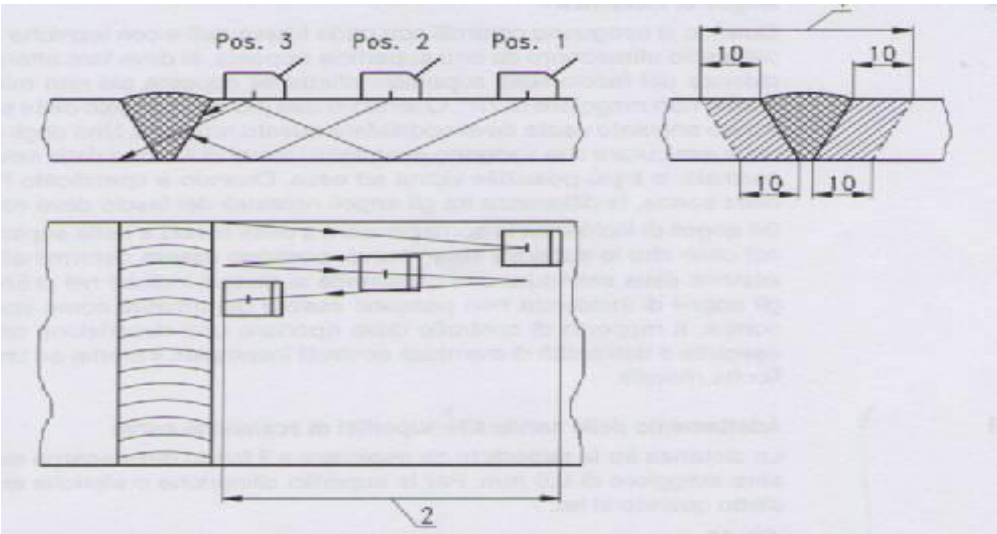


Attachment 2 - Calibration blocks

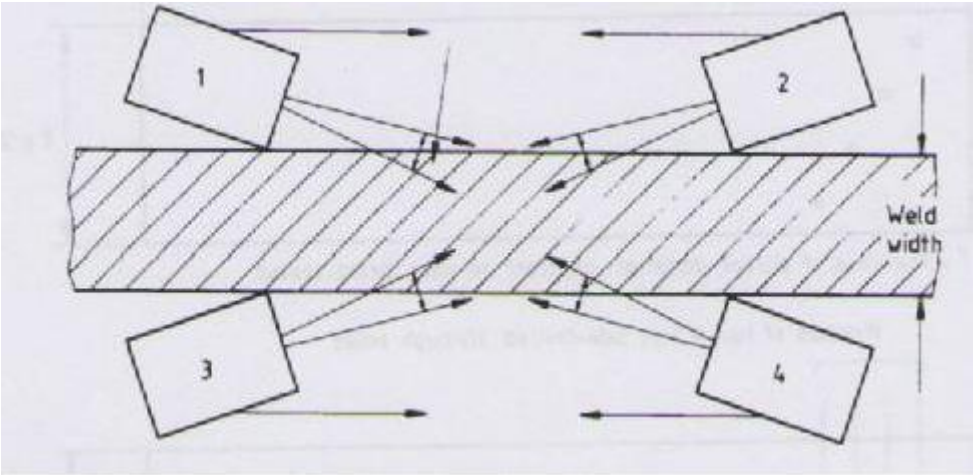
Wall thickness, d, in mm	Reference blocks and reference reflectors	Conditions
		
$10 \leq d \leq 15$		
$15 < d \leq 20$		$e > \frac{2\lambda s}{D_{eff}}$
$20 < d \leq 40$		$D_{SDH} \geq 1{,}5\lambda$ $e_6 = \frac{d-10}{2}$
$d > 40$		$e_7 \leq \frac{d-10}{2}$

Attachment 3 – scanning patterns





Attachment 4 – scan for transverse imperfections



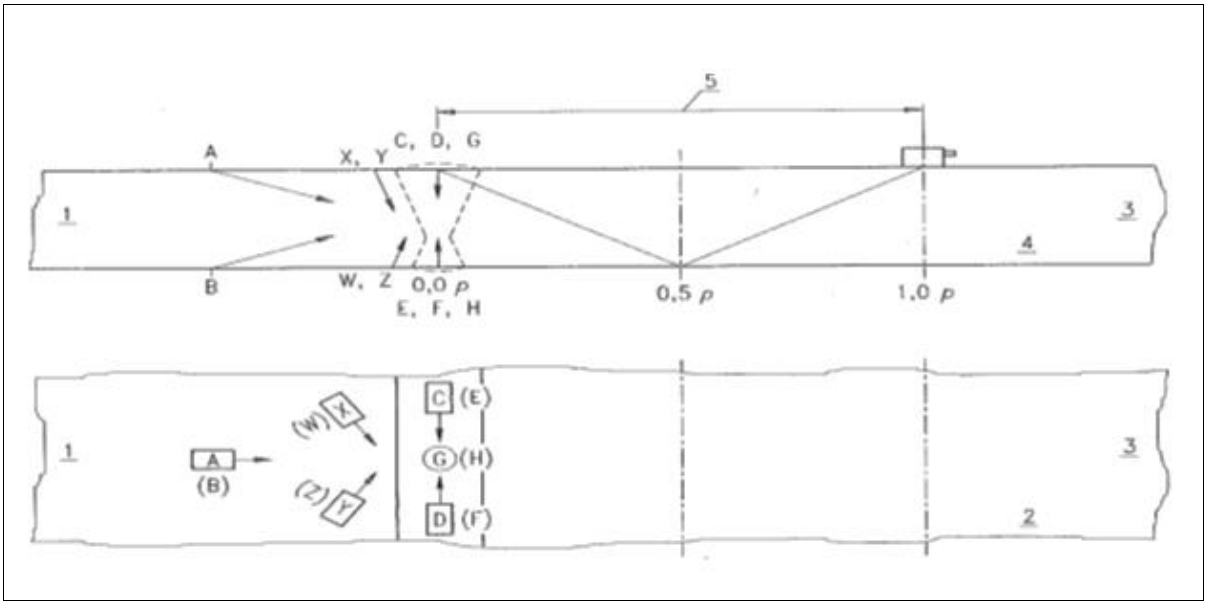
Attachment 5 – Examination technique

IDL N°	Rev.	Testing Level	Thickness Range (mm)	Joint Type
IDL-QCI-UT-0214	2	B-C	8 ÷ 15	Butt Weld
IDL-QCI-UT-0215	3	B-C	16 ÷ 30	Butt Weld
IDL-QCI-UT-0216	4	B-C	31 ÷ 100	Butt Weld
IDL-QCI-UT-0222	2	B-C	8 ÷ 15	T-Joint
IDL-QCI-UT-0223	2	B-C	16 ÷ 30	T-Joint
IDL-QCI-UT-0224	3	B-C	31 ÷ 100	T-Joint

ROSETTI MARINO SPA	**NDT INSTRUCTION SHEET SPECIFICATION**	**N°** **IDL-QCI-UT-0214** **Rev.** 02 **Data** 13/08/2020

UT TEST OF BUTT-JOINT V, 1/2V,K,X ON BEAMS,PLATES AND PIPE (GIRTH AND LONG.)

APPLICABLE UP TO 15 mm OF THICKNESS



PROBE CHARACTERISTIC

PROBE N°	ANGLE	FREQ. (Mhz)	PROBE DIMENSION (mm)	CRYSTAL	WAVE FORM	NOTE
1	0°	4	3,5x10	Double	Longitudinal	
2	70°	4	8x9	Single	Shear	
3	60°	4	8x9	Single	Shear	

(Different models of probes with similar characteristic may be used)

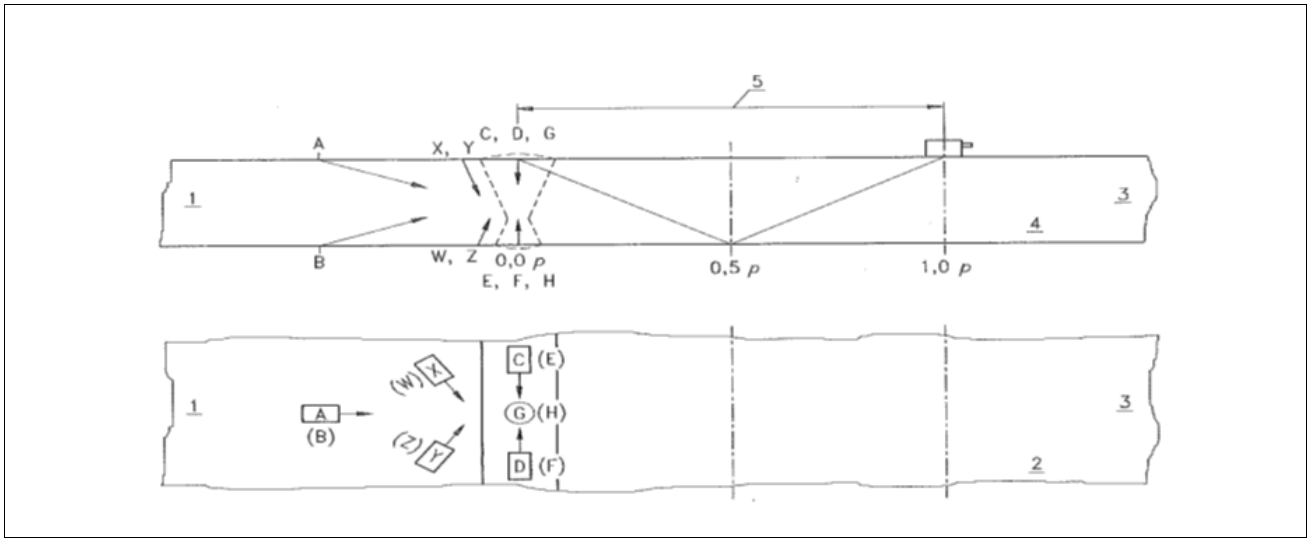
SCANNING DETAILS

SCAN Position	PROBE N°	SKIP	NOTE
PARENT MATERIAL	1	\	Angled probes scanning area only
A and B	2-3	0-1,25	
X-Y or W-Z	2	\	Transverse discontinuities

ROSETTI MARINO SPA	**NDT INSTRUCTION SHEET SPECIFICATION**	**N°** **IDL-QCI-UT-0215** **Rev.** 03 **Data** 07/12/2022

UT TEST OF BUTT-JOINT V, 1/2V,K,X ON BEAMS,PLATES AND PIPE (GIRTH AND LONG.)

APPLICABLE FROM 16mm TO 30 mm. OF THICKNESS



PROBE CHARACTERISTIC

PROBE N°	ANGLE	FREQ. (Mhz)	PROBE DIMENSION (mm)	CRYSTAL	WAVE FORM	NOTE
1	0°	4	3,5x10	Double	Longitudinal	
2	70°	4	8x9	Single	Shear	
3	60°	4	8x9	Single	Shear	
4	45°	4	8x9	Single	Shear	

(Different models of probes with similar characteristic may be used)

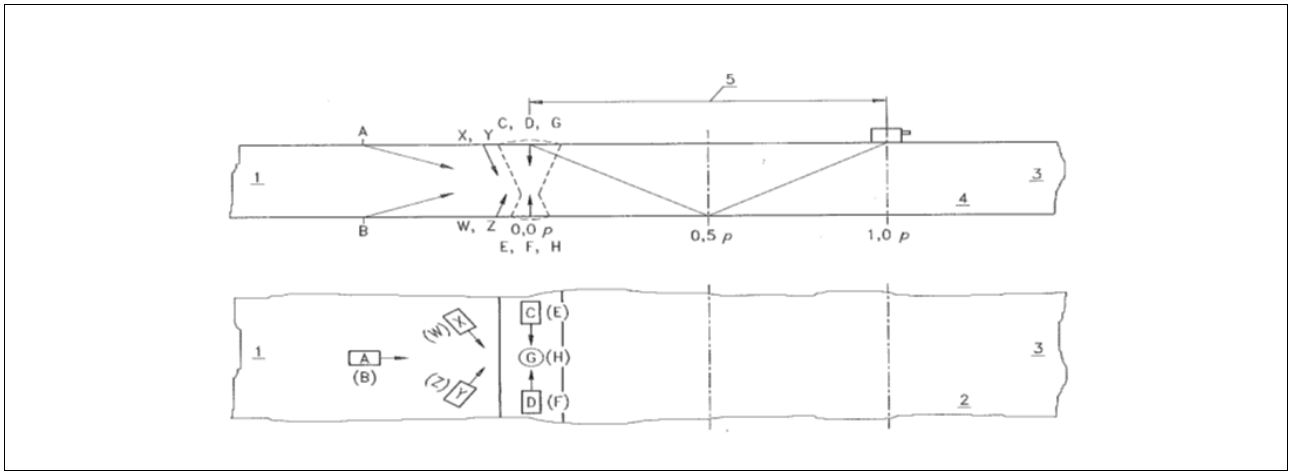
SCANNING DETAILS

SCAN Position	PROBE N°	SKIP	NOTE
PARENT MATERIAL	1	\	Angled probes scanning area only
A or B	2-3	0-1,25	
X-Y or W-Z	4	\	Transverse discontinuities

ROSETTI MARINO SPA	**NDT INSTRUCTION SHEET SPECIFICATION**	**N°** **IDL-QCI-UT-0216** **Rev.** 03 **Data** 07/12/2022

UT TEST OF BUTT-JOINT V, 1/2V,X,K ON BEAMS,PLATES AND PIPE (GIRTH AND LONG.)

APPLICABLE FROM 31mm TO 100 mm. OF THICKNESS



PROBE CHARACTERISTIC

PROBE N°	ANGLE	FREQ. (Mhz)	PROBE DIMENSION (mm)	CRYSTAL	WAVE FORM	NOTE
1	0°	2-4	3,5x10, Ø24 or Ø25	Single / Double	Longitudinal	
2	60°	2	14x14	Single	Shear	
3	45°	2	14x14	Single	Shear	
4	70°	2	14x14	Single	Shear	

(Different models of probes with similar characteristic may be used)

SCANNING DETAILS

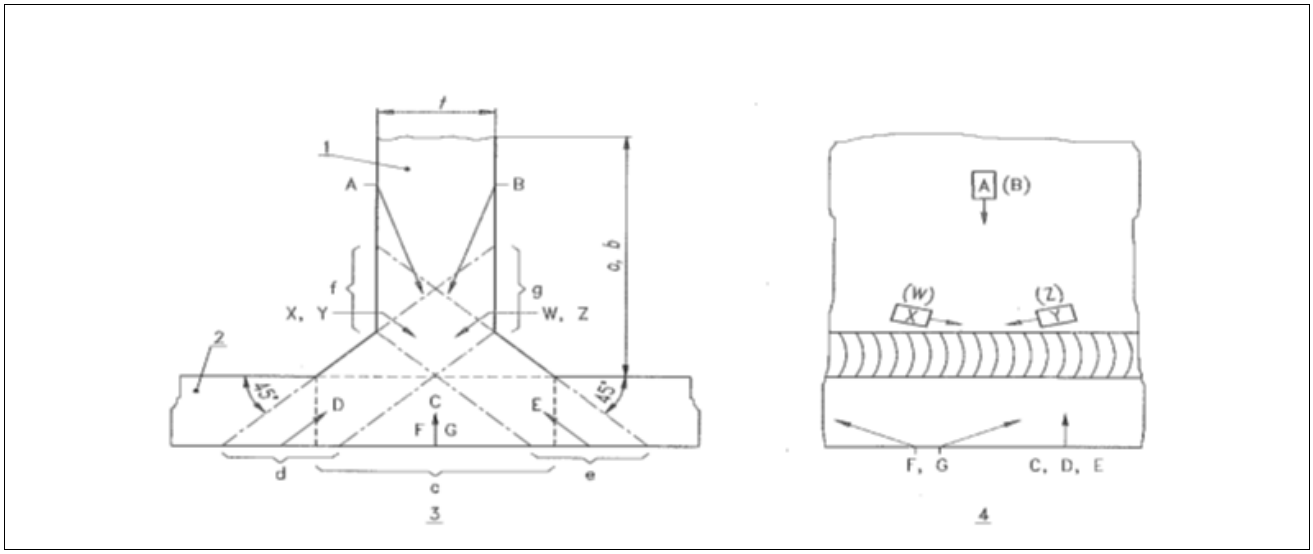
SCAN Position	PROBE N°	SKIP	NOTE
PARENT MATERIAL	1	\	Angled probes scanning area only
X-Y or W-Z	3	\	For Transverse discontinuities from 31mm to 60mm
C-D or E-F	2-3	\	For Transverse discontinuities from 60mm to 100mm
A and B	2-3	1,25	
A and B	4	0,5	

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ROSETTI MARINO SPA	**NDT INSTRUCTION SHEET SPECIFICATION**	**N°** **IDL-QCI-UT-0222** **Rev.** 02 **Data** 13/08/2020

UT TEST OF T JOINT 1/2V , K ON BEAMS, PLATES AND PIPE

APPLICABLE UP TO 15 mm OF THICKNESS



PROBE CHARACTERISTIC

PROBE N°	ANGLE	FREQ. (Mhz)	PROBE DIMENSION (mm)	CRYSTAL	WAVE FORM	NOTE
1	0°	4	3,5x10	Double	Longitudinal	
2	70°	4	8x9	Single	Shear	
3	60°	4	8x9	Single	Shear	

(Different models of probes with similar characteristic may be used)

SCANNING DETAILS

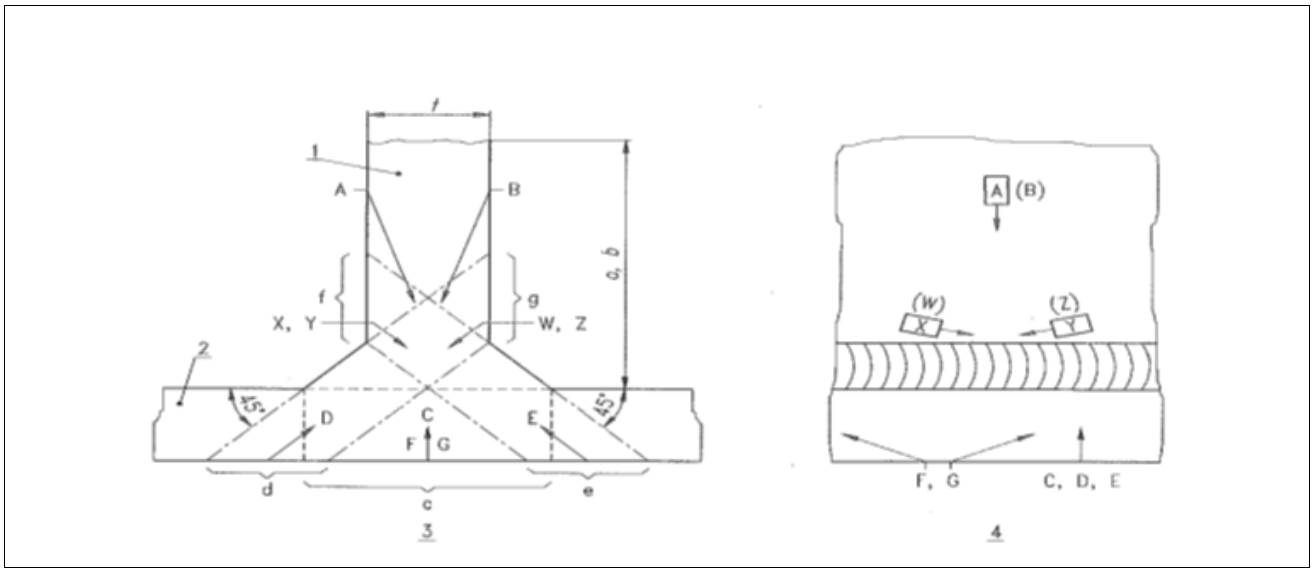
SCAN Position	PROBE N°	SKIP	NOTE
PARENT MATERIAL	1	\	Angled probes scanning area only
A or B	2-3	0-1,25	
C	1	\	

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ROSETTI MARINO SPA	**NDT INSTRUCTION SHEET SPECIFICATION**	**N°** **IDL-QCI-UT-0223** **Rev.** 02 **Data** 13/08/2020

UT TEST OF T JOINT 1/2V , K ON BEAMS, PLATES AND PIPE

APPLICABLE FROM 16mm TO 30 mm OF THICKNESS



PROBE CHARACTERISTIC

PROBE N°	ANGLE	FREQ. (Mhz)	PROBE DIMENSION (mm)	CRYSTAL	WAVE FORM	NOTE
1	0°	4	3,5x10	Dual	Longitudinal	
2	70°	4	8x9	Single	Shear	
3	60°	4	8x9	Single	Shear	
4	0°	4	3,5x10	Dual	Longitudinal	

(Different models of probes with similar characteristic may be used)

SCANNING DETAILS

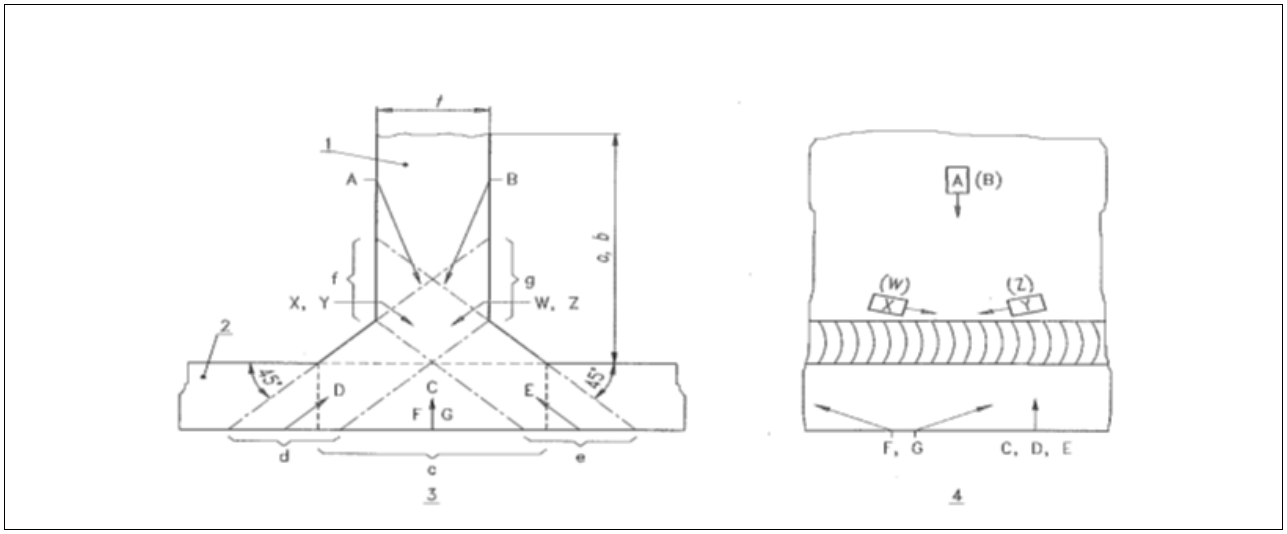
SCAN Position	PROBE N°	SKIP	NOTE
PARENT MATERIAL	1	\	Angled probes scanning area only
A and B	2-3	0-1,25	
C	4	\	Scanning zone c

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ROSETTI MARINO SPA	**NDT INSTRUCTION SHEET SPECIFICATION**	**N°** **IDL-QCI-UT-0224** **Rev.** 03 **Data** 13/08/2020

UT TEST OF T JOINT 1/2V , K ON BEAMS, PLATES AND PIPE

APPLICABLE FROM 31mm TO 100 mm OF THICKNESS



PROBE CHARACTERISTIC

PROBE N°	ANGLE	FREQ. (Mhz)	PROBE DIMENSION (mm)	CRYSTAL	WAVE FORM	NOTE
1	0°	4	3,5x10	Dual	Longitudinal	
2	60°	2	14x14	Single	Shear	
3	45°	2	14x14	Single	Shear	
4	70°	2	14x14	Single	Shear	
5	0°	4	3,5x10	Dual	Longitudinal	

(Different models of probes with similar characteristic may be used)

SCANNING DETAILS

SCAN Position	PROBE N°	SKIP	NOTE
PARENT MATERIAL	1	\	Angled probes scanning area only
A and B	2-3-4	0-0,75	
C	5	\	Scanning zone c

Attachment 6 – examination report

ROSETTI MARINO

TEST REPORT - NDT ACTIVITIES

RAPPORTO DI ESAME CON ULTRASUONI

ULTRASONIC TEST REPORT

DATA / Date

FOGLIO / Sheet n° 1 of

COMMESSA / JOB	PROGETTO / Project	CLIENTE / Client	NUMERO ORDINE / Order number	DISCIPLINA / Discipline

CODICE PROCEDURA / Procedure code	CODICE SPECIFICA / Specification number	ISTRUZIONE DI LAVORO UT / UT Work instruction
Rev.		Rev.

CRITERIO DI ACCETTABILITÀ / Acceptable criteria	INSPECTION TEST PLAN / ITP	FASE IPT / ITP Phase
	Rev.	

OGGETTO / Object	FASE DEL CONTROLLO / Examination Phase	TRATTAMENTO TERMICO / Post Weld Heat Treatment
☐ MAT. BASE Parent mat. ☐ SALDATURA Weld metal		☐ PRIMA del TT Before PWHT ☐ DOPO TT After PWHT ☐ NON APPLICABILE Not Applicable

STATO SUPERFICIALE / Superficial condition

☐ SALDATO As Welded ☐ SPAZZOLATO As brushed ☐ LAVORATO A MACCHINA As Machined ☐ CLADDATO As cladded ☐ MOLATO As Grounded

☐ LAMINATO As rolled ☐ GREZZO As forged ☐ SABBIATO As Blasted ☐ VERNICIATO As painted ☐ ALTRO Other

APPARECCHIATURA Equipment	TIPO / Type	NUMERO DI SERIE Serial number	LIQUIDO D'ACCOPPIAMENTO Couplant medium	SMORZAMENTO Damping	SOGLIA Reject

BLOCCO DI CALIBRAZIONE Calibration block	CONTROLLO MATERIALE BASE Parent material inspection	BLOCCO DI RIFERIMENTO Reference block	SENSIBILITÀ DI TARATURA Calibration sensitivity	TECNICA DI CONTROLLO Control technique	TARATURA SCALA Time base calibration

TRASDUTTORE Probe manufacturer	NUMERO DI SERIE Serial number	FREQUENZA Frequency (MHz)	DIMENSIONE Size (mm)	ANGOLO Beams Angle: NOMINALE Nominal (°)	ANGOLO Beams Angle: RISCONTRATO Actual (°)	USCITA FASCIO Probe index (mm)	GUA DAGNO Gain setting (dB)	SENSIBILITÀ SCANSIONE Scan sensitivity (dB)	PERDITA DI TRASFERIMENTO Transfer correction (dB)	ONDE Wave

LO STATO FISICO E L'ASPETTO ESTERNO DELL'APPARECCHIATURA COMBINATA E' STATO VERIFICATO PRIMA DELL'UTILIZZO E RISULTA CONFORME AI REQUISITI APPLICABILI
The combined equipment physical state and external aspect has been checked before using and it complies with the applicable requirements

OGGETTO CONTROLLATO / Tested object

COMPONENTE / Item

Nr. RAPPORTO Report Nr.	SALDATURA Weld number	DISEGNO Drawing Nr	FG. Sheet	MARCA Mark	MATERIALE Material	DIMENSIONE Dimension	Sp. Thk	WPS	TECNICA Process	ESTENSIONE Extent of test	ESITO result

NOTE / Remarks

TECNICO CND NDT Technician	CONTROLLO QUALITA Quality control supervisor	ISPETTORE CLIENTE Company Resp.	ISPETTORE TERZA PARTE Third part inspector
Company: Operator:			

SECOND PAGE IN CASE OF REJECTABLE FOR RECORDER INDICATIONS

MOD-QCI-35, rev. 0 del 27/10/2003

	CERTIFICATO D'ESAME CON ULTRASUONI - ULTRASONIC TEST CERTIFICATE	N°	Pag 1 di 1
		Data/date:	Rev.
Progetto / Project		Commessa / Job	
Cliente / Client		Disegno / Dwg.	

SCHIZZO - Sketch

Scanning Position

1 ☐
2 ☐
3 ☐
4 ☐
5 ☐
6 ☐
7 ☐

LOCALIZZAZIONE DIFETTI – DEFECTS LOCATION			
q	= DISTANZA DIFETTO – ASSE SALDATURA Flaw – Weld axis distance	Δ h	= ALTEZZA DELL'INDICAZIONE Flaw height
H	= ALTEZZA DEL PICCO Pitch level	Δ d	= DISTANZA TRA DUE INDICAZIONI COMPLANARI Distance between two coplanar flaws
(N)	= PUNTO DI RIFERIMENTO Reference point	EF	= DIFETTO EQUIVALENTE Equivalent flaw
L	= DISTANZA DI INDICAZIONE DA (N) Flaw distance from (N)	Δ l	= LUNGHEZZA INDICAZIONE Flaw length
A/R	= ACCETTABILE / RIPARARE Acceptable / Repair	P	= PROFONDITA' INDICAZIONE Flaw depth
P. us	= PERCORSO ULTRASONORO Ultrasonic path	D	= DISTANZA ASSE SONDA – ASSE SALDATURA Sound beam – weld axis distance

H	EF	Δ l	P	Δ h	q	D	Δ D	L	(N)	P. us	POS	A/R	NOTE

OPERATORE Operator	CONTROLLO QUALITA' Quality Control	ISPETTORE CLIENTE Company Representative	ISPETTORE A.I. Inspection Agency

Attachment 7 – acceptance levels

Threshold	T1	T2	T3	T4
Threshold values	Evaluation level	Reference level +6dB	Reference level - 6dB	9dB[a] or 15dB[b]

a) For transverse waves
b) Between reflections obtained with transverse waves and longitudinal waves

- Stage 1 (T1, i.e. evaluation level): All indications ≤ T1 are not classified.

- Stage 2 (T2, i.e. reference level +6 dB): An indication being at least twice as reflective as the reference reflector is classified as planar discontinuity.

Stage 3 of the flowchart procedure shall be applied only to those indications exceeding:

a) Thickness t for the range 12mm ≤ t ≤ 15mm
b) t/2 or 15mm, whichever is larger, for thickness over 15mm

For indications not exceeding the specified length, proceed to stage 4

- Stage 3 (T3, i.e. reference level -6 dB): If the indication echo amplitude is at least half of the reference echo and, if the imbalance in reflectivity is greater than or equal to T4, the indication is classified as planar:

    - with T4 = 9 dB for shear waves;
    - with T4 = 15 dB between reflections obtained with shear waves and longitudinal waves.

- The angles at which the ultrasonic beam is incident upon the indication shall have a difference of at least 10°.
- The comparison shall be made upon the same area of the indication.
- Stages 4 and 5: These criteria shall be fulfilled for at least two directions of examination.
- Stage 5: If the echo dynamic pattern does not match pattern 3, the indication is classified as non-planar.

Note:

H_d : Indication echo amplitude

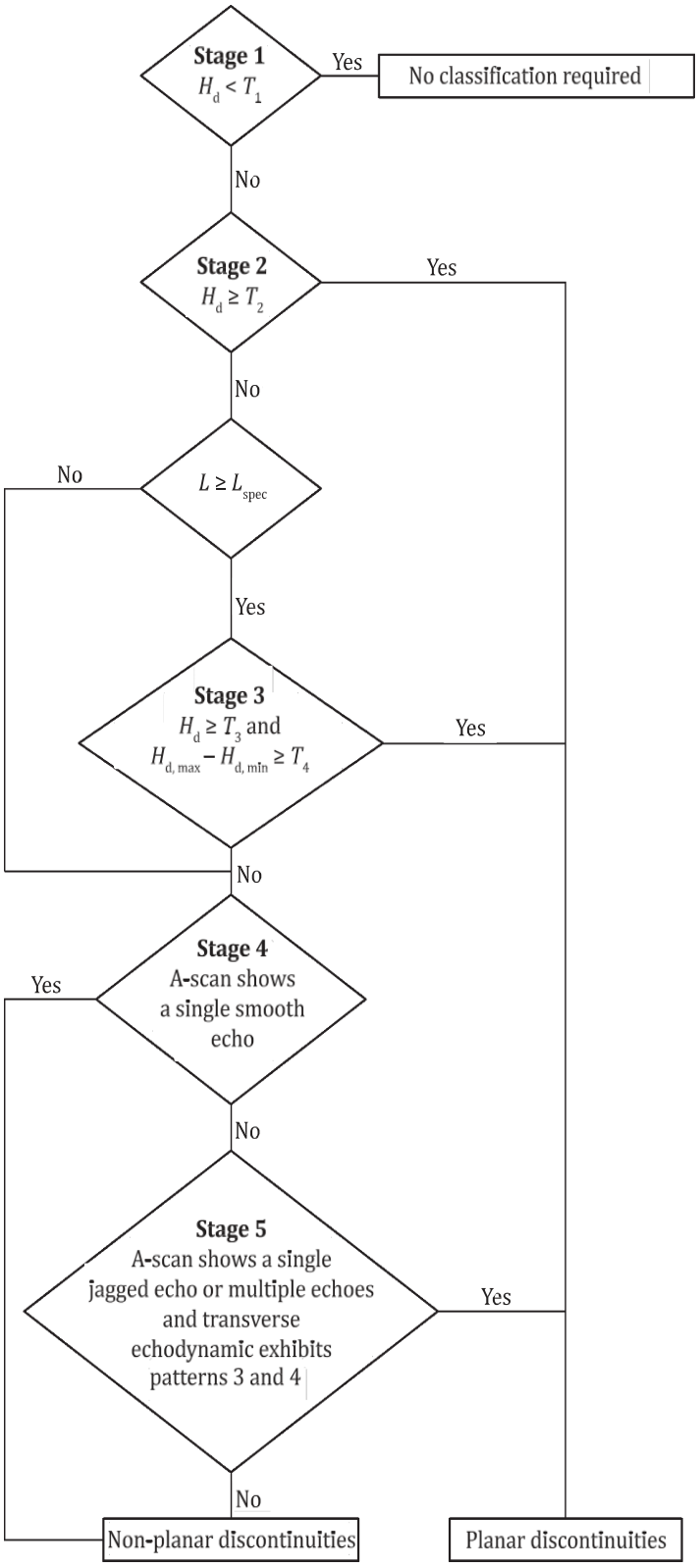
$H_{d,max}$: Maximum echo amplitude

$H_{d,min}$: Minimum echo amplitude

L : Length

L_{spec} : Specified Length

T1,T2,T3,T4 See table (above)



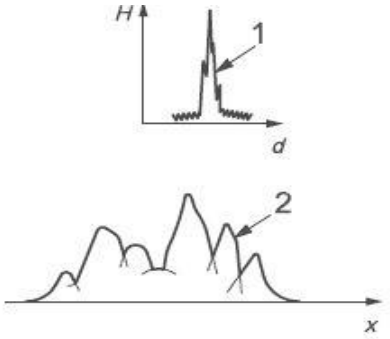
Pattern 3

Depending upon the angle of incidence of the probe beam on the reflector.

At any probe position, the A-scan shows a single but ragged echo.

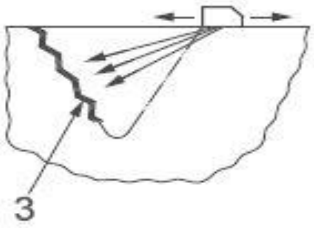
As the probe is moved, this may undergo large (greater than ±6 dB) random fluctuations in amplitude.

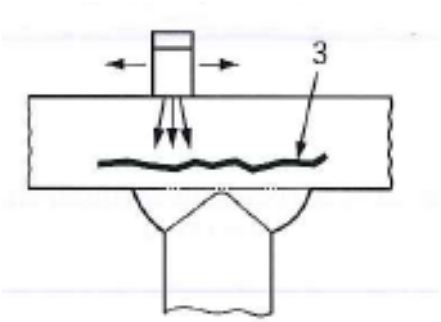
The fluctuations are caused by reflection from different facets of the reflector, and by random interference of waves scattered from groups of facets.



a) probe position of A-scan and variation in signal amplitude

b) typical occurrence in through thickness direction





c) typical occurrence in lateral (length) direction

Note:

1: A-scan

2: variation in peak signal amplitude

3: reflector

D: range

H: amplitude

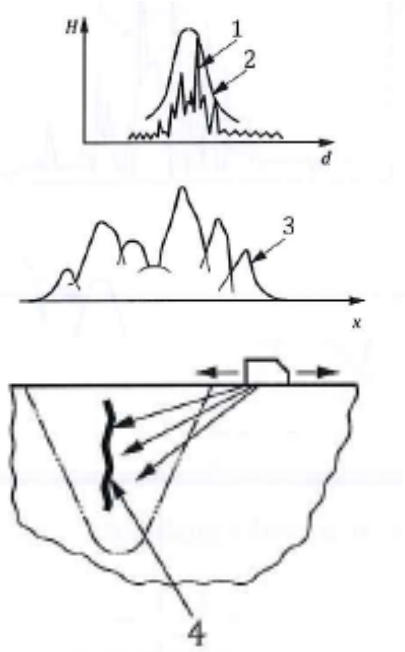
X: probe position

Pattern 4

At any probe position, the A-scan shows an extended train of signals within a bell-shaped pulse envelope.

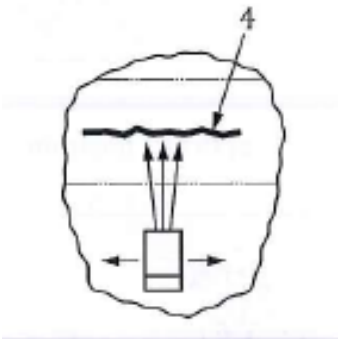
As the probe is moved, each subsidiary peak travels through the pulse envelope, rising to its own maximum towards the center of the envelope and then falling.

The overall signal may show large (greater than ±6dB) random fluctuations in amplitude.



a) Probe position of A-scan and variation in signal amplitude

b) typical occurrence in through thickness direction



Note:

1: A-scan

2: pulse envelope

3: variation in signal peak amplitude

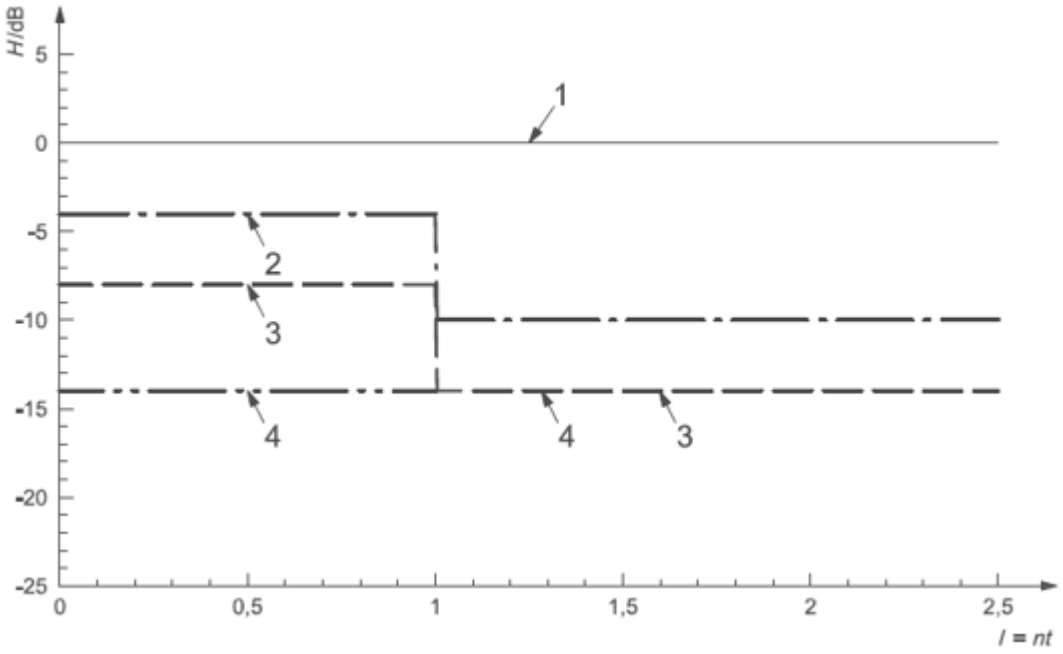
4: reflector

d: range

H: amplitude

x: probe position

LEVELS FOR TECHNIQUE 1 FOR THICKNESSES 8mm TO 15mm – ACCEPTANCE LEVEL 2



Key

1 Reference level

2 Acceptance level 2

3 Recording level

4 Evaluation level

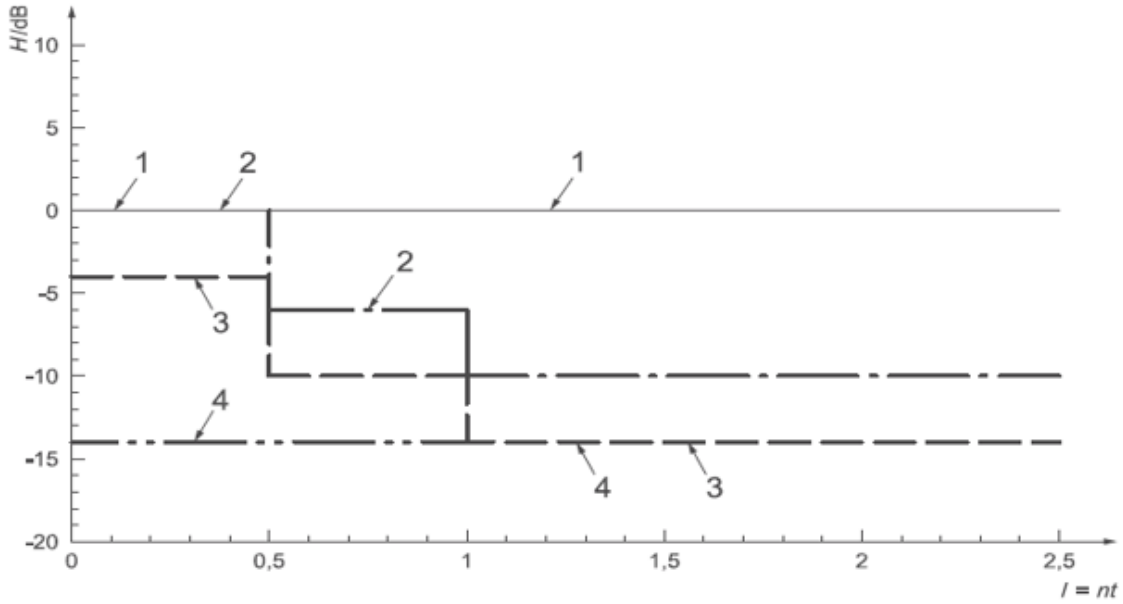
H Amplitude

L Indication length

n Multiplier of t

t Thickness

LEVELS FOR TECHNIQUE 1 FOR THICKNESSES 15mm TO 100mm – ACCEPTANCE LEVEL 2



Key

1 Reference level

2 Acceptance level 2

3 Recording level

4 Evaluation level

H Amplitude

L Indication length

n Multiplier of t

t Thickness

Technique	Evaluation level 2	Acceptance level 2	
		8mm≤ t < 15mm	15mm≤ t < 100mm
1 (side drilled holes)	H_0 – 14dB	For l≤t: H_0 – 4 dB For l>t: H_0 – 10 dB	For l≤0,5 t: H_0 For 0,5 t< l ≤t H_0 – 6dB For l > t H_0 – 10 dB

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