طرح نگهداشت و افزایش تولید 27 مخزن

NDE PROCEDURE

نگهداشت و افزایش تولید میدان نفتی بینک

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1. INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also, PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

2. GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – Supply Of Fire Water Pumps
EPD/EPC CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR/PURCHASER:	Joint Venture of: Hirgan Energy – Design & Inspection (D&I) Companies
VENDOR:	Kalaye Pump Company
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
TPI:	Third Party Inspector.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

PART I – PT PROCEDURE

3. SCOPE

3.1. This procedure establishes the minimum requirements and techniques for liquid penetrant testing of nonporous metal, the ferrous materials, steel casting, and their welds related.

3.2. This procedure applies to in-process, final, and in-service liquid penetrant inspections to detect discontinuities that are open to the part surface.

3.3. This procedure will address the use of Color Contrast Penetrants using Water Washable and Solvent removable.

3.4. This procedure shall be used for Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries which are fabricated as per ANSI/API Standard 610 and ISO 13709: 2003.

4. APPLICABLE CODES, STANDARDS, AND SPECIFICATIONS

4.1. ANSI/API Standard 610 11th Edition, September 2010, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries.
4.2. ISO 13709: 2003, Centrifugal pumps for petroleum, petrochemical, and natural gas industries.
4.3. ASME BPVC, Sec. V, Article 6.
4.4. ASME BPVC Sec VIII Div.1 Appendix 7 & 8
4.5. SNT-TC-1A-2006
4.6. ASTM e 165, e 1417, e 1209.
4.7. Company specification for fabrication of Pump.
4.8. Pump data sheet

5. PERSONNEL QUALIFICATION

5.1 .All personnel performing liquid penetrant testing shall be qualified by SNT-TC-1A or shall have a valid certificate issued by ASNT NDT Level - III Examiner.

5.2 .If liquid penetrant testing is to be performed by the NDT subcontractor, all personnel belonging to the subcontractor shall be qualified by a subcontractor in accordance with the subcontractor's qualification procedure based on SNT-TC-1A.

5.3 .Responsibility

5.3.1 .QC Manager shall be responsible for the implementation and control of this procedure.

5.3.2 .ASNT NDT Level III Examiner shall be responsible for the qualification of NDT Operator.

5.3.3 .NDT Level II operator shall be responsible for the interpretation of the liquid penetrant testing concerning this procedure and for preparing the test reports.

6. EXAMINATION PROCEDURE

6.1. General

6.1.1. As per clause 7.2.2 of API 610 the Method and Procedure of Examination shall be by ASME BPVC Sec V Article 6.

6.1.2. Penetrant materials shall be Colour contrasted using Water Washable and Solvent removable.
6.1.3. All materials used during the test (cleaners, penetrant, and developers) shall be certified not to exceed 1% by weight in sulphur, for Nickel base alloys, and the total Halogens content not to exceed 1% by weight for Austenitic or Duplex Stainless Steel and Titanium content, following the requirements of Article 6, Mandatory Appendix II. Records of certification shall include the penetrant materials manufacturer's batch numbers and test results. These records shall be maintained as required by the referencing Code section.
6.1.4. Penetrant materials from different manufacturers, or a different type or family group, shall not be intermixed.
6.1.5. With colour contrast penetrants, a minimum light intensity of 100 fc (1000 Lux), as measured with a calibrated light meter, is required on the surface to be examined. The light source, the technique used, and light level verification are required to be demonstrated one time, documented, and maintained on file.
6.1.6. When the casting specification requires heat treatment, these examinations shall be conducted after that heat treatment.
6.1.7. Visual inspection will be made of the tested area for surface defects.
6.1.8. All indications shall be evaluated following Para. 8.0 & 9.0.

6.2. Surface Conditioning

6.2.1. In general satisfactory results may be obtained when the surface of the part is in the as-welded, as-rolled, as-cast, or as-forged condition.

6.2.2. Surface preparation by grinding or machining may be necessary where surface irregularities could mask indications due to discontinuities.

6.2.3. Before the liquid penetrant examination, the surface to be examined and all adjacent areas within at least 1 in. (25mm) shall be cleared dry and free of all dirt, grease, lint, scale, welding flux, and spatter oil, or other extraneous matter that could interfere with the examination.

6.2.4. Cleaning may be accomplished using tergents, organic solvents, solutions, paint removers, vapor degreasing, sand or grit blasting, or by ultrasonic cleaning methods.

6.2.5. Final penetrant inspection shall be performed before application of any surface finish or coating such as anodize, paint, or plating.

6.2.6. Final liquid penetrant inspection shall be performed after completion of all manufacturing operations that can generate surface discontinuities or expose existing subsurface discontinuities.

6.3. Penetrant Application

6.3.1. The penetrant shall be applied by brushing, dipping, or spraying.

6.3.2. The minimum penetration time shall be under Table 1.0, but shall not exceed 30 minutes or that recommended by the penetrant manufacturer, and in no case shall the penetrant be allowed to dry during the dwell period.

Material	Form	Type of Discontinuity	Dwell Times (minutes) NOTES (1, 2)	
			Penetrant	Developer
Steel Or Cast Iron	Castings and Welds	Cold Shuts, Porosity,Lack of Fusion, cracks (all forms)	5	10

Table 1: Minimum Dwell Times

Notes:
1. for temperature ranges from 50°F to 125°F (10°C to 52°C).
2. for temperature range from 40°F to 50°F (5°C to 10°C) minimum dwell times shall be 2 times the value listed.

6.4. Excess Penetrant Removal

6.4.1. After the specified penetration (dwell) time has elapsed, any penetrant remaining on the surface shall be removed, taking care to minimize removal of penetrant from discontinuities.
6.4.2. Remove excess solvent removable penetrant, with clean, dry, lint free cloth or absorbent paper. If all the penetrants cannot be removed with the dry cloth or paper, the cloth or paper may be slightly dampened with solvent and surfaces lightly wiped to remove the remaining traces. Flushing the surface with solvent following the application of penetrant and before developing is prohibited.
6.4.3. Excess water washable penetrant shall be removed with a water spray. The water pressure shall not exceed 40psi (280kPa), and the water temperature shall not exceed 110°F (43°C). Rinse time should not exceed 120 seconds unless otherwise specified by part of the material specification.

6.5. Developing

6.5.1. A liquid non-aqueous developer shall be used and applied by spraying only. For solvent removable penetrants, the developer shall be applied as soon as possible after excess penetrant removal. Care shall be taken to ensure complete coverage of the part or examination area with an even, thin film of a developer.
6.5.2. For Water washable penetrants the developer will be applied to a dry surface. Developer solutions shall be frequently agitated. Care shall be taken to ensure complete coverage of the part or examination area with an even, thin film of a developer.
6.5.3. The minimum final interpretation developing time begins as soon as the wet developer coating is dry. The minimum developing time shall be specified in Table 1.0.
6.5.4. The observation of penetrant indication shall, as a rule, be made immediately after the formation.

6.6. Examination

6.6.1. For Colour Contrast penetrant examination shall begin immediately after application of the Non-aqueous developer and as the indications are forming. The final interpretation shall not be made before ten (10) minutes or later than a maximum of 60 minutes after the developer is dry. If the surface to be examined is large enough to preclude complete examination within the prescribed or established time, the examination shall be performed in increments.

6.7. Post Examination Cleaning

6.7.1. Post examination shall be performed as soon as possible upon completion of all inspection activities. Any cleaning shall be conducted using a process that does not adversely affect the part.

7. TECHNIQUES FOR STANDARD TEMPERATURES

7.1. The temperature of the penetrant and the surface of the part to be processed shall not be below 40°F (5°C) or above 125°F (52°C) throughout the examination period. Local heating or cooling is permitted provided the part temperature remains in the range of 40°F (5°C) to 125°F (52°C) during the examination.

8. PROCEDURE FOR NONSTANDARD TEMPERATURES

8.1. When a liquid penetrant examination cannot be conducted within the temperature range of 40°F to 125°F, the examination procedure requires qualification at the proposed higher or lower temperature range. This qualification shall require the use of a quench cracked aluminum block designated as a liquid penetrant comparator block.
8.2. Application of Liquid Penetrant Comparator Block
8.2.1. To qualify a liquid penetrant examination procedure at a temperature of less than 40°F, the proposed procedures shall be applied to block “B” after the block and all penetrant materials have been cooled and held at the proposed examination temperature until the comparison if completed. A standard procedure that has been previously demonstrated shall be applied to block “A” in the 40°F to 125°F range. The indications revealed on blocks “A” and “B” shall be compared and if the indications are essentially the same on both blocks the proposed procedure shall be qualified for use.
8.2.2. To qualify for an examination above 125°F, block “B” shall be held at this temperature throughout the examination. Block “A” shall be subjected to a previously demonstrated procedure in the 40°F to 125°F temperature range. The indications revealed on Blocks “A” and “B” shall be compared and if the indications are essentially the same on both blocks, the proposed procedure shall be qualified to use.
8.3.3. A procedure qualified at a temperature lower than 40°F shall be qualified from that temperature to 40°F. To qualify a procedure for temperatures above 125°F, the upper and lower temperature limits shall be established and the procedure qualified at these temperatures.

9. EXTENT OF TEST

9.1. All surfaces including machined gasket seating surfaces shall be examined fully unless the surfaces are examined by the Magnetic Particle method.
9.2. All casting having a maximum body thickness less than 4 ½ in. (114 mm) shall be examined as follows:
9.3. prescribed herein. When more than five castings are being produced, examination, as prescribed, shall be performed on the first five and on one additional casting for each five additional five castings produced. If any of these additional castings proves to be unacceptable, each of the remaining four castings of that group shall be examined fully.
9.4. All casting having a maximum body thickness of 4 ½ in. (114 mm) and greater and casting of a lesser thickness which is intended for severe service applications shall be examined as follows:
All surfaces including machined gasket seating surfaces shall be examined fully, unless the surfaces are examined by the Magnetic Particle method.

10. EVALUATION OF INDICATIONS

10.1. Since the penetrant indication include some non-relevant indications caused by reasons other than defects, great care must be taken for the discrimination between non-relevant and relevant indications.
10.2. Indications will be revealed by the color of penetrant material. All such indications are not necessarily imperfections.
10.3. An indication is the evidence of a mechanical imperfection. Only indications that have any dimension greater than 1/16 in. shall be considered relevant.
10.4. A linear indication is one having a length greater than three times the width.
10.5. A rounded indication is one of circular or elliptical shape with a length equal to or less than three times its width.
10.6. Any questionable or doubtful indications shall be re-examined to determine whether they are relevant or not.

11. ACCEPTANCE CRITERIA

These acceptance criteria shall apply unless other more restrictive standards are specified for specific materials.

11.1. For Fabrications

As per clause 7.2.2 of API 610, the ASME BPVC Sec VIII Div 1 Appendix 8 shall be used for fabrications and it is as follows:

11.1.1. Relevant linear indications

11.1.2. Relevant rounded indications greater than 3/16 in. (5mm).

11.1.3. Four or more relevant rounded indications in a line separated by 1/16 in. (1.5 mm) or less, edge to edge.

11.2. For Castings

11.2.1. As per clause 7.2.2 of API 610, the ASME BPVC Sec VIII Div 1 Appendix 7 shall be used for castings and it is as follows:

11.2.2. Surface indications determined by liquid penetrant testing are unacceptable if they exceed the following limits:

(a) All cracks and hot tears;

(b) any group of more than six linear indications other than those in (a) above in any rectangular area of 1½ in. x 6 in. (350 mm x 150 mm) or less or any circular area having a diameter of 3 ½ in. (88 mm) or less these areas being taken in the most unfavorable location relative to the indication being evaluated;

(c) other linear indications more ¼ in. (6 mm) long for thickness up to ¾ in. (19 mm) inclusive, more than one-third of the thickness in length for thicknesses from ¾ in. to 2 ¼ in. (19 mm to 57 mm), and more than ¾ in. (19mm to 57 mm), and more than ¾ in. (19 mm) long for thicknesses above 2 ¼ in. (57 mm)(aligned acceptable imperfections separated from one another by a distance equal to the length of the longer imperfection are acceptable);

(d) Indications of nonlinear imperfection which have any dimension exceeding 3/16 in. (5 mm).

12. RE-EXAMINATION

12.1. Treatment of indications believed a non-relevant any indication which is believed to be non-relevant shall be regarded as an imperfection unless it is shown by re-examination by the same method or by the use of other non-destructive methods and/or by surface conditioning that no unacceptable imperfection is perfect.

12.2. Examination of areas from where imperfections have been removed. After a defect is thought to have been removed and before weld repairs, the area shall be examined by suitable methods to ensure it has been removed or reduced to an acceptably sized imperfection.

12.3. Re-examination of Repair Areas

12.3.1. After repairs have been made, the repaired area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners and re-examined by the magnetic particle method and by all other methods of examination that were originally required for the affected area.

12.3.2. except the surfaces are examined by Magnetic Particle Method to ensure it has been removed or reduced to an acceptable size.

12.3.3. The finished surface of all repair welds shall be examined except the surfaces are examined Magnetic Particle Method.

12.3.4. Where the depth of repairs is less than 1 in. or 20% of the section thickness whichever is lesser, and when repaired section cannot be radiographed effectively the first layer of each ¼ in. 6 mm thickness of deposited weld metal shall be examined except the surfaces are examined by Magnetic Particle Method.

13. RECORDS

Examination condition and interpretation & evaluation shall be recorded on the report form of Liquid Penetrant Examination Attachnebt#1, attached to this procedure.

LIQUID PENETRANT EXAMINATION REPORT			
Client:		Report No. :	
Project Code:		Date of Report :	
Drawing No.:		Request No.:	
Item :		Material	
Time of Examination:		Thickness :	
Surface Condition : As Welded As Ground As Brushed As Machined As Forged As Cast			
Penetrant Batch No.: Marker : Spray Immerse Brush Other	Emulsifier Batch No.: Marker : Spray Immerse Brush Other	Remover Batch No.: Marker : Spray Immerse Brush Other	Developer Batch No.: Marker : Spray Immerse Brush Other
Examination Method Colour Fluorescent Water Washable		Solvent Post Emulsify able Other	
Surface Temperature : (20) ° C			
Dwell time : 15 Min. 00 sec.		Developing Time : 10 Min. 00 sec.	
Code / Standard :	Acceptance Criteria:	Extent of examination :	

Examination Sketch :

Part No	Weld No	Result		Test Location(Cm)		
		ACCEPT	REJECT	From	To	L(Cm)
Remarks: ----------				Total Test(Cm).:		

Satisfactory Unsatisfactory		Attachment : Yes No	
NDT Operator Level II:	Manufacturer:	NARGAN Co:	Client:
NAME : SIGN : *DATE:*	NAME : SIGN : *DATE:*	NAME : SIGN : *DATE:*	NAME : SIGN : *DATE:*

PART II - UT PROCEDURE

1. SCOPE

This procedure describes the minimum requirements for methods and techniques to be used when performing straight beam or angle beam, pulse-echo direct contact ultrasonic examination (manual) of welds and base metal in accordance with the requirements of Article 4, ASME Section V.

This procedure describes the general requirements for safety, materials, equipment, personnel, and technique and acceptance criteria. When differences exist between this procedure and technical specification, the technical specification shall govern.

The weld and/or material types and configuration to be examined shall be in accordance with manufacturing drawing.

This procedure is intended to be used on thickness of 8mm to 150mm.

2. REFERENCES

- ASME Sec. V. 2004 Ed. with 2005 Add.
- ASME Sec. VIII. Div1. 2004 Ed. with 2005 Add.
- ASNT SNT-TC-1A -2006
- ANSI/API Standard 610 Tenth Edition, October 2004 , Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries.

3. PERSONNEL

- Personnel performing this examination shall be qualified in accordance with the requirements of ASME Code and ASNT Recommended Practice, SNT-TC-1A Code Adopted 96 Ed. 98 Add. and 2001 Ed.
- Only qualified and certified UT Level II or III personnel in ultrasonic examination shall interpret test results to determine acceptability.

4. GENERAL REQUIREMENT

4.1. Surface Preparation

When the base material or weld surface interferes with the examination, the base material or weld shall be prepared as needed to permit the examination.

4.2. Examination Coverage

The volume shall be examined by moving the search unit over the examination surface so as to scan entire examination volume. Each pass of the search unit shall overlap a minimum of 10% of the transducer (piezoelectric element) dimension perpendicular to the direction of the scan.

4.3. Rate of search Unit Movement

The rate of search unit movement for examination shall not exceed 6in./sec unless calibration is verified at scanning speed.

4.4. Recording Sensitivity Level

The examinations recording of indications shall be made with respect to the reference level.

5. EQUIPMENT AND SUPPLIES

5.1. Instrument

A pulse-echo-type of ultrasonic instrument shall be used. The instrument shall be capable of operation at frequencies over the range of at least 1 MHZ to 5 MHZ and shall be equipped with a stepped gain control in units of 2.0dB or less. If the instrument has a damping control, it may be used of it does not reduce the sensitivity of the examination. The reject control shall be in the “off” position for all examinations, unless it can be demonstrated that it does not affect the linearity of the examination. The instrument, when required because of the technique being used, shall have both send and receive jacks for operation of dual search units or a single search unit with send and receive transducers.

5.2. Search Units

5.2.1. Straight beam(longitudinal Wave) Search Unit The transducers shall have an active area of not less than 5Φ nor more than 40Φ. Transducer frequency shall be 2 to 5MHz.

5.2.2. Angle Beam Search Unit The search unit shall produce a sound beam in the material being tested within plus or minus 20 of one of the following proper angels : 700, 600, 450.The transducer frequency shall be between 2 and 5 MHz, inclusive. The transducer crystal shall be square or rectangular in shape and may vary from 4mm to 15mm in width and from 4mm to 15mm in height.

5.3. Couplant

Couplants having good wetting characteristics such as glycerin, or SAE NO. 20 or SAE NO. 30 motor oil shall be used.

1) General
   The couplant, including additives, shall not be detrimental to the material being examined.

2) Control of Contaminants

3) Couplants used on nickel base alloys shall not contain more than 250 ppm of sulfur.

4) Couplants used on austenitic stainless steel or titanium shall not contain more than 250ppm of halides (chlorides plus fluorides).

5.4. Calibration Blocks

5.4.1. Non-Piping Calibration Blocks

(1) Basic Calibration Block

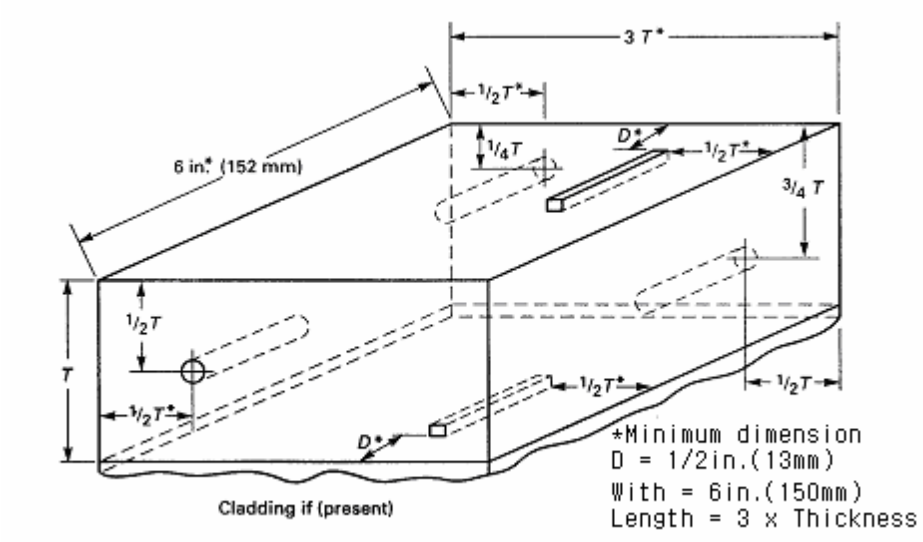
The basic calibration block configuration and reflectors shall be as shown in Fig.1. the block size and reflector locations shall be adequate to perform calibrations for the beam angles used.

(2) Block Thickness

When two or more base material thicknesses are involved, the calibration block thickness shall be determined by the average thickness of the weld. Alternatively, a calibration block having the greater base material thickness may be used provided the reference reflector size is based upon the average or smaller weld thickness.

(3) Block Range of Use

When the block thickness ±1 in.(25mm) spans two weld thickness ranges as shown in Fig.1, the block's use shall be acceptable in those portions of each thickness range covered by 1in.(25mm) of the calibration block's thickness. As an example, a calibration block with a thickness of 1 1/2in(38mm) could be used for weld thicknesses of 0.5in.(13mm) to 2.5in.(64mm). Weld Thickness(t) in.(mm) Calibration Block Thickness(T) in. (mm) Hole in. (mm)



Weld Thickness(t) in.(mm)	Calibration Block Thickness(T) in. (mm)	Hole Diameter in.(mm)	Notch Dimensions in.(mm)
Up to 1(25) Over 1(25) through 2(50) Over 2(50) through 4(100) Over 4(100)	3/4(19) or t 1 1/2(38) or t 3(76) or t t±1(25)	3/32(2.4) 1/8(3) 3/16(5) **	Notch Depth=2% T Notch Width=1/4(6)max. Notch Length=1(25)min.

** Minimum dimension
** For each increase in weld thickness of 2in.(50mm), or fraction thereof over 4in.(100mm), the hole diameter shall increase 1/16in.(1.5mm)

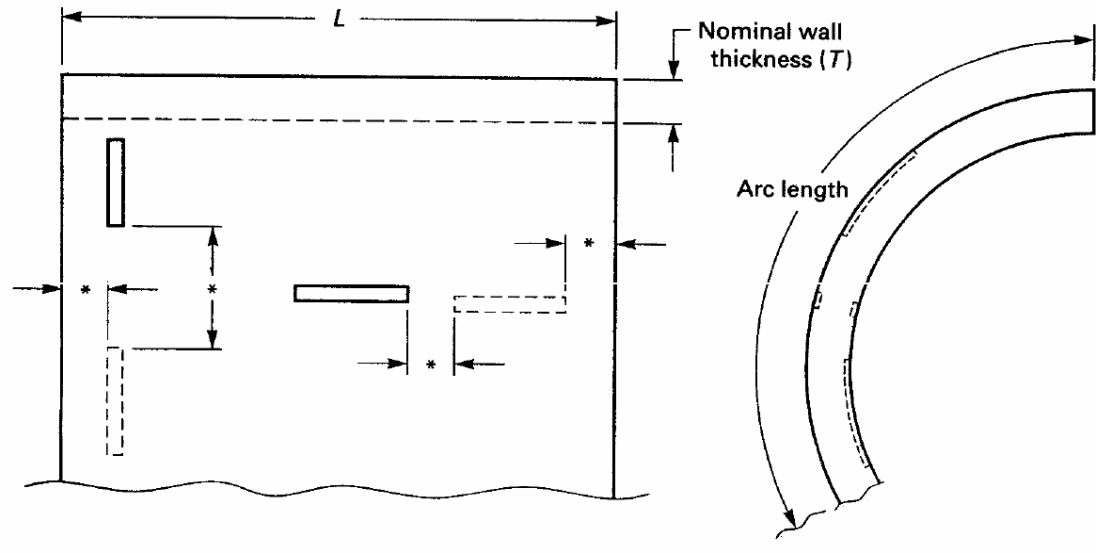
Fig. 1 Non-Piping Calibration Blocks

GENERAL NOTES:

(a)Holes shall be drilled and reamed 1.5in.(38mm) deep minimum, essentially parallel to the examination surface.
(b) For components equal to or less than 20in.(500mm) in diameter. calibration block diameter shall meet the requirements of T-434.1.7.2 Two sets of calibration reflectors (holes, notches) oriented 90 deg from each other shall be used. Alternatively, two curved calibration blocks may be used.
(c) The tolerance for hole diameter shall be ±1/32in.(0.8mm). The tolerance for hole location through the calibration block thickness(i.e., distance from the examination surface) shall be ±1/8in.(3.2mm).
(d) All three holes may be located on the same face (side) of the calibration block provided care is exercised to locate all the reflectors(holes. notches) to prevent one reflector from affection the indication from another reflector during calibration. Notches may also be in the same plane as the inline holes(See Appendix J, FIG.J-431). As in FIG. J-431, a sufficient number of holes shall be provided for both angle and straight beam calibrations at the 1/4T,1/2T and 3/4T depths.
(e) Minimum notch depth shall be 1.6%T and maximum notch depth shall be 2.2%T plus the thickness of cladding, if present.
(f) Maximum notch width is not critical. Notches may be made by EDM or with end mills up to 1/4in.(6.4mm)in diameter

5.4. Piping Calibration Blocks

The basic calibration block configuration and reflectors shall be as shown in Fig.2. The basic calibration block shall be a section of pipe of the same nominal size and schedule. The block size and reflector locations shall be adequate to perform calibration for the beam angles used.



* Notches shall be located not closer than T or 1in.(25mm), whichever is greater, to any block edge or to other notches.

GENERAL NOTES:

(a) The minimum calibration block length (L) shall be 8in.(200mm) or 8T, whichever is greater.
(b) For OD 4in.(100mm) or less, the minimum arc length shall be 270deg. For OD greater than 4in.(100mm), the minimum arc length shall be 8in.(200mm) or 3T, whichever is greater
(c) Notch depths shall be from 8% T minimum to 11% T maximum, Notch widths shall be 1/4in.(6mm) maximum. Notch lengths shall be 1in.(25mm) minimum.
(d) Maximum notch width is not critical. Notches may be made with EDM or with end mills up to 1/4in.(6mm) in diameter.
(e) Notch lengths shall be sufficient to provide for calibration with a minimum 3 to 1 signal-to-noise ratio.

Fig.2 Calibration Block for Pipe

6. CALIBRATION

6.1. instrument Linearity Checks

The requirements of 6.1.1 and 6.1.2 shall be met at intervals not to three months or prior to first use thereafter.

6.1.1. Screen Height Linearity.

Position an angle beam search unit on a calibration block, as shown in Fig.3 sothat indications from both the 1/2 and 3/4T holes give a 2:1 ratio of amplitudes between the two indications. Adjust the sensitivity (gain) so that the larger indication is set at 80% of full screen height(FSH). Without moving the search unit, adjust sensitivity (gain) to successively set the larger indication from 100% to 20% of full screen height, in 10% increments(or 2 dB steps if a fine control is not available), and read the smaller indication at each setting. The reading shall be 50% of the larger amplitude, within 5% of FSH. The settings and readings shall be estimated to the nearest 1% of full screen. Alternatively, a straight beam search unit may be used on any calibration block that provides amplitude differences, with sufficient signal separation to prevent overlapping of the two signals.

6.1.2. Amplitude Control Linearity.

Position an angle beam search unit on a basic calibration block, as shown in Fig.3 so that the indication from the 1/2T side-drilled hole is peaked on the screen. Adjust the sensitivity (gain) as shown in the following table. The indication shall fall within the specified limits. Alternatively, any other convenient reflector from any calibration block may be used with angle or straight beam search units.

The settings and readings shall be estimated to the nearest 1% of full screen.

Indication Set at % of Full Screen	DB Control Change	Indication Limits # of Full Screen
80%	-6 dB	32 to 48%
80%	-12 dB	16 to 24%
40%	+6 dB	64 to 96%
20%	+12 dB	64 to 96%

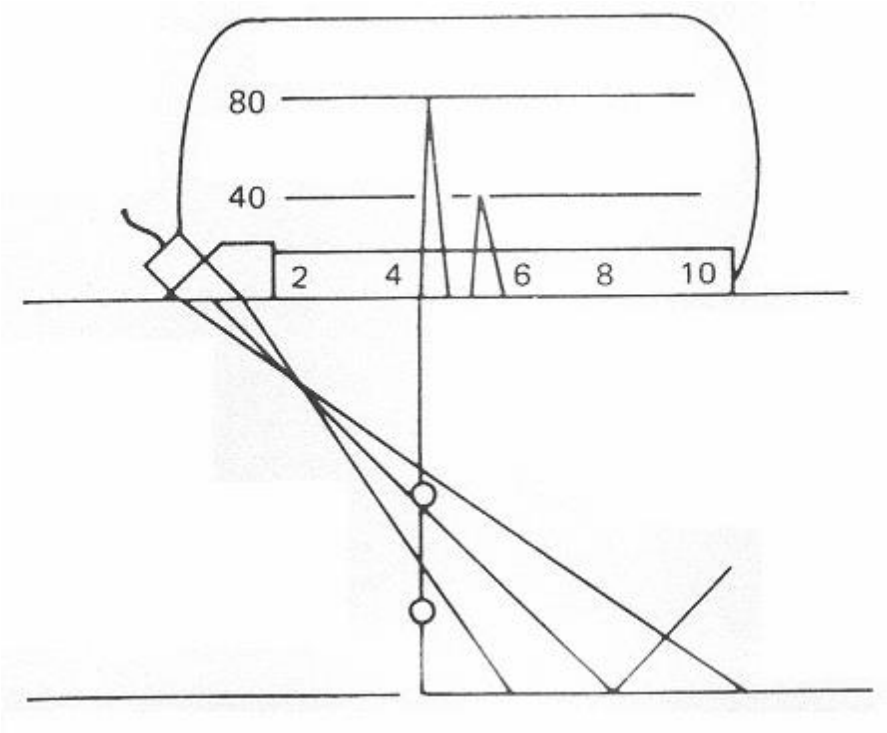


Fig. 3 LINEARITY

6.2. Calibration for Non-Piping

6.2.1. System Calibration for Distance Amplitude Techniques

(1) Calibration Block(s): Calibrations shall be performed utilizing the calibration block shown in Fig.1.

(2) Techniques: Para. 8.5 provide general techniques for both angle beam and straight beam calibrations. Other techniques may be used. The angle beam shall be directed toward the calibration reflector that yields the maximum response in the area of interest. The gain control shall be set so that this response is 80% ±5% of full screen height. This shall be the primary reference level. The search unit shall then be manipulated, without changing instrument settings, to obtain the maximum responses from the other calibration reflectors at their beam paths to generate the distance amplitude correction (DAC) curve. These calibrations shall establish both the distance range calibration and the distance amplitude correction.

(3) Angle Beam Calibration: As applicable, the calibration shall provide the following measurements:

(a) Distance range calibration;

(b) distance-amplitude;

(c) echo amplitude measurement from the surface which in the basic calibration block. When an electronic distance-amplitude correction device is used, the primary reference responses form the basic calibration block shall be equalized over the distance range to be employed in the examination. The response equalization line shall be at a screen height of 40% to 80% of full screen height.

(4) Straight Beam Calibration : The calibration shall provide the following measurements

(a) distance range calibration and;

(b) distance-amplitude correction in the area of interest.
When an electronic distance-amplitude correction device is used, the primary reference responses form the basic calibration block shall be equalized over the distance range to be employed in the examination. The response equalization line shall be at a screen height of 40% to 80% of full screen height.

6.2.2. System Calibration for Non-Distance Amplitude Techniques

Calibration includes all those actions required to assure that the sensitivity and accuracy of the signal amplitude and time outputs of the examination system are repeated from examination to examination. Calibration may be by use of basic calibration blocks with artificial or discontinuity reflectors.

6.3. Calibration for Piping

6.3.1. System Calibration for Distance Amplitude Techniques

(1) Calibration Block(s) : Calibrations shall be performed utilizing the calibration block shown in Fig. 2.
(2) Angle Beam Calibration : The angle beam shall be directed toward the calibration reflector that yields the maximum response. The gain control shall be set so that this response is 80% ±5% of full screen height. This shall be the primary reference level. The search unit shall then be manipulated, without changing instrument settings, to obtain the maximum responses from the calibration reflectors at the distance movements necessary to generate a three-point distance-amplitude correction(DAC) curve. Separate calibrations shall be established for both the axial and circumferential notches. These calibrations shall establish both the distance range calibration and the distance amplitude correction. (3) Alternate Calibration Reflectors : Side-drilled holes may be used provided that it can be demonstrated that the hole calibration produces a sensitivity equal to or greater than the notch calibration.
(4) Straight Beam Calibration : When required, straight beam calibrations shall be performed to the requirements of para. 8.6 using the side drilled hole alternate calibration reflectors of 6.3.1(3). This calibration shall establish both the distance range calibration and the distance amplitude correction.

6.3.2. System Calibration for Non-Distance Amplitude Techniques.
Calibration includes all those actions required to assure that the sensitivity and accuracy of the signal amplitude and time outputs of the examination system are repeated from examination to examination. Calibration may be by use of basic calibration blocks with artificial or discontinuity reflectors.

6.4. Calibration Confirmation

6.4.1. System Changes : When any part of the examination system is changed, a calibration check shall be made on the basic calibration block to verify that distance range points and sensitivity setting(s) satisfy the requirements of 6.4.3.
6.4.2. Periodic Examination Checks : A calibration check on at least one of the basic reflectors in the basic calibration block or a check using a simulator shall be made at the finish of each examination or series of similar examinations, every 4hr during the examination, and when examination personnel are changed. The distance range points and sensitivity setting(s) recorded shall satisfy the requirements 6.4.3.

6.4.3. Confirmation Acceptance Values

(a) Distance Range Points : If any distance range point has moved on the sweep line by more than 10% of the distance reading or 5% of full sweep, whichever is greater, correct the distance range calibration and note the correction in the examination record. All recorded indications since the last valid calibration or calibration check shall be reexamined and their values shall be changed on the data sheets or recorded. (b) Sensitivity Settings: If any sensitivity setting has changed by more than 20% or 2dB of its amplitude, correct the sensitivity calibration and note the correction in the examination record. If the sensitivity setting has decreased, all data sheets since the last valid calibration check shall be marked void and the area covered by the voided data shall be reexamined. If the sensitivity setting has increased, all recorded indications since the last valid calibration or calibration check shall be reexamined and their values shall be changed on the data sheets or re-recorded.

7. EXAMINATION

Before performing the angle beam examinations, a straight beam examination shall be performed on the volume of base material through which the angle beams will travel to locate any reflectors that can limit the ability of the angle beam to examine the weld volume.

7.1. Weld Joint Distance Amplitude Technique

7.1.1. Angle Beam Technique:

(a) Beam Angle : The search unit and beam angle selected shall be 45deg or an angle appropriate for the configuration being examined and shall be capable of detecting the calibration reflectors, over the required angle beam path.

(b) Reflectors Parallel to the Weld Seam : The angle beam shall be directed at approximate right angles to the weld axis from both sides of the weld(i.e., from two directions) on the same surface when possible. The search unit shall be manipulated so that the ultrasonic energy passes through the required volume of weld and adjacent base material.

(c) Reflectors 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 required volume of weld and adjacent base material. The search unit shall be rotated 180deg 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 direction.

7.1.2. Restricted Access Welds : Welds that cannot be fully examined from two directions using the angle beam technique(e.g., corner and tee joints) shall also be examined, if possible, with a straight beam technique. These areas of restricted access shall be noted in the examination report.

7.1.3. Inaccessible Welds : Welds that cannot be examined from at least one side (edge) using the angle beam technique shall be noted in the examination report. For flange welds, the weld may be examined with a straight beam or low angle longitudinal waves from the flange face provided the examination volume can be covered.

7.2. Evaluation Level

7.2.1. Distance Amplitude Techniques : All indications greater than 20% of the reference level shall be investigated to the extent that they can be evaluated in terms of the acceptance criteria.

7.2.2. Non-Distance Amplitude Techniques : All indications longer than 40% of the rejectable flaw size shall be investigated to the extent that they can be evaluated in terms of the acceptance criteria.Evaluation of Laminar Reflectors.

7.2.3. 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.

8. PROCEDURE

8.1. Preparation Prior to examination

1) Obtain procedure, drawing and other information.
2) Confirm previous steps on HOLD were signed-off appropriately.

8.2. Material and Equipment

1) Use the following material and equipment listed below, and record type or KPC Registered No. on the Examination Report.
a) Flaw detector
b) Search Unit
c) Couplant
d) Basic calibration Block

8.3. Surface Condition

Confirm the surface preparation to be examined.

8.4. Examination Area

1) Confirm the examination areas and scanning line on the part to be examined.
2) Mark scanning line on the part to be examined as follows ;
The layout of the weld shall consist of placing reference points on the center line of the weld. The standard spacing of the reference points shall be 12 in. All points shall be identified with their numbers : 0, 1, 2, 3, 4,etc. The numbers of points, distance apart, and starting point shall be recorded on the reporting form. The weld center line shall be divided for the two examination surfaces.
a) Circumferential (girth) welds The standard starting point shall be 0deg. The reference point shall be numbered clockwise, as viewed from the top of the component. The examination surfaces shall be identified as above or below the weld. b) Longitudinal (vertical) Welds Longitudinal welds shall be laid out from the center line of circumferential welds at the top end of the weld. The examination surface shall be identified as clockwise or counterclockwise as viewed from the top of the component.

8.5. System Calibration - Angle Beam

System calibration shall be performed prior to use of the system in the thickness range under examination.

8.5.1. Sweep Range Calibration

1) Side Drilled Holes (Fig.4)

(a) Delay Control Adjustment - Position the search unit for the maximum first indication from the 1/4T side-drilled hole (SDH). Adjust the left edge of this indication to line 2 on the screen with the delay control.

(b) Range Control Adjustment - Position the search unit of the maximum indication from the 3/4T SDH. Adjust the left edge of this indication to line 6 on the screen with the range control.

(c) Repeat Adjustments - Repeat delay and range control adjustments until the 1/4T and 3/4T SDH indications start at sweep lines 2 and 6.

(d) Notch Indication - Position the search unit for maximum response from the square notch on the opposite surface. The indication will appear near sweep line 8.

(e) Sweep Readings - Two divisions on the sweep now equal 1/4T

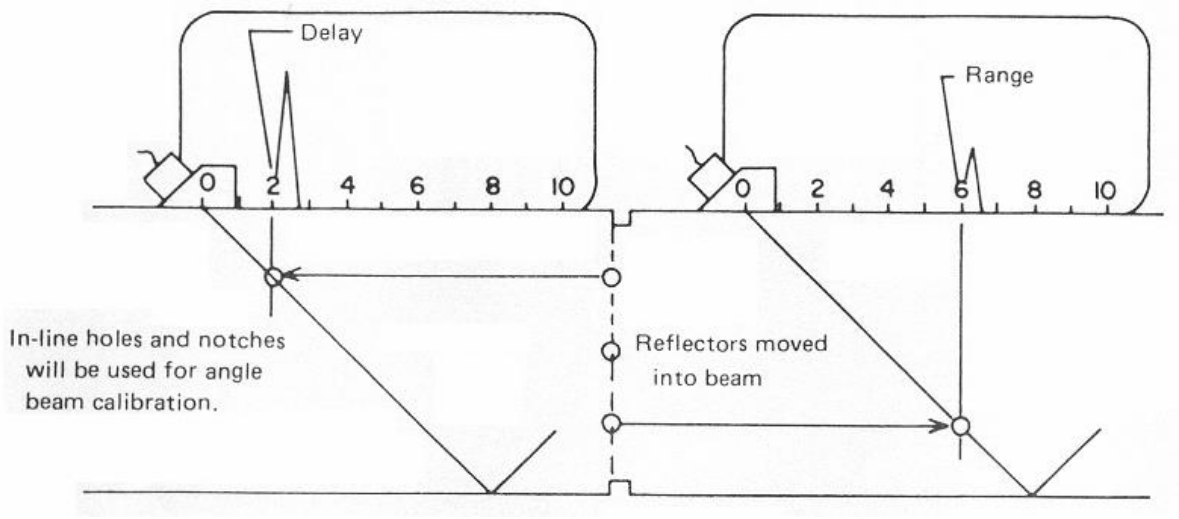


FIG. 4 SWEEP RANGE(SIDE DRILLED HOLES)

2) IIW Block (Fig.5) - IIW Reference Blocks may be used to calibrate the sweep range displayed on the instrument screen. They have the advantage of providing reflectors at precise distances that are not affected by side drilled hole location inaccuracies in the basic calibration block or the fact that the reflector is not at the side drilled hole centerline. These blocks are made in a variety of alloys and configurations. Angle beam range calibrations are provided from the 4in.(100mm) radius and other reflectors. The calibration block shown in Fig.5 provides an indication at 4in.(100mm) and a second indication from a reflection from the vertical notches at the center point 8in.(200mm) back to the radius and returning to the transducer when the exit point of the radius. Other IIW blocks provide signals at 2in.(50mm) and 4in.(100mm) and a third design provides indications at 4in.(100mm) and 9in.(225mm).

(a) Search Unit Adjustment - Position the search unit for the maximum indication from the 4in.(100mm) radius while rotation it side to side to also maximize the second reflector indication.

(b) Delay and Range Control Adjustment - Without moving the search unit, adjust the range and delay controls so that the indications start at their respective metal path distances.

(c) Repeat Adjustments - Repeat delay and range control adjustments until the two indication are at their proper metal path on the screen.

(d) Sweep Readings - Two divisions on the sweep now equal 1/5 of the screen range selected.

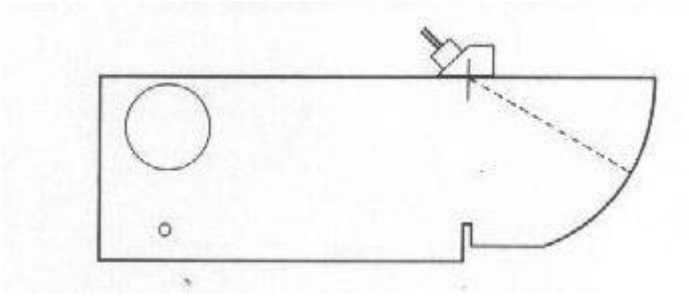


FIG. 5 SWEEP RANGE (IIW TYPE BLOCK)

3) Piping Block(Fig.6) - The notches in piping calibration blocks may be used to calibrate the distance range displayed on the instrument screen. They have the advantage of providing reflectors at precise distances to the inside and outside surfaces.
(a) Delay control Adjustment - Position the search unit for the maximum first indication from the inside surface notch at its actual beam path on the instrument screen. Adjust the left edge of this indication to its metal path on the screen with the delay control.
(b) Range Control Adjustment - Position the search unit for the maximum second indication from the outside surface notch. Adjust the left edge of this indication to its metal on the screen with the range control or velocity control.
(c) Repeat Adjustments - Repeat delay and range control adjustments until the two indications are at their proper metal paths on the screen.
(d) Sweep Readings - Two division on the sweep now equal 1/5 of the screen range selected.

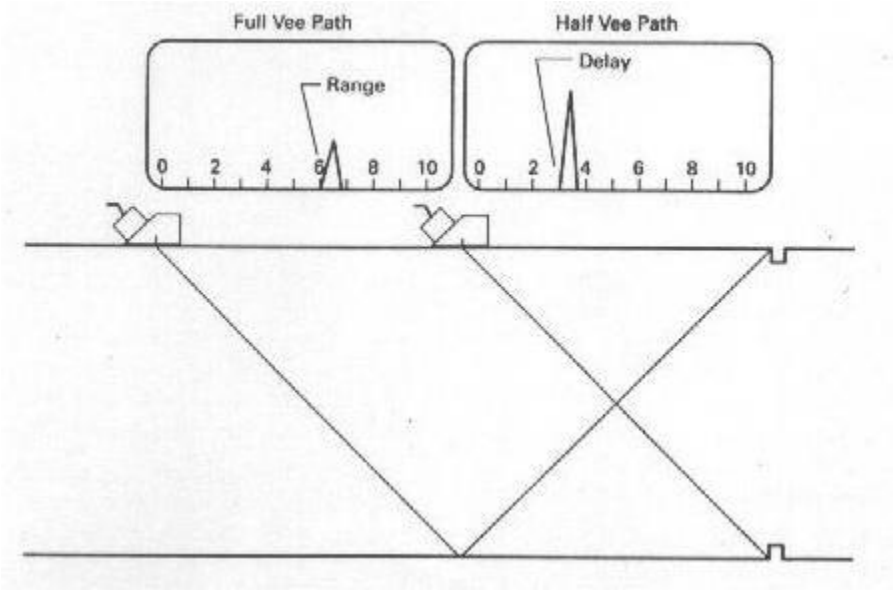


FIG. 6 SWEEP RANGE(NOTCHES)

8.5.2. Distance-Amplitude Correction

1) Calibration for Side Drilled Holes Primary Reference Level From Clad Side(Fig.7)
(a) Position the search unit for maximum response from the SDH, which gives the highest amplitude.

(b) Adjust the sensitivity (gain) control to provide an indication of 80%(±5%) of full screen height (FSH). Make the peak of the indication on the screen.
(c) Position the search unit for maximum response from another SDH.
(d) Make the peal of the indication on the screen.
(e) Position the search unit for maximum amplitude from the third SDH and mark the peak on the screen.
(f) Position the search unit for maximum amplitude from the 3/4T SDH after the beam has bounced from the opposite surface. The indication should appear near sweep line 10. Make the peak on the screen for the 3/4Tposition.
(g) Connect the screen marks fir the SDHs to provide the distance amplitude curve (DAC).\(h) For calibration correction for perpendicular reflectors at the opposite surface, refer to Straight Beam.

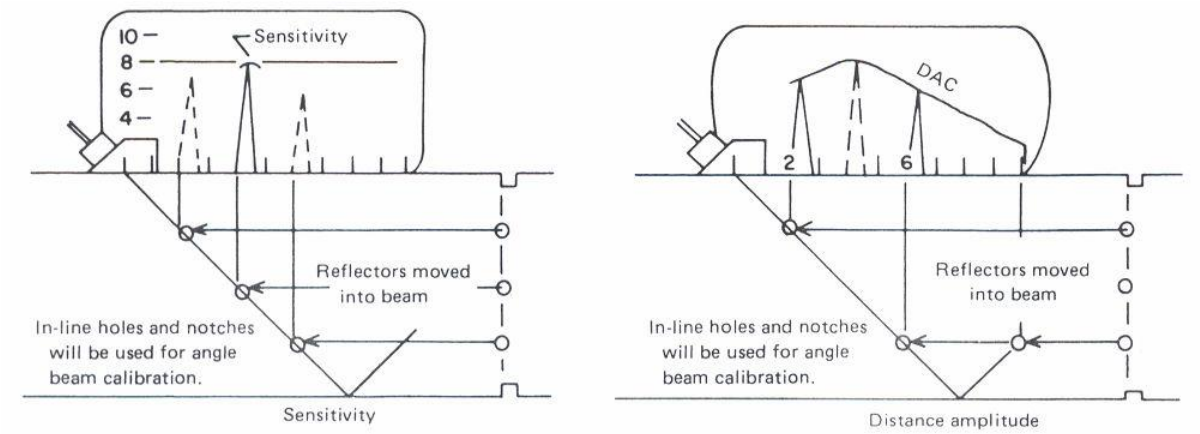


FIG. 7 SENSITIVITY AND DISTANCE AMPLITUDE CORRECTION (SIDE DRILLED HOLES)

2) Calibration for Side Drilled Holes Primary Reference Level From Unclad Side(Fig.7)
(a) From the clad side of the block. determine the dB change in amplitude between the 3/4T and 5/4T SDH positions.
(b) From the unclad side, perform calibrations as noted in 8.5.2 (a) through 8.5.2 (e).
(c) To determine the amplitude for the 5/4T SDH position, position the search unit for maximum amplitude from the 3/4T SDH. Decrease the signal amplitude by the number do dB determined in (a) above. Mark the height of this signal amplitude at sweep line 10(5/4T Position).
(d) Connect the screen marks to provide the DAC. This will permit evaluation of indications down to the clad surface (near sweep line 8).
(e) For calibration correction for perpendicular reflectors at the opposite surface, refer to Straight Beam.
3) Calibration for Piping Notches Primary Reference Level (Fig.8)
(a) Position the search unit for maximum response from the notch which gives the highest amplitude.
(b) Adjust the sensitivity (gain) control to provide an indication of 80% (±5%) of full screen height (FSH). Mark the peak of the indication on the screen. (c) Without changing the gain, position the search unit for maximum response from another notch.

(d) Mark the peak of the indication on the screen. (e) Position the search unit of maximum amplitude from the remaining notch at its Half vee, Full Vee or 3/2Vee beam paths and mark the peak on the screen.
(f) Position the search unit for maximum amplitude from any additional Vee Path(s) when used and mark the peak(s) on the screen.
(g) Connect the screen marks for the notches to provide the distance-amplitude curve (DAC).
(h) These points also may be captured by the ultrasonic instrument and electronically displayed.

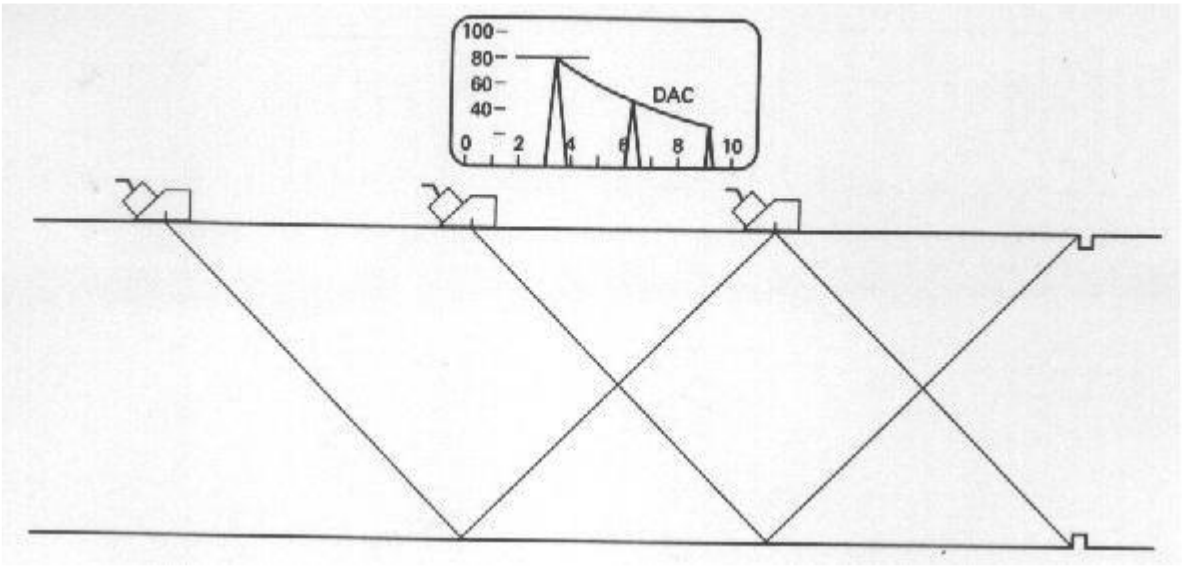


FIG. 8 SENSITIVITY AND DISTANCE-AMPLITUDE CORRECTION (NOTCHES)

8.5.3. Distance-Amplitude Correction Inner 1/4 Volume(Fig.9)

(a) Number of Beam Angles : The 1/4 volume angle calibration requirement may be satisfied by using one or more beams as required to calibrate on 1/8in.(3mm) maximum diameter side drilled holes in that volume.
(b) Calibration From Unclad Surface : When the examination is performed from the outside surface, calibrate on the 1/8in.(3mm) diameter side drilled holes to provide the shape of the DAC from 1/2in.(13mm) to t/4 depth. Set the gain to make the indication from 1/8in.(3mm) diameter side drilled hole at 1/4T depth the same height as the indication from the 1/4Tdepth hole as determined in 8.5.2 1) or 8.5.2 2) above. Without changing the gain, determine the screen height of the other near surface indications from the remaining 1/8in.(3mm) diameter side drilled holes from 1/2in.(13mm) deep to the 1/8in.(3mm) diameter side drilled hole just short of the 1/4T depth. Connect the indication peaks to complete the near surface DAC curve. Return the gain setting to that determined in 8.5.2 1) or 8.5.2 2).
(c) Calibration From Clad Surface : When the examination is performed from the inside surface, calibrate on the 1/8in.(3mm) diameter side drilled holes to provide the shape
of the DAC and the gain setting, as per 8.5.3 2) above.

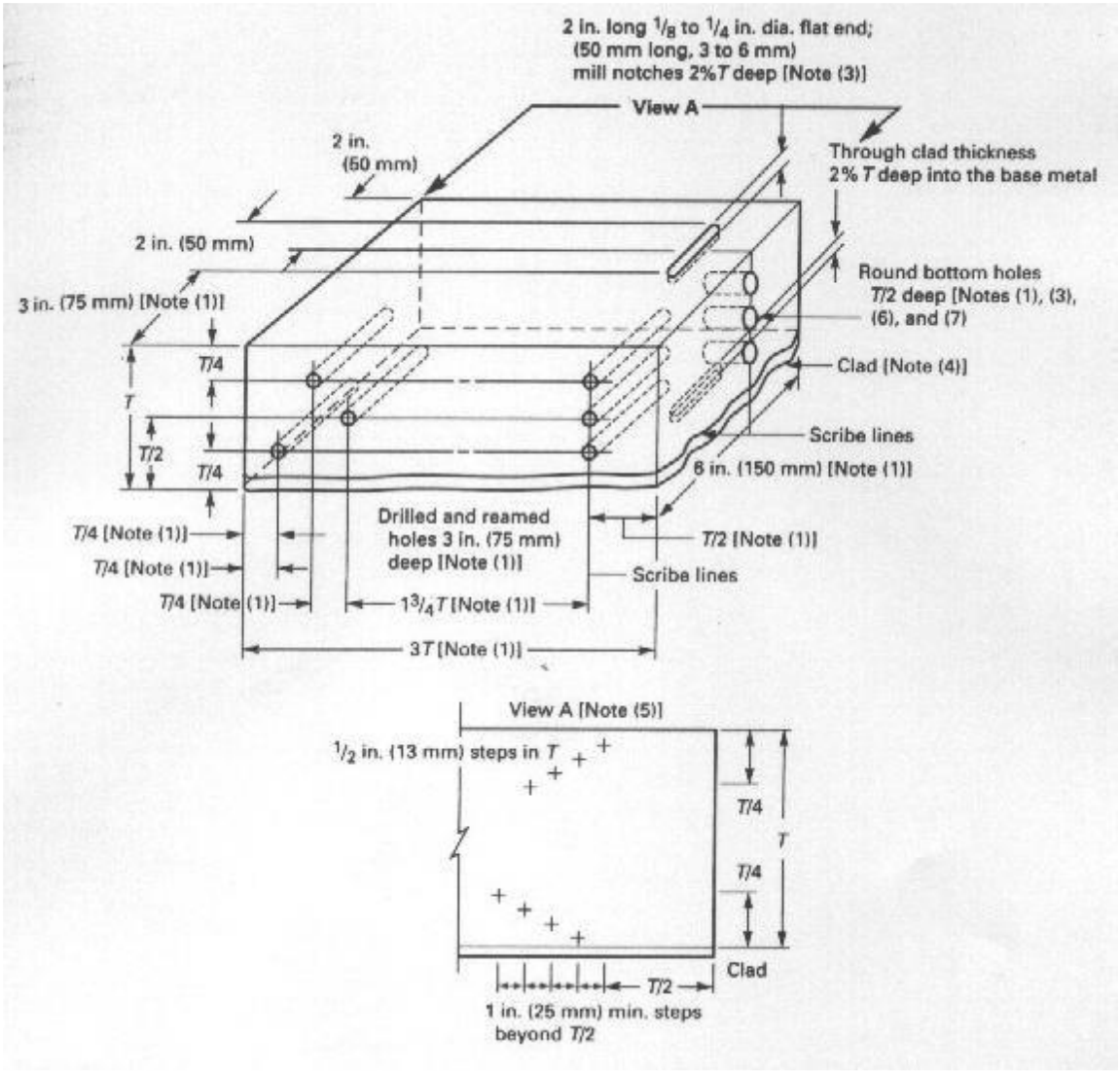


FIG. 9 BASIC CALIBRATION BLOCK

8.5.4. Position Calibration(Fig.10)

The following measurements may be made with a ruler, scale, or marked on an indexing strip. (a) 1/4T SDH Indication - Position the search unit for maximum response from the 1/4T SDH. Place one end of the indexing strip against the front of the search unit, the other end extending in the direction of the beam. Mark the number 2 on the indexing strip at the scribe line which is directly above the SDH. (If the search unit covers the scribe line, the marks may be made on the side of the search unit.) (b) 1/2T and 3/4T SDH Indications : Position the search unit for maximum indications from the 1/2T and 3/4T SDHs. Keep the same end of the indexing strip against the front of the search unit. Mark the numbers 4 and 6 on the indexing strip at the scribe line, which are directly above the SDHs.

(c) 5/4T SDH Indication : If possible, position the search unit so that the beam bounces from the opposite surface to the 3/4T SDH. Mark the number 10 on the indexing strip at the scribe line, which is directly above the SDH.
(d) Notch Indication : Position the search unit for the maximum opposite surface notch indication. Mark the number 8 on the indexing strip at the scribe line, which is directly above the notch.
(e) Index Numbers : The numbers on the indexing strip indicate the position directly over the reflector in sixteenths of the V-path. Depth : The depth from the examination surface to the reflector is T at 8, 3/4T at 6 and 10, 1/2T at 4, 1/4T at 2, and 0 at 0. Interpolation is possible for smaller increments of depth. The position marks on the indexing strip may be corrected for the radius of the hole if the radius is considered significant to the accuracy of reflector's location.

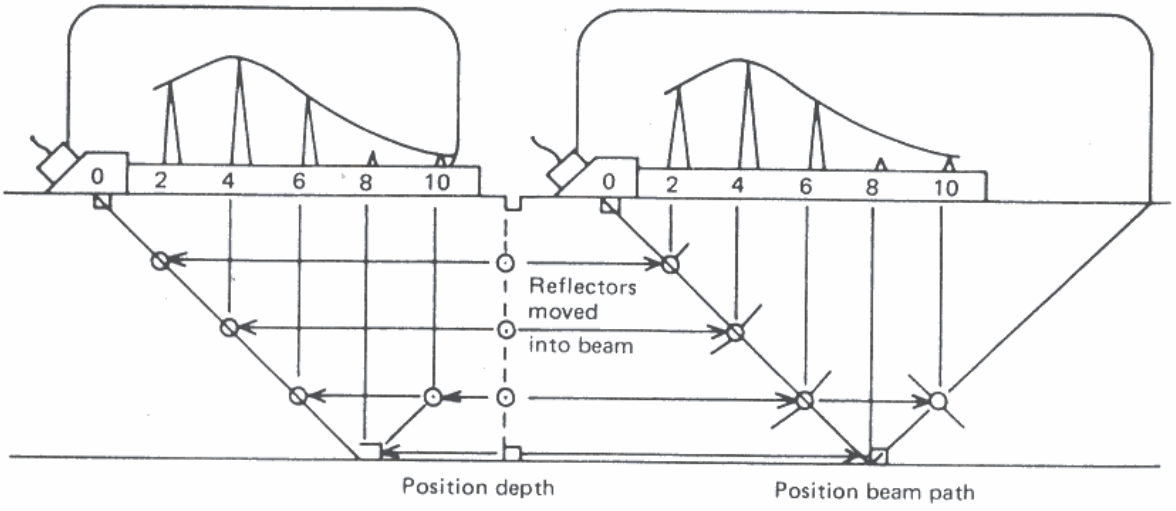


FIG. 10 POSITION DEPTH AND BEAM PATH

8.6. System Calibration - Straight Beam

8.6.1. Sweep Range Calibration (fig. 11)
(a) Delay Control Adjustment: Position the search unit for the maximum fist indication from the 1/4T SDH. Adjust the left edge of this indication to line 2 on the screen with the delay control.
(b) Range Control Adjustment: Position the search unit for the maximum indication from the 3/4T SDH. Adjust the left edge of this indication to line 6 on the screen with the range control.
(c) Repeat Adjustments: Repeat the delay and range control adjustments until the 1/4T and 3/4T SDH indications start at sweep lines 2 and 6.
(d) Back Surface Indication: The back surface indication will appear near sweep line 8.
(e) Sweep Readings: Two divisions on the sweep equal 1/4T.

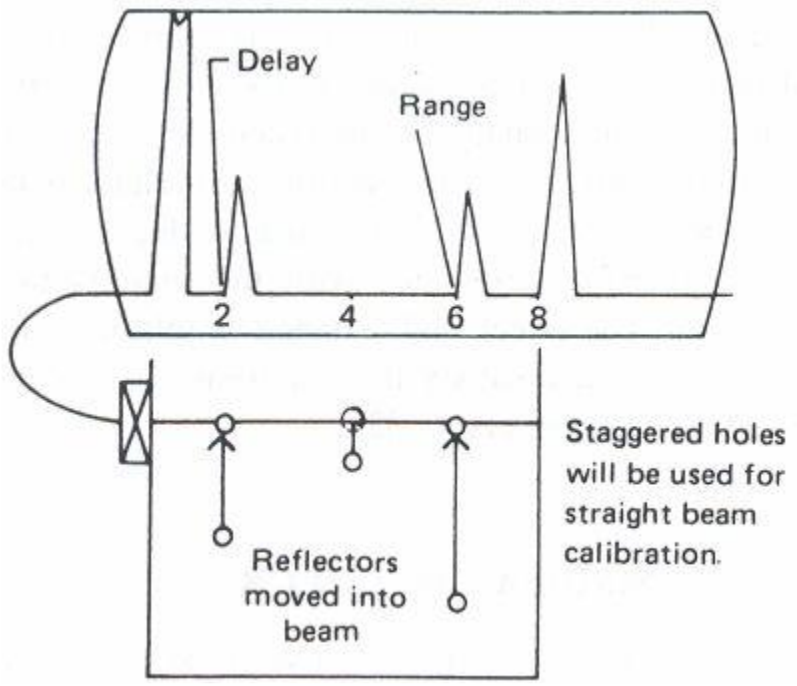


FIG. 11 SWEEP RANGE

8.6.2. Distance-Amplitude Correction (fig. 12)

(a) Position the search unit for the maximum indication from the SDH, which gives the highest indication.

(b) Adjust the sensitivity (gain) control to provide an 80% (±5%) of FSH indication. This is the primary reference level. Mark the peak of this indication on the screen

(c) Position the search unit for maximum indication from another SDH.

(d) Mark the peak of the indication on the screen.

(e) Position the search unit for maximum indication from the third SDH and mark the peak on the screen.

(f) Connect the screen marks for the SDHs and extend through the thickness to provide the distance-amplitude curve.

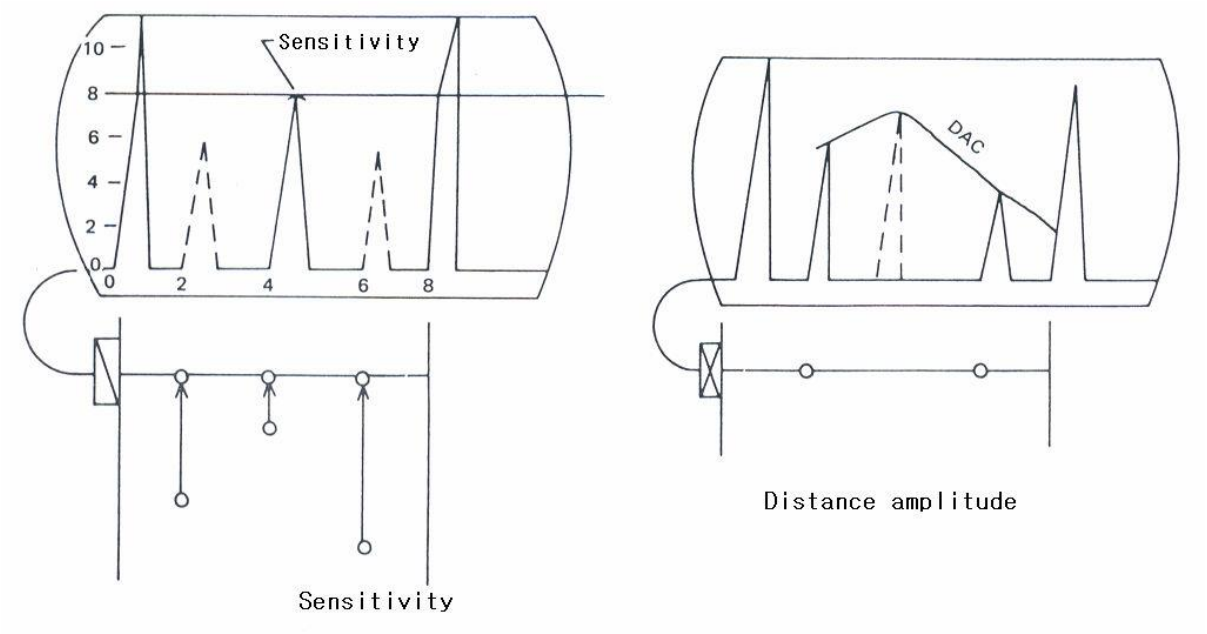


FIG. 12 SENSITIVITY AND DISTANCE AMPLITUDE CORRECTION

8.7. Scanning

1) Perform the scanning of the adjacent base metal to defect reflector by straight beam.
2) Perform the angle beam scanning to the weld.

8.8. Evaluation

1) Evaluation shall be performed by Level II and III.
2) Any reflector which causes an indication in excess of 20% of DAC shall be investigated to the extent that it can be evaluated in terms of the acceptance standard para. 9.0.

9. ACCEPTANCE STANDARD

9.1. ASME Sec. VIII Div. 1 (For Welded)

Imperfections which produce a response greater than 20% of the reference level shall be investigated to the extent that the operator can determine the shape, identity, and location of all such imperfections and evaluate them in terms of the acceptance standards given in 1) and 2) below.

1) Indications characterized as cracks, lack of fusion, or incomplete penetration is unacceptable regardless of length.

2) Other imperfections are unacceptable if the indications exceed the reference level amplitude and have length which exceeds:

(1) 1/4 in.(6mm) for T up to 3/4 in.(19mm) ;
(2) 1/3 T for from 3/4 in. to 2 1/4 in.(19mm to 57mm) ;
(3) 3/4 in. for T over 2 1/4 in.(57mm)

Where t is the thickness of the weld excluding any allowable reinforcements. For a butt weld joining two members having different thicknesses at the weld, t is the thinner of these two thicknesses.
If a full penetration weld includes a fillet weld, the thickness of the throat of the fillet shall be included in t.

9.2. ASME Sec. VIII Div. 1 (For Casting)

All parts of casting Materials having thicknesses in excess of 12 in. (305 mm) shall be examined ultrasonically in accordance with Article 5 of Section V. Any imperfections which do not produce indications exceeding 20% of the straight beam back reflection or do not reduce the height of the back reflection by more than 30% during a total movement of the transducer of 2 in. (51 mm) in any direction shall be considered acceptable . Imperfections exceeding these limits shall be repaired unless proved to be acceptable by other examination methods.

REPAIR REQUIREMENTS

Repair shall be examined by the same procedure used for detection of the discontinuities. Acceptability of repairs shall be determined by the same acceptance standards.

10. REPORTS AND RECORDS

10.1. Examination of Reports

A report of the examinations shall be made. the report shall include a record indication the weld(s) or volume examined (this may be marked-up sketched), the location of each recorded reflector, and the identification of the operator who carried out each examination or part thereof as detailed 11.3

10.2. Calibration Records

Instrument calibrations shall be included in the ultrasonic calibration records.

10.3. Examination Records

For each ultrasonic examination, the following information should be identified and recorded.

a) Procedure identification and revision ;
b) Ultrasonic instrument identification (including manufacturer’s serial number);
c) search unit(s) identification (including manufacturer’s serial number, frequency, and size);
d) beam angle(s) used ;
e) couplant used, brand name or type ;
f) search unit(s) used, type and length ;
g) special equipment, when used (search units, wedges, shoes, automatic scanning equipment, recording equipment, etc.) ;
h) computerized program identification and revision, when used ;
i) calibration block identification ;
j) simulation block(s) and electric simulator(s) identification, when used ;
k) instrument reference level gain and, if used, damping and reject setting(s) ;
m) data correlating simulation block(s) and electric simulator(s), when used, with initial calibration ;
n) identification of material or volume scanned ;
o) surface(s) from which examination was conducted, including surface condition ;

p) map or record of rejectable indications detected or areas cleared ;
q) area of restricted access or inaccessible areas ;
r) examination personnel identity and, when required by referencing Code Section, qualification level ;
s) date and time examinations were performed ; Items b) through m) may be included in a separate calibration record provided the calibration record identification is included in the examination record.

10.4. Evaluation Record

Records of any evaluations of indications shall be maintained and documented as required by the referencing Code section.

11. FORM

Ultrasonic Examination Report 001

	12. ULTRASONIC EXAMINATION REPORT
Report No:	Material:
Date of Report:	Thickness:
Customer:	Time of Examination:
Surface Condition: ► As Welded As Forged As Casted As Machined As Grounded Brushing Other:	
Welding Process (Es): ► SMAW GTAW GAMW FCAW SAW Other:	
Groove: ► V U X K Other: ----------	
Equipment : ID No: Search Unit: Test Blocks:	Couplant: Oil ► Grease Glycerin SCA Water Other : --------- Code/ Standard: Acceptance Criteria:
Examination Method: ► Pulse–Echo Straight Beam ► Angle Beam Degree:0 and 70 º	
Standard Sensivity: 80 % From: ► SDH FSH NOTCH B/REE Other: ----------	
Examination Sketch:	

Project Code:

Item No	Thickness(mm)	Test Location			Results	Remarks
		From	To	L(cm)		

Total Test Length (Cm):

Note: At the time of inspection not found any reject-able indication. All dimensions in mm.

Inspector (Level II ASNT): **Name:** **Signature:**	**Approved By:** **Name:** **Signature:**

PART III - MT PROCEDURE

شماره پیمان:	NDE PROCEDURE								شماره صفحه : 37 از 50
053 - 073 – 9184	پروژه	بسته کاری	صادرکننده	تسهیلات	رشته	نوع مدرک	سریال	نسخه	
	BK	GCS	KP	120	QC	PR	0003	V02	

1. SCOPE AND PURPOSE

1.1. This procedure describes the requirements and techniques of non-fluorescent, continuous & yoke type magnetic particle examination of the ferrous materials, steel casting and their welds related.

1.2. This Procedure describes techniques for non-fluorescent, continuous & yoke type Magnetic Particles Examination for detecting cracks and other discontinuities at or near the surface in ferromagnetic materials and their welds.

1.3. This procedure shall be used for Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries which are fabricated as per ANSI/API Standard 610 and ISO 13709: 2003.

2. APPLICABLE CODES, STANDARDS AND SPECIFICATIONS

2.1. ANSI/API Standard 610 Tenth Edition, October 2004, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries.

2.2. ISO 13709: 2003, Centrifugal pumps for petroleum, petrochemical and natural gas industries.

2.3. ASME BPVC , Sec. V , Article 7.

2.4. ASME BPVC Sec.VIII,Div.1 Appendix 6 &7

2.5. SNT-TC-1A-2006

2.6. ASTM E-125 Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings.

2.7. Company specification for fabrication of Pump.

3. PERSONNEL QUALIFICATION

3.1. All personnel performing magnetic particle testing shall be qualified in accordance with SNT-TC-1A or shall have a valid certificate issued by ASNT NDT Level - III Examiner.

3.2. If magnetic particle testing is to be performed by NDT subcontractor, all personnel belonging to subcontractor shall be qualified by subcontractor in accordance with subcontractor's own qualification procedure based on SNT-TC-1A.

3.3. Responsibility

3.3.1. Manager shall be responsible for the implementation and control of this procedure.
3.3.2. ASNT NDT Level III Examiner shall be responsible for the qualification of NDT Operator.
3.3.3. NDT Level II operator shall be responsible for interpretation of the magnetic particle with respect to this procedure and preparing the test reports.

4. SURFACE CONDITIONING

4.1. Surface preparation by grinding or machining may be necessary where surface irregularities could mask indications due to discontinuities.

4.2. Prior to magnetic particle examination, the surface to be examined and all adjacent areas within at least 1 in.(25mm) shall be cleared dry and free of all dirt, grease, lint, scale, welding flux and spatter, oil, or other extraneous matter that could interfere with the examination.

4.3. Cleaning may be accomplished using detergents, organic solvents, solutions, paint removers, vapor degreasing, sand or grit blasting, or by ultrasonic cleaning methods.

5. LIGHTING

5.1. Visible (Color Contrast) Magnetic Particle:

A minimum light intensity of 100 fc (1,000 lux) is required on the surface to be examined to ensure adequate sensitivity during the examination and evaluation of indications.

5.2. Fluorescent Magnetic Particles:

5.2.1. It shall be performed in a darkness area.
5.2.2. The examiner shall be in the darkened area for at least 5 minutes prior to performing examination to enable their eyes to adapt to dark viewing. Glasses or lenses worn by examines shall not be photosensitive.
5.2.3. Black light shall achieve a minimum 1,000 µw/cm2 on the surface of the part being examined throughout the examination.

6. EQUIPMENT AND MATERIALS

6.1. Equipment: Magnetizing is done by the use of portable yoke. Yokes may be of the fixed or articulated leg types, and when electromagnetic yokes are used to magnetize a local area, a longitudinal field is formed between the poles.

6.2. Wet Particles

6.2.1. The color of particles shall provide adequate contrast with the surface being examined, and the black, red or fluorescent particle shall be used.
6.2.2. Wet magnetic particles are designed to be suspended in a vehicle such as water or oil to the test surface by flowing, spraying or pouring.
6.2.3.For the concentration of wet magnetic particle suspensions, the recommended settling volume is from 1.2 to 2.4 ml per 100 ml of vehicle for non-fluorescent particles. In cases the particles are premixed with the suspending vehicle by the supplier, the bath concentration is normally determined by supplier's certificate.
6.2.4.The temperature of the wet particle suspension and the surface of the part shall not exceed 60 Centigrade Degree and not loss than medium freeze temperature.

7. CALIBRATION OF EQUIPMENT

7.1. Frequency of Calibration

7.1.1. The magnetizing force of yoke shall be checked at least once per 6 months, or whenever a yoke has been damaged. If yoke has not been in use for a year or more, a check shall be done prior to first use. The records should be kept in QA Department.
7.1.2. Light meters, both visible and fluorescent (black) light meters, shall be calibrated at least once a year or whenever the meter has been repaired. If meters have not been in use for one year or more, calibration shall be done before being used.

7.2. Lifting Power of Yoke

7.2.1. Alternating Current Electromagnetic Yoke shall have a lifting power of at least 10 lbs (4.5 Kg) at the maximum pole spacing that will be used.
7.2.2. Direct Current Electromagnetic Yoke shall have a lifting power of at least 40 lbs (18.1 Kg) at the maximum pole spacing that will be used.

8. EXAMINATION PROCEDURE

8.1. General

8.1.1. As per clause 7.2.2 of API 610 the Method and Procedure of Examination shall be in accordance with ASME BPVC Sec V Article 7.

8.2. Yoke Technique

8.2.1. Application: This method shall only be applied to detect discontinuities that are open to the surface of the part.
8.2.2. This method shall be performed by using AC yoke equipment.
8.2.3. The yoke legs shall be separated not less than 3 in. (75mm) nor more than 5 in. (125 mm) apart during examination.

8.3. Magnetizing Techniques

8.3.1. Sensitivity Measurement

8.3.1.1. A Magnetic Field Indicator may be used as a convenient rough check of the adequacy and direction of part magnetization.
8.3.1.2. A sufficient magnetic field must be generated in the part under examination to clearly develop the test pattern in the indicator.
8.3.1.3. In using this indicator, a suitable flux or field strength is indicated when a clearly defined line of magnetic particles forms across the copper face of the indicator when the magnetic particles are applied simultaneously with the magnetizing force. When a clearly defined line of particles is not formed in the desired direction, the magnetizing technique shall be changed or adjusted.

8.3.2. Direction of Magnetization

At least two separate examinations shall be performed on each area. During the second examination, the lines of magnetic flux shall be approximately perpendicular to those used during the first examination. A different technique for magnetization may be used for the second examination

8.3.3. Sequence of Operation

Examination shall be done by the continuous method; that is, the magnetizing current remains on while the examination medium is being applied and while excess medium is being removed whenever possible. The operating sequence will be as follows;

8.3.3.1. The surface to be tested will be thoroughly prepared and traces of grease, dirt, flux, spatter, etc. will be removed prior to the inspection.
8.3.3.2. When the casting specification requires heat treatment, these examinations shall be conducted after that heat treatment.
8.3.3.3. Visual inspection will be made of the tested area for surface defects.
8.3.3.4. White background paint may be applied to the surface being tested.
8.3.3.5. The magnetic field will be applied to the area which is to be tested.
8.3.3.6. Magnetic particles will be applied on the area which is to be tested.
8.3.3.7. All examinations will be conducted with sufficient overlap to ensure 100% coverage at the required sensitivity of the tested area under examination.
8.3.3.8. A second examination shall be made with the lines of flux approximately perpendicular, than those used during the first examination.
8.3.3.9. All indications shall be evaluated in accordance with Para. 8.0 & 9.0.

8.4. Application of Magnetic Particle

8.4.1. Dry Magnetic Particle

Dry magnetic particles shall be applied in such a manner that a light uniform dust-like coating settles upon the surface of the part while the part id being magnetized

8.4.2. Wet Magnetic Particle

Wet magnetic particles shall be applied either by spraying or flowing over the areas to be examined during the application of the magnetizing field current.

8.5. Observation of Magnetic Particle Indication

8.5.1. The observation of magnetic particle indication shall, as a rule, be made immediately after the formation.
8.5.2. Since the magnetic particle indication include some non-relevant indications caused by reasons other than defects, great care must be taken for the discrimination between non-relevant and relevant indications.

9. EVALUATION OF INDICATIONS

9.1. Indications will be revealed by retention of magnetic particles. All such indications are not necessarily imperfections, however, since excessive surface roughness, magnetic permeability variations (such as at the edge of heat affected zones), etc., may produce similar indications.

9.2. An indication is the evidence of a mechanical imperfection. Only indications which have any dimension greater than 1/16 in. shall be considered relevant.

9.2.1. A linear indication is one having a length greater than three times the width.
9.2.2. A rounded indication is one of circular or elliptical shape with a length equal to or less than three times its width.
9.2.3. Any questionable or doubtful indications shall be reexamined to determine whether they are relevant or not.

10. EXTENT OF TEST

10.1. All surface including machined gasket seating surfaces shall be examined fully, unless the surfaces are examined by Liquid Penetrant method.

10.2. All casting having a maximum body thickness less than 4 ½ in. (114 mm) shall be examined as follows:

10.3. When more than one casting of a particular design is produced, each of the first five shall be to the full extend prescribed herein. When more than five castings are being produced, examination as prescribed shall be performed on the first five and on one additional casting for each five additional five castings produced. If any of these additional castings proves to be unacceptable, each of the remaining four casting of that group shall be examined fully.

10.4. All casting having maximum body thickness 4 ½ in. (114 mm) and greater and casting of a lesser thickness which is intended for sever service applications shall be examined as follows:

10.5. All surface including machined gasket seating surfaces shall be examined fully, unless the surfaces are examined by Liquid Penetrant method.

11. ACCEPTANCE CRITERIA

This acceptance Criteria shall apply unless other more restrictive standards are specified for specific materials.

11.1. For Fabrications

As per clause 7.2.2 of API 610, the ASME BPVC Sec VIII Div 1 Appendix 6 shall be used for fabrications and it is as follows:

11.1.1. Relevant linear indications
11.1.2. Relevant rounded indications greater than 3/16 in. (5mm).
11.1.3. Four or more relevant rounded indications in a line separated by 1/16 in. (1.5 mm) or less, edge to edge.

11.2. For Castings

As per clause 7.2.2 of API 610, the ASME BPVC Sec VIII Div 1 Appendix 7 shall be used for fabrications and it is as follows:

11.2.1. All surfaces to be examined shall be free of Surface indication determined by examinations shall be compared with those indicated in ASTM E 125 Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings and shall be removed if they exceed the following limits:

	Type	Degree
I.	Linear Discontinuity (Hot tears and cracks)	All
II.	Shrinkage	2
III.	Inclusions	3
IV.	Chills and chaplets	1
V.	Porosity	1

Table 1

12. RE-EXAMINATION

12.1. Treatment of indications believed a non-relevant any indication which is believed to be non-relevant shall be regarded as an imperfection unless it is shown by re-examination by the same method or by the use of other non-destructive methods and/or by surface conditioning that no unacceptable imperfection is perfect.

12.2. Examination of areas from where imperfections have been removed :
After a defect is thought to have been removed and prior to making weld repairs, the area shall be examined by suitable methods to ensure it has been removed or reduced to an acceptably sized imperfection.

12.3. Re-examination of Repair Areas

12.3.1. After repairs have been made, the repaired area shall be blended into the surrounding surface so as to avoid sharp notches, crevices, or corners and re-examined by the magnetic particle method and by all other methods of examination that were originally required for the affected area.
12.3.2. Whenever an imperfection is repaired the excavated areas shall be examined except the surfaces are examined by Liquid Penetrant Method to ensure it has been removed or reduced to an acceptable size.
12.3.3. The finished surface of all repair welds shall be examined except the surfaces are examined by Liquid Penetrant Method.

12.3.4. Where the depth of repairs is less than 1 in. or 20% of the section thickness whichever is lesser, and when repaired section cannot be radiographed effectively the first layer of each ¼ in. 6 mm thickness of deposited weld metal shall be examined except the surfaces are examined by Liquid Penetrant Method.

13. DEMAGNETIZATION

When residual magnetism in the part could interfere with subsequent processing or usage, the part shall be demagnetized any time after completion of the examination.

14. RECORDS

Examination condition and interpretation & evaluation shall be recorded on the report form of Magnetic Particle Examination Attachnebt#1, attached to this procedure.

Attachment #1 MAGNETIC PARTICLE EXAMINATION REPORT

MAGNETIC PARTICLE

EXAMINATION REPORT

ITEM :		REPORT NO. : DATE OF REPORT: SHEET ..... OF	
DRAWING NO. :			
REFERENCE CODE :		ACCEPTANCE STD	
EQUIPMENT ACHAND YOKE	MAKER NDT CONSULTAN	MODEL MAG R™	ID. NO. S.N 510
APPARATUS	☐ P RODE ☑ YOKE	CURRENT	☑ AC ☐ DC
PARTICLE TYPE	☑ WET ☐ DRY	INK BRAND VISITEC 10 BLACK	CONTRAST BRAND VISITEC CP
MATERIAL :		JOINT TYPE :	
THICKNESS :		SURFACE CONDITION : As Weld ☐ As Ground ☐ As Brushed ☐ As Machined ☐ As Forged ☐ As Cast ☐	

Part No.	Result	REMARKS	Part No.	Result	REMARKS

	MT OPERATOR	Verify By	Client
NAME SIGN DATE			

PART IV- VT PROCEDURE

SCOPE

(a) This procedure contains methods and requirements for visual examination applicable when specified by a referencing Code Section. Specific visual examination procedures required for every type of examination are not included in this Article, because there are many applications where visual examinations are required. Some examples of these applications include nondestructive examinations, leak testing, in-service examinations and fabrication procedures.

(b) The requirements of Article 1, General Requirements, apply when visual examination, in accordance with Article 9, is required by a referencing Code Section.

(c) Definitions of terms for visual examination appear in Article 1, Mandatory Appendix I – Glossary of Terms in Nondestructive Examination, and Article 9, Mandatory Appendix I.

GENERAL

1. WRITTEN PROCEDURE REQUIREMENTS

1.1. Requirements. Visual examinations shall be performed in accordance with a written procedure, which shall, as a minimum, contain the requirements listed in Table T-921. The written procedure shall establish a single value, or range of values, for each requirement.

1.2. Procedure Qualification. When procedure qualification is specified by the referencing Code Section, a change of a requirement in Table T-921 identified as an essential variable shall require requalification of the written procedure by demonstration. A change of a requirement identified as a nonessential variable does not require requalification of the written procedure. All changes of essential or nonessential variables from those specified within the written procedure shall require revision of, or an addendum to, the written procedure.

1.3. Demonstration. The procedure shall contain or reference a report of what was used to demonstrate that the examination procedure was adequate. In general, a fine line 1/32 in. (0.8 mm) or less in width, an artificial imperfection or a simulated condition, located on the surface or a similar surface to that to be examined, may be considered as a method for procedure demonstration. The condition or artificial imperfection should be in the least discernable location on the area surface to be examined to validate the procedure.

2. PERSONNEL REQUIREMENTS

The user of this Article shall be responsible for assigning qualified personnel to perform visual examinations to the requirements of this Article. At the option of the manufacturer, he may maintain one certification for each product, or several separate signed records based on the area or type of work, or both combined. Where impractical to use specialized visual examination personnel, knowledgeable and trained personnel, having limited qualifications, may be used to perform specific examinations, and to sign the report forms. Personnel performing examinations shall be qualified in accordance with requirements of the referencing Code Section.

3. PHYSICAL REQUIREMENTS

Personnel shall have an annual vision test to assure natural or corrected near distance acuity such that they are capable of reading standard J-1 letters on standard Jaeger test type charts for near vision. Equivalent near vision tests are acceptable.

Table T-921 (ASME Sec. V, T-921.1)

Table T-921
Requirements of a Visual Examination Procedure

Requirement (as Applicable)	Essential Variable	Non Essential Variable
Change in technique used	...	...
Direct to or from translucent	X	...
Direct to remote	X	...
Remote visual aids	X	...
Personnel performance requirements, when required	X	...
Lighting intensity (decrease only)	X	...
Configurations to be examined and base material product forms (pipe, plate, forgings, etc.)	...	X
Lighting equipment	...	X
Methods or tools used for surface preparation	...	X
Equipment or devices used for a direct technique	...	X
Sequence of examination	...	X
Personnel qualifications	...	X

4. EQUIPMENT

Equipment used for visual examination techniques, for example, direct, remote, or translucent, shall have the capabilities as specified in the procedure. Capabilities include, but are not limited to viewing, magnifying, identifying, measuring, and/or recording observations in accordance with requirements of the referencing Code Section.

5. TECHNIQUE

5.1. APPLICATIONS

Visual examination is generally used to determine such things as the surface condition of the part, alignment of mating surfaces, shape, or evidence of leaking. In addition, visual examination is used to determine a composite material's (translucent laminate) subsurface conditions.

5.2. DIRECT VISUAL EXAMINATION

Direct visual examination may usually be made when access is sufficient to place the eye within 24 in (600 mm) of the surface to be examined and at an angle not less than 30 deg to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as a magnifying lens may be used to assist examinations. Illumination (natural or supplemental white light) for the specific part, component, vessel, or section thereof being examined is required. The minimum light intensity at the examination surface/site shall be 100 fc (1000 lx). The light source, technique used, and light level verification is required to be demonstrated one time, documented, and maintained on file.

5.3. REMOTE VISUAL EXAMINATION

In some cases, remote visual examination may have to be substituted for direct examination. Remote visual examination may use visual aids such as mirrors, telescopes, borescopes, fiber optics, cameras, or other suitable instruments. Such systems shall have a resolution capability at least equivalent to that obtainable by direct visual observation.

5.4. TRANSLUCENT VISUAL EXAMINATION

Translucent visual examination is a supplement of direct visual examination. The method of translucent visual examination uses the aid of artificial lighting, which can be contained in an illuminator that produces directional lighting. The illuminator shall provide light of an intensity that will illuminate and diffuse the light evenly through the area or region under examination. The ambient lighting must be so arranged that there are no surface glares or reflections from the surface under examination and shall be less than the light applied through the area or region under examination. The artificial light source shall have sufficient intensity to permit "candling" any translucent laminate thickness variations.

6. EVALUATION

Note: All examinations shall be evaluated in terms of the acceptance standards of UW 31, 32, 33, 35 and 36 of ASME BPVC.VIII.1

6.1. All examinations shall be evaluated in terms of the acceptance standards of the referencing Code Section.

6.2. An examination checklist shall be used to plan visual examination and to verify that the required visual observations were performed. This checklist establishes minimum examination requirements and does not indicate the maximum examination which the Manufacturer may perform in process.

MSS SP-55, Visual Method for Evaluation of Surface Irregularities, shall be used for visual inspection of casting parts.

7. DOCUMENTATION

7.1. REPORT OF EXAMINATION

7.1.1. A written report of the examination shall contain the following information:

(a) the date of the examination

(b) procedure identification and revision used

(c) technique used

(d) results of the examination

(e) examination personnel identity, and, when required

by the referencing Code Section, qualification level

(f) identification of the part or component examined

7.1.2. Even though dimensions, etc., were recorded in the process of visual examination to aid in the evaluation, there need not be documentation of each viewing or each dimensional check. Documentation shall include all observation and dimensional checks specified by the referencing Code Section.

8. RECORD MAINTENANCE

Records shall be maintained as required by the referencing Code Section.