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ASME CODE FOR ULTRASONIC TESTING THE KNOWLEDGE SINEQUATION

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Abstract

With the globalization stance of government, India is quickly emerging as an important business nation in the world. Many overseas reputed organizations have identified India for their international engineering business operations and have set up their offices as well as manufacturing facilities in recent past. Being techno economically competent many Indian industries have also started exports to the developed countries. Obviously, in this international competitive era, a product stands out amongst others only by it's virtue of soundness, reliability and safety. To accomplish this, qualified professionals, calibrated equipments / instruments, standard examination procedures and codified acceptance criteria are the sinequanon, where NDE assumes utmost importance. Amongst various NDE methods available for inspection, this paper highlights ASME Code requirements for ultrasonic examination. It is very essential to prepare a written NDE procedure, get it approved from an authorized person and satisfactorily demonstrate the procedure to an authorized inspector before its actual implementation on the job. Shortcuts to this would result in failure to meet code requirements and unpleasant situation for the product as well as organization. In particular this paper deals with ultrasonic examination of materials and welds as per ASME Section V, which is providing the guide lines for evolution of NDE procedures and presentation of proper NDE reports.

Key Words :
ASME Code, Sinequanon, Raw Materials, Welds, NDE Procedures, NDE Reports.

Introduction :

For any organization to sell a product in this international competitive era, the product must have the required quality, reliability, soundness as well as safety. To achieve these parameters the product must meet various international test specifications and code requirements. NDE plays a very important role in achieving the above parameters. For successful implementation of nondestructive examinations proper NDE procedures are very essential. This paper deals with following two aspects as per ASME Code :

(A) Procedure for ultrasonic examination of materials.
(B) Procedure for ultrasonic examination of welds.

The paper highlights about the essential as well as non-essential variables in preparing NDE procedures as well as essential requirements to be fulfilled while preparing NDE reports for both the above aspects at (A) and (B) as per ASME Section V Code requirements.

(A) Guide Lines for Preparing Written Procedure For Ultrasonic Examination Of Materials :

ASME Sec. V Article 5 gives the guide lines for ultrasonic examination of various materials. It also refers to Article 23 of the same section. It also suggests to consult referencing Code Section for specific requirements.
This Code requires that ultrasonic examination shall be performed in accordance with a written procedure. It specifies the minimum requirements of a written NDE procedure, requirements of a procedure qualification, essential as well as non-essential variable of a written NDE procedure, requirements of nondestructive examination report.
Variables of an ultrasonic examination procedure are tabulated on Page 4.
To cover the above aspects and to give one illustration the author suggests following format for a written ultrasonic examination procedure of plates :

1. Procedure No. Rev. No. and Date.
2. Scope.
3. Reference Documents.
4. Surface Condition of Materials.
5. Heat Treatment.
6. Equipment : Principle on which equipment function, Equipment Make and Model, Frequency Range, dB control settings available, Screen Height Linearity, Amplitude Control Linearity, Sweep Range Calibration Check, Etc.
7. Transducers : Type, Frequency, Size, Angle if type selected is angle beam transducer, Wave Mode, Any Special Search Unit.
8. Couplant : Brand and Type.
9. Responsibilities and Operator's Qualification.
10. Range Calibration of Instrument.
11. Sensitivity Calibrations and Calibration Checks.
12. Scanning and Sizing a Flaw, Scan Over Lap, Scanning Speed, Etc.
13. Acceptance / Rejection Criteria.
14. Report : Shown on Page 3.
15. Table showing essential as well as non-essential variables for the procedure.
16. Clause for Demonstration of the procedure to the satisfaction of AI.
17. Name, Qualification Level and Signature of person preparing the procedure.
18. Name Qualification Level and Signature of person approving the procedure.

UT REPORT FORMAT-1

Procedure No. Date
Report No. Date :
Job No.
Reference/Identification
Test date
Test Material
Surface Condition
Object
Test Equipment UFD Instrument : Make : Model:

Test Probe	Normal Beam		TR Probe	
	Frequency	Size	Frequency	Size
Couplant				
Test Range				
Calibration				
	Start Time		Finish Time	
Time Base				
Sensitivity (Echo Amplitude as % FSH)				
Gain	dB		dB	
Observations/ Remarks:				

Name of Operator	Inspection Authority
Qualification Level II	
Signature Date	Signature Date

TABLE T-522 of ASME Section V, Article-5
VARIABLES OF AN ULTRASONIC EXAMINATION PROCEDURE

Sr. No.	Requirement	Essential Variable	Non-essential Variable	Procedure Reference Para No.
1.	Material types and configurations to be examined, including thickness, dimensions and product from (castings, forgings, plate, etc.)	X		
2.	Personnel qualification requirements		X	
3.	Personnel performance requirements, when required	X		
4.	The surface/s from which the examination shall be performed	X		
5.	Surface condition (examination surface, calibration block)		X	
6.	Couplant : Brand name or type		X	
7.	Technique(s) (straight beam, angle beam, contact, and /or immersion)	X		
8.	Angle(s) and mode(s) of wave propagation in the material.	X		
9.	Search unit type(s), frequency(ies), element size(s)/shapes(s)	X		
10.	Special search units, wedges, shoes, or saddles, when used.	X		
11.	Ultrasonic instrument(s)	X		
12.	Calibration [(calibration block(s) and technique(s)]	X		
13.	Direction and extent of scanning	X		
14.	Automatic alarm and/or recording equipment, when applicable.		X	
15.	Scanning (manual vs. automatic)	X		
16.	Method for sizing indications	X		
17.	Computer enhanced data acquisition, when used	X		
18.	Records, including minimum calibration data to be recorded (e.g. instrument settings)		X	
19.	Scan overlap (decrease only)	X		

Note : 1. A revised procedure shall be prepared and approved by Level III for any change in essential or non-essential variable/s.

2. Whenever any change is made in any of the essential variable/s, re demonstration of the procedure to the satisfaction AI shall be done.

3. When ever any change is made in any of the non-essential variable/s re-demonstration of procedure to AI is not required.

(B) Guide Lines For Preparing Written Procedure For Ultrasonic Examination Of Welds :

ASME Sec. V Article 4 gives the guide lines for ultrasonic examination of various materials. It also suggests to consult referencing Code Section for specific requirements.

This Code requires that ultrasonic examination shall be performed in accordance with a written procedure. It specifies the minimum requirements of a written NDE procedure, requirements of a procedure qualification, essential as well as non-essential variable of a written NDE procedure, requirements of nondestructive examination report.

Variables of an ultrasonic examination procedure are tabulated on Page 7.

To cover the above aspects and to give one illustration the author suggests following format for a written ultrasonic examination procedure of welds :

1. Procedure No. Rev. No. and Date.
2. Scope.
3. Reference Documents.
4. Configuration.
5. Examination Surface.
6. Surface Condition of Materials.
7. Equipment : Principle on which equipment function, Equipment Make and Model, Frequency Range, dB control settings available, Screen Height Linearity, Amplitude Control Linearity, Sweep Range Calibration Check, Etc.
8. Transducers : Type, Frequency, Size, Angle, Wave Mode, Any Special Search Unit.
9. Couplant : Brand and Type.
10. Responsibilities and Operator's Qualification.
11. Range Calibration of Instrument.
12. Sensitivity Calibrations, Reference Standard Calibration Blocks, Calibration Check of Instrument, Gain Corrections.
13. Scanning and Establishment of a discontinuity, Sizing a Flaw, Scan Over Lap, Scanning Speed, Etc.
14. Acceptance / Rejection Criteria.
15. Report : Report No. and Date, Procedure No. Rev. No. Date, Equipment : Make, Model, Sr. No., Search Unit : Type, Size, Frequency, Angle, Wave Mode, Search Unit Cable : Type and Length, Special Search Unit if used, Couplant : Brand and Type, Identification of Calibration Block, Reference Reflector, Reference Level Gain, Scanning Sensitivity, Damping and Reject Settings if used, Identification and Location of weld examined, Surface from which examination was conducted and surface condition, Records of un-acceptable as well as recordable indications, record of inaccessible weld areas, Name and qualification Level of Operator, Date of Examination, Reference Code used, Computerized Program if used, Etc.
16. Marking and Repairing,
17. Re-examination.
18. Table showing essential as well as non-essential variables for the procedure.
19. Clause for Demonstration of the procedure to the satisfaction of AI.
20. Name, Qualification Level and Signature of person preparing the procedure.
21. Name Qualification Level and Signature of person approving the procedure.

Conclusions :

1. Nondestructive Examination requires preparation and approval of NDE Procedure.
2. It also requires satisfactory demonstration of the procedure to Authorized Inspector.

3. Person preparing and approving NDE procedure must have :
   (A) Required qualification and experience in NDE.
   (B) He must have relevant information about the part or component to be examined, its manufacturing process, service condition, type and location of discontinuity expected, method of determining such discontinuities, limitations involved with the applied NDE method and technique.
   (C) Applicable Code and Standards.
4. NDE requires properly calibrated equipments and properly trained, certified and experienced operators.

References :

1. ASME Sec. V : Article 4, Article 5, Article 23
2. SNT-TC-1A of ASNT, BIS Document : 13805
3. ASME Sec. VIII, Div. I, ASME Sec. III.

TABLE T- 421 OF ASME SECTION-V, ARTICLE- 4.
REQUIREMENTS OF AN ULTRASONIC EXAMINATION PROCEDURE

Sr. No.	Requirement	Essential Variable	Non-Essential variable	Procedure reference Para No.
1	Weld Configurations to be examined, including thickness dimensions and base material product form (Pipe, Plate, etc.)	X		
2	The surfaces from which the examination shall be performed	X		
3	Technique(s) (straight beam, angle beam, contact, and/or immersion)	X		
4	Angle(s) and mode(s) of wave propagation in the material.	X		
5	Search Unit type(s), frequency(ies), element size(s)/shapes(s)	X		
6	Special search units, wedges, shoes or saddles, when used.	X		
7	Ultrasonic instrument(s)	X		
8	Calibration (Calibration block(s) and technique(s))	X		
9	Directions and extent of scanning	X		
10	Scanning (manual vs. automatic)	X		
11	Method for discriminating geometric from flaw indications.	X		
12	Method for sizing indications	X		
13	Computer enhanced data acquisition, when used	X		
14	Scan overlap (decrease only)	X		
15	Personnel performance requirements, when required	X		
16	Personnel qualification requirements		X	
17	Surface condition (examination surface, calibration block)		X	
18	Couplant: brand name or type		X	
19	Automatic alarm and/or recording equipment, when Applicable		X	
20	Records, including minimum calibration data to be recorded (e.g. instrument settings)		X	

Note:

1. **A revised procedure shall be prepared and approved by Level III for any change in essential or non-essential variable/s.**
2. **Whenever any change is made in any of the essential variable/s, re demonstration of the procedure to the satisfaction AI shall be done.**
3. **When ever any change is made in any of the non-essential variable/s re-demonstration of procedure to AI is not required.**