

# PROCEDURE FOR ULTRASONIC EXAMINATION OF FORGINGS, PRESSWORK AND ROLLED BARS

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REV. 4

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## 1. PURPOSE AND APPLICABILITY

The purpose of this procedure is that of describing the method to be used for testing forgings, presswork and rolled bars. and defining the acceptance criteria referred to by the drawings and the parts specifications.

## 2. REFERENCE DOCUMENTS

ASME Sect V article 5, ASTM A 388, E 428, Doc. SNT-TC-1A.

## 3. EQUIPMENT

### 3.1. Instrument

Ultrasonic instruments complying with the requirements of ASME Sect V shall be used.

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### 3.2 Probes and examination frequency

Longitudinal wave flat probes having 4 or 5 MHz frequency for  $\leq 70$  mm thickness and 2 to 2.5 MHz frequency for  $> 70$  mm thickness will be used. The probe diameter can be 10 to 12 or 24 mm according to the dimensions of the part to be examined and of curvature of which scanning is made. It is to be considered that as regards curvature diameters smaller than 250 mm, 24 mm diam. probes cannot be used. Other types of probe (with rectangular crystal, angle beam, different frequency, etc.) can be used to get more information about the defect position and nature. The contact surface of probe can be protected with a sheath for scanning. Said sheath shall be removed during evaluation of discontinuity.

### 4. COUPLING MEDIA

As coupling media oil, glycerol or water-based paste may be used, on condition that it is compatible with the material of the part under examination. The same media shall be used for both examination and calibration.

### 5. SURFACE CONDITION

The surfaces of the parts to be examined shall be clean, free from slag, oxidation or other substances that might interfere with the examination. Roughness should not be more than  $3.2 \mu\text{m}$  ( $125 \mu\text{inch}$ )

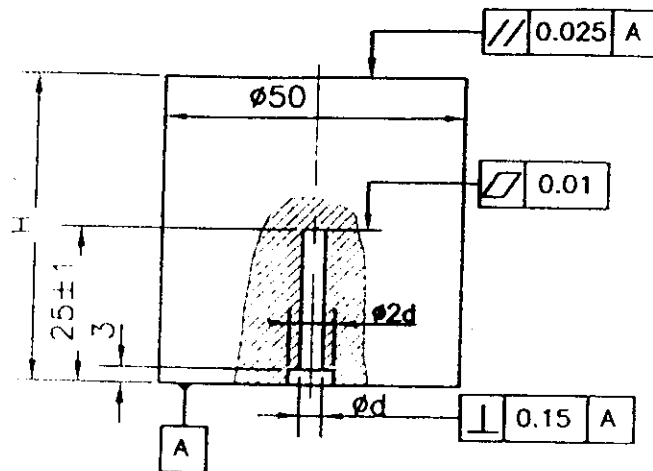
### 6. CALIBRATION OF SENSITIVITY

#### 6.1. Calibration Blocks

Calibration blocks will be realized in accordance with the criteria specified by ASTM E 428, and in particular to the dimensions detailed in fig. 1 and table 1.

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FIGURE 1



H = BLOCK "W" 60 mm

BLOCK "X" 100 mm

BLOCK "Y" 175 mm

d 2, 3, 4 mm

TABLE 1

CODE NUMBER	BLOCK MATERIAL (TYPICAL)	HOLE DIAM. mm	APPLICATION
B1 Wo X oY	40 Ni Cr Mo 7 quenched and tempered	2	CARBON STEEL
B2 Wo X oY		3	LOW-ALLOY STEEL
B3 Wo X oY		4	FERRITIC AND MARTENSITIC STAINLESS STEELS
A1 Wo X oY	AISI 316 solubilized	2	AUSTENITICS
A2 Wo X oY		3	
A3 Wo X oY		4	

## 6.2 CALIBRATION

## 6.2.1 Calibration lines for test on thickness upto 70 mm

- Adjust emission power to the minimum setting. Do not use filters or suppressor.
- Place the probe on an area of the forging free from defects and at the maximum thickness of the part. Adjust the instrument so that the backwall echo is situated at approx. 3/4 of the sweep line.
- Place the probe on block "w" and adjust the amplification so that the peak of the echo of the flat bottom hole meets the  $80 \pm 5\%$  of the screen height (hw). Without changing the amplification, place the probe on block "x" and mark on the screen, the maximum point of the echo of the flat bottom hole (hx). Trace on the screen, broken lines defined the 100% and 50% calibration lines, as illustrated in fig.2.

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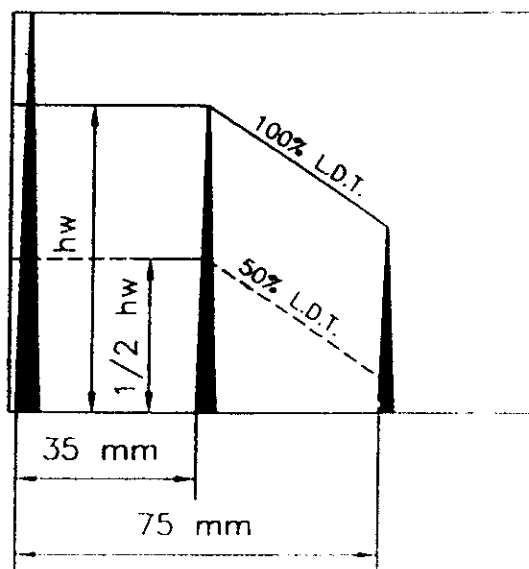
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FIGURE 2 – CALIBRATION LINES FOR THICKNESS UP TO 70 mm



6.2.2. Calibration lines for test on thickness over 70 mm.

- As in the item 6.2.1. a.
- As in the item 6.2.1. b.
- Place the probe on block "x" and adjust the amplification so that the peak of the echo of the flat bottom hole meets the  $80 \pm 5\%$  of the screen height ( $h_x$ ). Without changing the amplification, place the probe on block "y" and mark on the screen, the maximum point point of the echo of the flat bottom hole ( $h_y$ ). Trace, on the screen, broken lines defined the 100% and 50% calibration lines as illustrated, in fig. 3. & fig. 4.
- Regarding the ultrasonic paths longer than 200 mm only, it is allowed to use a higher number of blocks in order to obtain a more precise definition of calibration lines, on condition that the dimensions of the artificial defect is in accordance with what defined at point 9 for any acceptance class.

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FIGURE 3

CALIBRATION LINES FOR THICKNESS FROM 70 TO 200 mm

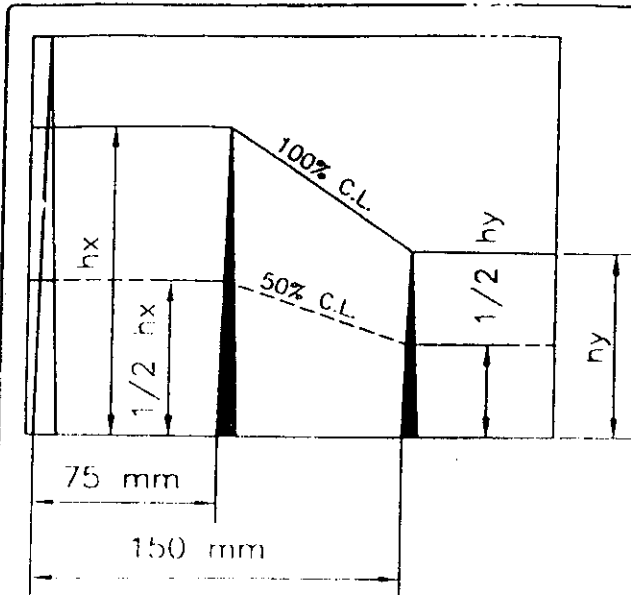
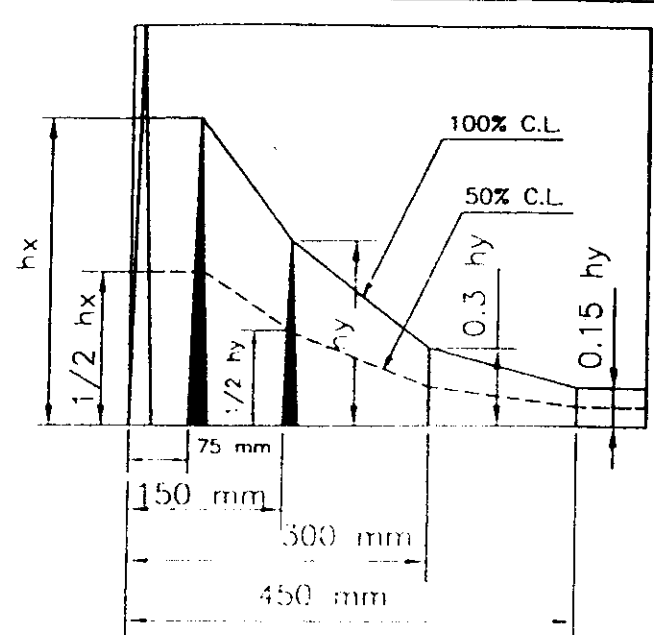


FIGURE 4

CALIBRATION LINES FOR THICKNESS OVER 200 mm



### 6.3. Correction for curved surfaces

Calibration sensitivity for curved surfaces must be increased by an amount shown in table 2.

TABLE 2

CURVATURE DIAMETER OF PART	mm	OVER 800	FROM 600 TO 800	FROM 400 TO 600	FROM 200 TO 400	FROM 100 TO 200	UNDER 100
Correction for probes diameter 10 TO 12 mm	dB	0	0	2	2	4	6
Correction for probes diameter 24 mm	dB	0	2	4	8		

### 6.4. Calibration check

The calibration of the instrument/probe system shall be checked at least at the beginning and end of the each test, and always when a probe or cable is changed, or when another operator starts to use the equipment.

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## 7. EXAMINATION

### 7.1. Scanning sensitivity

The scanning sensitivity is the one obtained through the calibration procedures described in paragraph 6, increased by 6 dB.

This increase is to be taken into consideration and subtracted when the magnitude and extension of any discontinuity must be evaluated for acceptance and recording purposes.

### 7.2. Scanning technique

7.2.1. Lateral translation of the probe shall take place with an overlap of at least 10% of one scanning on the next, and a speed of forward/backward motion not exceeding 150 mm/sec (6"/sec.)

7.2.2. Within the limits of the geometry and dimensions of the part, scanning shall be effected in both radial and axial directions and from both parallel faces of the part.

## 8. RECORDING

Indications to be recorded are all those regarding discontinuities that produce echo reflections with amplitude more than 50% of the corresponding one in the reference curve. As regards the recorded discontinuities, the following aspects should be noted:

- The extension of the surface or length measured by the "6 dB drop" method.
- The position on the part.
- The distance separating one discontinuity from another.

## 9. ACCEPTANCE CRITERIA

Indications clearly identified as coming from defects of the crack and forging lap type are not acceptable.

Indications from defects such as inclusions or porosity can be accepted within the limits stated in table 3.

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TABLE 3

DEFECT CLASSES		1a	2a	3a
DIAMETER OF CYLINDER PLAIN END mm		2	3	4
DEFECTS WITH ECHO GREATER THAN 10% OF CALIBRATION LINE		NOT ACCEPTABLE		
DEFECTS WITH ECHO UP TO 10% FROM 50% TO 80% OF CALIBRATION LINE	MAX. QUANTITY	5		
	MAX. DIMENSION	15		
DEFECTS WITH ECHO UP TO 10% FROM 10% TO 50% OF CALIBRATION LINE	MAX. QUANTITY	10		
	MAX. DIMENSION	20		
DEFECTS WITH ECHO UP TO 10% OF CALIBRATION LINE		NEGLECTIBLE		
% REDUCTION OF BACK WALL ECHO AT DEFECTS IN COMPARISON WITH 100% OF SCREEN IN AREA FREE FROM DEFECTS	%	20	40	60
MINIMUM ALLOWED DISTANCE BETWEEN DEFECTS	mm	100	50	

## 10. EXAMINATION CERTIFICATE

The ultrasonic examination report shall contain at least the following information :

- Manufacturer
- job order, drawing, denomination, serial numbers of unit examined
- customer, inspection authority
- Extension of examination and/or stage of intervention.
- Operating conditions such as:
  - present conditions of surfaces examined.
  - coupling means used.
  - instrument, probes, calibrator blocks utilized.

f) recording of significant defects.

g) results of examination.

h) Signature of operator and/or level II technician in-charge.

## 11. PERSONNEL

Personnel conducting ultrasonic examination shall be qualified at least at level I in accordance with the recommendations of ASNT/ISNT. The test result shall be evaluated by personnel qualified at least at Level II in accordance with the recommendations of ASNT/ISNT.

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