



CHW Forge Private Limited

**Technique sheet for Ultrasonic Examination
of Forging Cone (Part No. LFC-17004-002-211000)**

Doc. No. : QAQC/UT/TS/IAI-01

Current Rev. : E3

Date of Rev. : 16-02-2023

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**Cover Sheet of Technique sheet for Ultrasonic Examination of
Forging Cone**


Document No.	QAQC/UT/TS/IAI-01
Customer Name	Israel Aerospace Industries (IAI)
PO No	H000114471
Item Description	FORGING CONE AS PER DRG. NO LFC-17004-211000 Rev. C
Part No.	LFC-17004-002-211000
Material Grade	AL 7075 T7452 as per AMS 4323
Drawing No.	LFC-17004-211000 Rev. C
Work Order No.	WO/22-23/E-651 AS
PO Sr. No.	06
Quantity	10 no's

4	E3	Fourth Submission	16-02-22	Pankaj	Suneel Sh.
3	E2	Third Submission	06-02-22	Pankaj	Suneel Sh.
2	E1	Second submission	16-12-22	Pankaj	Suneel Sh.
1	E0	First Submission	10-08-22	Pankaj	Suneel Sh.
ISSUE NO	REV NO	DESCRIPTION	DATE	PRP.BY	APP. BY

Submitted by: CHW Forge Private Limited	Approved by: Israel Aerospace Industries (IAI)
Suneel Sharma CHW Forge  	


Comments (If any):


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Pankaj Kumar ASNT NDT Level II	Sunil Kumar Sharma ASNT NDT Level III  	E3	16-02-2023

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Item Description	Part No	Size /Drawing no.	Product form
FORGING CONE	LFC-17004-002-211000	DRG. NO LFC-17004-211000 Rev. C	Hollow Forging

Test Standard	MIL-STD-2154, 1982 & AMS2630 REV.E
Acceptance Criteria	Quality Class A of MIL-STD-2154
Test Procedure No.	As per MIL-STD-2154 & AMS2630
Technique	Manual, Contact Pulse Echo Method
Ultrasonic Instrument	A-Scan Display 1) Model: USM-36, Make: GE, or 2) Model: Einstein II DGS, Make: Modsonic
Couplant	SAE-10 (Mobile Oil), Same Couplant shall be used for calibration & Product Scanning.
UT Examination Stage	Proof Machined after complete Heat Treatment
Range Calibration block identification	100 mm thick reference block & IIW V1 block for angle verification
Sensitivity Calibration (Normal Beam Probe)	2 mm FBH Blocks shall be used. Add the 9 dB for 1.2 mm FBH sensitivity.
Sensitivity Calibration (Angle Beam Probe)	0.51 mm dia X 6.4 mm L, SDH block to attend the sensitivity equal to 1.2 mm FBH
Sensitivity Calibration Technique	Distance Amplitude Curve
Scanning Sensitivity Level	Reference dB + Transfer correction + 6 dB (Scanning dB)
Scanning Coverage	100% accessible with 50% overlap from both opposite direction.
Sizing Technique	DGS or 20 dB drop method for extended discontinuity
Recording Level	50% amplitude of indications w.r.t. DAC
Acceptance Level	Longitudinal wave For isolated discontinuity: 2.0 mm FBH or greater For Multiple discontinuity: 1.2 mm FBH or greater Linear discontinuity: 1.2 mm response in 25.4 mm Length

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Details of reference Blocks-

Normal Beam Examination:

Direction	Thickness	Reference FBH size	Beam Path required for DAC	Identification of reference block
A Direction	61.5 mm	1.2 mm	15 mm, 30 mm, 56 mm	Hole 3E Block no. AL-19, Hole 3G Block no. AL-19, & Hole 3B Block no. AL-18
B Direction	811.8 mm	2 mm + 9 dB (Note-1)	150 mm, 250 mm & 480 mm (Note-1)	Hole 3A Block no. AL-22, Hole 3B Block no. AL-22, & Block no. AL-20

Note-1: The scanning shall be done from both opposite faces to cover the entire thickness. The flat bottom hole size shall be 2 mm for better detectability in large sound path. The 1.2 mm FBH sensitivity shall be established by adding 9 dB based on following equation-

$$20 \log_{10} A_1/A_2$$

Where A1 is the area of 2 mm dia FBH and A2 is the area of 1.2 mm dia FBH


(Result of calculation 8.8 dB for 2.0 mm to 1.2 mm FBH conversion)

Angle Beam Examination:

Direction	Thickness	Reference FBH size	Beam Path required for DAC	Identification of reference block
A Direction	61.5 mm	0.51 mm SDH x 6.4 mm L	28 mm, 46 mm, 84 mm	Block No AL-21

Note: The entry surface finish of the calibration blocks shall not be better than of entry surface of material under examination.

Sketch of reference blocks is attached in Annexure-A

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Dimension verification report of Reference block for Normal beam:


Block Sr. #	Hole #	FBH Diameter in (mm) Tolerance ± 0.0127	Metal Travel Distance in (mm) Tolerance ± 0.381	Overall Length in (mm) Tolerance ± 0.127	Hole Depth in (mm) Tolerance ± 0.127	Block Diameter/Size in (mm) Tolerance ± 0.508			End Face Flatness in (mm)	Parallelism in (mm)	FBH Perpendicularity (Minutes)	Hole Bottom Flatness in (mm) Tolerance Per 3.175	Centered in (mm)	Entry Surface Finish	Other Surface Finish
						Length	Width	Height							
AL-18	1	1.2	40.3	50.1	9.9	58.3	61.9	50.1	With in .0127	With in .020	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
	2	1.2	56.3	65.9	9.9	90.4	61.9	65.9	With in .0127	With in .020	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
	3	1.2	71.9	81.9	9.9	76.5	61.9	81.9	With in .0127	With in .015	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
AL-19	1	1.2	10.3	19.9	9.9	46.5	61.8	19.9	With in .0127	With in .020	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
	2	1.2	15.3	25.1	9.9	63.8	61.8	25.1	With in .0127	With in .020	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
	3	1.2	20.1	29.9	9.9	70.1	61.8	29.9	With in .0127	With in .015	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
	4	1.2	30.3	40.0	9.9	72.3	61.8	40.0	With in .0127	With in .025	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
AL-21	1	2.0	480.1	501.2	20.1	101.2	102.1	501.2	With in .0127	With in .025	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
AL-22	1	2.0	150.2	170.1	20.2	75.5	80.3	170.1	With in .0127	With in .025	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm
	2	2.0	250.2	270.0	20.1	75.8	80.3	270.0	With in .0127	With in .025	With in 20	With in .0254	With in .025	6.3 μm	6.3 μm
	3	2.0	319.9	340.2	20.1	77.2	80.3	340.2	With in .0127	With in .025	With in 20	With in .0254	With in .0254	6.3 μm	6.3 μm

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Dimension verification report of Reference block for Angle beam:

Block Sr. #	Hole #	FBH Diameter in (mm) Tolerance ± 0.0127	Metal Travel Distance (Half Skip 45°) in (mm) Tolerance ± 0.381	Overall Length in (mm) Tolerance ± 0.127	Hole Depth in (mm) Tolerance ± 0.127	Block Diameter/Size in (mm) Tolerance ± 0.508			Entry Surface Finish	Other Surface Finish
						Length	Width	Height		
AL-20	1	0.5	28	400	6.0	400	130	50	6.3 μm	6.3 μm
	2	0.5	56	400	6.1	400	130	50	6.3 μm	6.3 μm
	3	0.5	84	400	6.1	400	130	50	6.3 μm	6.3 μm
	4	0.5	113	400	6.2	400	130	50	6.3 μm	6.3 μm
	5	0.5	141	400	6.1	400	130	50	6.3 μm	6.3 μm
	6	0.5	169	400	6.1	400	130	50	6.3 μm	6.3 μm

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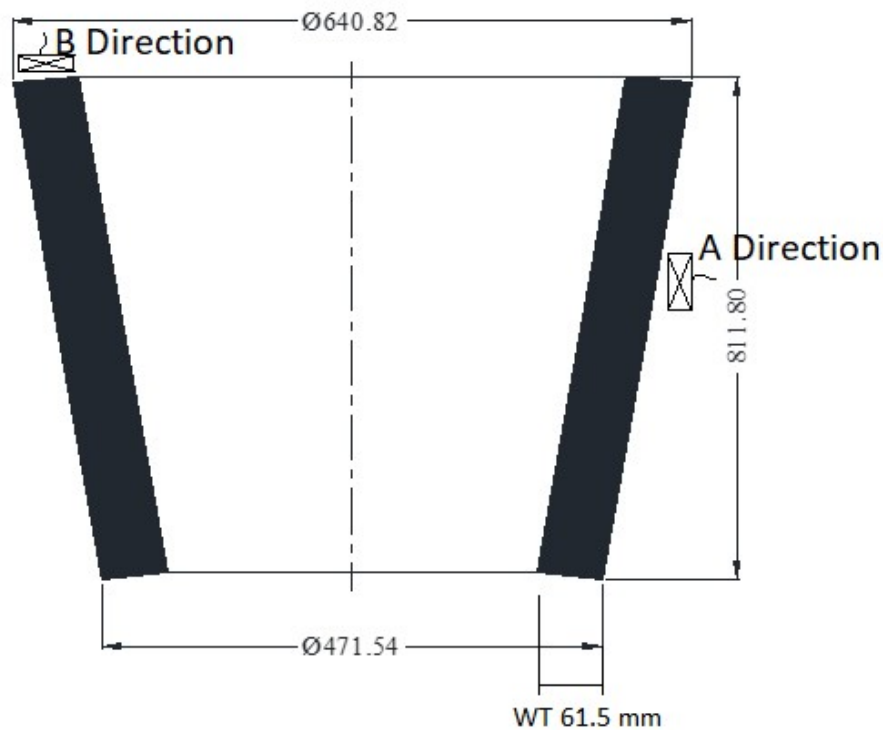
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**Proof Machining sketch with scanning directions for Item Sr. No. 6, DRG. NO LFC-17004-211000 Rev. C
Part No. LFC-17004-002-211000**


**Search Unit Details**

Sr. No.	Probe Details (Crystal Size, Type, Angle)	Frequency	Make	Wave Mode	Scanning Directions
1	24 mm Ø, Dual, 0°	4 MHz	GE	Longitudinal	A Direction
2	24 mm Ø, Single, 0°	2 MHz	GE	Longitudinal	B Direction
3	20x22 mm Angle Beam, 45°	2 MHz	GE	Shear	A Direction

Remark:

- 1) Inaccessible or restricted area should be mentioned in the report.
- 2) Other Sizes or Frequency probes may be used for better evaluation.
- 3) Angle beam scanning to be done in both axial & circumferential direction clockwise & anticlockwise direction.
- 4) During B direction scanning, both opposite faces shall be parallel to each other to get maximum amplitude of back echo.

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Examination Procedure:

1. Personal Qualification:

NDT personnel trained, qualified and certificated as per written practice no. QAQC/WI/09 established in line with requirements of SNT-TC-1A of ASNT shall be deployed on job. Evaluation & interpretation of results shall be done by minimum level II personal.

2. Instrument Calibration:

- a. The instrument performance characteristics shall be evaluated in accordance with ASTM E317 as per the following requirements-

Characteristic	Requirement
Signal to noise ⁽¹⁾	2:1
Vertical linearity, percent of full scale	≤5
Horizontal linearity, percent of full scale	≤3
Gain or attenuator accuracy	±2 dB per 20 dB of control range
Voltage regulation—Voltage fluctuations shall not cause amplitude variations exceeding:	±5%

- b. Any substitution of electronic gates, displays, search units, and other similar equipment for any reason shall require recalibration of the complete system.
- c. Determine the angle of angle beam probe with help of IIW calibration block. The angle shall not be vary more than 1 degree.

3. Surface Preparation:


- a. Surface shall be no rougher than 125 micro inches (3.2 μm) for effective coupling of search unit. Surface roughness of calibration block and test object shall be same.
- b. The surface of the forging to be examined shall be free of extraneous material such as loose scale, paint, dirt etc.
- c. The testing shall be performed at ambient surface temperature.
- d. The 200 mm grid shall be marked by marker on job surface before scanning to ensure complete coverage.

4. Range Calibration:

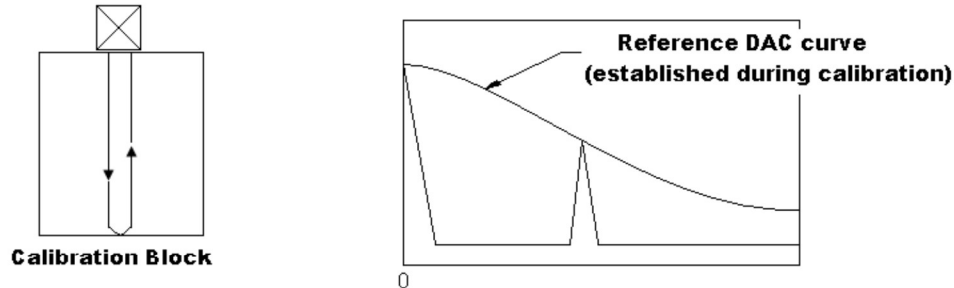
Range calibration shall be done with 100 mm thick aluminum block for & IIW V1 block for angle verification

5. Transfer correction:

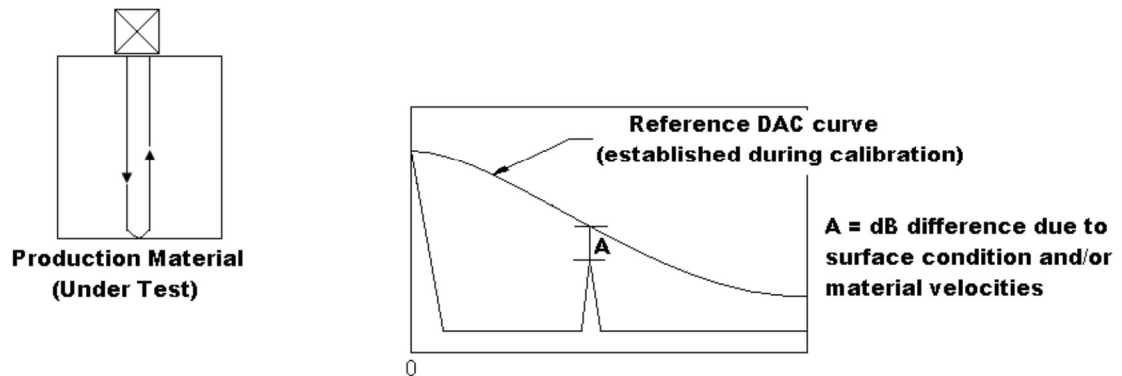
- a. Normal Beam Examination: The transfer correction shall be accomplished by using the calibration block to establish a DAC. The DAC is established by obtaining a number of backwall echoes and setting the gain to bring the first back-echo to a reference level to 80%, utilizing the peaks of the multiple back-wall echos to establish a DAC curve. Using

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the test material, obtain a back-wall echo, and continue to set the gain to bring the back-echo to the established DAC curve, the transfer correction is the difference in gain. Reference Figure given below-





CONDITION A - CALIBRATION BLOCK

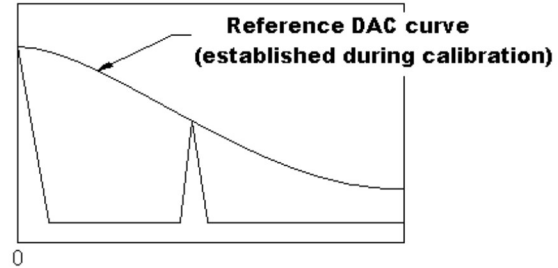
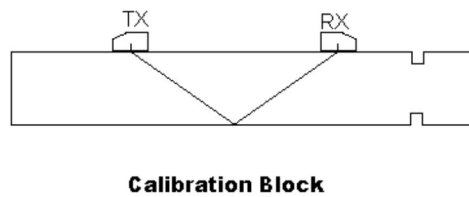


CONDITION B - PRODUCTION MATERIAL

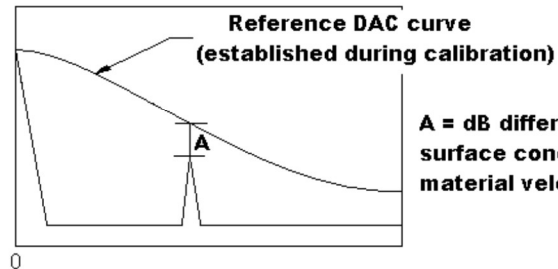
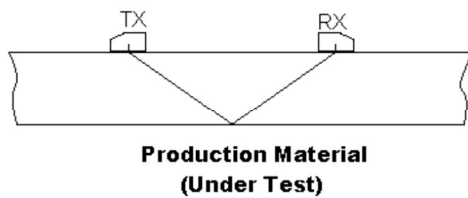
- b. Angle Beam Examination: Transfers shall be accomplished by using the through transmission method and two identical angle probes. For any material thickness, at least full skip shall be used. The amplitudes of both, calibration block and production material shall be evaluated at the established DAC level, the difference in the gain levels between the calibration block and production material responses (A) shall be recorded and used for the correction of the reference sensitivity. Reference Figure given below-
- c. Each type of material and each size and wall thickness shall be considered separately in applying the transfer method. In addition, at least two (2) areas on the production material under examination shall be checked.
- d. Acoustic compatibility between the reference standard material and the material to be tested shall be within 12 dB. If the acoustic compatibility differences are less than 12 dB, the instrument sensitivity shall be increased to compensate for the differences in acoustic compatibility. If the acoustic compatibility differences are greater than 12 dB, a different reference standard shall be used.

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CONDITION A - CALIBRATION BLOCK

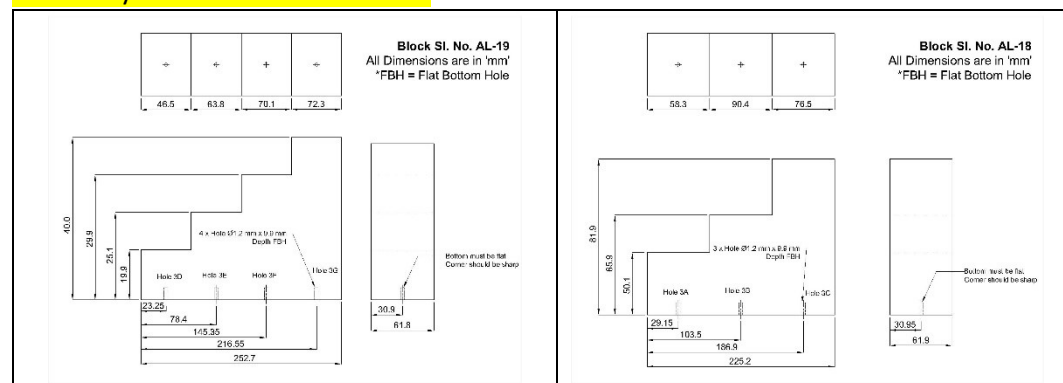



CONDITION B - PRODUCTION MATERIAL

6. Sensitivity Calibration and DAC preparation:

- Direction A**, Normal beam scanning: The Distance Amplitude curve shall be prepared with help of above specified reference blocks on page no.3 of this technique sheet.
- Electronic distance amplitude correction shall be prepared, Maximum 80% signal height shall be adjusted for 15 mm sound path FBH and remaining 02 FBH sound paths (30 mm & 56 mm) shall be plotted. Ensure minimum 20% signal height of last reference hole sound path on screen.
- Add transfer correction if any and this will remain added during evaluation of any indication.

Sensitivity calibration block details:



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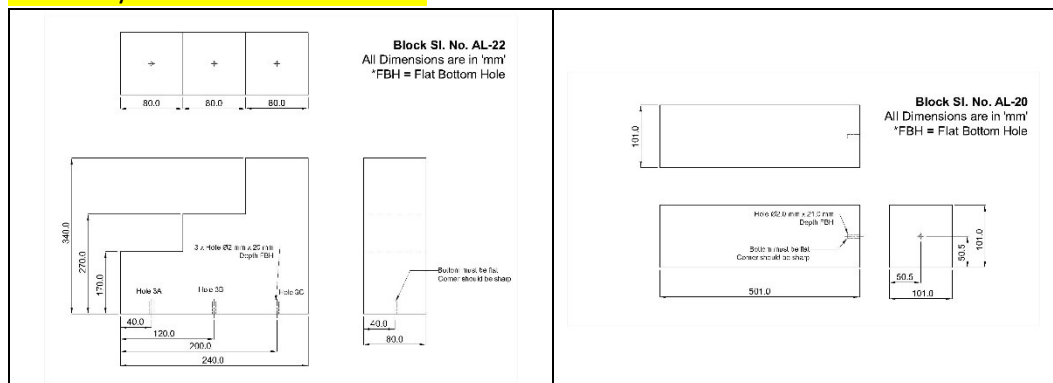
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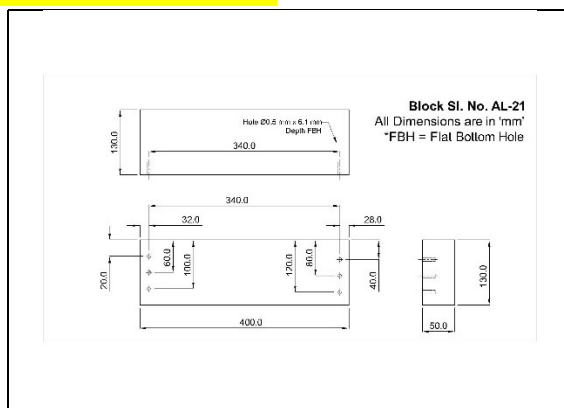
- d. **Direction B**, Normal beam scanning: The Distance Amplitude curve shall be prepared with help of above specified reference blocks on page no.3 of this technique sheet.
- e. Electronic distance amplitude correction shall be prepared, Maximum 80% signal height shall be adjusted for 150 mm sound path FBH and remaining 02 FBH sound paths (250 mm & 480 mm) shall be plotted. Ensure minimum 20% signal height of last reference hole sound path on screen.
- f. Add 9 dB for conversion 2.0 mm to 1.2 mm FBH sensitivity.
- g. Add transfer correction if any and this will remain added during evaluation of any indication.

Sensitivity calibration block details:




- h. **Direction A, Angle Beam scanning:** The Distance Amplitude curve shall be prepared with help of above specified reference blocks on page no.3 of this technique sheet.
- i. Electronic distance amplitude correction shall be prepared, Maximum 80% signal height shall be adjusted for 28 mm sound path SDH and remaining 02 sound paths (56 mm & 84 mm) shall be plotted. Ensure minimum 20% signal height of last reference hole sound path on screen.
- j. Add transfer correction if any and this will remain added during evaluation of any indication.

Sensitivity calibration block details:



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7. Scanning:

- a. Scanning shall be performed at a gain level 6dB higher than the reference level which will be reduced during evaluation on any indication.
- b. The Scanning speed shall be maintained maximum 150 mm per second with 50% overlap of each pass. This will be ensure by scanning traces of probe on surface.
- c. Any indication which height 50% or above of the DAC shall me marked for further evaluation.
- d. Scanning shall be performed grid wise to ensure 100% coverage.
- e. Scanning shall be done in both circumferential and axial direction of surface.
- f. For B direction the scanning shall be done on both opposite faces to cover entire length of the forging.
- g. The angle beam scanning shall be done in clockwise and anti-clockwise directions.

8. Recording:

- a. All test related data shall be recorded in Ultrasonic examination log sheet.

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