



NONDESTRUCTIVE TEST

EFFECTIVITY

MODEL: ALL

PART 4 - ULTRASONIC FUSELAGE SKIN SCRIBE MARK CRACK INSPECTION - LOWER SKIN AT THE LAP JOINTS, DOUBLERS, AND EXTERNAL STRUCTURE

1. Purpose

- A. Use this procedure to find cracks in the lower skin panels of the fuselage at the lap joints.
- B. This procedure looks for cracks in the lower skin panels that are:
 - (1) 0.200 inches (5.08 mm) long (or more)
 - (2) Are in the forward and aft direction
 - (3) Are 50% of the skin thickness in skins that are from 0.032 to 0.040 inch (0.81 to 1.02 mm) thick
 - (4) Are 0.020 inch (0.51 mm) deep in skins that are from 0.041 to 0.125 inch (1.04 to 3.17 mm) thick.
 - (5) On the outer surface of the skin and in an area that begins approximately 0.030 inches (0.76 mm) above the lower edge of the upper skin and continues to the lower edge of the upper skin.
- C. See Figure 1 for the inspection area at the lap joint.
- D. This procedure examines skins that are from 0.032 to 0.125 inch (0.81 to 3.17 mm) thick. For skins that are from 0.126 to 0.250 inch (3.20 to 6.35 mm) thick, refer to Part 4, 53-30-06 for the inspection procedure.
- E. This inspection procedure uses a specially designed, 10 MHz, 70 degree shear wave, potted transducer. The inspection is done with the transducer on the outer surface of the lower skin.
- F. A transducer positioner is used to help examine skin thicknesses that are from 0.046 to 0.125 inch (1.17 to 3.17 mm) thick. The transducer positioner puts the transducer at the correct distance from the edge of the upper skin. It is not necessary to use the positioner to examine skin thicknesses from 0.032 to 0.045 inch (0.81 to 1.14 mm).

2. Equipment

- A. General
 - (1) Use inspection equipment that can be calibrated on the reference standard as specified in par. 4.
 - (2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.



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B. Instrument

- (1) Use an ultrasonic instrument that operates at a frequency of 10 MHz. Broadband instruments can be used if they can do the calibration instructions of this procedure.
- (2) The instruments that follow were used to help prepare this procedure.
 - (a) Sonic-136, Nortec 1200; Staveley Instruments, Inc.
 - (b) USD 10, 15; Krautkramer Branson
 - (c) USN 50, 52L, 60; Krautkramer Branson
 - (d) EPOCH 4; Panametrics, Inc.

C. Transducer – This procedure uses a specially designed transducer. The transducers that follow were used to help prepare this procedure and are the only ones that can be used.

- (1) SUS 1020; NDT Engineering Corp.
- (2) XAB-6087; Xactex Corp.
- (3) TEK-5000; Techna NDT

D. Reference Standard – Use the applicable reference standard NDT1086-XXX (see Fig. 2). The XXX in the reference standard number is the reference standard thickness. The Calibration Table in the “Instrument Calibration,” section identifies the reference standard thickness to be used to examine the different airplane skin thicknesses.

E. Couplant – Use a couplant that will not cause damage to the airplane structure. It is recommended to use a light weight couplant with a viscosity that is almost the same as the viscosity of water.

F. Transducer Positioner – Use the transducer positioner NDT1086-P1 for the SUS 1020 transducer and/or NDT1086-P2 for the XAB-6087 or TEK-5000 transducer (see Fig. 3). The transducer positioner is used to examine airplane skin thicknesses from 0.046 to 0.125 inch (1.17 to 3.18 mm).

3. Preparation for Inspection

CAUTION: REMOVE PAINT AND SEALANT CAREFULLY TO PREVENT DAMAGE TO THE SURFACE OF THE SKIN. SEE THE AIRPLANE MAINTENANCE MANUAL (AMM) FOR MORE INSTRUCTIONS IF NECESSARY.

- A. Remove the paint and sealant from the inspection surface at the lower skin of the lap joint before inspection. The paint must be removed from the lower edge of the upper skin to a minimum of 1.0 inch (25 mm) below the lower edge of the upper skin for the length of the lap joint to be examined. If the transducer positioner is used, paint must be removed a minimum of 1.5 inch (38 mm) below the lower edge of the upper skin. Make sure the inspection area is clean and the edge of the upper skin is free of paint and/or sealant.



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- B. Service experience has shown that crack indications can be missed because of human-factors such as:
- Not fully understanding the inspection procedures.
 - Incorrect or defective NDT reference standards.
 - Incorrect equipment set-up and calibration before the inspection.
 - Incorrect monitoring of the NDT instrument display.
 - Not sufficient time permitted to do the inspections.
 - Not sufficient access to the inspection areas.
 - Incorrect records made of areas not examined or remaining to be examined because of work shift changes or breaks during the inspection that result in areas missed.
 - Incorrect records made of inspection results.

Take steps to make sure that the human factors specified above, as well as other human-factors, do not occur during this inspection.


- C. Use of work stands for access to the inspection area is recommended. The inspector must keep the transducer in touch with the inspection surface at the correct angle.
- D. Questions or concerns about this NDT procedure can be answered by the Boeing Commercial Airplane Group.

4. Instrument Calibration


- A. Identify the thickness of the airplane skin to be examined. Use the Structural Repair Manual (SRM), Boeing Engineering Drawings, or other sources to identify the skin thicknesses.
- B. Identify the reference standard to use during calibration. The Calibration Table that follows identifies:
- (1) The applicable reference standard to use for the different airplane skin thicknesses.
 - (2) The distance from the exit point on the transducer to the front edge of the transducer positioner. Use the transducer positioner, NDT1086-P1 or NDT1086-P2, on reference standards NDT1086-050 thru NDT1086-120 to put the transducer at the location that will point the sound beam at the inspection area.



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Reference Standard	Skin Thickness Range (Nominal)	Distance from the Transducer Exit Point to the Front Edge of the Transducer Positioner
NDT1086-032	0.032 to 0.035 inch (0.81 to 0.89 mm)	The Front of the Transducer must be Flush with the Edge of the upper skin
NDT1086-040 	0.036 to 0.045 inch (0.91 to 1.14 mm)	The Front of the Transducer must be Flush with the Edge of the upper skin
NDT1086-050	0.046 to 0.055 inch (1.17 to 1.40 mm)	0.27 inch (6.8 mm)
NDT1086-060	0.056 to 0.065 inch (1.42 to 1.65 mm)	0.33 inch (8.4 mm)
NDT1086-070	0.066 to 0.075 inch (1.68 to 1.91 mm)	0.39 inch (9.9 mm)
NDT1086-080	0.076 to 0.085 inch (1.93 to 2.16 mm)	0.44 inch (11.2 mm)
NDT1086-090	0.086 to 0.095 inch (2.18 to 2.41 mm)	0.49 inch (12.4 mm)
NDT1086-100	0.096 to 0.105 inch (2.44 to 2.67 mm)	0.55 inch (14.0 mm)
NDT1086-110	0.106 to 0.115 inch (2.69 to 2.92 mm)	0.62 inch (15.7 mm)
NDT1086-120	0.116 to 0.125 inch (2.95 to 3.18 mm)	0.66 inch (16.8 mm)

Calibration Table

 You can use reference standard NDT3065 as an alternative (reference Part 6, 53-30-22). Use notches C and D (on reference standard NDT3065) to calibrate the ultrasonic instrument.

- C. When the transducer positioner is used, put the transducer in the positioner. Make sure that the transducer sound exit point is the distance that is specified in the Calibration Table from the front edge of the transducer positioner. It is recommended to use a caliper to measure the distance.
- D. Set the instrument frequency to 10 MHz if a broadband instrument is not used.
- E. Apply a sufficient amount of couplant on the inspection surface of the reference standard at the EDM notch locations identified as "A" and "B". See Fig. 4, Detail I for calibration on reference standards NDT1086-032 and NDT1086-040. See Fig. 5, Detail I for calibration on reference standards NDT1086-050 thru NDT1086-120.



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- F. Put the transducer on the inspection surface of the reference standard at the notch location identified as "A". See Figure 4 or 5, Detail I.
- G. Make sure the front of the transducer/positioner is against the edge of the top piece.
- H. Adjust the instrument gain, delay and range controls, as necessary, to get a signal from the notch to show on the screen display.

NOTE: It is possible that a noise signal from the front of the transducer can occur at approximately the same screen width location as the signals from the "A" and "B" notches in reference standard NDT1086-032. If this occurs, use the transducer positioner to set the transducer away from the edge of the upper piece, to separate the notch signal from the noise signal. Set the transducer to the most forward position in the positioner.

- I. Move the transducer from side to side, along the surface to get a maximum signal from the notch. Keep the front of the transducer/positioner against the edge of the top piece at all times.

NOTE: It is possible that the notch signal height will be higher when the transducer is turned away from the edge of the upper piece. Make sure that the front of the transducer/positioner is always against the edge of the top piece during calibration.

- J. Adjust the instrument gain to get the maximum notch signal to 80% of full screen height (FSH). See Figure 4 or 5, Detail II.

- K. Adjust the instrument delay and range controls as follows:

- (1) To calibrate on reference standards NDT1086-032 and NDT1086-040, set the front edge of the notch signal to 50% of full screen width (FSW) with the front edge of the initial pulse set to 0% of FSW. See Figure 4, Detail II.
- (2) To calibrate on reference standards NDT1086-050 thru NDT1086-120, set the front edge of the notch signal to 90% of full screen width (FSW) with the front edge of the initial pulse set to 0% of FSW. See Figure 5, Detail II.

- L. Adjust the instrument delay control to set the front edge of the notch signal to 10% of FSW. The initial pulse will no longer be on the screen display. See Figure 4 or 5, Detail III.

- M. Move the transducer to the notch location identified as "B" and monitor the screen width location of the notch signal on the screen display. The notch signal will occur at approximately 15% of FSW. See Figure 4 or 5, Detail IV.

NOTE: It will be necessary to make small adjustments to the range and delay controls to get the 5% of FSW separation between the "A" and "B" notches on reference standards NDT1086-110 and NDT1086-120.



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- N. Make sure the "B" notch signal is 80% of FSH or higher. If the signal height is less than 80% of FSH, add the gain necessary to put the signal at 80% of FSH.

NOTE: When the transducer positioner is used, it can be necessary to make a small adjustment to the distance between the transducer exit point and the edge of the upper piece. Make an adjustment only if the signal from the "B" notch is less than 50% of the signal from the "A" notch.

- O. Move the transducer to a fastener location and monitor the screen width location of the fastener hole signal on the screen display. The signal of the fastener hole will be between 50 and 75% of FSW. See Figure 4 or 5, Detail IV.

- P. Set the audible alarm to 80% of FSH as shown in Figure 4 or 5, Detail III and IV.

- Q. Do a scan on the reference standard to find the maximum scan speed that can be used to find the notch. Use a scan speed that will not cause the notch signal to decrease less than 60% of FSH.

- R. Add 6 dB of gain.

5. Inspection Procedure

- A. Calibrate the instrument as specified in par. 4.

- B. Put a sufficient amount of couplant on the inspection areas. Use the same couplant on the airplane that was used on the reference standard during the calibration in par. 4.

NOTE: Too much couplant on the front of the transducer can prevent crack identification or cause false indications. Do not let too much couplant get on the front of the transducer during a scan.

- C. Put the transducer on the inspection surface with the front of the transducer/positioner against the edge of the upper skin at the lap joint. See Figure 1 for the typical transducer position.

- D. Make a scan of the lap joint and monitor the instrument screen display at all times. During the scan:

- (1) Make sure the transducer or transducer positioner touches the edge of the upper skin and is pointed in the correct direction during the complete scan of the inspection area.
- (2) Do not move the transducer faster than the maximum scan speed identified during calibration in paragraph 4.Q.
- (3) Monitor the screen display for the fastener hole signal from the lower row of fasteners in the lap joint to occur between 50 and 100% of FSW.

NOTE: It is possible that not all fastener holes will show on the screen display.



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6. Inspection Results

- A. Signals that are 80% of FSH or higher and are between 10 and 20% of FSW are possible crack indications. Make sure the additional 6 dB of scan gain is removed to make an analysis of possible crack signals. Make a mark at the crack indication locations with a grease pencil, felt pen or wax pencil.
- B. Carefully monitor the direction and position of the transducer at all times to help identify the causes of the signals that occur.
- C. For areas of the inspection surface that have a dent or an uneven surface, do paragraph 6.D.(3).
- D. Do more analysis of the area that gives an indication of a possible crack as follows:
 - (1) Do a careful visual inspection at the location of the ultrasonic indication. If the cause of the indication is not because of a fastener in the lower skin that is in the path of the transducer, continue to make an analysis of the indication as specified in the steps that follow.
 - (2) An ultrasonic signal can occur in the inspection area which can be caused from sound that is a reflection off the front of the transducer. Move the transducer away from the edge of the upper skin, if the signal does not move from left to right on the screen display, the signal is a noise signal from the transducer and is not a crack signal. A signal from a crack will move from the left to the right side of the screen display and be separate from a noise signal as the transducer is moved away from the lap joint.
 - (3) If there is internal access to the lower skin at the crack indication location and the skin is between 0.032 to 0.040 inch (0.81 to 1.02 mm) thick, do an eddy current inspection as specified in Part 6, 53-30-23. Do the Part 6, 53-30-23 inspection with the probe on the inner surface of the lower skin.

NOTE: This ultrasonic inspection procedure finds cracks that are 0.020 inch (0.51 mm) deep in skins that are from 0.041 inch to 0.125 inch (1.04 to 3.17 mm) thick (see par. 1.B.(4)). But, the Part 6, 53-30-23 eddy current inspection procedure finds cracks that are half the part thickness. Thus, the Part 6, 53-30-23 eddy current inspection procedure can not be used to make sure of the crack indications found in skins that are more than 0.040 inch (1.02 mm) thick.



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- (4) If you cannot put the eddy current probe on the lower skin at the correct location to do the eddy current inspection identified in par. 6.D.(3), or if the lower skin thickness is more than 0.040 inch (1.0 mm) thick, do the steps that follow:
- (a) Open up the lap joint at the area of the indication. Refer to the Structural Repair Manual for instructions to help open the lap joint.

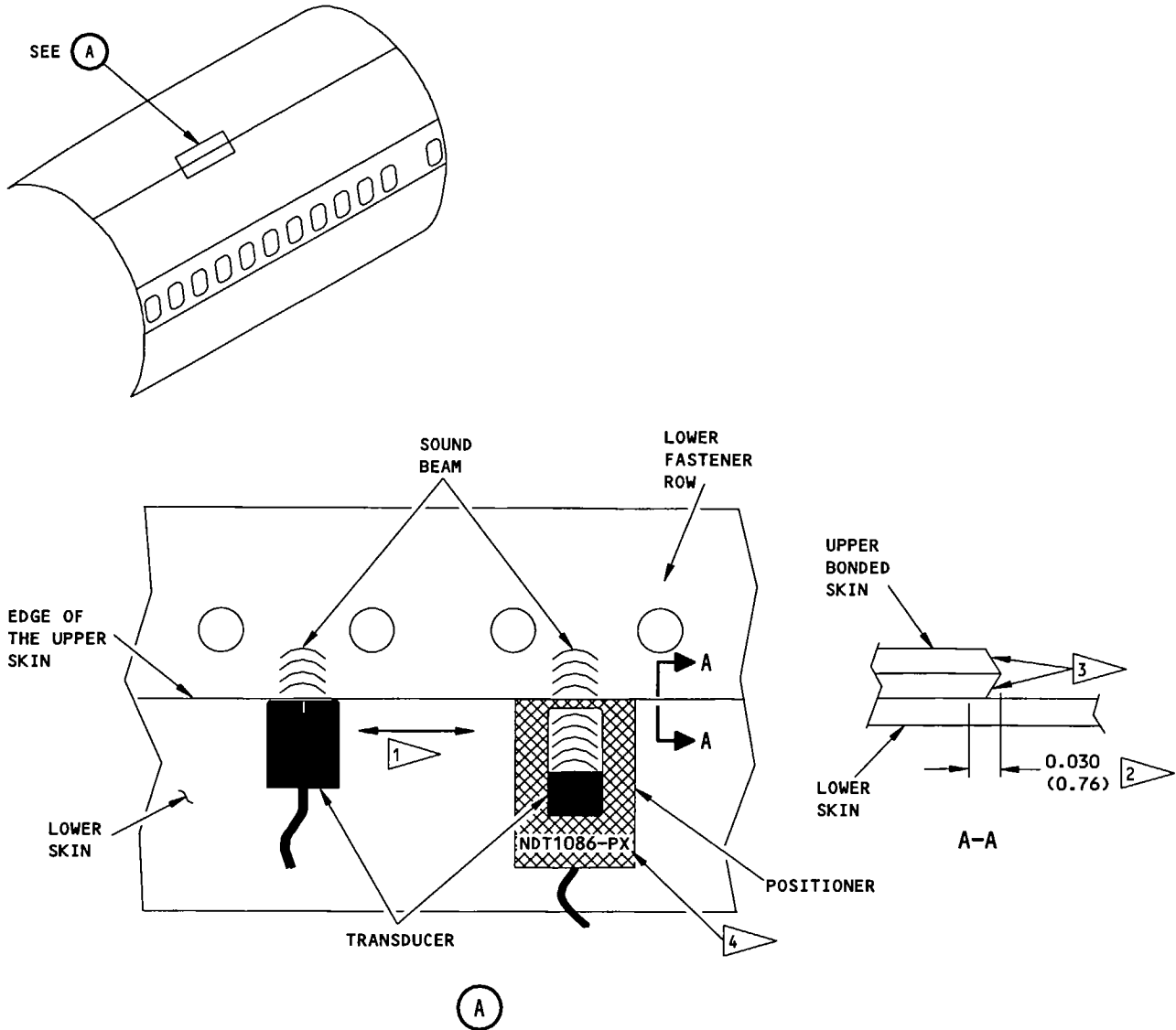
CAUTION: REMOVE SEALANT CAREFULLY TO PREVENT DAMAGE TO THE SURFACE OF THE SKIN. SEE THE STANDARD OVERHAUL PRACTICES MANUAL (SOPM) FOR MORE INSTRUCTIONS, IF NECESSARY.

- (b) Carefully remove the sealant from the outer surface of the inner skin at the location of the crack indication.
- (c) Do the ultrasonic inspection again.

NOTE: Keep the upper and lower skins together when you do the inspection to help put the transducer in the correct location.

- (d) If there are no crack indications with the second ultrasonic inspection, no further inspections are necessary. The initial crack indication can be thought to be a false crack indication.
- (e) If there continues to be an ultrasonic indication, do a high frequency eddy current inspection as specified in Part 6, 51-00-00, Fig. 4 or 23 at the location of the crack indication. Use reference standard 126 or an equivalent. If an indication is found with this inspection or with the eddy current inspection procedure specified in par. 6.D.(3), the indication must be thought to be from a crack.
- (f) If there is a crack indication with the ultrasonic inspection specified in par. 6.D.(4)(c) and no crack indication with the eddy current inspections specified in par. 6.D.(3) and 6.D(4)(e), ask Boeing for more instructions.

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NOTES:

- DIMENSIONS ARE IN INCHES
(MILLIMETERS ARE IN PARENTHESES)

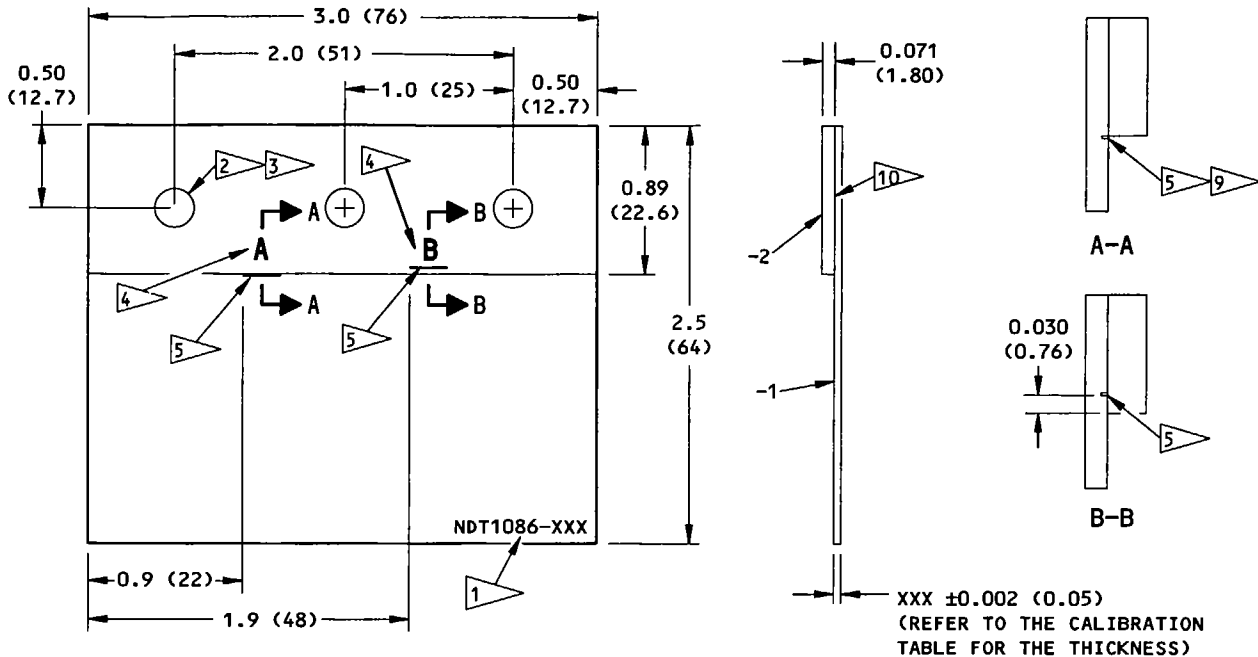
- 1 POSSIBLE CRACK DIRECTION IN THE LOWER SKIN.
- 2 INSPECTION ZONE
- 3 THE UPPER SKIN AND DOUBLER CAN HAVE A CHAMFER. THE LOCATION, SIZE AND SHAPE CAN BE DIFFERENT
- 4 TRANSDUCER POSITIONER NDT1086-P1 OR -P2, AS APPLICABLE

TRANSDUCER (WITH AND WITHOUT POSITIONER)
ON THE LOWER SKIN OF THE LAP JOINT

Inspection Areas
Figure 1

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NONDESTRUCTIVE TEST



NOTES:

- DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (UNLESS SPECIFIED DIFFERENTLY):

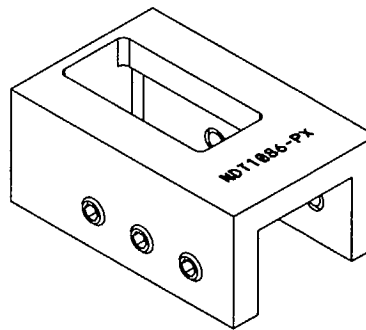
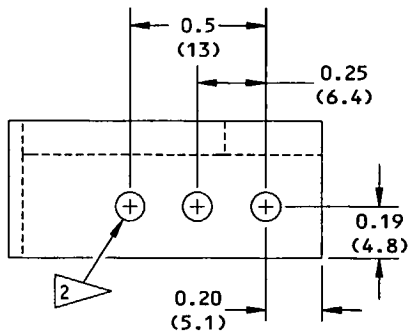
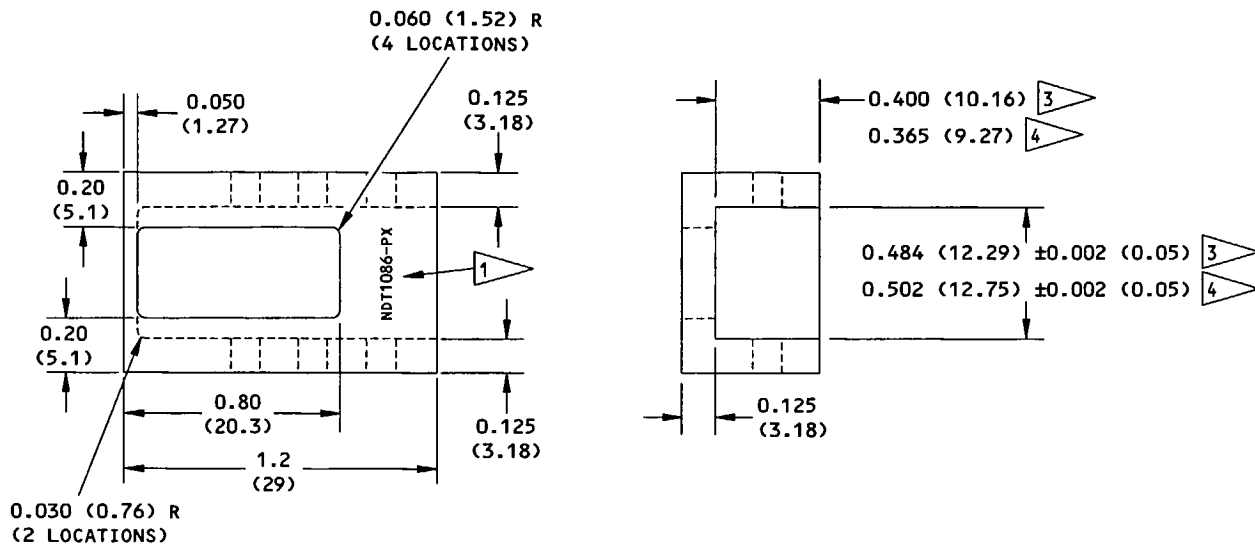
INCHES	MILLIMETERS
X.XXX = ±0.005	X.XX = ±0.1
X.XX = ±0.025	X.X = ±0.5
X.X = ±0.050	X = ±1
- SURFACE ROUGHNESS: 63 Ra OR BETTER
- MATERIAL: ALUMINUM (CLAD OR BARE)
- 1 BOTTOM PIECE. USE A THICKNESS THAT IS IDENTIFIED IN THE CALIBRATION TABLE OF THIS PROCEDURE FOR THE RANGE OF AIRPLANE SKIN THICKNESSES TO BE EXAMINED.
- 2 TOP PIECE. USE A 0.071 INCH (1.80) THICK PIECE (TYPICAL) FOR ALL REFERENCE STANDARDS.
- 1 ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT1086-XXX. XXX IDENTIFIES THE BOTTOM PIECE THICKNESS IN THOUSANDTHS OF AN INCH. EXAMPLE: NDT1086-050 USES A -1 BOTTOM PIECE THAT IS 0.050 INCH (1.27) THICK.
- 2 BACR15GF5D RIVET (3 LOCATIONS). USE A -4 RIVET LENGTH FOR A TOTAL REFERENCE STANDARD THICKNESS OF UP TO 0.100 (2.54). USE A -5 RIVET LENGTH FOR A TOTAL REFERENCE STANDARD THICKNESS BETWEEN 0.100 (2.54) TO 0.150 (5.08).

- 3 USE ONLY A SUFFICIENT AMOUNT OF PRESSURE DURING ASSEMBLY TO KEEP THE TWO PIECES TOGETHER. BE CAREFUL NOT TO DAMAGE THE BOTTOM PIECE DURING ASSEMBLY.
- 4 ETCH OR SCRIBE THE LETTER ON THE SURFACE OF THE TOP PIECE TO IDENTIFY THE LOCATION OF THE EDM NOTCH AND THE TRANSDUCER POSITION FOR THE INSTRUMENT CALIBRATION.
- 5 EDM NOTCH:
 - LENGTH: 0.200 (5.08) ±0.010 (0.25)
 - DEPTH: 6 7 8
 - WIDTH: 0.005 (0.13) ±0.002 (0.05)
- 6 0.010 (0.25) ±0.002 (0.05) IN NDT1086-032, NDT1086-040
- 7 0.015 (0.38) ±0.002 (0.05) IN NDT1086-050
- 8 0.020 (0.51) ±0.002 (0.05) IN NDT1086-060 THRU NDT1086-120
- 9 PUT THE EDM NOTCH FLUSH (±0.005 (0.13)) WITH THE EDGE AS SHOWN IN SECTION A-A.
- 10 APPLY FAY SURFACE SEALANT, BMS 5-95, CLASS B BETWEEN THE TOP AND BOTTOM PIECES AS SPECIFIED IN BAC 5000. MAKE SURE THE SEALANT DOES NOT EXTEND BEYOND FAYING SURFACE.

Reference Standard NDT1086-XXX
Figure 2



NONDESTRUCTIVE TEST



NOTES:

- DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (UNLESS SPECIFIED DIFFERENTLY):

INCHES	MILLIMETERS
X.XXX = ±0.005	X.XX = ±0.1
X.XX = ±0.025	X.X = ±0.5
X.X = ±0.050	X = ±1

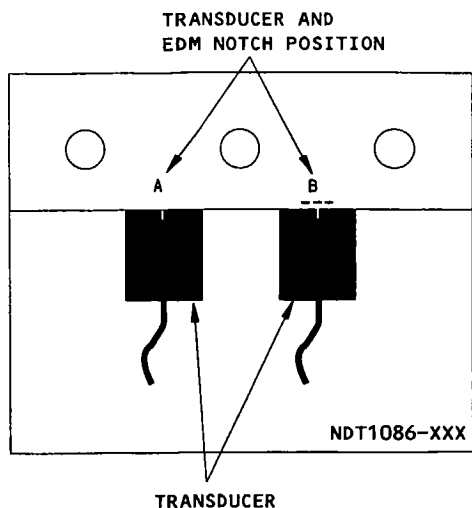
- SURFACE ROUGHNESS: 63 Ra OR BETTER
- MATERIAL: ALUMINUM
- DEBURR ALL EDGES

- 1 ETCH OR SCRIBE THE TRANSDUCER POSITIONER NUMBER THAT IDENTIFIES THE TRANSDUCER THAT WILL FIT INTO IT. USE NDT1086-P1 FOR THE SUS1020 TRANSDUCER. USE NDT1086-P2 FOR THE XAB-6087 OR TEK-5000 TRANSDUCER.
- 2 DRILL AND TAP FOR A 6-32 SET SCREW (6 LOCATIONS)
- 3 DIMENSION FOR THE SUS 1020 TRANSDUCER
- 4 DIMENSION FOR THE XAB-6087 AND TEK-5000 TRANSDUCER

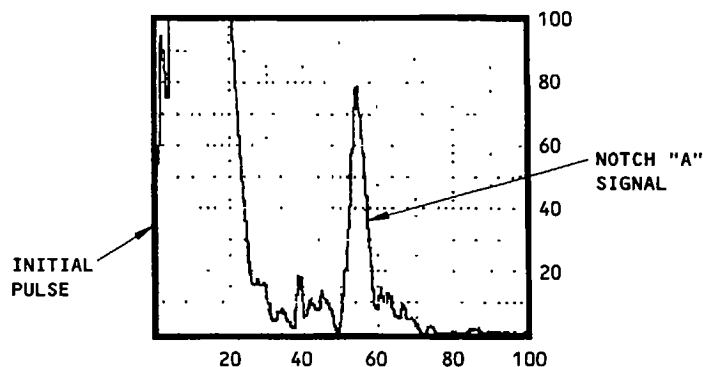
Transducer Positioner NDT1086-P1 and -P2
Figure 3

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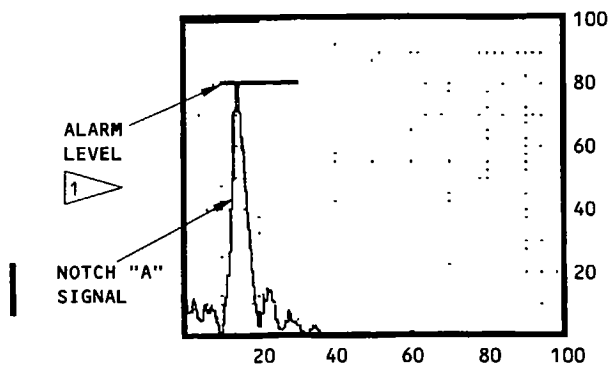
NONDESTRUCTIVE TEST



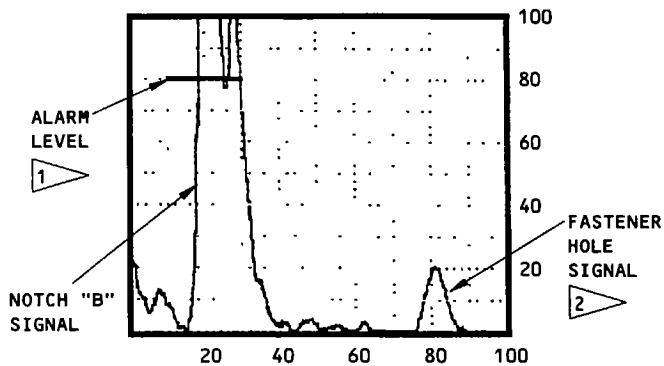
TRANSUCER POSITIONS ON REFERENCE
STANDARDS NDT1086-032 AND -040
DETAIL I



SCREEN DISPLAY OF THE INITIAL
CALIBRATION OF THE NOTCH "A" SIGNAL
DETAIL II



SCREEN DISPLAY OF THE NOTCH "A"
SIGNAL SET TO 10% OF FSW
DETAIL III



SCREEN DISPLAY OF THE NOTCH "B"
SIGNAL AND THE FASTENER HOLE SIGNAL
DETAIL IV

NOTES:

- THE SCREEN DISPLAYS SHOWN IN DETAILS II THRU IV ARE EXAMPLES. DIFFERENT INSTRUMENTS AND TRANSDUCERS CAN CAUSE DIFFERENT DISPLAYS.

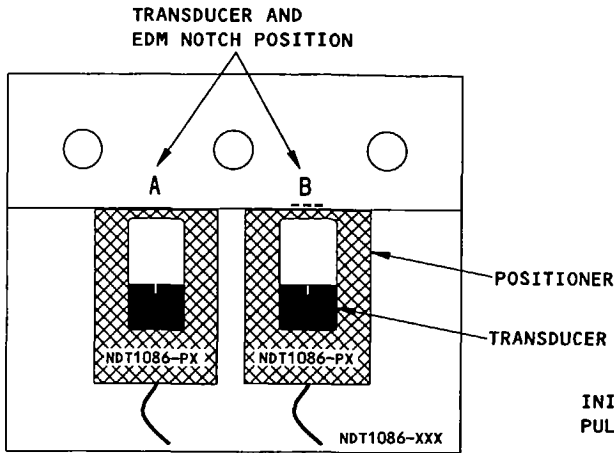
1 THE ALARM LEVEL IS SET TO 80% OF FULL SCREEN HEIGHT.

2 FASTENER HOLE SIGNAL ADDED TO THE SCREEN DISPLAY TO SHOW LOCATION.

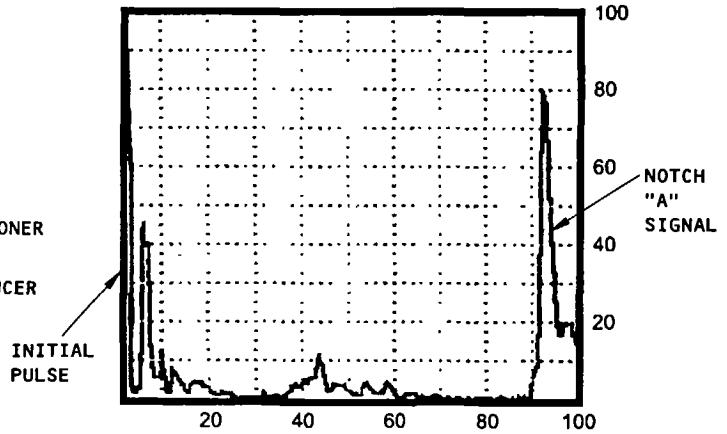
Instrument Calibration on Reference Standards
NDT1086-032 and NDT1086-040
Figure 4

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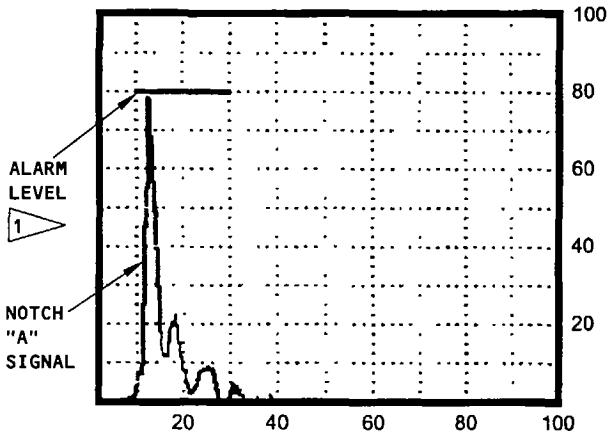
NONDESTRUCTIVE TEST



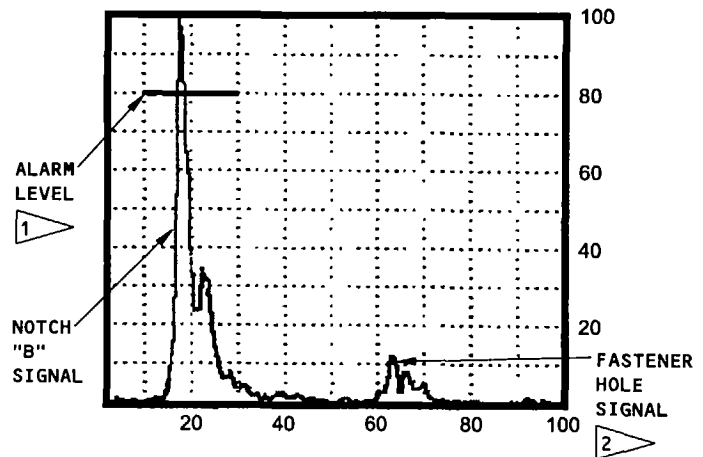
TRANSDUCER POSITIONS ON REFERENCE STANDARDS NDT1086-050 THRU -120
DETAIL I



SCREEN DISPLAY OF THE INITIAL CALIBRATION OF THE NOTCH "A" SIGNAL
DETAIL II



SCREEN DISPLAY OF THE NOTCH "A" SIGNAL SET TO 10% OF FSW
DETAIL III



SCREEN DISPLAY OF THE NOTCH "B" SIGNAL AND THE FASTENER HOLE SIGNAL
DETAIL IV

NOTES:

- THE SCREEN DISPLAYS SHOWN IN DETAILS II THRU IV ARE EXAMPLES. DIFFERENT INSTRUMENTS AND TRANSDUCERS CAN CAUSE DIFFERENT DISPLAYS.
- THE TRANSDUCER SHOWN IN THE POSITIONER IS NOT SET TO A SPECIFIC DISTANCE, IT IS ONLY FOR DISPLAY. REFER TO THE CALIBRATION TABLE IN PAR. 4 FOR THE DISTANCE TO SET FOR THE APPLICABLE REFERENCE STANDARD.

1 ▷ THE ALARM LEVEL IS SET TO 80% OF FULL SCREEN HEIGHT.

2 ▷ FASTENER HOLE SIGNAL ADDED TO THE SCREEN DISPLAY TO SHOW LOCATION.

Instrument Calibration on Reference Standards
NDT1086-050 Thru NDT1086-120
Figure 5

EFFECTIVITY
MODEL: ALL

PART 4 - ULTRASONIC

FUSELAGE SKIN SCRIBE MARK CRACK INSPECTION - LOWER SKIN
AT THE LAP JOINTS, DOUBLERS, AND EXTERNAL STRUCTURE (PHASED ARRAY)

1. Purpose

- A. Use this procedure to find cracks in the lower skin panels of the fuselage at the lap joints with paint up to 0.007 inches (0.18 mm) thick or without paint on the airplane skin. See Fig. 1 for the typical inspection area.
- B. This procedure examines skins that are from 0.032 to 0.310 inch (0.81 to 7.87 mm) thick.
- C. This procedure uses an ultrasonic phased array instrument that displays a color image of a sector type scan. Ultrasonic signals are displayed as a red image against a green background.
- D. This procedure can be used as an alternative to the procedures that follow. A single inspection with this procedure will do the inspections of the two procedures that follow.
 - (1) Part 4, 53-30-05
 - (2) Part 6, 53-30-22
- E. This procedure looks for cracks in the lower skin panels that are:
 - (1) 0.200 inches (5.08 mm) long (or more)
 - (2) Are in the forward and aft direction
 - (3) Are 0.018 inch (0.46 mm) deep in skins that are from 0.032 to 0.040 inch (0.81 to 1.10 mm) thick.
 - (4) Are 0.020 inch (0.51 mm) deep in skins that are from 0.041 to 0.310 inch (1.04 to 7.87 mm) thick.
 - (5) On the outer surface of the skin and in an area that begins approximately 0.030 inches (0.76 mm) above the lower edge of the upper skin and continues to 0.063 inches (1.60 mm) below the lower edge of the upper skin.

2. Equipment

A. General

- (1) Use inspection equipment that can be calibrated on the reference standard as specified in par. 4.
- (2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.



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B. Instrument

- (1) Use an ultrasonic phased array instrument that:
 - (a) Has a multi-element ultrasonic array that can sweep a sound beam from 25 to 80 degrees.
 - (b) Operates at a frequency of 10 MHz.
 - (c) Has an A-Scan and S-Scan sectorial or sector type display mode.
- (2) The instruments that follow were used to help prepare this procedure.

NOTE: You can use other phased array instruments. If you want to use a different phased array instrument, it is necessary for Boeing to examine the instrument and the calibration instructions supplied by the instrument manufacturer before you can use it in this procedure.

- (a) OmniScan MX; made by RD Tech, Division of Olympus, with one of the modules that follows:
 - 1) Automated OmniScan MX PA module (16:16, 16:128); software version MXU-2.0RX (X = 7 or higher) or PA 1.4RX (X = 4 or higher).
 - 2) Manual OmniScan MX PA module (16:16M, 16:64M); software version MXU-M-2.0RX (X = 4 or higher).

NOTE: Before you use the OmniScan MX to do this procedure, make sure that the instrument has the software version specified above. The "R" letter at the end of the application software is a reference for the "maintenance" version. If the instrument has an older software version, contact Olympus NDT Canada to get the latest software version and technical aid to install it.

NOTE: If you have software version PA 1.4R4 or higher, it is not necessary to use the MXU-2.0RX instrument.

- (b) Phasor XS; software version 1.06; made by GE Inspection Technologies.

NOTE: Before you use the GE Phasor XS to do this procedure, make sure that the instrument has software version 1.06 or higher. If the instrument has an older software version, contact GE Inspection Technologies to get the latest software version and technical aid to install it.

C. Probe

- (1) Use a phased array probe that operates at a frequency of 10 MHz.



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- (2) For the OmniScan MX, the RD Tech array probe assemblies that follow were used to help prepare this procedure.
 - (a) For skin thicknesses between 0.032 and 0.140 inch (0.81 to 3.55 mm), use a 10L16 or 10L16E5-5 16-element phased array probe with a SA1-N60S5X5 or SA00-N60S wedge.
 - (b) For skin thicknesses between 0.141 and 0.310 inch (3.58 to 7.87 mm), use a 10L16 or 10L16E5-5 16-element phased array probe with a SA00-N45S wedge.
- (3) For the Phasor XS, the GE array probe assemblies that follow were used to help prepare this procedure.
 - (a) For skin thicknesses between 0.032 and 0.140 inch (0.81 to 3.55 mm), use a 115-000-411, 16 element phased array probe with a 360-141-129 wedge.
 - (b) For skin thicknesses between 0.141 and 0.310 inch (3.58 to 7.87 mm), use a 115-000-411, 16 element phased array probe with a 360-141-148 wedge.

D. Reference Standard

- (1) Use the applicable reference standard NDT1094-XXX or NDT1094-XXX-A. See Fig. 2 for a drawing of the reference standard. The XXX in the reference standard number is the reference standard thickness. Table 1 in par. 3.F. identifies the reference standard thickness to be used to examine the different airplane skin thicknesses.

NOTE: NDT1094-XXX cannot be used if button head fasteners do not let the probe touch the edge of the lap. See par. 5.I. To do par. 5.I., NDT1094-XXX-A must be used (because it has notch D).

- E. Couplant – Use a couplant that will not cause damage to the airplane structure. It is recommended to use a light weight couplant with a low viscosity.

3. Preparation for Inspection

- A. Identify the inspection area.

CAUTION: REMOVE PAINT AND SEALANT CAREFULLY TO PREVENT DAMAGE TO THE SURFACE OF THE SKIN. SEE THE AIRPLANE MAINTENANCE MANUAL (AMM) FOR MORE INSTRUCTIONS IF NECESSARY.

- B. Remove paint only if it is specified by the maintenance documents. If paint removal is necessary, do the steps that follow:
 - (1) Remove the paint from the lower edge of the upper skin to a minimum of 1.0 inch (25 mm) below the edge of the upper skin for the length of the lap joint to be examined.



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- C. If the maintenance documents do not specify paint removal for the inspection, make an estimate of the paint thickness below the skin laps with an eddy current procedure (lift-off measurement) that uses a direct reading or an indirect reading. To do an indirect reading procedure for paint thickness measurement, use an impedance plane instrument and do the steps that follow:

NOTE: You can refer to the paint thickness instructions in the McDonnell Douglas Nondestructive Testing Standard Practice Manual, Part 6, 06-10-01.002, or you can do the steps that follow.

- (1) Apply nonconductive tape or shims that have three different known thicknesses on the bottom piece of the reference standard at three locations. One layer of Teflon tape that is 0.0035 inch (0.09 mm) thick (at the first location), two layers that total 0.007 inch (0.18 mm) thick (at the second location) and three layers that total 0.010 inch (0.27 mm) thick (at the third location) will be satisfactory for the paint thickness estimate. The three known thicknesses can be different (by a small quantity) than the three examples given above only if the thicknesses are known or measured mechanically before they are put on the reference standard.
- (2) With a shielded, surface eddy current probe and the instrument set between 500 kHz to 1 MHz, set the gain so that 4 different lift-off amplitudes are shown on the screen. These signals include the balance point on the surface of the reference standard that is not painted and the lift-off signals from the 3 different nonconductive shims specified in par. 3.C.(1) above. Make sure the probe is kept perpendicular to the surface at each shim location. Make a mark on the screen with a grease pencil or water soluble marker for each of these lift-off amplitudes.

NOTE: We recommend that you use a collar around the probe to hold it perpendicular to the surface.

- (3) Do not balance the probe on the airplane for this paint thickness measurement. Put the probe at 3 to 5 different locations in each inspection area below the lap splice (against the upper skin edge) to get paint thickness measurements. Compare the measurements on the airplane skin with the measurements taken on the shims on the reference standard. Take an average of all thickness measurements.
- D. Do the paint thickness measurement that is specified above in each frame bay along each lap splice lower skin that will be examined. If the paint thickness is more than 0.007 inch (0.18 mm) it must be removed in that frame bay before you do this ultrasonic inspection.
- E. Remove the sealant fillet below the upper skin edge so the front of the transducer wedge will touch the edge of the upper skin at all times. Make sure the inspection area is clean and the edge of the upper skin is free of paint and/or sealant.



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- F. Identify the thickness of the airplane skin to be examined. Use the Structural Repair Manual (SRM), Boeing Engineering Drawings or other sources to identify the skin thicknesses. Refer to the Calibration Table that follows to identify the applicable reference standard to use for the different airplane skin thicknesses.

Reference Standard	Skin Thickness Range (Nominal)	Wedge
		(a) RD Tech (b) GE
NDT1094-040, NDT1090-040-A	0.032 to 0.045 inch (0.81 to 1.14 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1094-050, NDT1094-050-A	0.046 to 0.059 inch (1.17 to 1.50 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1094-070, NDT1094-070-A	0.060 to 0.079 inch (1.52 to 2.01 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1094-090, NDT1094-090-A	0.080 to 0.099 inch (2.03 to 2.51 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1094-110, NDT1094-110-A	0.100 to 0.119 inch (2.54 to 3.02 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1094-130, NDT1094-130-A	0.120 to 0.140 inch (3.05 to 3.56 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1094-155, NDT1094-155-A	0.141 to 0.170 (3.58 to 4.32 mm)	(a) SA00-N45S (b) 360-141-148
NDT1094-185, NDT1094-185-A	0.171 to 0.190 (4.34 to 4.83 mm)	(a) SA00-N45S (b) 360-141-148
NDT1094-215, NDT1094-215-A	0.191 to 0.220 (4.85 to 5.59 mm)	(a) SA00-N45S (b) 360-141-148
NDT1094-245, NDT1094-245-A	0.221 to 0.250 (5.61 to 6.35 mm)	(a) SA00-N45S (b) 360-141-148
NDT1094-275, NDT1094-275-A	0.251 to 0.280 (6.38 to 7.11 mm)	(a) SA00-N45S (b) 360-141-148
NDT1094-300, NDT1094-300-A	0.281 to 0.310 (7.13 to 7.87 mm)	(a) SA00-N45S (b) 360-141-148

Table 1 - Calibration Data



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4. Instrument Calibration

NOTE: The instrument calibration instructions identified in par. 4.A. are for the OmniScan MX instrument, MXU-M-2.0RX for the Manual module and MXU-2.0RX and PA 1.4RX for the Automated module, and the phased array probe assemblies identified in par. 2.C.(2).

NOTE: The instrument calibration instructions identified in par. 4.B. are for the Phasor XS instrument, software version 1.06 or higher, and the phased array probe assemblies identified in par. 2.C.(3).

NOTE: Make sure that your instrument has the software version identified in par. 2.B.(2) or higher. If the instrument has an older version, contact the instrument manufacturer to get the latest version and, if necessary, technical aid to install it.

NOTE: If button head fasteners adjacent to the edge of the upper member do not let the probe do a scan along the edge, go to par. 5.I. for special inspection instructions. See Fig. 6, Detail I.

A. Calibrate the OmniScan MX instrument as follows:

- (1) Make sure the ultrasonic module and phased array probe are connected to the instrument as specified in the manufacturer's instructions.
- (2) Attach the applicable wedge to the probe for the skin thicknesses to be examined. Refer to Table 1 to identify the wedge to use.
- (3) Energize the instrument and select the Ultrasonic Phased Array (F2). The instrument automatically opens the Default.ops setup file.
- (4) If software version PA 1.4RX (automated module) is used:
 - (a) Open a stored setup file for this procedure, if available. Select Ultrasonic Phased Array (F2). The instrument automatically opens the Default.ops setup file and select Open (F8) or (keypad 4).
 - (b) If a setup file for this procedure has not been stored, do par. 4.A.(7)(a) thru (i) to create a setup file.
- (5) If software version MXU-2.0RX (automated module) or MXU-M-2.0RX (manual module) is used:
 - (a) Open a stored setup file for this procedure, if available. Select File > File (F2) > Open (F8) or (keypad 4) and select User Listed Files (F3).



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- (b) If a setup file for this procedure has not been stored, select File > File (F2) > Open (F8) or (keypad 4) and select Sample Listed Files (F3). Refer to the Default Setup Files table below to identify the applicable setup file for the module used. Open the applicable default setup file and do par. 4.A.(8)(a) thru (h) to create a setup file.

PA Module Type	Ordering Number	Default Setup File
16:16M	OMNI-M-PA1616M	ONDT_Default-PA16-16M.ops
16:64M	OMNI-M-PA1664M	ONDT_Default-PA16-64M.ops
16:16	OMNI-M-PA1616	ONDT_Default-PA16-16.ops
16:128	OMNI-M-PA16128	ONDT_Default-PA16-128.ops

Default Setup Files

- (6) The instructions in par. 4.A.(7) and 4.A.(8) will identify the menus and options, followed by the parameter to be put in.

NOTE: The menus and options are shown in **bold** letters and the parameters are in regular letters. The first element shown is the menu listed in the Main menu (blue button), followed by the submenu (buttons F2 thru F6), and followed by the option (buttons F7 thru F12).

NOTE: Some calibration steps do not apply for the Manual OmniScan MX PA module (software version MXU-M-2.0RX). These steps will be identified with “*Only for the Automated Module*” after each of them.

NOTE: Not all of the instrument parameters will be identified in the calibration instructions. Only those parameters necessary for this procedure will be identified in the steps, all others will use the instrument default parameters.

NOTE: The OmniScan instrument has key pad commands that make the set-up easier. This procedure references key pad numbers where they are applicable. To enter a parameter, use the drop down selection when available or enter the value if there is no drop down selection.

- (7) To create a setup file if software version PA 1.4RX with the automated module is used, do the steps that follows:

- (a) **Utilities > Pref. > Units (F7) > Millimeters**
- (b) **Probe/Part** and **PGM Probe** menus define the parameters for the probe, wedge and test part. Set the parameters as follows:
 - 1) **Probe/Part > Wizard (F6) > Start (F8)**
 - a) **Operation (F9) > Modify**
 - b) **Next (F8)**



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- c) **Geometry (F9)** > Plate
- d) **Thickness (F10)** > 0.00 or smallest value.
- e) **Material (F12)** > Aluminum
- f) **Next (F8)**
- g) **Tx/Rx mode (F9)** > PE
- h) **Next (F8)**
- i) **Tx Wedge (F10)** > Refer to Table 1 in par. 3.F. to identify the applicable wedge for the skin thickness you will examine. Scroll through the list to select the applicable wedge and accept it.
 - 1. Go to par. 4.A.(7)(b)1)j) if the correct wedge is selected.
 - 2. If the SA00-N60S or SA1-N60S5X5 wedges are not in the list, do the steps that follow to define a wedge and store it in the list:
 - a. Exit out of the **Wizard** (Reject button)
 - b. **Probe/Part > Select (F2) > Select (F9) > Defines**
 - c. **Define Wedge (F11) > New (F3) > Serial Number (F8)** > enter in "SA00-N60S" or "SA1-N60S5X5"
 - d. **Save (F6)**, automatically goes to **Edit (F4)** menu
 - e. **Angle (F7)** > 39.0
 - f. **Velocity (F9)** > 2330.0
 - g. **Pri. offset (F10)** > -14.2 (make sure this is a minus number)
 - h. **Height (F12)** > 2.3
 - i. **Save (F6)**
 - j. **Close (Main Menu)**
 - k. **Probe/Part > Select (F2) > Select (F9) > Select Tx/Rx**
 - l. Do a check of the **Select Wedge (F11)** option to make sure the correct wedge number has been entered.



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3. If the SA00-N45S wedge is not in the list, do the steps that follow to define a wedge and store it in the list:
 - a. Exit out of the **Wizard** (Reject button)
 - b. **Probe/Part > Select (F2) > Select (F9) > Defines**
 - c. **Define Wedge (F11) > New (F3) > Serial Number (F8) > enter** in "SA00-N45S"
 - d. **Save (F6)**, automatically goes to **Edit (F4)** menu
 - e. **Angle (F7) > 31.0**
 - f. **Velocity (F9) > 2330.0**
 - g. **Pri. offset (F10) > -14.32** (make sure this is a minus number)
 - h. **Height (F12) > 2.63**
 - i. **Save (F6)**
 - i. **Close (Main Menu)**
 - k. **Probe/Part > Select (F2) > Select (F9) > Select Tx/Rx**
 - l. Do a check of the **Select Wedge (F11)** option to make sure the correct wedge number has been entered.

- j) Do a check of the **Tx Probe (F10)** option (letters grayed out) to make sure probe number "10L16" or "10L16E5-5" is entered. The probe, when connected to the instrument, will automatically be detected at the time the instrument is energized.

NOTE: The complete wedge name does not always fit in the display window.

1. If the correct probe is shown in **Tx Probe (F10)**, continue with the **Wizard** and do steps a. thru j. that follow:
 - a. Press **Next (F8)** two times
 - b. **Continue Law Wizard (F9)** this will allow parameters to be entered for the **PGM Probe** menu.
 - c. **Scan Type (F9) > Sectorial**



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- d. **Next (F8)**
 - e. **Velocity (F9) > SW**
 - f. Press Next (F8) two times
 - g. Set Beam Angle
 - 1 **Min. Angle (F9) > 45** (when the SA00-N60S or SA1-N60S5X5 wedge is used). 25 (when the SA00-N45S wedge is used).
 - 2 **Max. Angle (F10) > 80** (when the SA00-N60S or SA1-N60S5X5 wedge is used). 70 (when the SA00-N45S wedge is used).
 - 3 **Focus Depth (F12) > 10.00**
 - h. **Next (F8)**
 - i. **Generate (F8)**
 - j. If the correct probe number is shown, go to par. 4.A.(7)(c).
2. If the correct probe number is not shown, do the steps that follow:
- a. If the 10L16 or 10L16E5-5 probes are not shown in the **Tx Probe (F9)** option, it is possible that the correct probe number is in the stored list and the instrument did not automatically detect it. Do the steps that follow to recall the correct probe number from the stored list:
 - 1 Exit out of the **Wizard** (Reject button)
 - 2 **Probe/Part > Select (F2) > Select (F9) > Defines**
 - 3 **Auto Detect (F12) > Off**
 - 4 **Select Probe (F10) >** scroll through the list, select "10L16" or "10L16E5-5" and accept it (press **Close**).
 - 5 **Select (F9) > Select Tx/Rx**
 - 6 Do a check of the **Select Probe (F10)** option to make sure the correct probe number has been selected.



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- b. If the 10L16 or 10L16E5-5 probes are not shown in the drop down list from the **Select Probe (F10)** option, the probe must be defined and stored. Do the steps that follow to define the correct probe number and store it:
- 1 **Select (F9) > Defines**
 - 2 **Define Probe (F10) > New > Serial Number (F8) > enter in "10L16" or "10L16E5-5"**
 - 3 **Save (F6)**, automatically goes to **Edit (F4)** menu
 - 4 **Freq (F7) > 10**
 - 5 **Probe Type (F9) > Angle Beam**
 - 6 **Element Qty. (F10) > 16**
 - 7 **Pitch (F11) > 0.30**
 - 8 **Save (F6)**
 - 9 **Close (Main Menu)**
 - 10 **Probe/Part > Select (F2) > Select (F9) > Select Tx/Rx**
 - 11 Do a check of the **Select Probe (F10)** option to make sure the correct probe number has been entered.
- c. **PGM Probe > Wizard (F6) > Start (F8)**, do par. 4.A.(7)(b1))1.c. thru i.

(c) **Display** menu defines the view of the screen display.

- 1) **Selection (F2)**
 - a) **Display (F7) > A S [C]**
- 2) **Rulers (F3)**
 - a) **UT Unit (F7) > True Depth**
 - b) **DAC/TCG (F10) > Off**
 - c) **Gate (F11) > Off**
- 3) **Color (F5) > Load (F10)** select Alarm.pal and **Open (F7)**



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(d) **UT** menu defines the instrument ultrasonic parameters.

1) **Advanced (F6) > Points Qty. (F10) > Auto**

2) **General (F2)**

a) **Gain (F7) > 20.0**

b) **Start (F8) > 0.00**

c) Make sure that the beam cursor on the screen display is set to the minimum angle (steepest angle).

d) **Range (F9) > 21.0 +/- 0.5**

3) **Pulser (F3)**

a) **Voltage (F10) > Low**

4) **Receiver (F4)**

a) **Filter (F8) > 15 MHz**

b) **Rectifier (F9) > FW**

c) **Video Filter (F10) > On**

(e) **Scan > Synchro (F3) > Source (F7) > Clock**

(f) **Gate/Alarm** menu define the gate and TCG parameters.

1) **Gate (F2)**

a) **Gate (F7) > A**

b) **Start (F8) > 1.20**

c) **Width (F9) > 8.0 +/- 0.1** (when the SA00-N60S or SA1-N60S5X5 wedge is used). **16.0 +/- 0.1** (when the SA00-N45S wedge is used)

d) **Threshold (F10) > 95**

e) **Gate (F7) > B**

f) **Start (F8) > 0.0**



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- g) **Width (F9) > 0.0** or smallest value
- h) **Threshold (F10) > 0**
- i) **Gate (F7) > I**
- j) **Start (F8) > 0.0**
- k) **Width (F9) > 1.20**
- l) **Threshold (F10) > 10**

2) **DAC/TCG (F5)**

- a) If the skin thickness you will examine is less than 0.141 inch (3.58 mm), do the steps that follow:

NOTE: Make sure that the beam cursor on the screen display is set to the minimum angle before the TCG curve is made.

1. **Curve (F8) > TCG**
2. **Mode (F7) > Edit**
 - a. **Add (F11)**
 - b. **Point (F8) > 2**
 - c. **Position (F9) > 10.0 +/- 0.1**
 - d. **Gain (F10) > 17.0**
 - e. **Add (F11)**
 - f. **Point (F8) > 3**
 - g. **Position (F9) > 14.2 +/- 0.1**
 - h. **Gain (F10) > 24.0**
- b) If the skin thickness you will examine is equal to or more than 0.141 inch (3.58 mm), then do not set the TCG. Leave it de-energized.



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- (g) **Reading** menu
 - 1) **Result (F2)**
 - a) **Field 1 (F8) > A%**
 - b) **Field 2 (F9) > PA**
 - c) **Field 3 (F10) > None**
 - d) **Field 4 (F11) > None**
 - (h) **File > Save Setup As (F9) > File name (F9)** enter a file name and **Save (F7)**
 - (i) Do a check of all the parameters that were entered, to make sure that they are correct. If it is necessary to change a parameter, make sure to save the setup file again.

- (8) To create a setup file if software version MXU-2.0RX (automated module) or MXU-M-2.0RX (manual module) is used, do the steps that follows:
 - (a) **Preferences > Pref. (F2) > Units (F7) > Millimeters**
 - (b) **Wizard** menu define the parameters for the probe, wedge, test part and focal law. Set the parameters as follows:
 - 1) **Wizard > Group (F2) > Start (F8)**
 - a) **Next (F8)** (**Only for the Automated Module*)
 - b) **Geometry (F9) > Plate**
 - c) **Thickness (F10) > 0.00 +/- 0.05**
 - d) **Material (F12) > Aluminum**
 - e) **Next (F8)**
 - f) Press **Next (F8)** two times (**Only for the Automated Module*)
 - g) Do a check of the **Probe (F10)** option (letters grayed out) to make sure probe number "10L16" or "10L16E5-5" is entered. The probe, when connected to the instrument, will automatically be detected at the time the instrument is energized.
 - 1. If the correct probe is shown in **Probe (F10)**, press **Next (F8)** and go to par. 4.A.(8)(b)1)h).



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2. If the correct probe number is not shown, do the steps that follow:
 - a. If the 10L16 or 10L16E5-5 probes are not shown in the **Probe (F10)** option, it is possible that the correct probe number is in the stored list and the instrument did not automatically identify it. Do the steps that follow to recall the correct probe number from the stored list:
 - 1 **Auto Detect (F11)** > Off
 - 2 **Probe (F10)** > from the list on the left side of the window, highlight "A00" and press the Select button. From the list on the right side of the window, highlight "10L16-A00" or "10L16E5-5" and press the Select button.
 - 3 Do a check of the **Probe (F10)** option to make sure the correct probe number has been selected, press **Next (F8)** and go to par. 4.A.(8)(b)1)h).
 - b. If the 10L16 or 10L16E5-5 probes are not shown in the list from the **Probe (F10)** option, the probe must be defined and stored. Do the steps that follow to define the correct probe number and store it:
 - 1 **Auto Detect (F11)** > Off
 - 2 **Select (F9)** > Defines
 - 3 **Define Probe (F10)** > **New (F3)** > **Serial Number (F8)** > enter in "10L16-A00" or "10L16E5-5"
 - 4 **Save (F6)**, automatically goes to **Edit (F4)** menu
 - 5 **Freq (F7)** > 10
 - 6 **Probe Type (F9)** > Angle Beam
 - 7 **Element Qty. (F10)** > 16
 - 8 **Pitch (F11)** > 0.30
 - 9 **Save (F6)**
 - 10 **Select and Close (F7)**
 - 11 **Select (F9)** > Select Tx/Rx
 - 12 Do a check of the **Probe (F10)** option to make sure the correct probe number has been selected.
 - 13 **Next (F8)**



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- h) **Wedge (F10)** > Refer to Table 1 in par. 3.F. to identify the applicable wedge for the skin thickness you will examine. From the list on the left side of the window, highlight "SA00" or "SA1" and press the Select button. From the list on the right side of the window, highlight the applicable wedge and press the Select button.

1. If the correct wedge is selected in **Wedge (F10)**:

- a. Press **Next (F8)**
- b. Press **Next (F8)** (**Only for the Automated Module*)
- c. Go to par. 4.A.(8)(b1)i)

2. If the SA00-N60S, SA1-N60S5X5 or SA00-N45S wedges are not in the list, do the steps that follow to define a wedge and store it in the list:

- a. **Select (F9)** > Defines
- b. **Define Wedge (F10)** > **New (F3)** > **Serial Number (F8)** > enter in "SA00-N60S", "SA1-N60S5X5" or "SA00-N45S", as applicable, for the wedge to be used.
- c. **Save (F6)**, automatically goes to **Edit (F4)** menu
- d. **Angle (F7)** > 39.0 (for SA00-N60S and SA1-N60S5X5),
31.0 (for SA00-N45S)
- e. **Pri. offset (F10)** > -14.20 (for SA00-N60S and SA1-N60S5X5),
-14.32 (for SA00-N45S)

NOTE: Make sure the **Pri. offset** value is a minus number

- f. **Height (F12)** > 2.30 (for SA00-N60S and SA1-N60S5X5),
2.63 (for SA00-N45S)
- g. **Save (F6)**
- h. **Select and Close (F7)**
- i. **Select (F9)** > Select Tx/Rx
- j. Do a check of the **Wedge (F10)** option to make sure the correct wedge number has been entered.
- k. Press **Next (F8)**
- l. Press **Next (F8)** (**Only for the Automated Module*)



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- i) Select **Continue Law Wizard (F9)**. This will let parameters be entered for the **Focal Law** menu.
 1. **Law Config. (F9) > Sectorial**
 2. **Next (F8)**
 3. **Wave Type (F9) > SW**
 4. **Next (F8)** two times
 5. **Set Beam Angle**
 - a. **Min. Angle (F9) > 45** (when the SA00-N60S or SA1-N60S5X5 wedge is used). 25 (when the SA00-N45S wedge is used).
 - b. **Max. Angle (F10) > 80** (when the SA00-N60S or SA1-N60S5X5 wedge is used). 70 (when the SA00-N45S wedge is used).
 - c. **Focus Depth (F12) > 10.00**
 6. **Next (F8)**
 7. **Generate (F8)**
- (c) **UT Settings** menu defines the instrument ultrasonic parameters.
 - 1) **Advanced (F6) > Points Qty. (F10) > Auto** (**Only for the Automated Module*)
 - 2) **General (F2)**
 - a) **Start (F8) > 0.00 +/- 0.02**
 - b) **Range (F9) > 21.0 +/- 0.5**
 - 3) **Pulser (F3)**
 - a) **Voltage (F10) > 40** or lowest value available
 - 4) **Receiver (F4)**
 - a) **Filter (F8) > 15 MHz**
 - b) **Video Filter (F10) > On**



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- (d) **Display** menu defines the view of the screen display.
 - 1) **Selection (F2)**
 - a) **Display (F7) > A S [C]**
 - 2) **Overlay (F3)**
 - a) **Sizing Curves (F9) > Off**
 - b) **Gate (F10) > Off**
 - 3) **Color (F5) > Load (F10) > Sample Listed Files (F3) > select ONDT_Alarm.pal and Open (F7)**

- (e) **Gate/Alarm** menu define the gate and TCG parameters.
 - 1) **Gate (F2)**
 - a) **Gate (F7) > A**
 - b) **Start (F9) > 1.20**
 - c) **Width (F10) > 15.0 +/- 0.01**
 - d) **Threshold (F11) > 95**
 - e) **Gate (F7) > B**
 - f) **Start (F9) > 0.0**
 - g) **Width (F10) > 0.5**
 - h) **Threshold (F11) > 0**
 - i) **Gate (F7) > I**
 - j) **Start (F9) > 0.0**
 - k) **Width (F10) > 1.20 +/- 0.01**
 - l) **Threshold (F11) > 10**
 - 2) **Sizing Curves (F5)**



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- a) If the skin thickness you will examine is less than 0.141 inch (3.58 mm), do the steps that follow:

NOTE: Make sure that the beam cursor on the screen display is set to the minimum angle before the TCG curve is made.

1. **Curve (F8) > TCG**
2. **Mode (F7) > Edit**
 - a. **Add (F11)**
 - b. **Point (F8) > 2**
 - c. **Position (F9) > 10.0 +/- 0.1**
 - d. **Gain (F10) > 17.0**
 - e. **Add (F11)**
 - f. **Point (F8) > 3**
 - g. **Position (F9) > 14.2 +/- 0.1**
 - h. **Gain (F10) > 24.0**

- b) If the skin thickness you will examine is equal to or more than 0.141 inch (3.58 mm), then do not set the TCG. Leave it de-energized.

- (f) **Measurements** menu

1) **Reading (F2)**

- a) **Field 1 (F9) > A%**
- b) **Field 2 (F10) > PA^**
- c) **Field 3 (F11) > None**
- d) **Field 4 (F12) > None**

- (g) **File > File (F2) > Save Setup as (F9) > File name (F9)** enter a file name and **Save (F7)**

- (h) Do a check of all the parameters that were entered, to make sure that they are correct. If it is necessary to change a parameter, make sure to save the setup file again. When the instrument calibration is done, go to par. 4.C.



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B. Calibrate the Phasor XS instrument as follows:

- (1) Connect the phased array probe to the instrument as specified in the manufacturer's instructions.
- (2) Attach the applicable wedge to the probe for the skin thicknesses to be examined. Refer to Table 1 to identify the wedge to use.
- (3) Energize the instrument and select PHASED ARRAY. The instrument opens the DEFAULT dataset (setup) file, if a dataset file has not been stored. If a dataset file has been stored, the instrument opens the last file stored when the instrument was last turned off.
- (4) If a dataset file for this procedure has been stored, recall the file from the applicable **SOURCE/DEST** submenu.
- (5) If a dataset file for this procedure has not been stored, do the steps that follow to create a dataset file. The instructions in the steps that follow will identify the menus and options, followed by the parameter to be put in.

NOTE: The menus, submenus, and functions are shown in **bold** letters and the parameters are in regular letters. The first element shown in the menu, followed by the submenu, and followed by the function.

NOTE: Not all of the instrument parameters will be identified in the calibration instructions. Only those parameters necessary for this procedure will be identified in the steps, all others will use the instrument default parameters.

NOTE: The Home key, returns the instrument to the phased array home menu which displays all the menus.

(a) **CONFIG > REGION > UNITS > mm**

(b) **PROBE** menu defines the parameters for the probe and wedge. Set the parameters as follows:

1) **PRB GEO**

a) **FREQUENCY > 10.0 MHz**

b) **NUM ELEMENTS > 16**

c) **PITCH > 0.31 mm**

2) **WDGE GEO**

a) **VELOCITY > 2337 m/s**

b) **WEDGE FRONT > 11.50 mm (360-141-129), 14.50 mm (360-141-148)**



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- c) **OFFSET Z** > 3.85 mm (both wedges)
 - d) **ANGLE** > 39.0 deg (when the 360-141-129 wedge is used), 34.0 deg (when the 360-141-148 wedge is used)
- 3) **OFFSET**
- a) **PROBE DELAY** > 0.000 μ s
 - b) **ORIGIN OFFSET** > 0.00 mm (this is an initial setting)
- (c) **PART** menu defines the parameters for the test material
- 1) **PLAN**
 - a) **MATERIAL** > ALUMINUM
 - b) **MAT THICKNESS** > 5.00 mm
 - c) **VELOCITY** > 3100 m/s (this is a preset value)
 - (d) **SCAN** menu defines the parameters for the scan type
 - 1) **ELECTRNC**
 - a) **TYPE** > SECTOR
 - b) **FOCAL POINT** > 10.00 mm
 - c) **WAVE TYPE** > SHEAR
 - 2) **SCN PATT**
 - a) **ANGLE START** > 45.0 deg (when the 360-141-129 wedge is used).
25 (when the 360-141-148 wedge is used).
 - b) **ANGLE STOP** > 80.0 deg (when the 360-141-129 wedge is used).
70 (when the 360-141-148 wedge is used).
 - c) **ANGLE STEP** > 1.0 deg
 - 3) **APERTURE**
 - a) **NUM OF STEPS** > 1
 - b) **FIRST ELEMENT** > 1
 - c) **APERTURE SIZE** > 16
 - d) **APERTURE STEP** > 1



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(e) **DISPLAY** menu defines the view of the screen display

- 1) **VIEW > ANG CORRECTED > ON**
- 2) **IMAGE**
 - a) **AMP COLR PALET > CUSTOM**
 - b) **VIDEO REVERSE > NORMAL**
- 3) **BACKGRND > COLOR LEG > OFF**
- 4) **RESULTS1**
 - a) **READING 1 > BEAM**
 - b) **READING 2 > A%A**
 - c) **READING 3 > PA**
 - d) **READING 4 > OFF**
- 5) **RESULTS2 > LARGE READING > READING 1**

(f) **UT** menu defines the instrument ultrasonic parameters

- 1) **BASE**
 - a) **DISPLAY DELAY > 0.00 mm**
 - b) **LEG > 1.0 (when the 360-141-129 wedge is used). 2.0 (when the 360-141-148 wedge is used).**
- 2) **PULSER**
 - a) **VOLTAGE > 50 V**
 - b) **WIDTH > 60 ns**
 - c) **PRF VALUE > AUTO HIGH**
- 3) **RECEIVER > FREQUENCY > HIGH PASS 5MHz**
- 4) **GATEMODE**
 - a) **GATE SELECT > GATE A**
 - b) **TOF MODE > PEAK**



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- c) **LOGIC** > POSITIVE
- d) **GATE DISPLAY** > OFF
- 5) **GATE POS**
 - a) **GATE SELECT** > GATE A
 - b) **GATE START** > 1.00 mm
 - c) **GATE WIDTH** > 16.00 mm
 - d) **GATE THRESHOLD** > 95%
- (g) Press and hold the Home key for approximately 3-4 seconds to let the instrument calculate all of the parameters that have been entered. A clock symbol will show in the large reading window as the instrument does the calculation and it will go out of view when finished.
- (h) Press the freeze key once and set the parameters as follows. Press the freeze key again once to return the instrument to operation after the parameters have been entered.
 - 1) **CURSOR 1**
 - a) **ON/OFF** > OFF
 - b) **ORIGIN LINE** > on
 - c) **ORIGIN OFFSET** > 0.00 mm
 - d) **RIGHT KNOB** > BEAM CURSOR
- (i) Setup the TCG mode in the **UT** menu as follows:
 - 1) **NRM/TCG**
 - a) **GATE START** > 1.00 mm
 - b) **RECORD** > START
 - c) **CYC GAIN CNTL** > +0.00 dB/CYC
 - 2) **TCG EDIT**
 - a) Press **BEAM** and adjust the beam cursor to the extreme top or bottom angle of the sector display to get the range of angles to show as follows:
 - 1. 45.0 -> 80.0 (when the 360-141-129 wedge is used)



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2. 25.0 -> 70.0 (when the 360-141-148 wedge is used)

b) Record two points as follows:

NOTE: Use the same parameters to record the two points for each wedge part number.

1. With **POINT** set to **NEW**, press **POINT POS.** and set the parameter to 5.280 μ s.

2. Press **POINT GAIN** and set the parameter to 12.0 dB.

3. Press **POINT** twice to record **POINT > 1.**

4. Set **POINT** to **NEW** again and do steps a) and b) above again, but use a **POINT POS.** of 20.0 μ s and a **POINT GAIN** of 20.0 dB.

5. Press **POINT** twice to record **POINT > 2.**

(j) Push and hold the **GAIN STEP KEY** to display the gain as **dB** (digital gain) in the gain window.

1) Set the gain value to 10.0 **dB**.

(k) Push the view key until the **A scan** and **sector scan** are displayed as shown in Fig. 4, Detail XII.

(l) Store the data set file in **FILES > FILENAME > ACTION > STORE DATASET**. Go to **FILENAME** to name the file. It is recommended to create a data set file for each wedge.

(m) Do a check of all the parameters that were entered, to make sure that they are correct. If it is necessary to change a parameter, make sure to save the data set file again.

C. Use the reference standard identified in Table 1 in par. 3.F. for the applicable airplane skin to be examined. Use the Structural Repair Manual (SRM), Boeing Engineering Drawings, or other sources to identify the skin thicknesses.

D. Calibrate the equipment as follows for all the reference standards specified in Table 1 in par. 3.F.

(1) Apply a sufficient amount of couplant on the inspection surface of the reference standard at the "A", "B" and "C" EDM notch locations and a fastener location. See Fig. 3, Detail I.

(2) Put the probe at notch location "A" on the reference standard. See Fig. 3, Detail I.

(3) Make sure the front of the probe is flush against the edge of the top piece. Keep the front of the probe against the edge of the top piece at all times.



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- (4) Move the probe from side to side, along the surface, to get the maximum image from the notch.

NOTE: It is possible that the notch signal height will be larger when the transducer is turned away from the edge of the upper piece. Make sure that the front of the transducer is always against the edge of the top piece during calibration.

- (5) Adjust the instrument gain and do a scan of notch "A" again. The correct gain adjustment is the lowest possible gain setting that makes the notch image just start to show red (smallest visible image) and causes a signal to occur that is 95 to 105% of FSH. See Fig. 3, Detail II. Monitor the A-scan to help maximize the signal. Record the gain level.
- (6) Set the beam cursor on the notch image that is nearest to the top of the sector scan display (highest angle).
- (7) Identify the angle and PA (see NOTE below) locations of the notch image on the sector scan as follows. See Fig. 3, Detail II.

NOTE: PA is the surface distance between the front of the wedge to the notch image.

- (a) Make a note of the beam angle.

- (b) Make a note of the PA measurement (0.00 +/- 0.20 mm) displayed in the PA Data area of the screen display. The PA measurement will be more accurate when the cursor intersects with the image and the CL or Origin Line (front of the wedge).

NOTE: If the Phasor XS is used, it can be necessary to adjust the position of the cursor line with the notch image, to get a PA measurement of 0.00 +/- 0.20 mm. If an adjustment is necessary, refer to par. 4.B.(5)(h) and make the adjustment to the **ORIGIN OFFSET** parameter.

- (c) If multiple notch images occur, position the cursor on the image nearest to the initial pulse and nearest the top (higher angle).

- (d) Use the data from par. 4.D.(7)(a) thru (c) to evaluate possible red images that can occur during the inspection.

- (8) Put the probe at notch location "B" on the reference standard and maximize the signal on the sector scan display. See Fig. 3, Detail I.
- (9) Set the beam cursor on the notch image.
- (10) If the signal is less than 95% of FSH, adjust the signal height and make a note of the additional gain. Do par. 4.D.(7) again to identify the locations of the image to get a PA measurement of 0.75 +/- 0.20 mm. See Fig. 3, Detail III.
- (11) Put the probe at notch "C" on the reference standard and maximize the signal on the sector scan display. See Fig. 3, Detail IV.



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- (12) Set the beam cursor on the notch image.
- (13) If the signal is less than 95% of FSH, then adjust the signal height and make a note of the additional gain. Do par. 4.D.(7) again to identify the locations of the image to get a PA measurement of -1.60 ± 0.20 mm. See Fig. 3, Detail V.
- (14) If additional gain was added in par. 4.D.(10) or (13), record this gain setting and use it as the calibration gain level. If no gain was added, use the gain level recorded in par. 4.D.(5).

E. Move the probe to a fastener location (See Fig. 3, Detail IV) and do the steps that follow:

- (1) Add sufficient gain to the calibration gain level set in par. 4.D.(14) to see the fastener signal on the sector scan display.
- (2) The fastener image can show as a dark green and/or red image at approximately 75% of the full sector scan width. See Fig. 3, Detail VI. The fastener position can change a small quantity for different skin thicknesses.
- (3) Remove the gain added in par. 4.E.(1) and set the gain level to the value recorded in par. 4.D.(14).

F. Save your final calibration set-up.

G. Do a scan on the reference standard to find the maximum scan speed that can be used to find all the notch locations and fastener locations.

5. Inspection Procedure

A. Identify the airplane skin thicknesses to be examined and if the inspection area is painted or not painted.

NOTE: All decals in the inspection area must be removed. It is not possible to do the inspection through a decal.

NOTE: If button head fasteners adjacent to the edge of the upper member do not let the probe do a scan along the edge, go to par. 5.I. for special inspection instructions. See Fig. 6, Detail I.

B. Open the correct setup file. If a setup file has not been stored, follow the steps in par. 4.A.(7) or par. 4.A.(8) if the OmniScan MX is used. Refer to par. 4.B.(5) if the Phasor XS is used.

C. Calibrate the equipment as specified in par. 4.D. on the applicable reference standard. Table 1 identifies the reference standard to use for the skin thickness to be examined.



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D. Set the calibration gain and scan gain levels as follows:

(1) To examine airplane skins without paint.

- (a) Make a note of the calibration gain level that was set in par. 4.D.(14). Use this gain level to examine crack indications.
- (b) Add 12 dB of gain. This is the scan gain level. Use this gain level to make scans of the airplane.

(2) To examine airplane skins with paint.

(a) Additional gain is added to the calibration gain level set on the reference standard in par. 4.D.(14) to allow for paint. Use the gain levels to examine for crack indications. The additional gain to add is as follows:

1) If the OmniScan MX instrument is used:

- a) For skin thicknesses from 0.032 to 0.055 inch (0.81 to 1.40 mm), add 6 dB
- b) For skin thicknesses from 0.056 to 0.100 inch (1.42 to 2.54 mm), add 9 dB
- c) For skin thicknesses from 0.101 to 0.310 inch (2.56 to 7.87 mm), add 12 dB

2) If the Phasor XS instrument is used:

- a) For skin thicknesses from 0.032 to 0.310 inch (0.81 to 7.87 mm), add 6 dB

(b) Add 12 dB of gain. This is the scan gain level. Use this gain level to make scans of the painted airplane.

NOTE: If the Phasor XS is used it can be necessary use a combination of analog gain (dBA) and digital gain (dBD) to add the additional gain necessary.

E. Refer to Fig. 4 for sector scan screen displays of calibration notch "A" of reference standards NDT1094-050, NDT1094-070, NDT1094-090, NDT1094-110, NDT1094-130, NDT1094-155, NDT1094-185, NDT1094-215, NDT1094-245, NDT1094-275 and NDT1094-300.

F. Put a sufficient amount of couplant on the inspection areas. Use the same couplant on the airplane that was used on the reference standard during the calibration in par. 4.

NOTE: Too much couplant on the front of the probe wedge can prevent crack identification or cause false indications. Do not let too much couplant get on the front of the probe wedge during a scan.

G. Put the probe on the inspection surface with the front of the probe wedge against the edge of the upper skin at the lap joint. See Fig. 1 for the typical probe position.



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- H. Make a scan along the skin panel and monitor the sector scan display at all times. During the scan:
- (1) Make sure the probe is against the edge of the upper skin during the complete scan of the inspection area.
 - (2) Do not move the probe faster than the speed set in par. 4.G.
 - (3) Monitor the sector scan display for images from the lower row of fasteners in the lap splice. If you cannot see the fastener images, it is permitted to increase the gain until you can see them, but remember to return to your calibration gain to examine ultrasonic signals as specified in par. 6.
 - (4) Monitor the sector scan display for red images that occur at the approximate angle and the same PA distances as the notch images from the reference standard during calibration. Make a mark at the location with an approved marker.
- I. Inspection instructions when button head fasteners do not let the probe do a scan along an edge. See Fig. 6, Detail I.
- (1) Adjust the instrument as specified in par. 4.A. or par. 4.B., as applicable, for the instrument you will use.
 - (2) Measure the distance X, from the edge to the far side of the button head fastener. See Fig. 6, Detail I.
 - (3) Put the beam cursor at the lowest angle (smallest value) on the sector scan display.
 - (4) Adjust the display range.
 - (a) To 70 mm for the Omniscan. See par. 4.A.(7)(d)2)c).
 - (b) To **LEG** equal to 5 for the Phasor XS. See par. 4.B.(5)(f)1)b).

NOTE: Other ranges can be used if necessary.
 - (5) Adjust the Gate start and width, if necessary, so that noise signals are not included in the gate.
 - (a) For the Omniscan, see par. 4.A.(7)(f)1)e) thru i) for instructions to change the gate.
 - (b) For the Phasor XS, see par. 4.B.(5)(f)5) for instructions to change the gate.
 - (6) Put the probe on the reference standard so the front edge of the wedge is at a distance X, (identified in par. 5.I.(2)), away from EDM notch D. See Fig. 6, Detail II.

NOTE: Reference standard NDT1094-XXX-A must be used. Reference standard NDT1094-XXX-A has EDM notch D.



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- (7) Do par. 4.D.(1) thru par. 4.D.(7), but only use notch D to calibrate the instrument at a distance X from the EDM notch.
- (8) Do par. 5.D. to add the necessary gain.
- (9) Put the transducer on the airplane surface behind the button head fasteners. See Fig. 6, Detail III.
- (10) Do par. 5.H. to do the inspection, but make the scan with the probe at distance X away from the edge as shown in Fig. 6, Detail I.

6. Inspection Results

NOTE: To evaluate signals from a skin with button head fasteners that do not let the probe touch the edge of the upper skin, go to par. 6.D.

A. Red images on the sector scan display that occur at the approximate angle (+/- 5 degrees) and at PA distances between -1.80 to 0.95 mm as the notch images from the reference standard (with the instrument set at the calibration level) are possible cracks. These areas must be examined some more. Use the procedures that follow:

- (1) Make sure you are at the correct calibration gain level (not the scan gain level).
 - (a) If the inspection area is not painted, make sure you are at the calibration gain level for bare skins as specified in par. 4.D.(14).
 - (b) If the inspection area is painted, make sure you add the additional gain specified in par. 5.D.(2)(a) to the calibration gain level. The increased gain is necessary to adjust for the sound that is blocked by the paint.
- (2) Do a check to make sure you still have a red image. Do the steps that follow only if you still have a red image at the correct calibration gain level.
 - (a) Make sure the red image is not caused by sound reflection from the front of the probe wedge as follows:
 - 1) Move the probe away from the edge of the upper skin.
 - a) If the image does not move as the probe is moved, the signal is a noise signal from the probe and is not a crack signal. No more inspection is necessary.
 - (b) Set the beam cursor on the notch image. If multiple images occur at a different angle from a possible crack, use the image that is nearest to the cursor angle that was used during calibration.



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- (c) Record the angle and the PA distance of the image in the sector scan to make sure that it is within the sector scan locations of the notches in the reference standard.

NOTE: Paint can cause the angle to be higher and the PA distance to be larger than if the surface were bare. This condition occurs more with skin thicknesses between 0.032 to 0.055 inches (0.81 to 1.40 mm) and paint thicknesses of 0.004 to 0.007 inch (0.102 to 0.178 mm).

- (3) Use the steps that follow to evaluate indications identified when you made the initial scan of the airplane. If the lap is not open or can be used to guide the probe, do the steps that follow:
 - (a) If the inspection surface that the probe will touch is painted, remove the paint from the surface that the probe will touch on the lower skin and do the inspection again. Use the instructions that follow:
 - (b) Use the PA-distances recorded in par. 6.A.(2)(c) to identify the notch on the reference standard that is the nearest as possible to the angle and PA distance of the signal identified during the initial scan. Use this notch on the reference standard when you calibrate to evaluate the signal.
 - (c) Do par. 4.D.(3) thru 4.D.(7)(c), but only do the calibration for the notch in the reference standard that is nearest the angle and PA distance as the location identified in par. 6.A.(2)(c).
 - (d) Put the probe at the location to be examined on the airplane. Make sure the front of the probe is against the edge of the lap.
 - (e) Set the beam cursor on the signal.
 - (f) Move the probe along the lap to maximize the signal.
 - (g) If the signal is less than 95% of FSH or the crack indication cannot be found at the evaluation gain level, no more inspections are necessary.
- (4) Do the steps that follow to do more analysis:
 - (a) Look for conditions that can cause false indications. An image can occur in the inspection area that is caused by couplant in front of the probe wedge or sealant particles remaining beneath the lap splice edge. Remove the couplant or sealant particles with an approved tool and do the inspection again.
 - (b) If the red image in the sector scan display is between the PA distances set for notches "A" and "C" (0.00 to -1.80 mm), examine the area with high frequency eddy current as specified in Part 6, 53-30-22.



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- (c) If the red image in the sector scan display is between the PA distances set for notches "A" and "B" (0.00 to 0.95 mm), do the steps that follow:
- 1) If there is internal access to the lower skin at the location where the image was identified and the skin is between 0.032 to 0.040 inch (0.81 to 1.02 mm) thick, examine the area with mid-frequency eddy current (Inspection for Cracks that are On The Back Side and Not Fully Through the Thickness of an Aluminum Part). See Part 6, 53-30-23.

NOTE: The phased array ultrasonic inspection procedure finds cracks that are 0.020 inch (0.51 mm) deep in skins that are from 0.041 to 0.140 inch (1.04 to 3.56 mm) thick (see par. 1.E.(4)). But, the Part 6, 53-30-23 inspection procedure finds cracks that are half the part thickness and can not be used to make sure of possible crack indications found in skins that are more than 0.040 inch (1.02 mm) thick.

- 2) If you cannot put the eddy current probe on the lower skin at the correct location to do the inspection identified in par. 6.A.(4)(c)1), or if the lower skin thickness is more than 0.040 inch (1.0 mm) thick, do the steps that follow:
 - a) Tell Boeing that you plan to open a lap joint.
 - b) Open up the lap joint at the area of the indication. Refer to the Structural Repair Manual for instructions to help open the lap joint.

CAUTION: REMOVE SEALANT CAREFULLY TO PREVENT DAMAGE TO THE SURFACE OF THE SKIN. SEE THE STANDARD OVERHAUL PRACTICES MANUAL (SOPM) FOR MORE INSTRUCTIONS IF NECESSARY.

- c) Carefully remove the sealant from the outer surface of the inner skin at the location of the crack indication.
- d) Calibrate the instrument and do the inspection again.
 1. If the upper and lower skins can be left together so that the upper skin can be used as a probe guide, then do par. 6.A.(3) to evaluate the signal.
 2. If the upper skin cannot be used as a probe guide, do the instructions that follow to do the "free field" calibration:
 - a. Put couplant on the reference standard at probe position 1 (see Fig. 5).
 - b. Put the probe at probe position 1 (see Fig. 5).



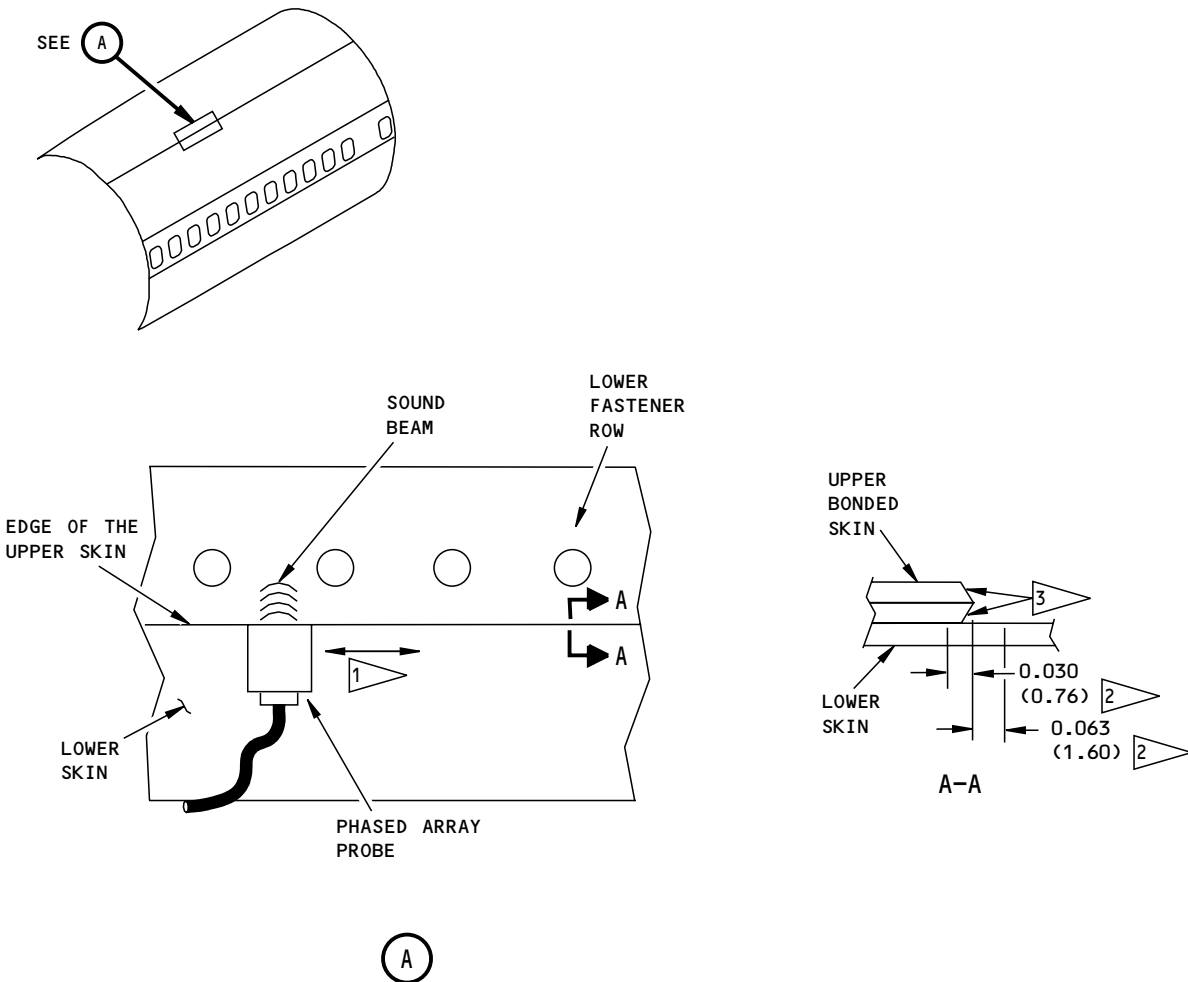
NONDESTRUCTIVE TEST

- c. Move the probe toward EDM notch C and monitor the sector scan display. The notch signal will move from right to left on the sector scan as you move the probe to probe position 3 (see Fig. 5).
 - d. When the signal is at the "CL" line on the sector scan display, adjust the probe to maximize the signal.
 - e. Set the beam cursor on the notch image.
 - f. Adjust the gain until the signal is from 95 to 105% of FSH.
 - g. Put the probe at the location to be examined on the airplane, away from the scribe.
 - h. Move the probe toward the location of the indication until the signal is at the "CL" position on the sector scan display.
 - i. Adjust the beam cursor so it is above the signal.
 - j. Move the probe to maximize the signal.
 - k. If the signal is less than 95% of FSH or if there are no crack indications, no more inspections are necessary. The initial crack indication can be thought to be a false crack indication.
- e) If there continues to be an ultrasonic indication, do a high frequency eddy current inspection as specified in Part 6, 51-00-00, Fig. 4 or 23 at the location of the crack indication. Use reference standard 126 or an equivalent. If an indication is found with this inspection or with the eddy current inspection procedure specified in par. 6.A.(4)(c)1), the indication must be thought to be from a crack.
- f) If there is a crack indication with the phased array ultrasonic inspection, and no crack indication with the eddy current inspections specified in par. 6.A.(4)(c)1) and 6.A.(4)(b), ask Boeing for more instructions.
- B. If an indication is found with one or each of the eddy current inspection procedures specified in par. 6.A. of this procedure, the indication must be thought to be from a crack. If the eddy current procedures specified in par. 6.A. cannot be done, the ultrasonic indication must be thought to be from a crack.
- C. It is not necessary to examine red areas on the sector scan that occur outside of the PA distances of 0.95 to -1.80 mm unless you do the button head fastener inspection specified in par. 6.D.



NONDESTRUCTIVE TEST

- D. To evaluate signals that occur when you examine an edge blocked by button head fasteners, do the steps that follow:
- (1) Do a high frequency eddy current inspection along the edge of the upper skin as specified in Part 6, 53-30-22. Use the upper skin as a probe guide to examine the lower skin for cracks.
 - (2) To analyze the signals, do the steps that follow:
 - (a) If the phased array probe fits between the button head fasteners and can touch the upper skin, then calibrate the instrument again as specified par. 4. and follow the steps in par. 5. and 6. to analyze the results.
 - (b) If the space between the button head fasteners does not let the phased array probe do the inspection, remove the paint and do the inspection with a single crystal transducer as specified in Part 4, 53-30-05.
 - (c) As a final check of the crack signal, open the lap and do par. 6.A.(4)(c)2)c).



NOTES:

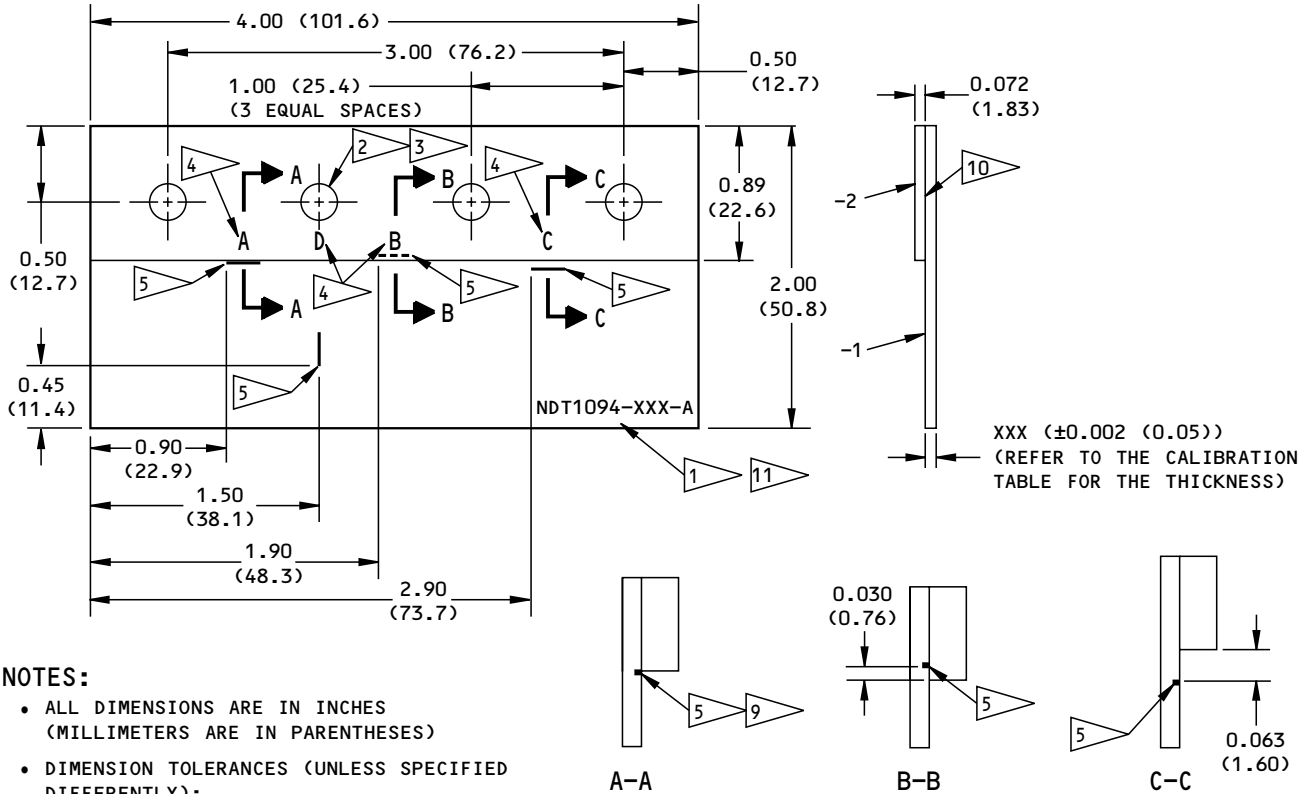
- DIMENSIONS ARE IN INCHES
(MILLIMETERS ARE IN PARENTHESES)

- 1 POSSIBLE CRACK DIRECTION IN THE LOWER SKIN.
- 2 INSPECTION AREA
- 3 THE UPPER SKIN AND DOUBLER CAN HAVE A CHAMFER. THE DIMENSIONS AND SHAPE CAN BE DIFFERENT.

PHASED ARRAY PROBE
ON THE LOWER SKIN OF THE LAP JOINT

Inspection Areas
Figure 1

NONDESTRUCTIVE TEST



NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- DIMENSION TOLERANCES (UNLESS SPECIFIED DIFFERENTLY):

INCHES MILLIMETERS

X.XXX = ±0.005 X.XX = ±0.10
 X.XX = ±0.025 X.X = ±0.5
 X.X = ±0.050 X = ±1

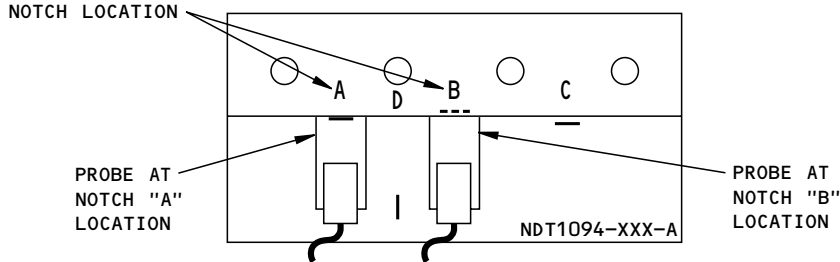
- SURFACE ROUGHNESS: 63 Ra OR BETTER
- MATERIAL: ALUMINUM (CLAD OR BARE)
- 1 BOTTOM PIECE. USE A THICKNESS THAT IS IDENTIFIED IN THE CALIBRATION TABLE OF THIS PROCEDURE FOR THE RANGE OF AIRPLANE SKIN THICKNESSES TO BE EXAMINED.
- 2 TOP PIECE. USE A 0.071 (1.80) THICK PIECE (TYPICAL) FOR ALL REFERENCE STANDARDS.

- ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT1094-XXX-A. XXX IDENTIFIES THE BOTTOM PIECE THICKNESS, IN THOUSANDTHS OF AN INCH. -A IDENTIFIES THAT THE REFERENCE STANDARD HAS NOTCH D. EXAMPLE: NDT10XX-050-A USES A -1 BOTTOM PIECE THAT IS 0.050 INCH (1.27) THICK.
- BACR15GF5D RIVET (4 LOCATIONS). USE A -4 RIVET LENGTH FOR A TOTAL REFERENCE STANDARD THICKNESS OF UP TO 0.100 (2.54). USE A -5 RIVET LENGTH FOR A TOTAL THICKNESS BETWEEN 0.100 TO 0.150 (2.54 TO 5.08)
- USE ONLY A SUFFICIENT AMOUNT OF PRESSURE DURING ASSEMBLY TO KEEP THE TWO PIECES TOGETHER. BE CAREFUL NOT TO DAMAGE THE BOTTOM PIECE DURING ASSEMBLY.

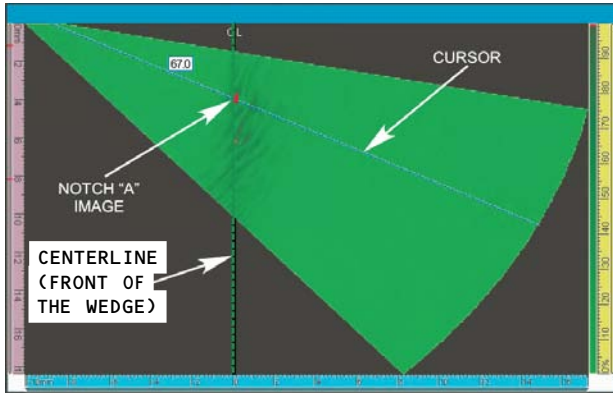
- ETCH OR SCRIBE THE LETTER ON THE SURFACE OF THE TOP PIECE TO IDENTIFY THE LOCATION OF THE EDM NOTCH AND THE TRANSDUCER POSITION FOR THE INSTRUMENT CALIBRATION.
- EDM NOTCH:
 LENGTH: 0.200 (5.08) ±0.010 (0.25)
 DEPTH: 6 7 8
 WIDTH: 0.005 (0.13) ±0.002 (0.05)
- 0.010 (0.25) ±0.002 (0.05) IN NDT1094-040-A
- 0.015 (0.38) ±0.002 (0.05) IN NDT1094-050-A
- 0.020 (0.51) ±0.002 (0.05) IN NDT1094-070-A, -090-A, -110-A, -130-A, -155-A, -185-A, -215-A, -245-A, -275-A, -300-A
- PUT THE EDM NOTCH FLUSH (±0.005 (0.13)) WITH THE EDGE AS SHOWN IN SECTION A-A.
- APPLY FAY SURFACE SEALANT, BMS 5-95, CLASS B, BETWEEN THE TOP AND BOTTOM PIECES AS SPECIFIED IN SOPM 20-50-19. MAKE SURE THE SEALANT DOES NOT EXTEND BEYOND THE FAYING SURFACE.
- IF YOU HAVE REFERENCE STANDARD NDT1094-XXX, IT IS PERMITTED TO ADD NOTCH D TO YOUR REFERENCE STANDARD IF YOU ADD "-A" TO THE REFERENCE STANDARD NUMBER.

Reference Standard NDT1094-XXX-A
 Figure 2

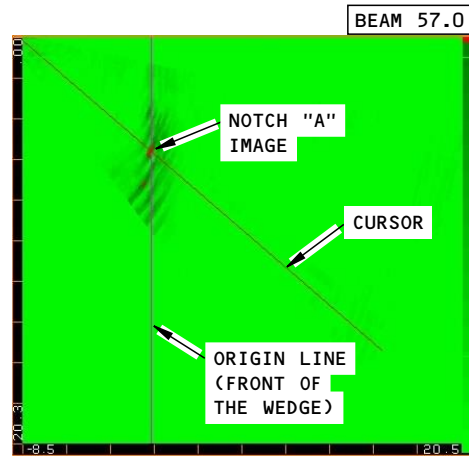
NONDESTRUCTIVE TEST



PROBE POSITION ON THE REFERENCE STANDARD
DETAIL I



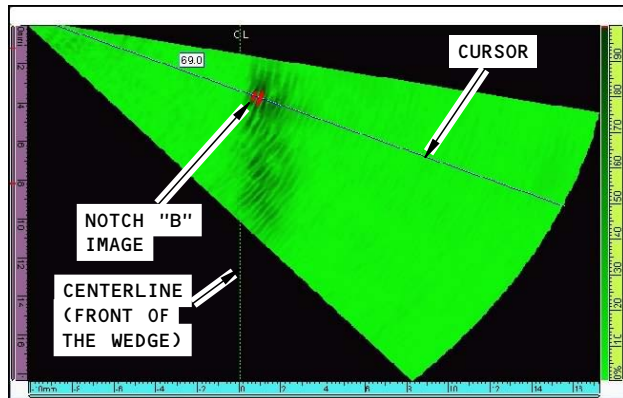
OMNISCAN MX SCREEN DISPLAY



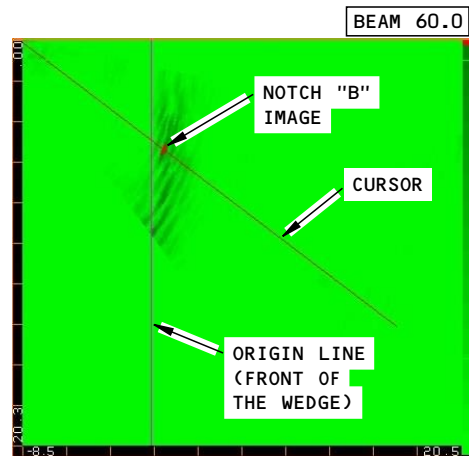
PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY WITH CORRECT GAIN SETTING ON THE "A" NOTCH IMAGE

DETAIL II



OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "B" NOTCH IMAGE

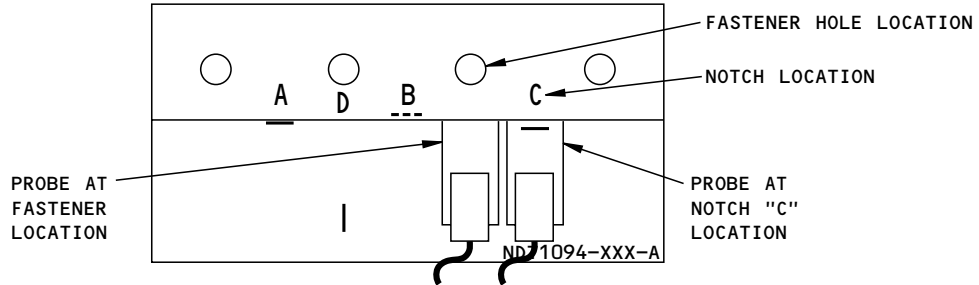
DETAIL III

NOTES:

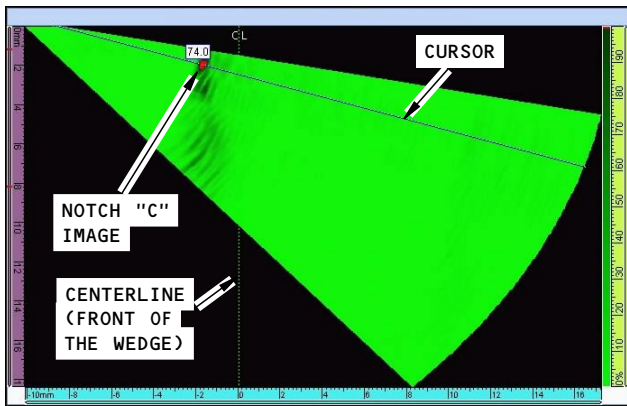
- THE SCREEN DISPLAY IN DETAILS II, III AND V ARE AN EXAMPLE OF THE TYPICAL SECTOR SCAN DISPLAY, WITH THE NOTCH IMAGES SHOWN TAKEN FROM THE NDT1094-040 REFERENCE STANDARD. THE IMAGES AND THE CURSOR ANGLE SHOWN IN DETAILS II, III, V AND VI CAN BE DIFFERENT WITH YOUR PROBE AND WEDGE. SEE FIG. 4 FOR THE SECTOR SCAN DISPLAY OF THE NOTCH "A" FROM REFERENCE STANDARDS NDT1094-050, NDT1094-070, NDT1094-090, NDT1094-110, NDT1094-130, NDT1094-155, NDT1094-185, NDT1094-215, NDT1094-245, NDT1094-275 AND NDT1094-300.

Instrument Calibration
Figure 3 (Sheet 1)

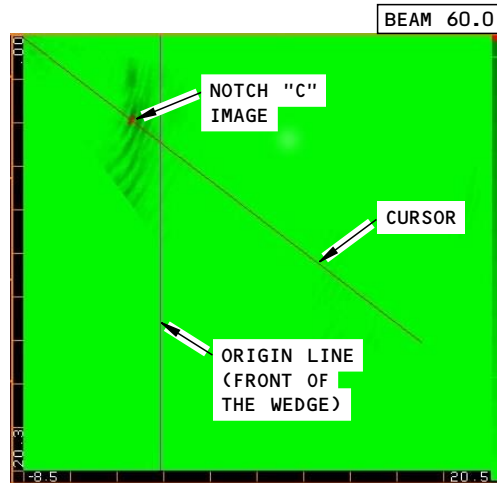
NONDESTRUCTIVE TEST



PROBE POSITION ON THE REFERENCE STANDARD
DETAIL IV

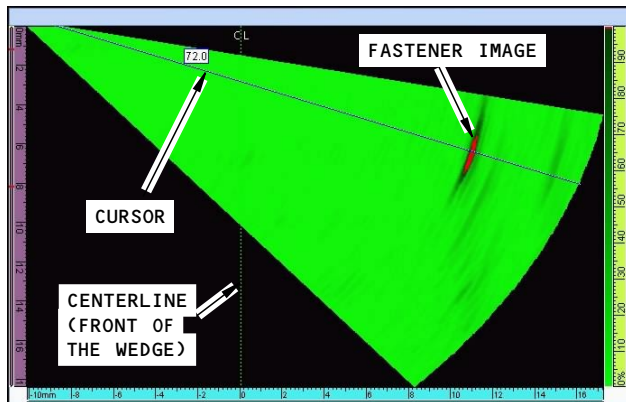


OMNISCAN MX SCREEN DISPLAY

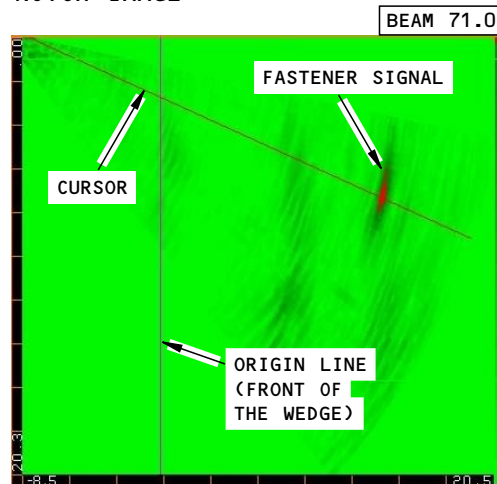


PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "C" NOTCH IMAGE
DETAIL V



OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

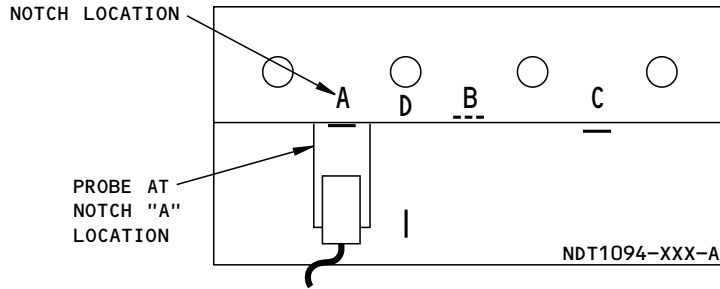
SCREEN DISPLAY OF THE FASTENER HOLE IMAGE
DETAIL VI

NOTES:

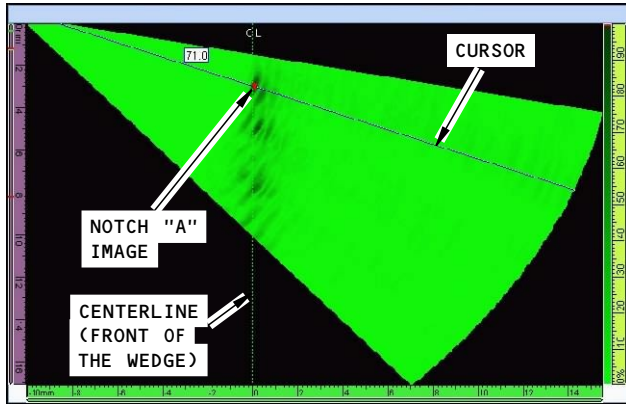
- THE FASTENER HOLE IMAGE SHOWN IN DETAIL VI IS AN EXAMPLE OF THE TYPICAL IMAGE, WITH THE SCAN GAIN ADDED.
- THE LOCATION OF IMAGE ON THE SECTOR SCAN WILL BE DIFFERENT AS THE SKIN THICKNESS CHANGES.

Instrument Calibration
Figure 3 (Sheet 2)

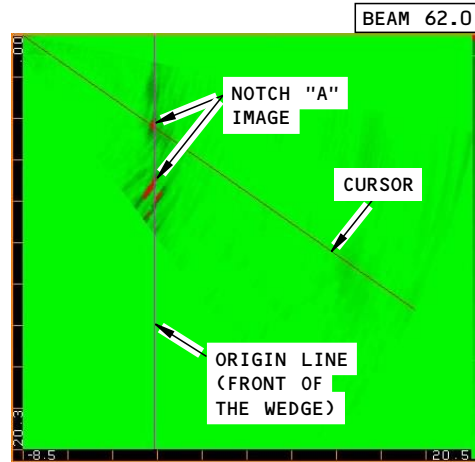
NONDESTRUCTIVE TEST



PROBE POSITION ON THE REFERENCE STANDARD
DETAIL I

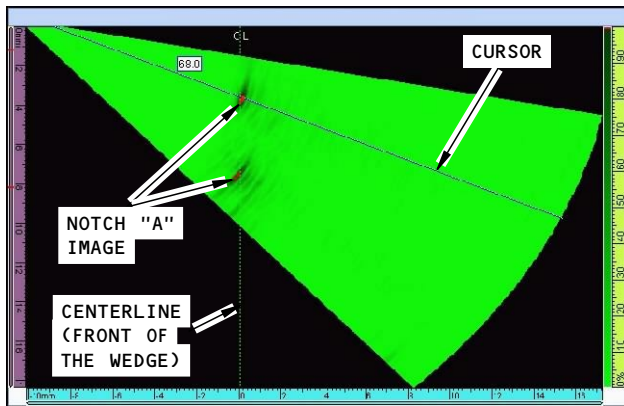


OMNISCAN MX SCREEN DISPLAY

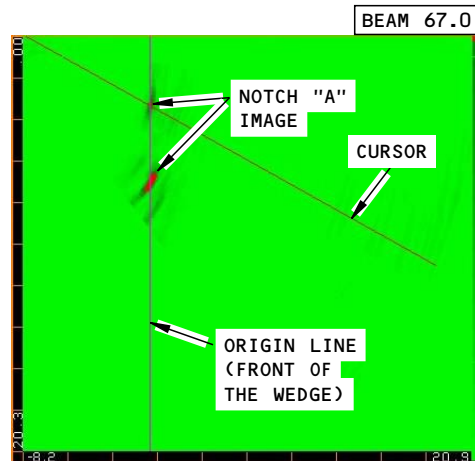


PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE
FROM REFERENCE STANDARD NDT1094-050
DETAIL II



OMNISCAN MX SCREEN DISPLAY



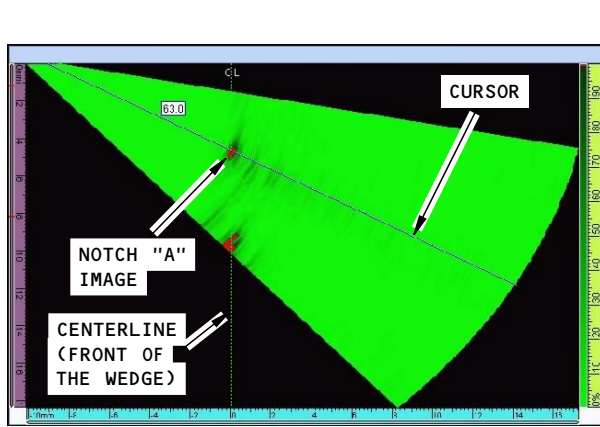
PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE
FROM REFERENCE STANDARD NDT1094-070
DETAIL III

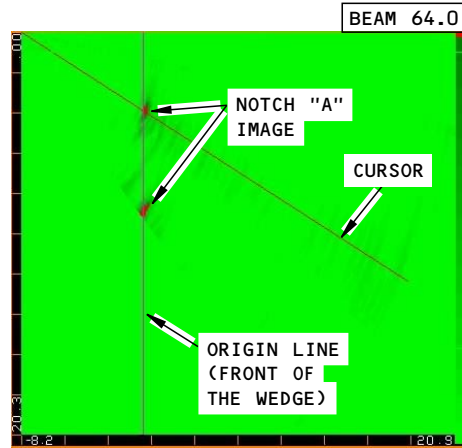
NOTES:

- THE NOTCH IMAGES SHOWN IN DETAILS II THRU XII ARE AN EXAMPLE WITH THE INSTRUMENT GAIN SET TO THE CALIBRATION GAIN. THE IMAGES AND ANGLES SHOWN IN DETAILS II THRU XII CAN BE DIFFERENT WITH YOUR PROBE AND WEDGE

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 1)

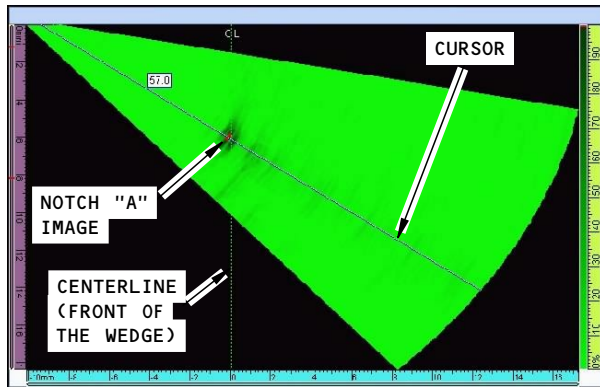


OMNISCAN MX SCREEN DISPLAY

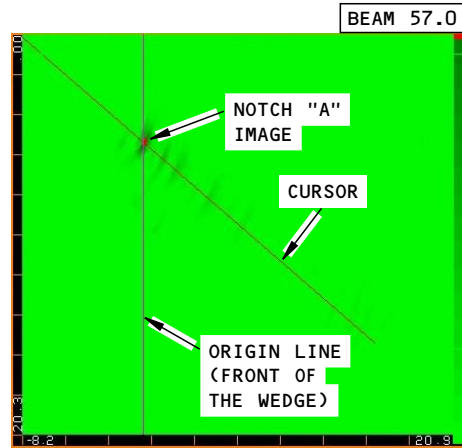


PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE FROM REFERENCE STANDARD NDT1094-090
DETAIL IV

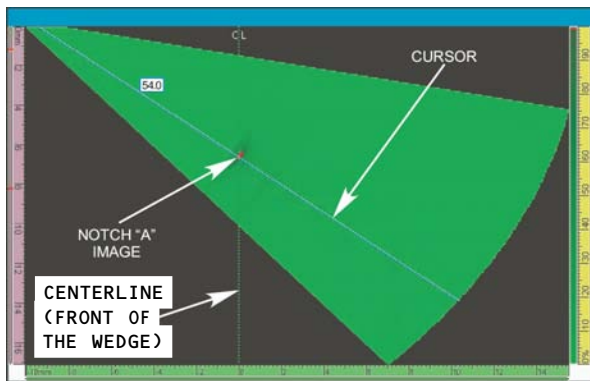


OMNISCAN MX SCREEN DISPLAY

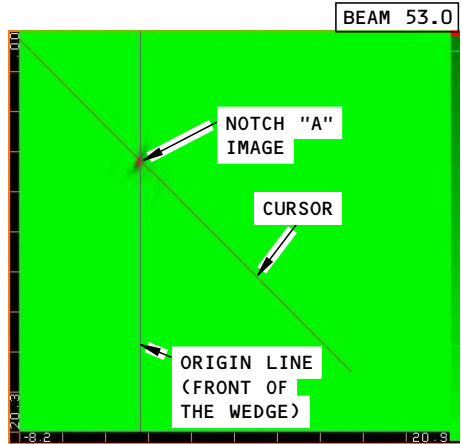


PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE FROM REFERENCE STANDARD NDT1094-110
DETAIL V



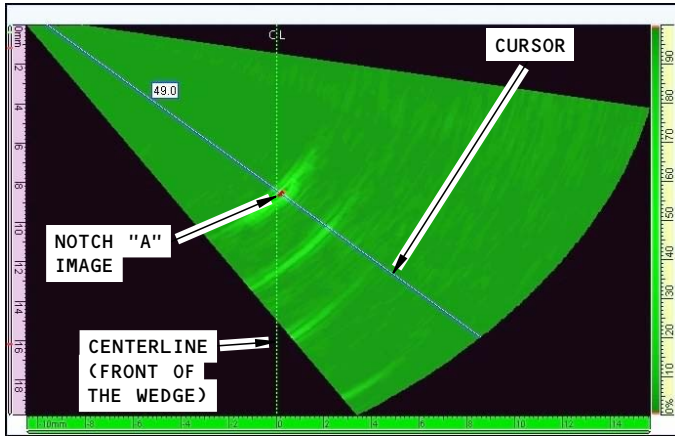
OMNISCAN MX SCREEN DISPLAY



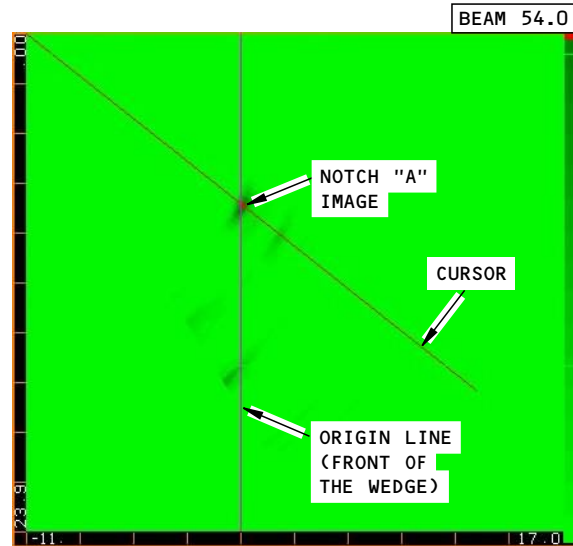
PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE FROM REFERENCE STANDARD NDT1094-130
DETAIL VI

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 2)

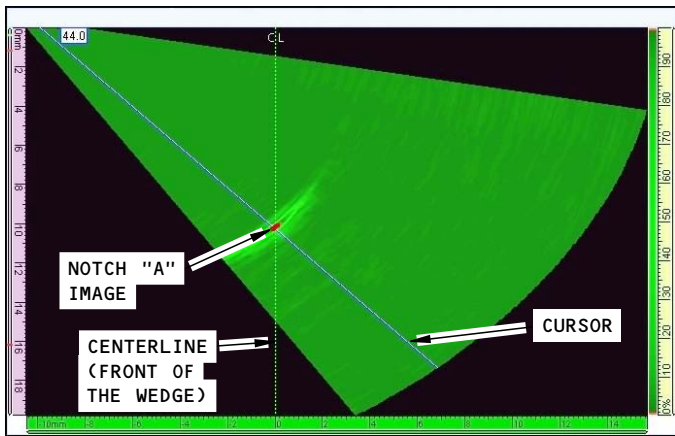


OMNISCAN MX SCREEN DISPLAY

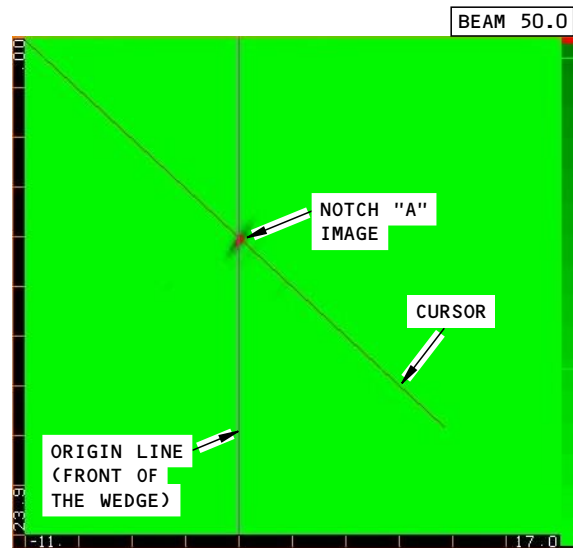


PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE
FROM REFERENCE STANDARD NDT1094-155
DETAIL VII



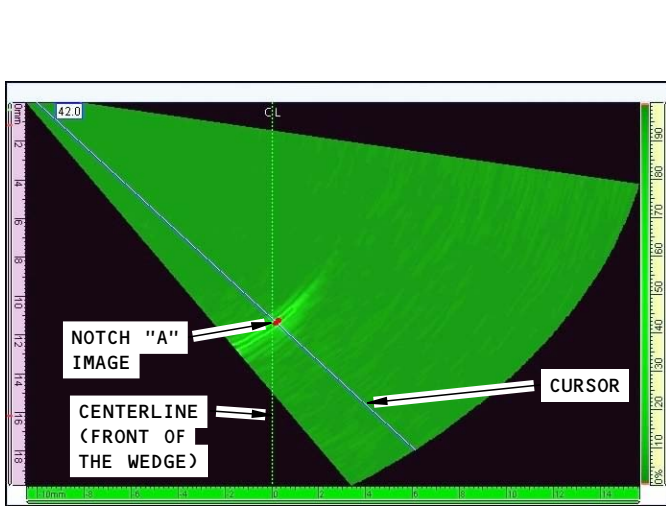
OMNISCAN MX SCREEN DISPLAY



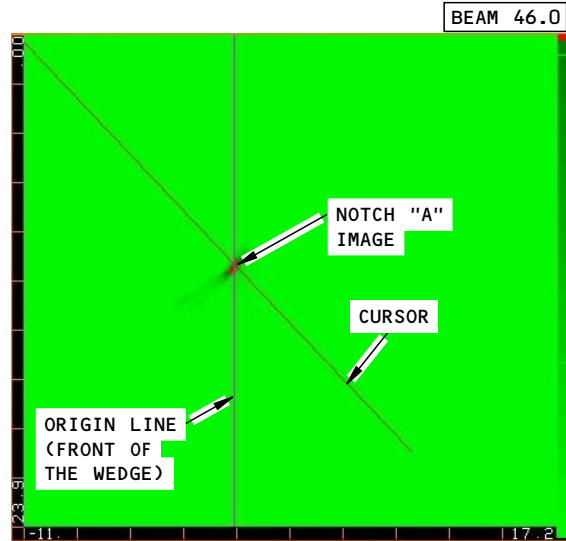
PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE
FROM REFERENCE STANDARD NDT1094-185
DETAIL VIII

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 3)

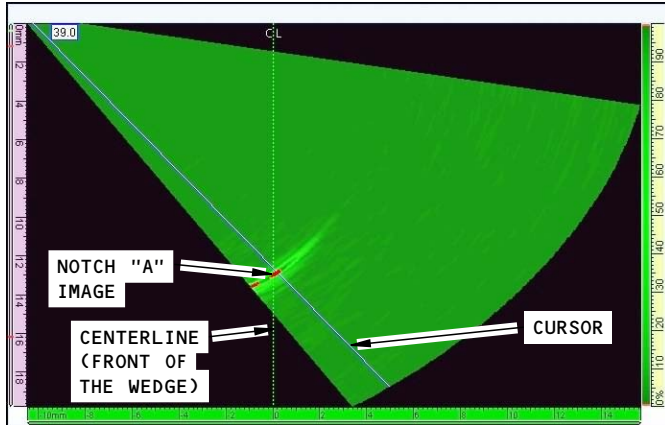


OMNISCAN MX SCREEN DISPLAY

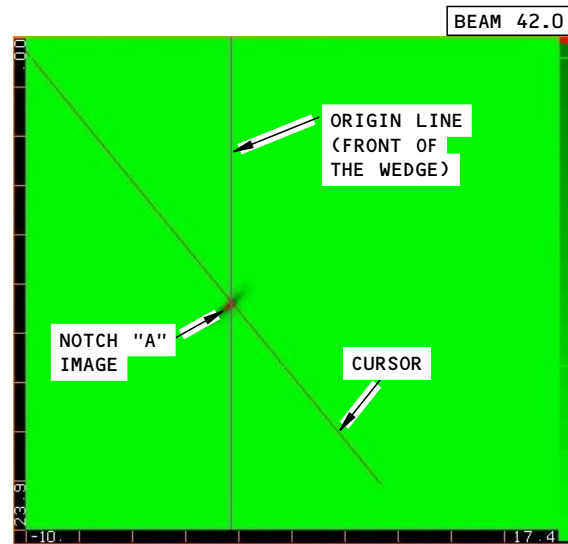


PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE
FROM REFERENCE STANDARD NDT1094-215
DETAIL IX



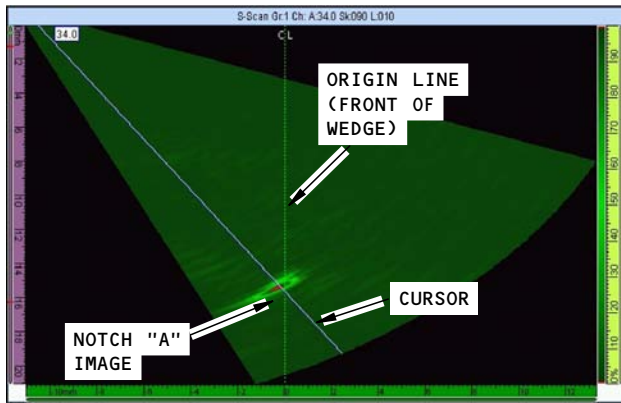
OMNISCAN MX SCREEN DISPLAY



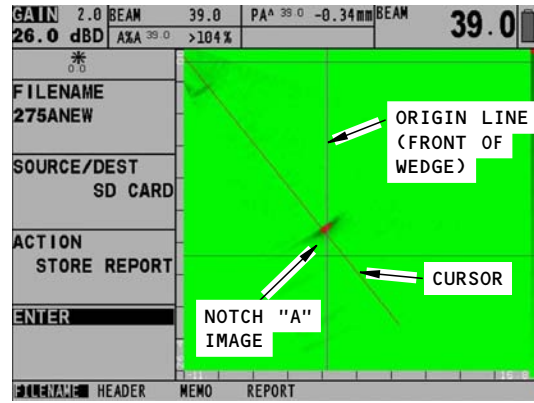
PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE "A" NOTCH IMAGE
FROM REFERENCE STANDARD NDT1094-245
DETAIL X

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 4)

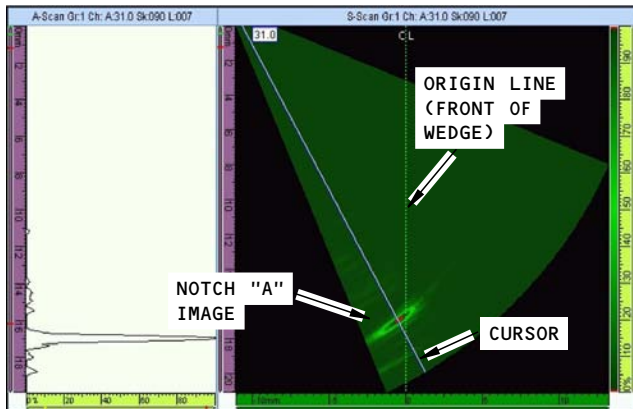


OMNISCAN MX SCREEN DISPLAY

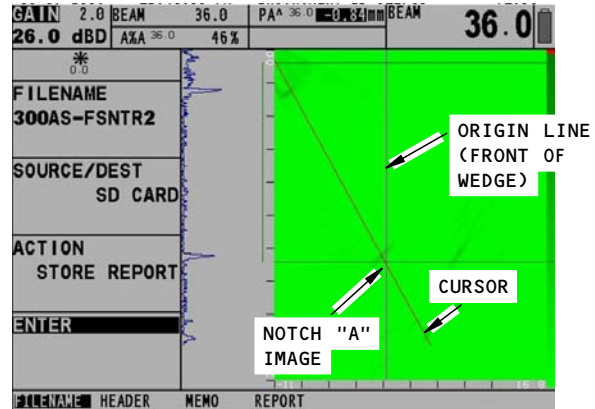


PHASOR XS SCREEN DISPLAY

SCREEN DISPLAY OF THE NOTCH "A" IMAGE
FROM REFERENCE STANDARD NDT1094-275
DETAIL XI



OMNISCAN MX SCREEN DISPLAY

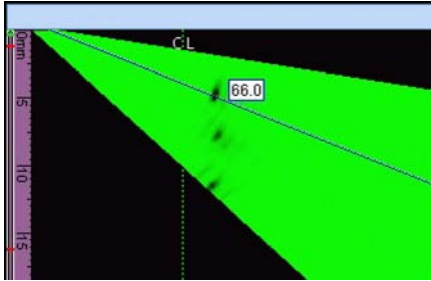
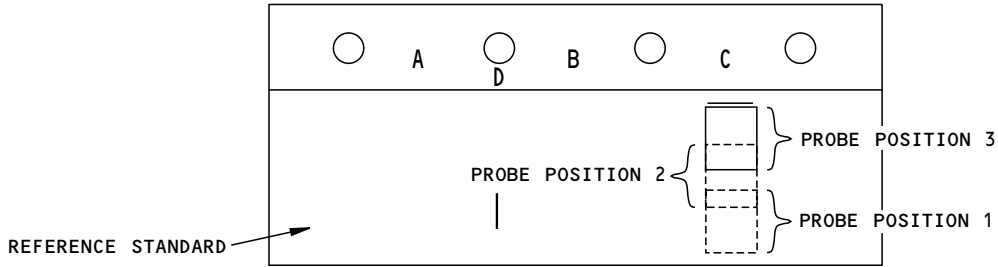


PHASOR XS SCREEN DISPLAY

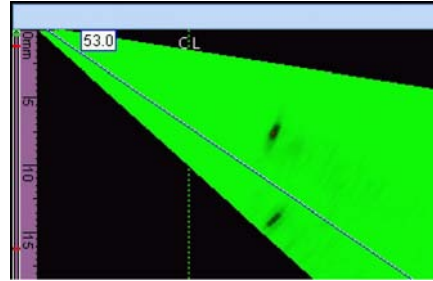
SCREEN DISPLAY OF THE NOTCH "A" IMAGE
FROM REFERENCE STANDARD NDT1094-300
DETAIL XII

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 5)

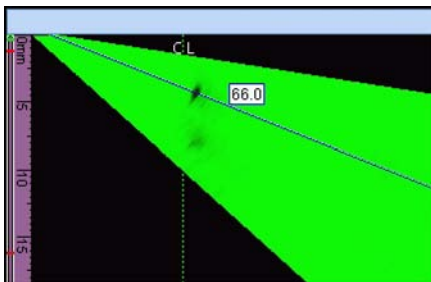
NONDESTRUCTIVE TEST



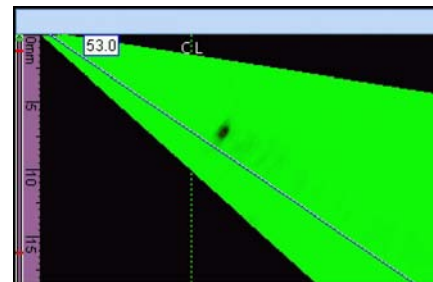
TYPICAL SIGNAL AT PROBE POSITION 1



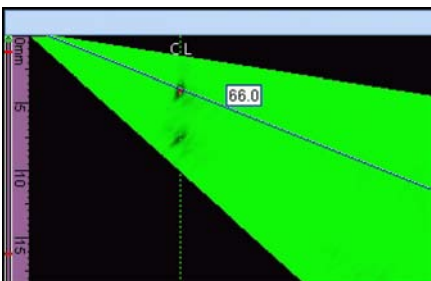
TYPICAL SIGNAL AT PROBE POSITION 1



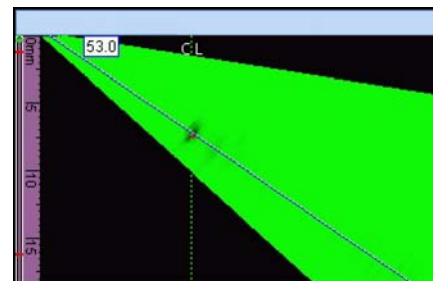
TYPICAL SIGNAL AT PROBE POSITION 2



TYPICAL SIGNAL AT PROBE POSITION 2



TYPICAL SIGNAL AT PROBE POSITION 3



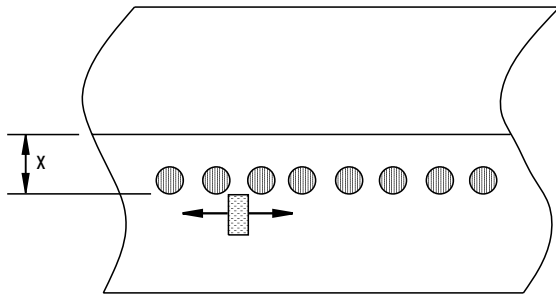
TYPICAL SIGNAL AT PROBE POSITION 3

TYPICAL SCREEN IMAGES FOR
"FREE-FIELD" CALIBRATION
(REFERENCE STANDARD 1094-070 SHOWN)

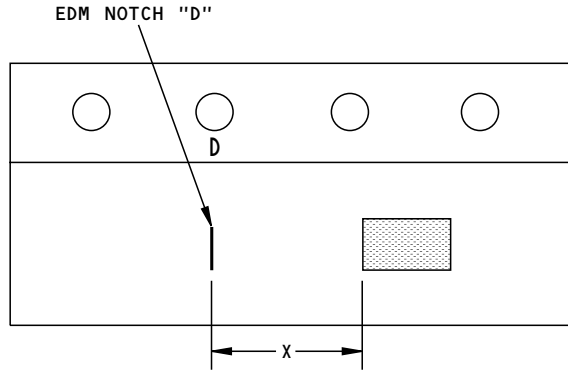
TYPICAL SCREEN IMAGES FOR
"FREE-FIELD" CALIBRATION
(REFERENCE STANDARD 1094-130 SHOWN)

"Free-field" Calibration
Figure 5

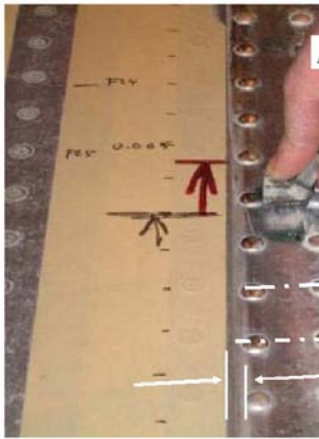
NONDESTRUCTIVE TEST



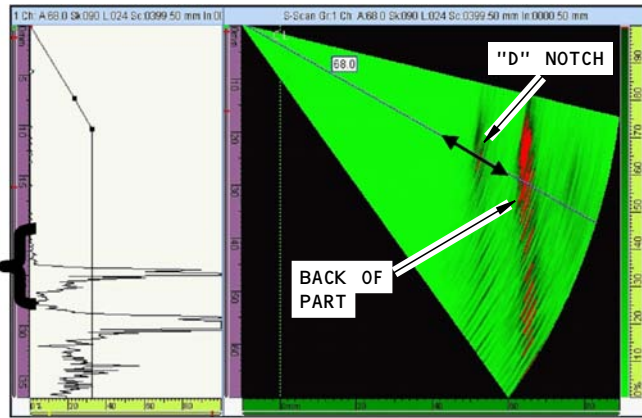
DETAIL I



DETAIL II

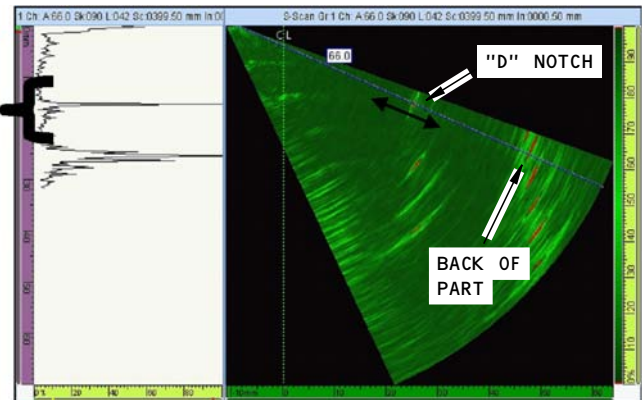


DETAIL III



0.080 (2.0 mm) THICK SKIN.
PROBE 1.75 INCH (44.5 mm) FROM THE EDGE

GATE LOCATION



0.250 (6.35 mm) THICK SKIN.
PROBE 1.0 INCH (25 mm) FROM THE EDGE

DETAIL IV

NOTES:

X = THE DISTANCE FROM THE FRONT OF THE WEDGE
TO THE EDGE OF THE UPPER PIECE

Button Head Fasteners That Do Not Let the Probe Touch the Edge
Figure 6