ULTRASONIC BOND INSPECTION OF FUSELAGE DOUBLERS

1. Purpose

A. Use this procedure to find disbonds between the fuselage skin and the bonded skin doublers. This procedure examines the bonded doubler areas where there are no fasteners and areas where there are fasteners such as stringer and frame locations. The maximum thickness that the skin or the doubler can be to use this procedure is 0.080 inch (2.0 mm). This procedure can be done from the outer skin surface or from the bonded doubler surface for areas where there are no fasteners. To examine areas at the stringer and frame locations where there are fasteners, do the inspection on the outer skin surface. See Figure 1 for the typical skin doubler.

B. This inspection procedure uses a low frequency bondtester to examine for disbonds that are 1 square inch (25 mm) or larger. A low frequency bondtester is an ultrasonic instrument that operates without a liquid couplant.

C. This procedure uses two reference standards. Reference standard NDT1039-t1/t2 is used to examine the bonded doubler areas, where there are no fasteners. Reference standard NDT3267-t1/t2 is used to examine the bonded doubler areas at stringer and frame locations, where there are fasteners.

D. Service Bulletin Reference: 737-53A1349

2. Equipment

NOTE: Refer to Part 1, 51-01-00 for data about the equipment manufacturers.

A. Instrument - All ultrasonic (low frequency) bondtester equipment that can do the calibration instructions of this procedure can be used. The instruments that follow were used to help prepare this procedure.

(1) Bondmaster 1000 Series/600; Olympus NDT

(2) Bondascope 3100; NDT Systems

(3) S-9 Sondicator; Zetec, Inc.

(4) US-5200; Uniwest

(5) Bondcheck V95; Rohmann Inc.

B. Probes

(1) The probes that follow were used to help prepare this procedure and are supplied with the instrument.

(a) S-PC-P13 or S-PC-P14 for the Bondmaster 1000 Series/600; Olympus NDT

(b) PCMS31 or PCHS31 for the Bondascope 3100; NDT Systems

(c) SP3L-DTE for the S-9 Sondicator; Zetec, Inc.

(d) SF3624 for the US-5200; Uniwest

(e) SP Probe for the Bondcheck V95; Rohmann Inc.

C. Reference Standards

(1) Make reference standards NDT1039-t1/t2 to examine the bonded doubler areas where there are no fasteners as shown in Figure 2. See Figure 2, Table I for the reference standard thickness combinations to use to examine skin or doubler thicknesses of up to 0.080 inch (2.0 mm).

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(2) Make reference standards NDT3267-t1/t2 to examine the bonded doubler areas at the stringer and frame locations, where there are fasteners, as shown in Figure 3. See Figure 3, Table I for the reference standard thickness combinations to use to examine skin or doubler thicknesses of up to 0.080 inch (2.0 mm).

(3) You can get the reference standards from one of the composite reference standard manufacturers identified in Part 1, 51-01-00.

3. Prepare for the Inspection

A. Refer to the applicable Service Bulletin that identifies the inspection areas and the skin and doubler thicknesses. If necessary, refer to the engineering drawings that show the structure and the thicknesses for the airplane to be examined.

B. Clean dirt or loose paint from the inspection surface. If an inspection is to be done on the inside surface (doubler side), it can be necessary to remove the corrosion compound if it is not easy to make a scan.

4. Instrument Calibration

A. Identify the thickness of the airplane skin and doubler that are to be examined and get the applicable reference standard. Table I in Figure 2 shows reference standard NDT1039-t1/t2 thickness combinations to use for the skin and doubler thicknesses to be examined where there are no fasteners. Table I in Figure 3 shows reference standard NDT3267-t1/t2 thickness combinations to use for skin and doubler thicknesses to be examined at stringer and frame locations where there are fasteners.

B. Put the probe on the disbond area (probe position 1) of the reference standard and center the probe in the area. See Figure 4 for the probe position on reference standard NDT1039-t1/t2 and NDT3267-t1/t2.

C. Calibrate the instrument as specified in the instrument's instruction manual or an equivalent approved procedure.

D. Move the probe in the bonded area and make small adjustments to the calibration as necessary to get a stable signal.

E. Move the probe to the disbonded area (probe position 2). See Figure 4 for the probe position on reference standard NDT1039-t1/t2 and NDT3267-t1/t2.

NOTE: If you use a Sondicator S-9, Bondmaster 1000 Series/600, or Bondascope 3100 instrument, turn the probe so that the tips are parallel to the edge of the disbond.

F. Make sure that you get a disbond signal from the instrument when the probe is moved to the disbonded area. If you do not get a disbond signal, adjust the instrument calibration again until you get a disbond signal.

G. Adjust the instrument's alarm controls so that the alarm operates when the probe is moved across the disbond area.

H. Identify the maximum scan speed that can be used during the inspection as follows:

(1) Move the probe across the disbonded area.

(2) Increase the scan speed until the alarm does not operate. The maximum scan speed is the maximum speed the probe can be moved across the disbonded area and continue to have the disbond alarm operate correctly.

5. Inspection Procedure

A. Calibrate the instrument with the applicable reference standard as specified in Paragraph 4.

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B. Put the probe on the surface of the skin or bonded doubler in an area where the bond is to be examined.

C. Compare the signal you get from this location to the bonded signal you got during calibration. If the signal is very different than the reference standard signal, do the steps specified below, as necessary, to help identify the cause of the different signal.

(1) Do a check again to make sure of the skin and doubler thicknesses and to make sure there is no other bonded structure in the area. Refer to the engineering drawings if necessary.

(2) Move the probe to a different area that has the same skin/doubler thickness to make sure that the initial area is not disbonded.

(3) Make small adjustments to the instrument display to see if you can get the signal to be almost the same as the signal you got from the reference standard. After you make the adjustments, make sure the instrument can continue to find the disbond in the reference standard.

D. Move the probe away from the bonded doubler and monitor the instrument display to make sure you get a disbond signal. If you do not get a disbond signal, do Paragraph 5.C.(3) again.

E. Make a scan of the bonded doubler areas as follows:

(1) Move the probe along areas of constant thickness.

NOTE: If a Sondicator S-9, Bondmaster 1000 Series/600, or Bondascope 3100 probe is used, make sure the probe tips are aligned so that they are 90 degrees to the edge of the doubler.

(2) Move the probe slowly. Use the same or a slower scan speed than that used during calibration.

(3) Do the scan of an area in increments that are not larger than the radius of the probe. It is recommended that a straightedge be used to guide the probe.

(4) Make a mark adjacent to the probe at the location of a disbond signal.

6. Inspection Results

A. An area that gives a signal that looks the same or almost the same as the signal you got from the disbonded area of the reference standard is a possible disbond. Do more analysis of the area as follows:

(1) Do a visual examination to see if the doubler is disbonded. If a visual examination is not possible, refer to the engineering drawings to make sure the signal is not caused by the configuration of the doubler.

(2) Use a high-frequency bondtester to examine the area as specified in Part 4, 51-40-00, Procedure 1. Use a reference standard with the same skin/doubler thicknesses or use an area on the airplane with the same thicknesses to calibrate the instrument.

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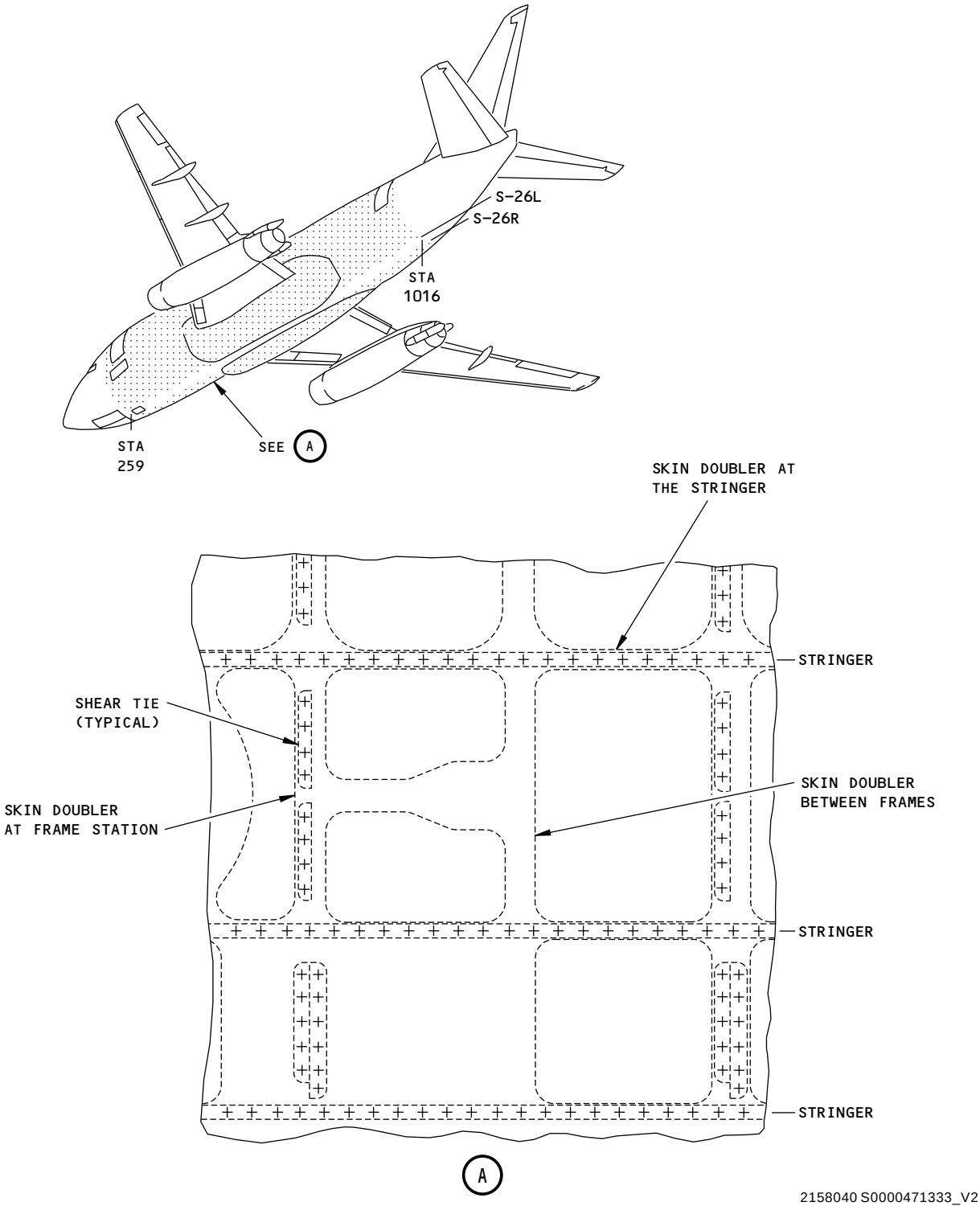

2158040 S0000471333_V2

Typical Skin Doubler Configuration
Figure 1

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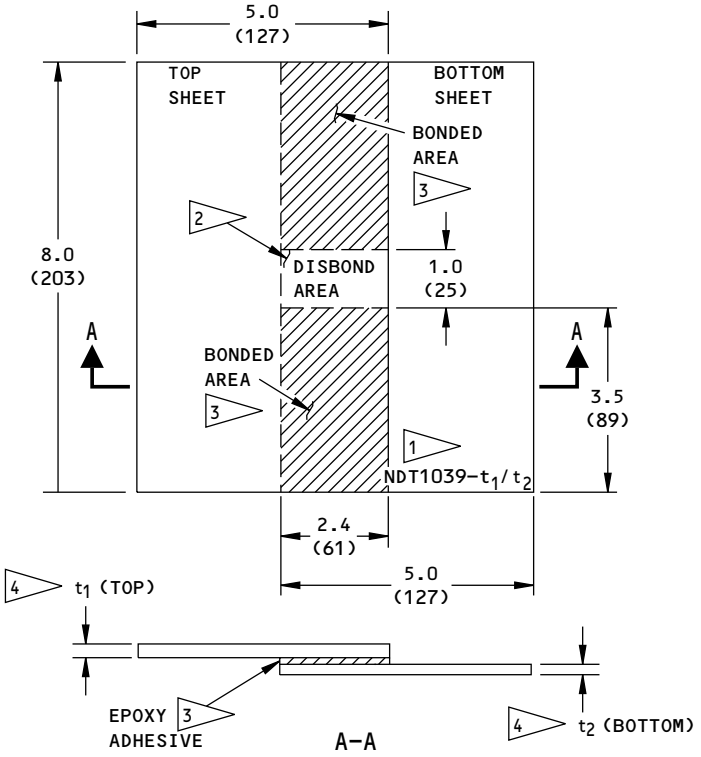

REFERENCE STANDARD THICKNESS COMBINATION t1/t2	SKIN THICKNESS RANGE (t1)	DOUBLER THICKNESS RANGE (t2)
0.080/0.063 (2.0/1.6)	0.071-0.080 (1.8-2.0)	0.063 (1.6)
0.063/0.056 (1.6/1.4)	0.063 (1.6)	0.056 (1.4)
0.050/0.040 (1.3/1.1)	0.045-0.050 (1.1-1.3)	0.036-0.045 (0.9-1.1)
0.040/0.040 (1.0/1.0)	0.032-0.040 (0.8-1.0)	0.032-0.040 (0.8-1.0)
0.040/0.020 (1.0/0.50)	0.032-0.040 (0.8-1.0)	0.014-0.020 (0.35-0.50)

TABLE I

NOTES

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

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

- MATERIAL: 2000 SERIES ALUMINUM, CLAD OR BARE

1. ETCH OR SCRIBE THE REFERENCE STANDARD NUMBER NDT1039-t_1/t_2. t_1 IS THE THICKNESS OF THE TOP SHEET AND t_2 IS THE THICKNESS OF THE BOTTOM SHEET.
2. TO MAKE THE DISBOND AREA, DO NOT APPLY ADHESIVE IN THE AREA. YOU CAN USE A TEFLON INSERT THAT IS THE APPROXIMATE THICKNESS OF THE EPOXY ADHESIVE. THE INSERT WILL NOT LET THE ADHESIVE FLOW INTO THE DISBOND AREA.
3. USE AN EPOXY ADHESIVE THAT IS 0.004-0.005 (0.10-0.13) THICK FOR SUFFICIENT STRENGTH.
4. CHOOSE THE t_1 AND t_2 SHEET THICKNESSES FROM TABLE I ABOVE FOR THE STRUCTURE THICKNESSES TO BE EXAMINED.

2158042 S0000471334_V3

Reference Standard NDT1039-t1/t2
Figure 2

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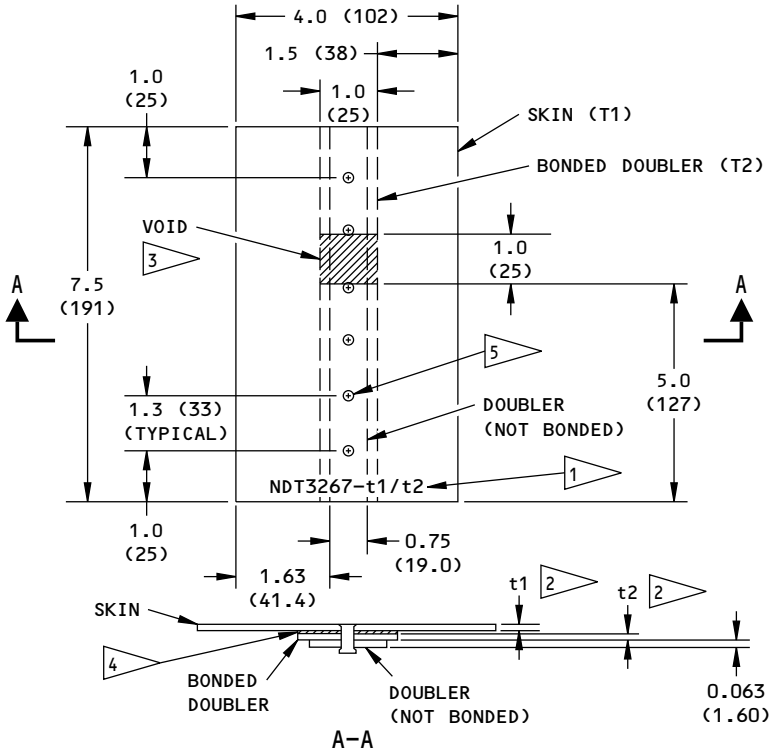

REFERENCE STANDARD THICKNESS COMBINATION t1/t2	SKIN THICKNESS RANGE (t1)	DOUBLER THICKNESS RANGE (t2)
0.080/0.063 (2.0/1.6)	0.071-0.080 (1.8-2.0)	0.063 (1.6)
0.063/0.056 (1.6/1.4)	0.063 (1.6)	0.056 (1.4)
0.050/0.040 (1.3/1.1)	0.045-0.050 (1.1-1.3)	0.036-0.045 (0.9-1.1)
0.040/0.040 (1.0/1.0)	0.032-0.040 (0.8-1.0)	0.032-0.040 (0.8-1.0)

TABLE I

NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (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

- MATERIAL: 2000 SERIES ALUMINUM, CLAD OR BARE

1 ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER, NDT3267-t1/t2, AT APPROXIMATELY THIS LOCATION. t1 IS THE THICKNESS OF THE SKIN AND t2 IS THE THICKNESS OF THE BONDED DOUBLER.

2 CHOOSE THE t1 AND t2 THICKNESS FROM TABLE I ABOVE FOR THE STRUCTURE THICKNESS TO BE EXAMINED.

3 VOID - TO MAKE THE VOID: USE TWO LAYERS OF FEP BETWEEN THE SKIN AND THE BONDED DOUBLER. EACH LAYER OF FEP IS 0.001 (0.02) THICK. MAKE SURE TO COAT THE FEP WITH FREEKOTE. DO NOT PUT ADHESIVE AT THE VOID LOCATION. DO A THROUGH TRANSMISSION ULTRASONIC C-SCAN TO MAKE SURE THERE IS A VOID.

4 USE EPOXY ADHESIVE, BMS 5-101, GRADE 5, 0.004-0.005 (0.10-0.13) THICK. APPLY THE ADHESIVE TO THE SURFACE OF THE BONDED DOUBLER THAT MATES WITH THE SKIN.

5 INSTALL BACR15GF6D* FASTENERS (6 LOCATIONS). USE FASTENERS WITH THE SAME GRIP LENGTH AS THE APPLICABLE REFERENCE STANDARD TOTAL THICKNESS.

2505431 S0000589224_V1

Reference Standard NDT3267-t1/t2
Figure 3

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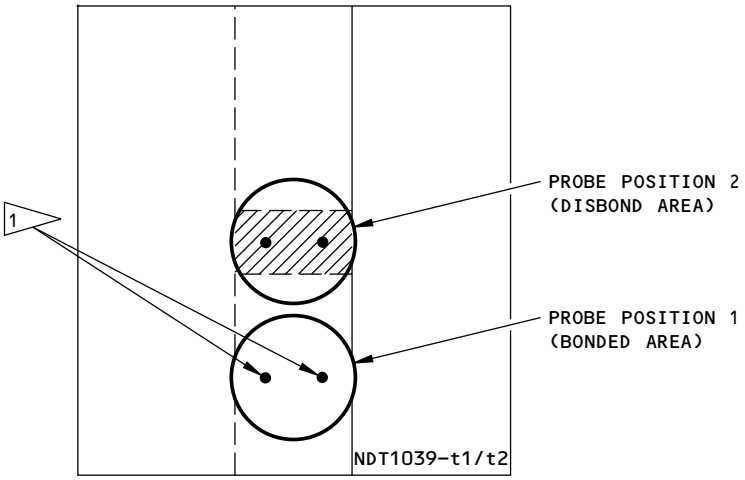
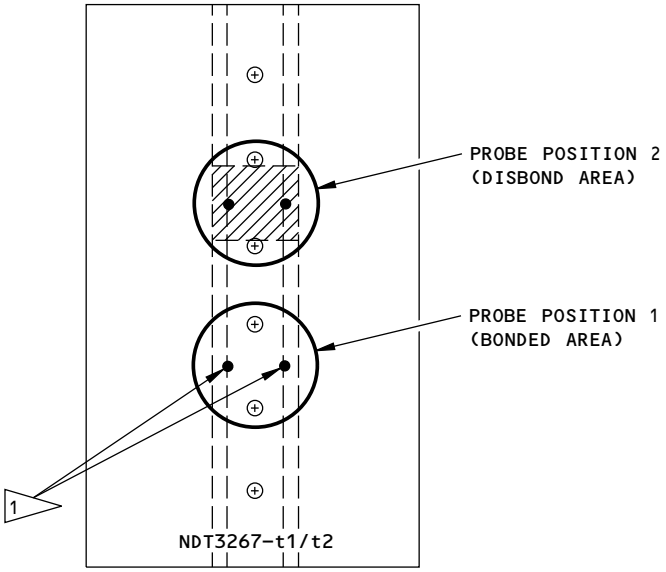


PROBE POSITIONS ON REFERENCE STANDARD
NDT1039-t1/t2



PROBE POSITIONS ON REFERENCE STANDARD
NDT3267-t1/t2

1 TYPICAL PROBE TIP POSITIONS FOR THE SONDICATOR S-9, BONDMASTER 1000 SERIES/600, OR THE BONDASCOPE 3100 PROBE.

2505440 S0000589226_V1

Instrument Calibration
Figure 4

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ULTRASONIC BOND INSPECTION OF WINDOW BELT DOUBLERS

1. Purpose

A. To find the disbonding of the fuselage-window-belt doublers. The structure has a 0.072 inch (1.8 mm) thick aluminum outer skin and a 0.063 inch (1.6 mm) bonded doubler. The inspection can be done from the external or internal surfaces of the skin.

B. Service Bulletin Reference: 737-53-1078, 737-53-1079, 737-53A1349

2. Equipment

NOTE: Refer to Part 1, 51-01-00 for information on equipment manufacturers.

A. Instrument

(1) Any bond inspection instrument that can find disbonds of one square inch or larger in the structure described above is satisfactory. The following instruments, for which a liquid couplant is not necessary, were used to develop this procedure.

(a) Sondicator S-2B; Automation Industries, Inc.

(b) S-3 Audible Bondtester; Zetec Corporation

(c) ABE (Advanced Bond Evaluator); UNIWEST

(d) Sondicator S-5; Zetec Corporation

B. Probes

(1) Sondicator Probe, P/N 57A8805; Staveley Sensor, Inc./Qualcorp Search Units

(2) Sondicator Probe, P/N 0030-51-01; Zetec Corporation

NOTE: Sondicator probes are used with the Sondicator S-2B and S-3 audible bondtester instruments.

(3) ABE Probe, P/N 93126; UNIWEST

C. Reference Standard

(1) Make reference standard 370 or NDT1039-t1/t2 as shown in Figure 1. See Table 1 in Figure 1 for the reference standard thickness combinations to use to examine skin or doubler thicknesses of up to 0.063 inch (1.6 mm). Refer to Part 1, 51-01-00 for data about composite reference standard manufacturers.

NOTE: If a reference standard is not available, the instrument may be calibrated at an area on the airplane that is known to be bonded and has the same skin and doubler thickness. Instrument calibration on the airplane, however, is less accurate because it does not allow examination of the response level to voids. It is recommended that this procedure be performed only by personnel with prior experience in this type of inspection.

3. Prepare for the Inspection

A. Identify the areas to be inspected.

B. Clean the loose dirt, paint flakes, or blisters from the inspection surface.

C. Locate the position of the bonded doubler by the fastener pattern around the windows. Refer to Figure 2.

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4. **Instrument Calibration**

A. Calibrate the instrument using the manufacturer's instructions.

NOTE: If using the Sondicator S2-B, calibration may be done per Paragraph 4.B.

B. Sondicator S2-B Alternate Calibration Method

(1) Calibration Method Using Reference Standard

(a) Place the probe on the reference standard over a bonded area.

(b) Set both the amplitude and the phase dial controls to the zero position. Set the phase, phase/AMPTD switch to phase/AMPTD.

(c) Turn the amplitude dial control clockwise to get a 0.2 "amplitude meter" needle reading.

NOTE: The "phase meter" needle may increase to read as high as 1.0 (full scale) because these controls interact to a degree.

(d) Turn the phase dial control clockwise and monitor the "phase meter" needle peak (full scale) and then go back to zero. Continue to turn the phase control clockwise until the "phase meter" needle again reaches full scale and goes back to zero a second time.

NOTE: Because of the interactive amplitude/phase control, the "amplitude meter" needle should read approximately 0.9 after Paragraph 4.B.(1)(d) is completed.

(e) Move the probe over the disbonded area of the reference standard. "Phase meter" needle should go from zero to full scale.

NOTE: Monitor only "phase meter" response to find the disbonded condition.

(f) To do a check of the excess noise, place the probe over a bonded area of the reference standard and slowly move the probe a short distance (back and forth). If the "phase meter" needle changes more than half scale while moving the probe, turn the phase control clockwise until the "phase meter" needle moves left to the zero position and does not change more than 0.1. Do a check for a full scale "phase meter" change per Paragraph 4.B.(1)(e).

(2) Calibration Method on Airplane

(a) Place the probe on the skin over a doubler within the inspection area which is known to be bonded.

(b) Calibrate per Paragraph 4.B.(1)(b) thru Paragraph 4.B.(1)(d).

(c) Slowly move the probe until the probe is over a skin-only area. When the probe is placed on the skin only, the "phase meter" needle should move from 0.6 to zero and the "amplitude meter" needle may or may not move from 0.7 to 1.0. If this meter response change is not gotten, the bonded doubler area used for calibration may be disbonded, so move to another bonded doubler area and repeat Paragraph 4.B.(2)(a) thru Paragraph 4.B.(2)(c).

(d) To do a check of the excess noise, place the probe over a known bonded area on the airplane and slowly move the probe a short distance (back and forth). If "phase meter" needle changes more than half scale while moving the probe, turn the phase control clockwise until the "phase meter" needle moves left to the zero position and does not change more than 0.1. Do a check for a full scale "phase meter" change per Paragraph 4.B.(2)(c).

C. Examine the operation of the instrument on bonded and disbonded portions of the reference standard.

NOTE: If the instrument calibration is being done on the airplane, examine the operation of the instrument on single thickness and bonded double thickness areas.

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5. **Inspection Procedure**

A. Calibrate the instrument per Paragraph 4.

B. Place the probe on the fuselage skin away from the doubler, Figure 3, probe position 1. The instrument should give a single thickness (disbond) indication almost the same as the response on the reference standard.

NOTE: If fuselage is painted, small adjustments of the instrument positions may be necessary to get the same response on the fuselage skin as on the reference standard.

C. Move the probe across the bonded doubler, Figure 3, probe position 2. The instrument should give a double thickness (bonded) indication almost the same as the response on the reference standard.

NOTE: If the fuselage is painted, small adjustments of the instrument positions may be necessary to get the same response on the fuselage skin as on the reference standard. If instrument adjustments are made, do a check of the response at probe position 1.

D. Move the probe across the doubler to inspect all areas, refer to Figure 3. Index probe every 0.5 inch (12.7 mm) to make sure that the inspection coverage is complete.

NOTE: To avoid response errors, do not slide probe over fasteners.

6. **Inspection Results**

A. All areas that give a response almost the same as the calibration disbond response, show a disbond and should be investigated more.

B. Visually make sure of disbond indications from the interior. Get access to the interior by removing the internal panels and insulation.

C. If visual separation of the skin and doubler in Paragraph 6.B. cannot be found, insert a 0.005 inch (0.13 mm) feeler gauge between the skin and doubler at the unsatisfactory disbond location.

D. If disbonds are found, refer to the related service bulletin for further inspection requirements.

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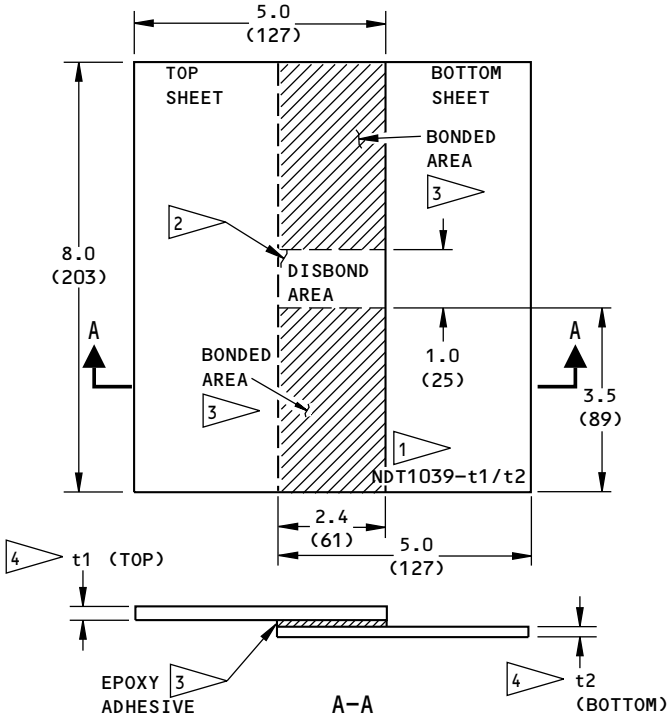

REFERENCE STANDARD THICKNESS COMBINATION t1/t2	AIRPLANE SKIN OR DOUBLER THICKNESS RANGE
0.063/0.056 (1.6/1.4)	0.063 (1.6) 0.056 (1.4)
0.050/0.040 (1.3/1.1)	0.050 (1.3) 0.045 (1.1)
0.040/0.040 (1.0/1.0) 5	0.040 (1.0) 0.036 (0.9) 0.032 (0.8) 0.027 (0.7)
0.040/0.020 (1.0/0.50)	0.020 (0.50) 0.014 (0.35)

TABLE I

NOTES

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

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

- MATERIAL: 2000 OR 7000 SERIES ALUMINUM (CLAD OR BARE)

1 ETCH OR SCRIBE THE REFERENCE STANDARD NUMBER, NDT1039-t1/t2, AT APPROXIMATELY THIS LOCATION. t1 IS THE THICKNESS OF THE TOP SHEET AND t2 IS THE THICKNESS OF THE BOTTOM SHEET.

2 TO MAKE THE DISBOND AREA, DO NOT APPLY ADHESIVE IN THE AREA. YOU CAN USE A TEFLON INSERT THAT IS THE APPROXIMATE THICKNESS OF THE EPOXY ADHESIVE. THE INSERT WILL NOT LET THE ADHESIVE FLOW INTO THE DISBOND AREA.

3 USE AN EPOXY ADHESIVE THAT IS 0.004 - 0.005 (0.10 - 0.13) THICK FOR SUFFICIENT STRENGTH.

4 CHOOSE THE t1 AND t2 SHEET THICKNESSES FROM TABLE I ABOVE FOR THE STRUCTURE THICKNESSES TO BE EXAMINED.

5 REFERENCE STANDARD 370 CAN BE MADE WITH 0.036 (0.9) OR 0.040 (1.0) t1/t2 SHEET THICKNESSES.

2502778 S0000587794_V2

Reference Standard NDT1039-t1/t2
Figure 1

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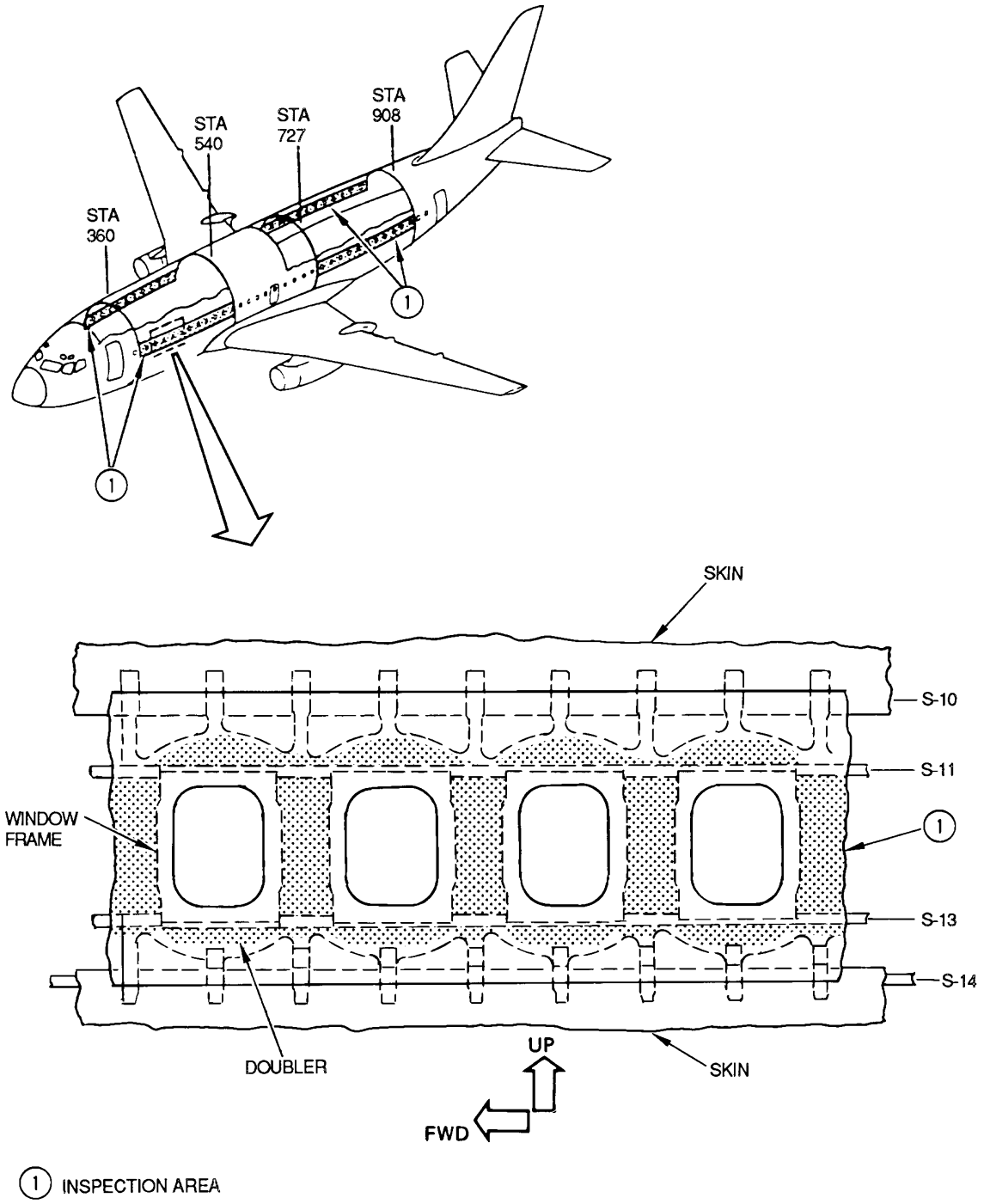

TYPICAL SECTION OF WINDOW BELT SKIN PANEL

2158046 S0000471337_V1

Inspection Area
Figure 2

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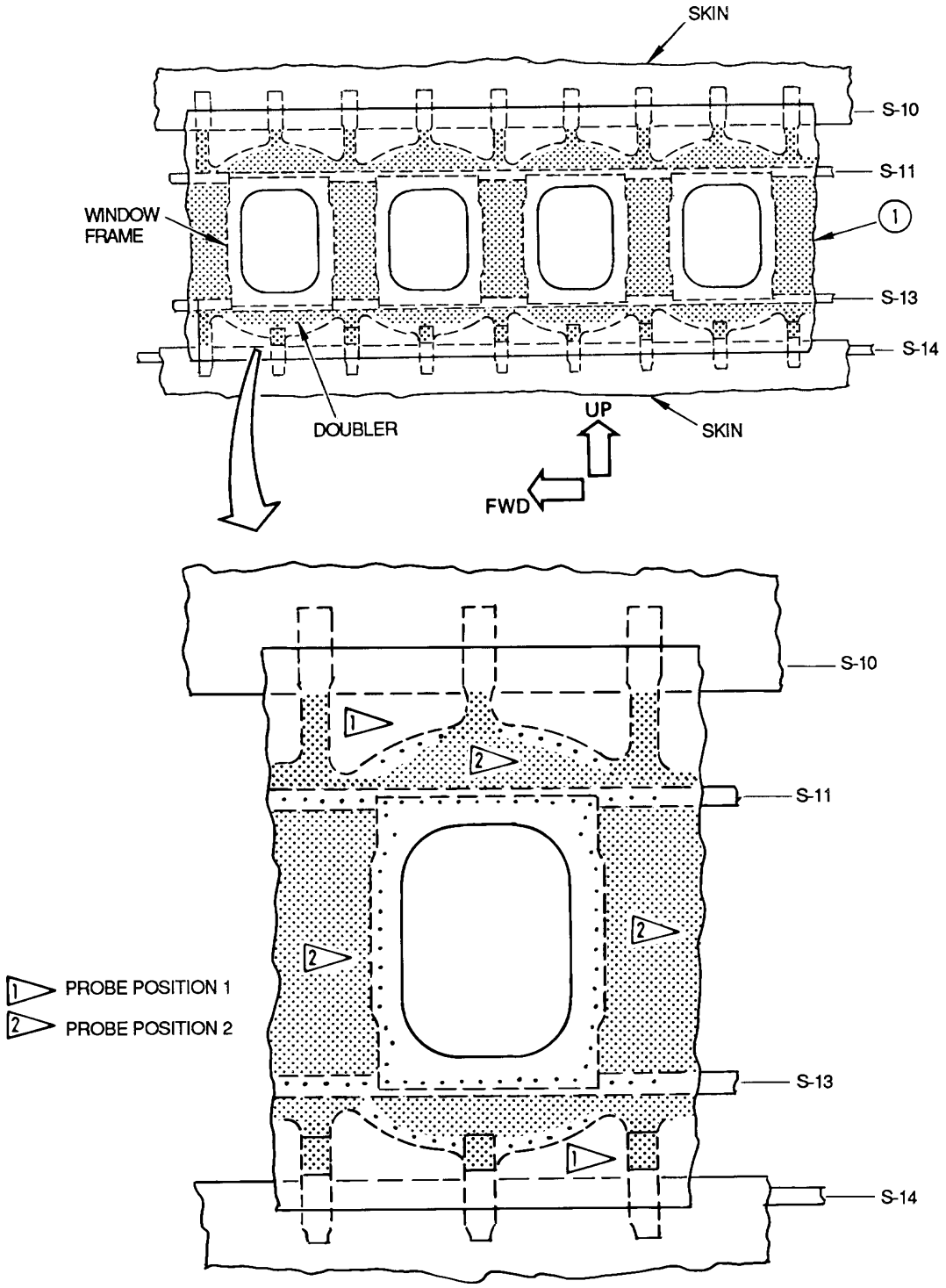

2158048 S0000471338_V2

Inspection Procedure
Figure 3

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PART 4 - ULTRASONIC

FUSELAGE SKIN BEHIND THE UPPER RIB PLUS CHORD

1. **Purpose**

   A. This procedure can be used to examine the fuselage skin behind the upper rib plus chord for horizontal cracks. The area of the skin examined for cracks extends from station 578 to station 639; from the top edge of the chord to 0.37 inch (9 mm) below the top edge of the chord. See Figure 1.

   B. 737 Supplemental Structural Inspection Document (D6-37089) Reference:

      (1) Item: F-55

2. **Equipment**

   NOTE: Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

   A. Instruments - All pulse echo ultrasonic instruments are permitted for use if they:

      (1) Can operate at a frequency of 10 MHz.

      (2) Can find the defect in the reference standard as specified in the calibration instructions of this procedure.

      (3) The instruments specified below were used to help prepare this procedure:

         (a) Epoch 2001; Panametrics

         (b) USL 38; Krautkramer Branson

   B. Ultrasonic Transducers - The transducer must have a shear wave angle between 70 and 75 degrees and operate at 10 MHz.

      (1) The shear wave transducers specified below were used to help prepare this procedure:

         NOTE: Only one transducer is necessary to do this inspection.

         (a) Staveley sensors (Automation Industries) transducer part number 57K0961 or SPO-5319; 10 MHz, 75 degree.

         (b) Staveley sensors (Automation Industries) transducer part number 57A3090 or SPO-5320; 10 MHz, 70 degree.

         (c) KB Aerotech transducer part number 226-590; 10 MHz. Wedge part number W-203; 70 degree.

   C. Reference Standards - Make reference Standard NDT392 as specified in Figure 2.

   D. Ultrasonic Couplant - Use a noncorrosive oil, grease or gel.

3. **Prepare for the Inspection**

   A. Prepare for the inspection of the bonded skin area located behind the vertical flange of the upper rib chord as follows:

      (1) Get access on top of the wing skin where it is attached to the fuselage.

      (2) Remove the upper wing fairings to get to the skin area at buttocks line (BL) 70.85 between Stations 578 and 639.

      (3) Clean the area on the skin where the transducer will touch between Stations 578 and 639 immediately above the upper rib chord. See Figure 1.

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(4) Make sure the paint in the inspection area is clean and smooth so that the transducer can transmit sufficient sound to the crack area. See Figure 1.

NOTE: All loose or soft paint must be removed from the skin where the transducer will touch. See the area immediately above the upper rib chord in Figure 1. Loose, soft, or rough paint in this area will not permit sound to be transmitted sufficiently through the skin.

4. Instrument Calibration

NOTE: Refer to the instruments instruction manual for the instrument operation instructions.

A. Set the instrument frequency to 10 MHz.

B. Apply sufficient couplant on reference standard NDT392 at position 1 and 2. See Figure 3.

C. Put the transducer at position 1 so it points directly at the fastener hole. See Figure 3.

D. Set the front surface signal at 0 on the horizontal baseline while the transducer is at position 1. See Figure 3.

E. Set the signal from the fastener hole at 8.0 on the horizontal baseline. See Figure 3.

F. Put the transducer at position 2 so it points directly at the reference notch. See Figure 3.

NOTE: The reference line represents the top of the upper rib chord. During the calibration, the front edge of the transducer must be approximately at the edge of the reference line. See Figure 3.

G. Set the signal from the reference notch at 5.0 on the horizontal baseline while the transducer is at position 2. See Figure 3.

NOTE: It is satisfactory if the front surface signal is not at 0 when the notch signal and hole signal are at 50 percent and 80 percent of full screen width.

H. Put the transducer at position 1 and lightly move the transducer along the reference line until the maximum signal from the hole is shown at 8.0 on the horizontal baseline. See Figure 3.

I. With the maximum signal height shown on the screen, adjust the gain so this signal at 8.0 on the horizontal baseline is 100 percent full screen height.

J. Increase the gain 12 dB.

NOTE: During the calibration, it is possible for some added signals to come into view between 3.0 and 8.0 on the horizontal baseline when the gain is increased 12 dB. These signals will not cause a problem during the inspection because they will decrease when the transducer is put on the bonded skin of the airplane.

5. Inspection Procedure

A. Calibrate the equipment as specified in Paragraph 4.

B. Apply sufficient couplant on the skin where the transducer will be put. See Figure 1.

NOTE: The couplant must be put on sufficiently thick to make sure that the sound will transmit sufficiently through the bonded skin.

C. Put the transducer on the skin with the sound beam pointed down at station 578 immediately above the upper rib chord. See Figure 1.

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D. Slowly do a scan with the transducer in the aft direction and at the same time monitor the screen for signals between 4.5 and 10.0 on the horizontal baseline. Make sure the sound beam is pointed down. See Figure 1.

NOTE: It is possible that some of the fastener hole signals will not come into view on the screen because of the tight fit of the fasteners. A fastener hole signal will come into view on the screen between 7.0 and 9.0 on the horizontal baseline and decreases to 0 percent full screen height during a short scan. Compare these signals to the fastener hole signal on the reference standard.

E. Continue to do the scan as specified in Paragraph 5.D. until the transducer gets to Station 639. Make sure the transducer sound beam points down during the scan.

F. Make sure the steps in Paragraph 5. are done on the left and right sides of the airplane.

6. Inspection Results

A. Signals that come into view between 4.5 and 10.0 on the horizontal baseline and are 50 percent of full screen height or more are possible crack indications.

B. If a signal comes into view on the screen and decreases to 0 percent full screen height during a short scan, the signal can possibly be from a fastener hole. Do the steps that follow to make sure the signal is not caused by a reflection from a fastener hole.

(1) See if the transducer is aligned with a fastener hole.

(2) Put the transducer at position 1 on reference standard NDT392 and slowly move the transducer in two directions along the reference line. See Figure 3. Monitor how the signal from the fastener hole decreases during a short scan as compared to the notch signal.

C. Internal signals from the transducer can possibly occur on the screen display. To see if the signals are from cracks (and not from an internal signal caused by the transducer), slowly move the transducer up (and away from the rib plus chord) and see if the signals stay in the same location on the horizontal baseline. If these signals stay in the same location, then they are from the transducer and are not crack signals.

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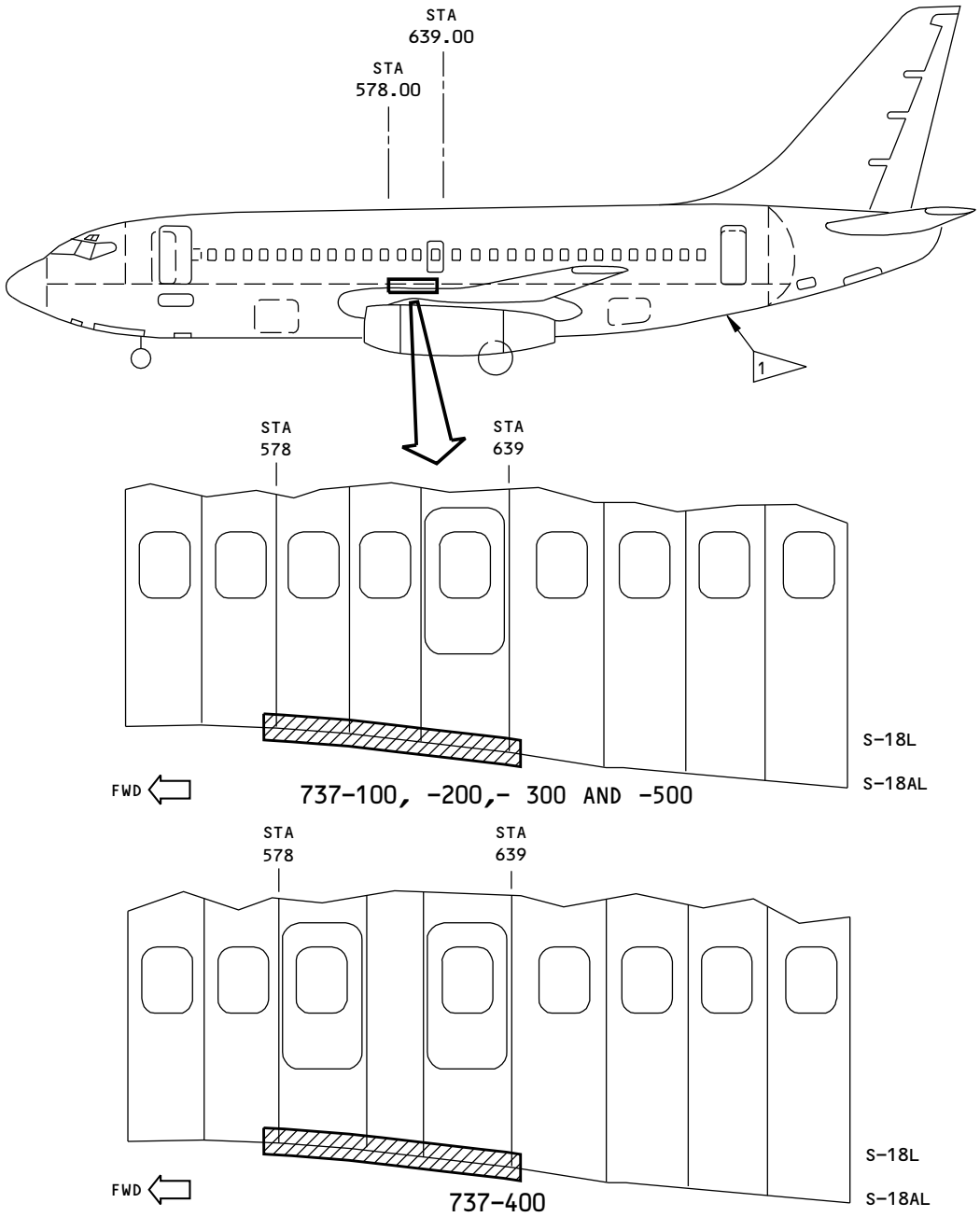

THESE VIEWS ARE OF THE LEFT SIDE OF THE AIRPLANE WHILE YOU STAND ON THE WING. THE RIGHT SIDE IS EQUIVALENT

NOTES:

INSPECTION AREA, SEE FIGURE 1 (SHEET 2) FOR MORE DETAIL

1 THE AIRPLANE SHOWN IS A 737-500. THE INSPECTION IS DONE ON 737-100 THRU -500.

2158051 S0000471340_V1

Ultrasonic Inspection of the Skin Adjacent to the Upper Rib Plus Chord
Figure 1 (Sheet 1 of 2)

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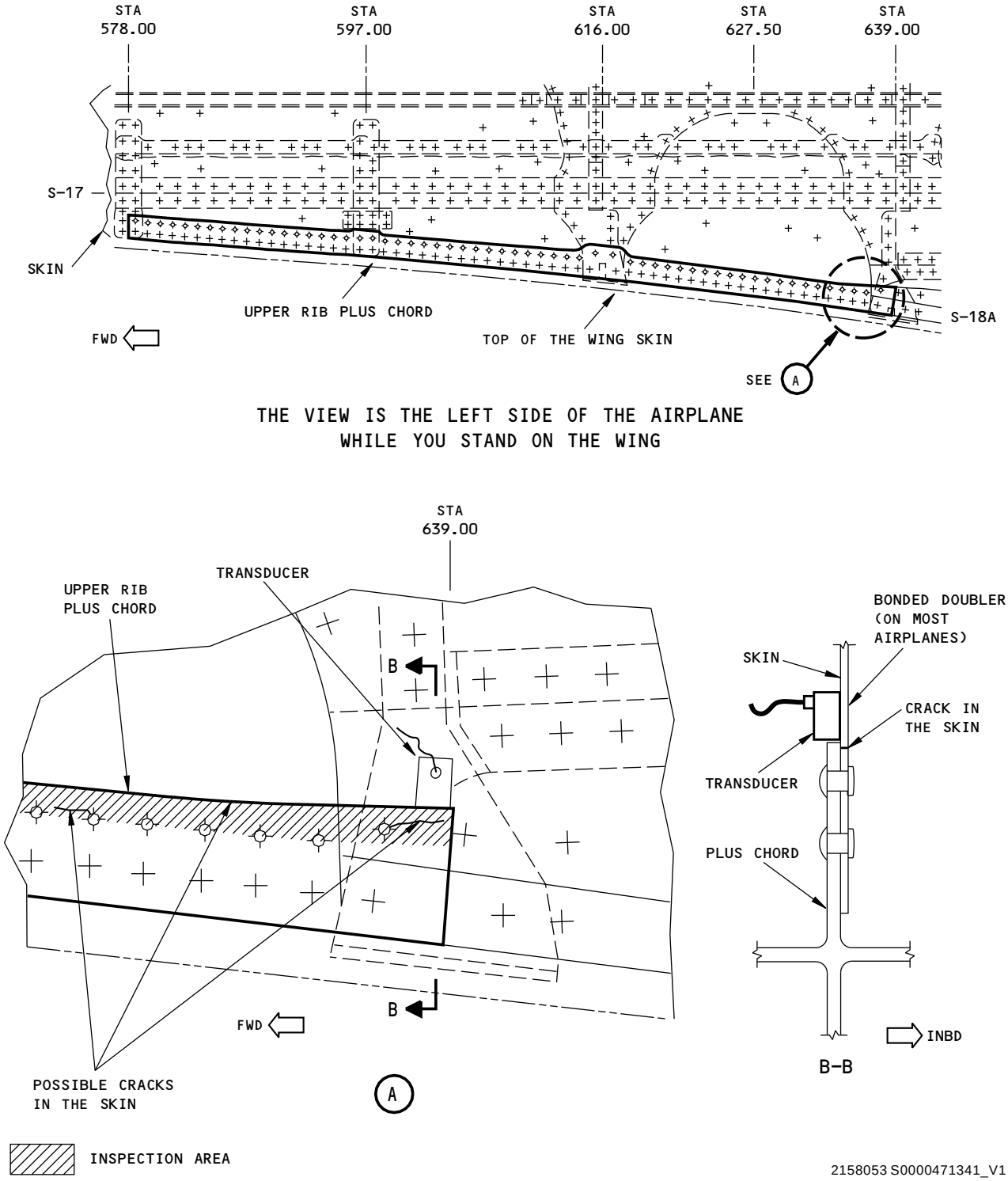

Ultrasonic Inspection of the Skin Adjacent to the Upper Rib Plus Chord
Figure 1 (Sheet 2 of 2)

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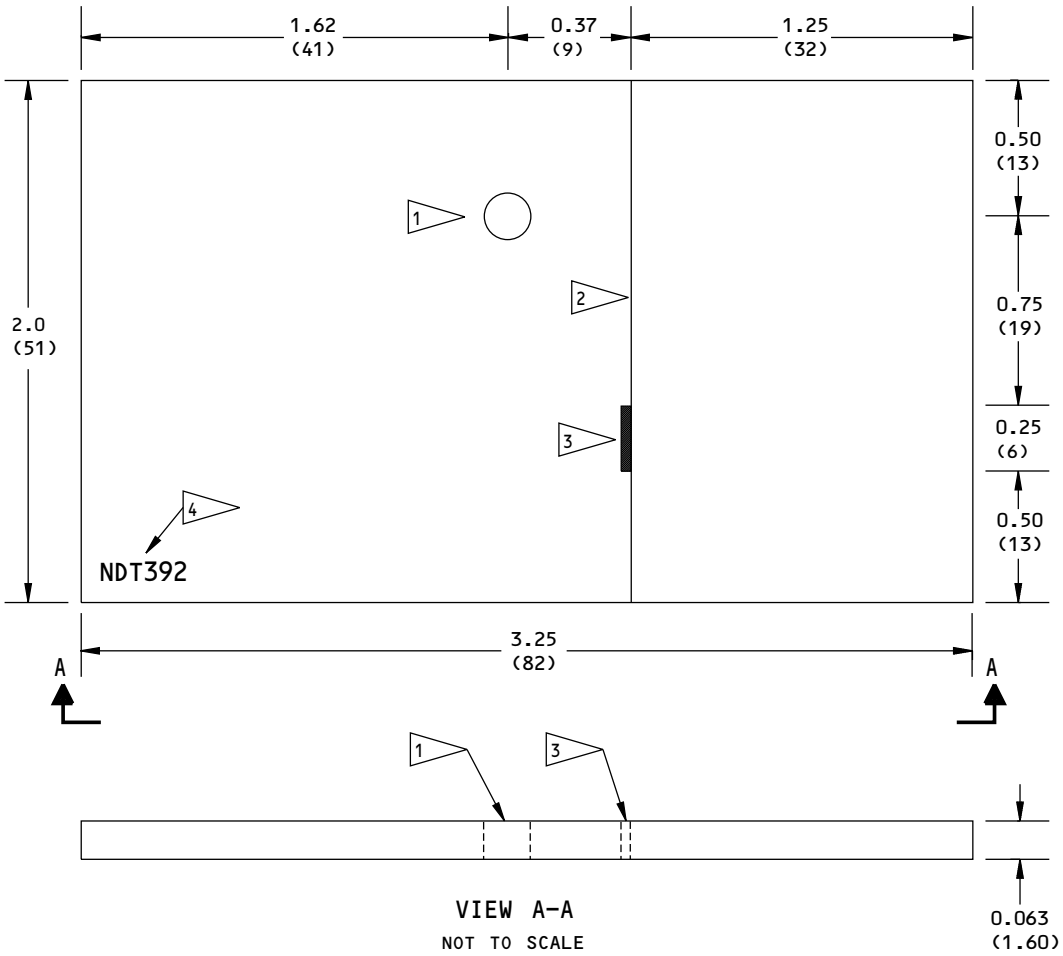

NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS IN PARENTHESES)
- DIMENSION 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

- MATERIAL: 2024-T3, T4 OR T6 CLAD OR BARE OR 7075-T3, T4 OR T6 CLAD OR BARE

1 DRILL A 0.25 (6.3) DIAMETER HOLE

2 REFERENCE LINE. MAKE THE REFERENCE LINE WITH A SHARP BLADE. THE MAXIMUM DEPTH IS 0.007 (0.17)

3 EDM NOTCH OR JEWELERS SAWCUT:
LENGTH: 0.250 ±0.025 (6.35 ±0.64)
DEPTH: THROUGH THE 0.063 (1.60) PLATE THICKNESS
WIDTH: 0.025 (0.63) MAXIMUM

4 ETCH OR STAMP THE REFERENCE STANDARD PART NUMBER NDT392

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Reference Standard NDT392
Figure 2

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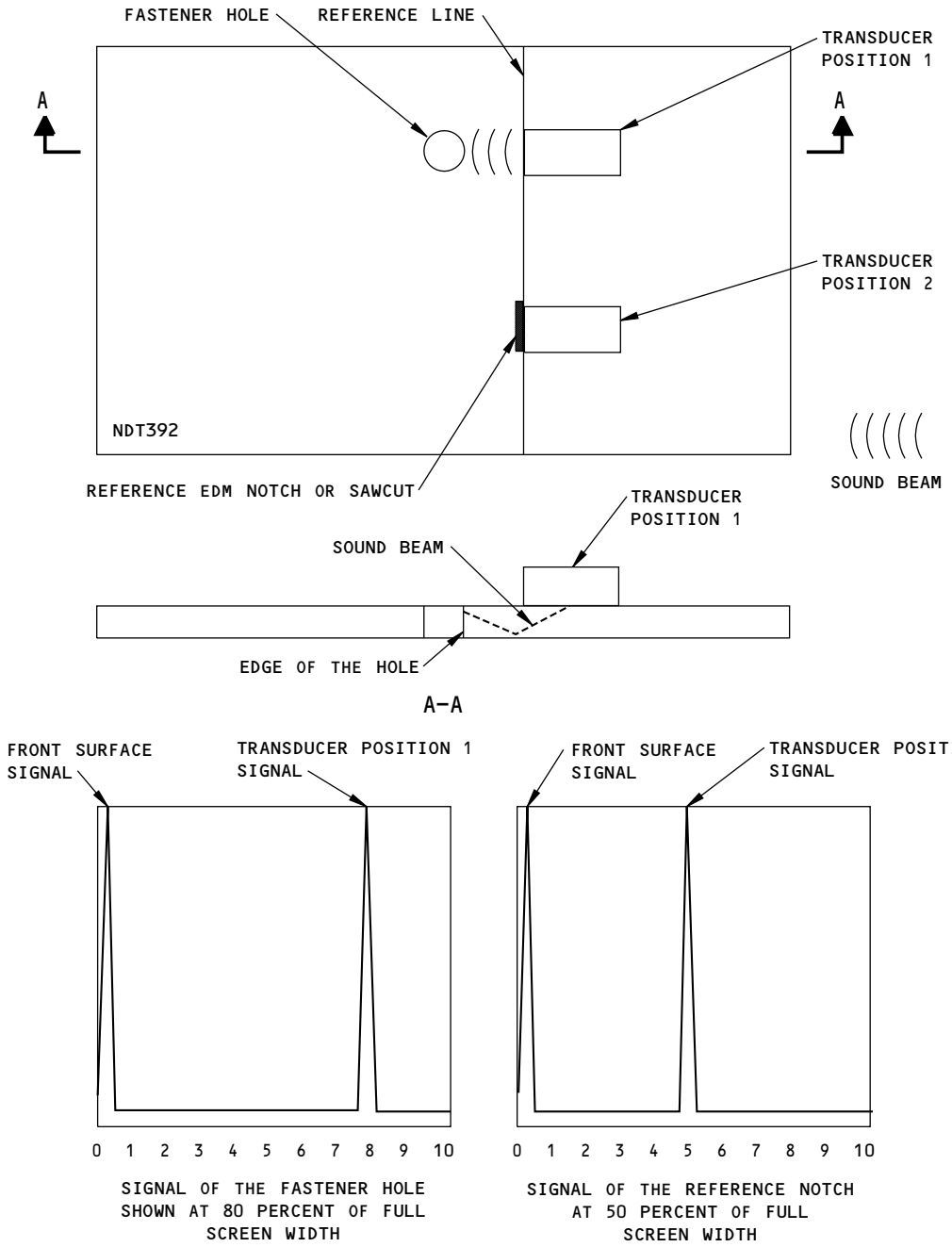

NOTES:

- MAKE SURE THE EDGE OF THE TRANSDUCER IS AT THE EDGE OF THE REFERENCE LINE DURING THE CALIBRATION. THIS REFERENCE LINE IS WHERE THE TOP EDGE OF THE UPPER RIB CHORD WILL BE ON THE AIRPLANE.
- SLOWLY MOVE THE TRANSDUCER AT POSITION 1 TO GET THE MAXIMUM SIGNAL FROM THE FASTENER HOLE. ADJUST THE GAIN SO THAT THE SIGNAL IS AT 100 PERCENT OF FULL SCREEN HEIGHT AND THEN INCREASE THE GAIN 12 DB.

2158058 S0000471343_V1

Calibration Positions with Screen Signals
Figure 3

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FUSELAGE SKIN CRACK INSPECTION - LOWER SKIN AT THE LAP SPLICES

1. Purpose

A. Use this procedure to find cracks in the lower skin panels of the fuselage at the lap splices. This procedure looks for cracks in the lower skin that are 0.200 inches (5.1 mm) long (or more), are in the forward and aft direction, and are 50% (or more) through the thickness of the lower skin. The inspection area at a lap splice starts approximately 0.030 inches (0.76 mm) from the edge of the upper skin and extends to 0.25 inches (6.4 mm) from the edge. See Figure 1 for the inspection area at a lap splice. Refer to the Service Bulletin for the body station locations to be examined.

B. This procedure examines three different thicknesses of lower skins for cracks:

(1) 0.040 inch (1.00 mm) thick lower skins that are bonded to a 0.023 inch (0.58 mm) internal doubler. This inspection is for the possible crack in the 0.040 inch (1.00 mm) thick skin.

(2) 0.071 inch (1.80 mm) thick lower skins.

(3) 0.100 inch (2.54 mm) thick lower skins.

C. This inspection procedure uses a 10 MHz potted transducer that puts a 75 degree shear wave in aluminum. The inspection is done with the transducer on the external surface of the lower skin.

2. Equipment

NOTE: Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

A. All ultrasonic equipment that can do the calibration instructions of this procedure can be used.

(1) Instrument - It is necessary to use an ultrasonic instrument that can operate at 10 MHz. Broadband instruments can be used if they can do the calibration instructions of this procedure. The instruments specified below were used to help prepare this procedure:

(a) Sonic-136, 1200; Staveley Instruments, Inc.

(b) USD 15, 10; Krautkramer Branson

(c) USN 50, 52L; Krautkramer Branson

(2) Transducer - Use a potted transducer that can put a 10 MHz, 75-degree, shear wave in aluminum. The transducers specified below were used to help prepare this procedure.

(a) SU 1075AS; NDT Engineering Corp.

(b) 389-044-140, KBA; Krautkramer Branson

(3) Reference Standard - Reference Standard NDT3039, as specified in Figure 2, is available from Boeing. Ask the Service Engineering Group of Boeing for the reference standard.

(4) Couplant - All ultrasonic couplants that will not cause damage to the airplane structure can be used. A light grease works good.

3. Prepare for the Inspection

A. Refer to the Service Bulletin that identifies the Body Station locations for the inspection areas.

B. Clean the inspection surface. Remove paint only if it is loose.

4. Instrument Calibration

A. Calibrate the equipment to examine a lower skin that is 0.040 inch (1.0 mm) thick and is bonded to an internal doubler as follows:

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(1) Set the instrument frequency to 10 MHz.

(2) Apply a sufficient quantity of couplant on the section A inspection surface of reference standard NDT3039 at transducer positions 1 and 2. See Detail I in Figure 3.

(3) Put the transducer at position 1 on the inspection surface of the reference standard as shown in Detail I in Figure 3.

(4) Make sure the front of the transducer is against the edge of the sealant and that the sound beam points in the direction of the EDM notch.

(5) Adjust the instrument gain, delay and range controls as necessary to get a signal from the notch to show on the screen display.

(6) Move the transducer from side to side, along the surface to get a maximum signal from the notch. Keep the front of the transducer against the edge of the sealant at all times.

(7) Adjust the instrument gain to get the maximum notch signal to be between 50 and 80% of full screen height. See Detail II in Figure 3 for the screen display.

(8) Adjust the instrument delay and range controls to set the notch signal to 70% of full screen width with the initial pulse set to 0%. See Detail II in Figure 3 for the screen display.

(9) Move the transducer to position 2. See Detail I in Figure 3.

(10) Do Paragraph 4.A.(6) and, if necessary, Paragraph 4.A.(7) again. See Detail III in Figure 3 for the screen display.

(11) Monitor the screen width location of the notch signal on the screen display. It must be approximately 80% of full screen width. See Detail III in Figure 3.

(12) Increase the instrument gain 6 dB.

(13) Move the transducer to a fastener location and monitor the screen width location of the fastener hole signal on the screen display. It must be approximately 90% of full screen width. See Detail III in Figure 3.

B. Calibrate the equipment to examine a lower skin that is 0.071 inch (1.80 mm) thick.

(1) Do Paragraph 4.A.(2) thru Paragraph 4.A.(13) again, but use section B of the reference standard as shown in Detail I in Figure 3.

C. Calibrate the equipment to examine a lower skin that is 0.100 inch (2.54 mm) thick.

(1) Do Paragraph 4.A.(2) thru Paragraph 4.A.(13) again, but use section C of the reference standard as shown in Detail I in Figure 3.

5. Inspection Procedure

A. Refer to the Service Bulletin that identifies the Body Station location of the inspection areas.

B. Calibrate the instrument for the applicable skin thickness to be examined.

(1) Refer to Paragraph 4.A. for the 0.040 inch (1.0 mm) thick lower skin (that is bonded to the 0.023 inch (0.58 mm) internal doubler).

(2) Refer to Paragraph 4.B. for the 0.071 inch (1.80 mm) thick lower skin.

(3) Refer to Paragraph 4.C. for the 0.100 inch (2.54 mm) thick lower skin.

C. Put a sufficient quantity of couplant on the external surface of the lower skin, within the inspection area identified in the Service Bulletin.

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D. Put the transducer on the inspection surface with the front of the transducer against the sealant and pointed in the direction of the fasteners. See Figure 1 for the typical transducer positions which will be used to examine all the inspection area for cracks.

E. Make a scan of all the inspection areas identified in the Service Bulletin and monitor the instrument screen display. During the scan inspection, do the steps that follow:

(1) Move and turn the transducer a small amount (approximately 10 to 15 degrees) away from the original location to examine for off-angle cracks.

(2) Monitor the screen display for a signal from the fastener location that is approximately 90% of full screen width to make sure that there is a sufficient quantity of sound in the inspection area.

(3) Make a mark at the location(s) that cause signals to occur that are 50% (or more) of the signal height set in Paragraph 4.A.(7) and are between 65 to 85% of full screen width.

(4) Carefully monitor the direction and position of the transducer at all times to help identify the causes of the signals that can occur.

(5) Make sure that couplant does not collect between the transducer and the sealant. This can cause noise signals to occur on the screen display.

6. Inspection Results

A. Do an analysis of signals that are 50% or more of the height of the signal that was set in Paragraph 4.A.(7) and are also between 65 to 85% of full screen width as follows:

NOTE: The screen width locations specified above (65 to 85%) can be different if the width of the sealant fillet on the airplane is less than 0.200 inch (5 mm) wide.

(1) If the signal is 65 to 75% of full screen width, calibrate the instrument gain to that set in Paragraph 4.A.(7) with the transducer at position 1 on the reference standard. Do not add additional gain.

(2) If the signal is 75 to 85% of full screen width, calibrate the instrument gain to that set in Paragraph 4.A.(7) with the transducer at position 2 on the reference standard. Do not add additional gain.

(3) Signals that are 80% of full screen height (or higher) that occur for a length of 0.20 inch (5 mm) (or longer) are possible crack signals. Do the steps that follow to identify the length of an indication:

(a) Move and turn the transducer a small amount along the surface to get a maximum signal height from the indication.

(b) Make a mark on the surface at that location.

(c) Adjust the instrument gain to set the maximum signal height to 80% of full screen height.

(d) Move the transducer along the surface, away from the marked location, until the signal goes to 40% of full screen height.

(e) Make a mark on the surface; this identifies one end of the indication.

(f) Move the transducer in the opposite direction until the signal goes to 40% of full screen height again; this identifies the other end of the indication.

(g) Make a mark on the surface; this identifies the other end of the indication.

B. Do more analysis of the area that gives a possible crack signal as follows:

(1) Separate the lap splice skins and do a surface eddy current inspection on the outer surface of the lower skin, as specified in Part 6, 51-00-00, Procedure 4 or Part 6, 51-00-00, Procedure 23.

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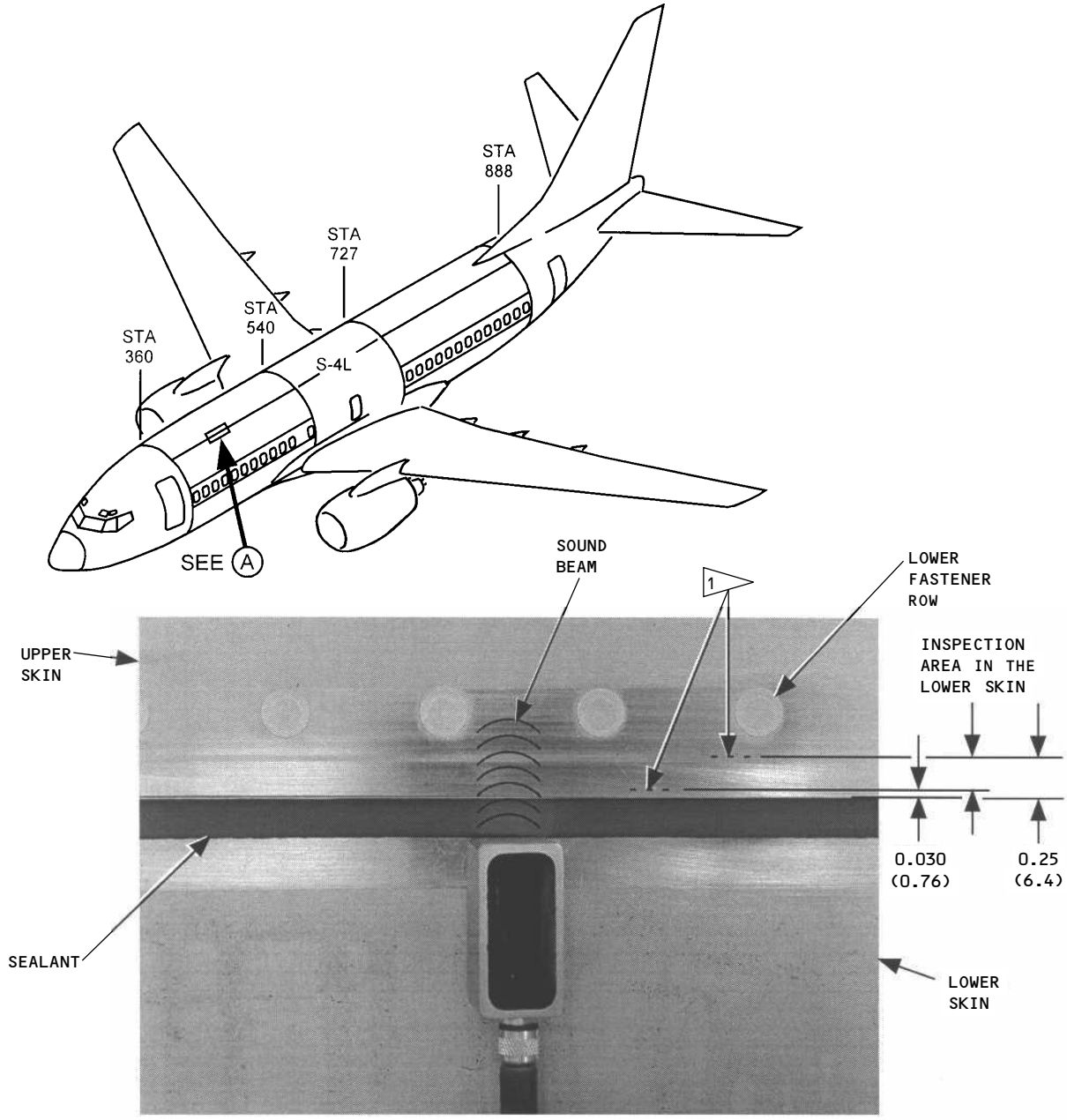

TRANSDUCER ON THE LOWER SKIN OF THE LAP SPLICE

A

NOTES:

- DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)

1 LOCATION AND DIRECTION OF POSSIBLE CRACKS IN THE LOWER SKIN

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Fuselage Skin Crack Inspection - Lower Skin at the Lap Splices
Figure 1

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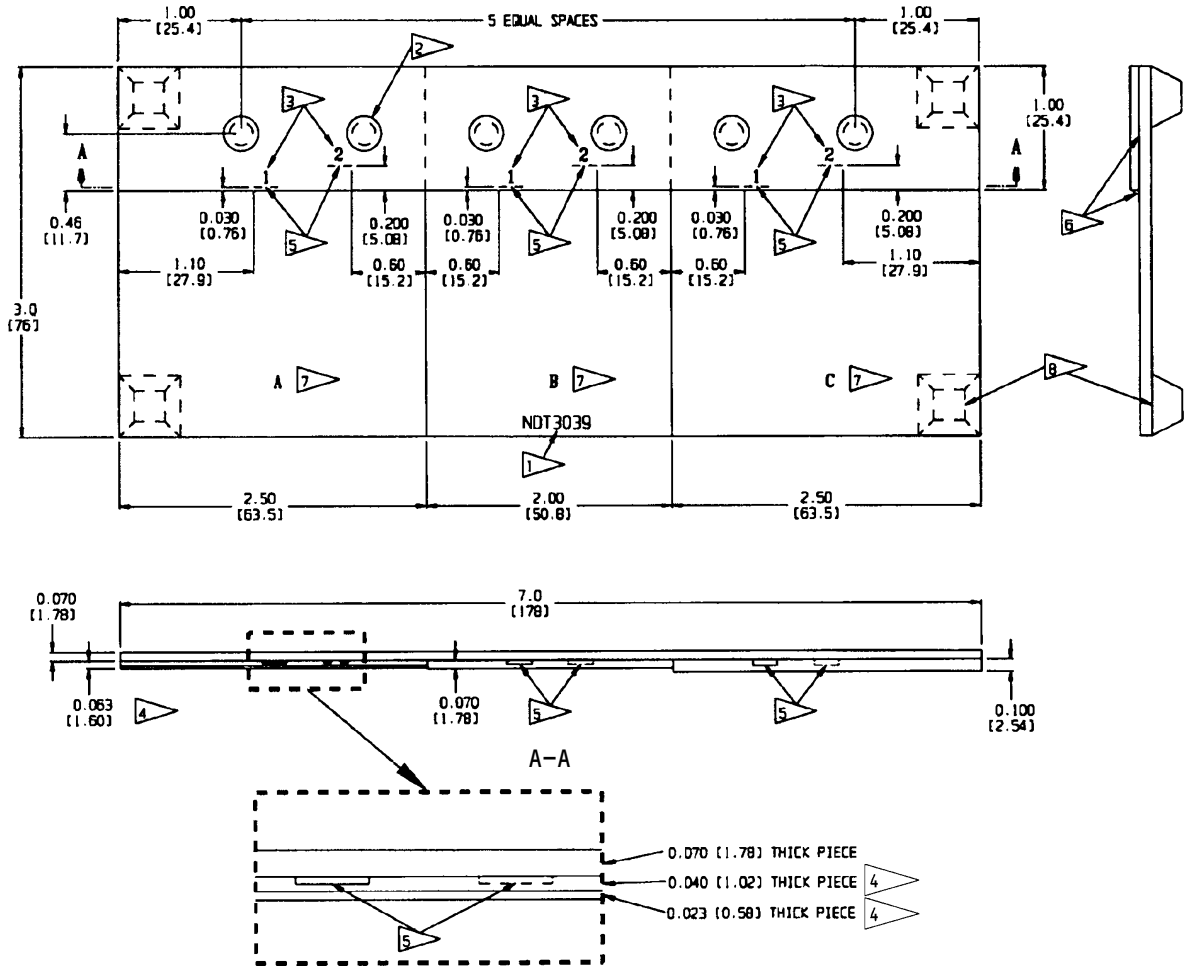

2158063 S0000471346_V1

Reference Standard NDT3039
Figure 2 (Sheet 1 of 2)

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NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCES (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: 2024-T3 OR T4 ALUMINUM (CLAD OR BARE)
- APPLY A 0.0005 TO 0.0010 (0.013 TO 0.025) LAYER OF PRIMER ON EACH SIDE OF THE REFERENCE STANDARD AND APPLY ENAMEL (0.002 TO 0.003 (0.051 TO 0.076) THICK) ON THE TOP SURFACE ONLY, AFTER THE SEALANT IS FULLY CURED.

1 ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT3039.

2 BACR15GF6D6 (6 LOCATIONS)
MAKE SURE THE 0.040 INCH (1.02 MM) THICK PIECE AND THE 0.023 INCH (0.58 MM) THICK PIECES ARE BONDED TOGETHER BEFORE THE FASTENER HOLES ARE DRILLED.

3 ETCH OR SCRIBE THE NUMBER ON THE SURFACE OF THE TOP PIECE TO IDENTIFY THE LOCATION OF THE EDM NOTCH AND THE TRANSDUCER POSITION FOR THE INSTRUMENT CALIBRATION.

4 BOND A 0.040 INCH (1.02 MM) THICK PIECE TO A 0.023 INCH (0.58 MM) THICK PIECE AS SPECIFIED IN BAC 5514-5101 TO MAKE THE 0.063 INCH (1.60 MM) THICK PIECE.

5 EDM NOTCH:
LENGTH: 0.200 (5.08) ±0.010 (0.25)
DEPTH: 50% THROUGH THE THICKNESS
WIDTH: 0.007 (0.18) ±0.002 (0.05)

6 APPLY FAY SURFACE SEALANT, BMS 5-95, CLASS B BETWEEN THE TOP AND BOTTOM PIECES AS SPECIFIED IN BAC 5000. MAKE THE SQUEEZED OUT SEALANT INTO A CONTINUOUS FILLET OF 0.20 INCH (5 MM) TO 0.25 INCH (6.4 MM) WIDE ALONG THE EDGE OF THE TOP PIECE.

7 ETCH OR STEEL STAMP THE LETTER SHOWN TO IDENTIFY THE SECTION OF THE REFERENCE STANDARD TO USE FOR THE INSTRUMENT CALIBRATION.

8 BOND RUBBER FEET AT FOUR LOCATIONS.

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Reference Standard NDT3039
Figure 2 (Sheet 2 of 2)

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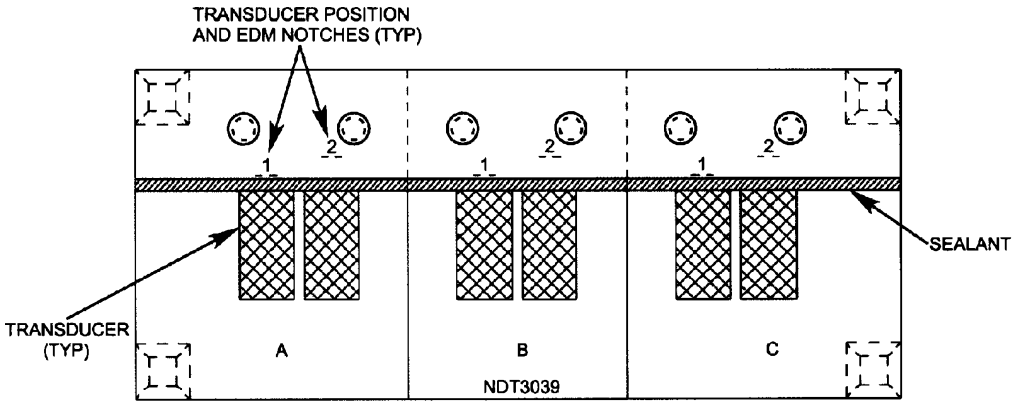
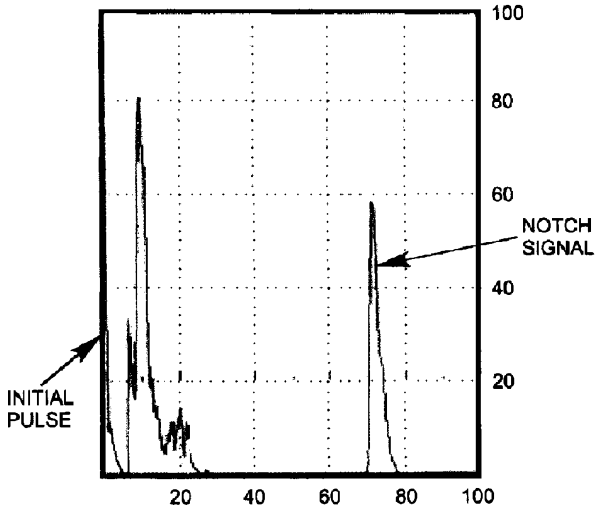
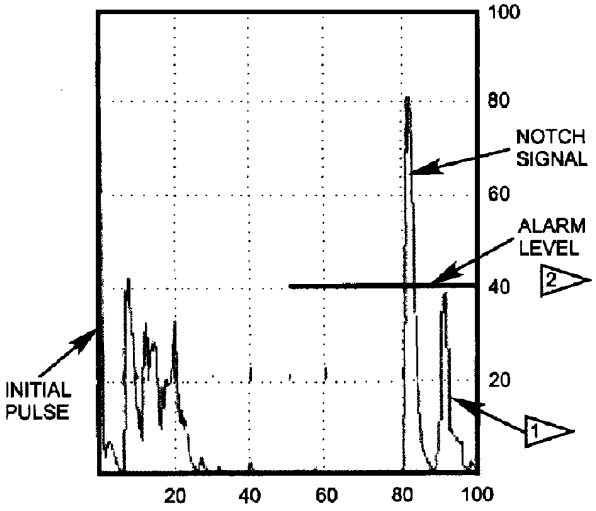


TRANSDUCER POSITIONS ON
THE REFERENCE STANDARD
DETAIL I



SCREEN DISPLAY OF THE NOTCH SIGNAL
WITH THE TRANSDUCER AT POSITION 1
DETAIL II



SCREEN DISPLAY OF THE NOTCH SIGNAL
WITH THE TRANSDUCER AT POSITION 2
DETAIL III

NOTES:

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

1 SIGNAL FROM THE FASTENER LOCATION. THIS SIGNAL DOES NOT OCCUR ON THE SCREEN DISPLAY AT THE SAME TIME AS THE NOTCH SIGNAL. THIS FASTENER SIGNAL WAS ADDED TO DETAIL III TO SHOW THE APPROXIMATE SCREEN WIDTH LOCATION.

2 THE ALARM LEVEL SHOWN IN DETAIL III IS SET TO 50% OF THE NOTCH SIGNAL.

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Instrument Calibration
Figure 3

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FUSELAGE SKIN SCRIBE LINE 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 Paragraph 4.

(2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

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.

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(2) XAB-6087; Xactex Corp.

(3) TEK-5000; Techna NDT

D. Reference Standard – Use the applicable reference standard NDT1086-XXX (see Figure 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 Figure 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. Prepare for the 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.

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. Table 1 that follows identifies:

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(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.

Table 1: Calibration Table

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 *[1]	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)

*[1] 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 Table 1 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 Detail I in Figure 4, for calibration on reference standards NDT1086-032 and NDT1086-040. See Detail I in Figure 5, for calibration on reference standards NDT1086-050 thru NDT1086-120.

F. Put the transducer on the inspection surface of the reference standard at the notch location identified as “A”. See Figure 4 or Detail I in Figure 5.

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.

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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 Detail II in Figure 5.

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 Detail II in Figure 4.

(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 Detail II in Figure 5.

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 Detail III in Figure 5.

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 Detail IV in Figure 5.

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.

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 Detail IV in Figure 5.

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

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 Paragraph 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 Paragraph 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.

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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.

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 a medium frequency eddy current (MFEC) 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. If a crack indication does not occur during this inspection, the possible crack signal is not caused by a crack and no more inspection is necessary.

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 Paragraph 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.

(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 Paragraph 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.

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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 all of 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 (HFEC) inspection as specified in Part 6, 51-00-00, Procedure 4 or Part 6, 51-00-00, Procedure 23, at the location of the crack indication.

1) You must calibrate the HFEC instrument on a reference standard that has a 0.008 to 0.010 inch (0.20 to 0.25 mm) deep notch. Calibrate with one of the reference standards (or an equivalent) that follow:

a) DAC GSET AL.01; Boeing NDT Standard Practices Manual (TP-MDC-93K0393)

b) SRS-0824A; Olympus NDT (NDT Engineering)

c) VMA 3RS-1.0; VM Products, Inc.

d) RS0824-2024T3; Techna NDT

2) If a crack indication does not occur during this HFEC inspection, the signal is not caused by a crack and no more inspection is necessary. If a crack indication does occur during this HFEC inspection, the indication must be thought to be from a crack or a conductivity change.

3) To help identify if an indication is from a crack or from a conductivity change, compare the horizontal width of the signals that occur on the instrument screen display when you move the probe across the possible crack in the inspection area and the simulated crack of the reference standard. Make sure you move the probe in a direction that is 90 degrees to the direction of the possible and simulated cracks.

a) If the signal is from a crack, the width of the signal from the inspection area will be almost the same as the width of the notch signal from the reference standard.

b) If the width of the signal from the inspection area is wider than the width of the notch signal from the reference standard, the signal is not a crack indication.

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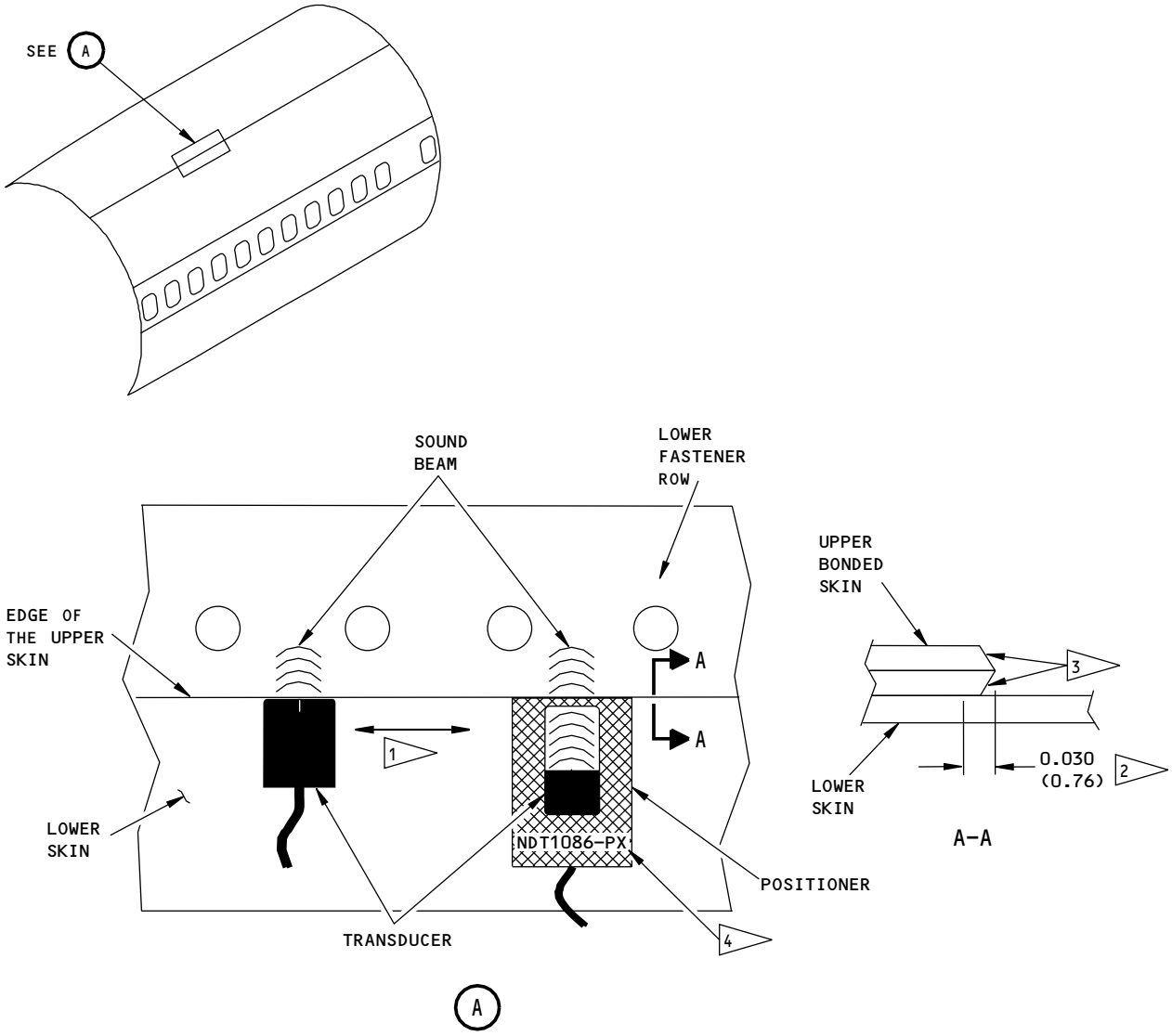

NOTES:

- 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

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Inspection Areas
Figure 1

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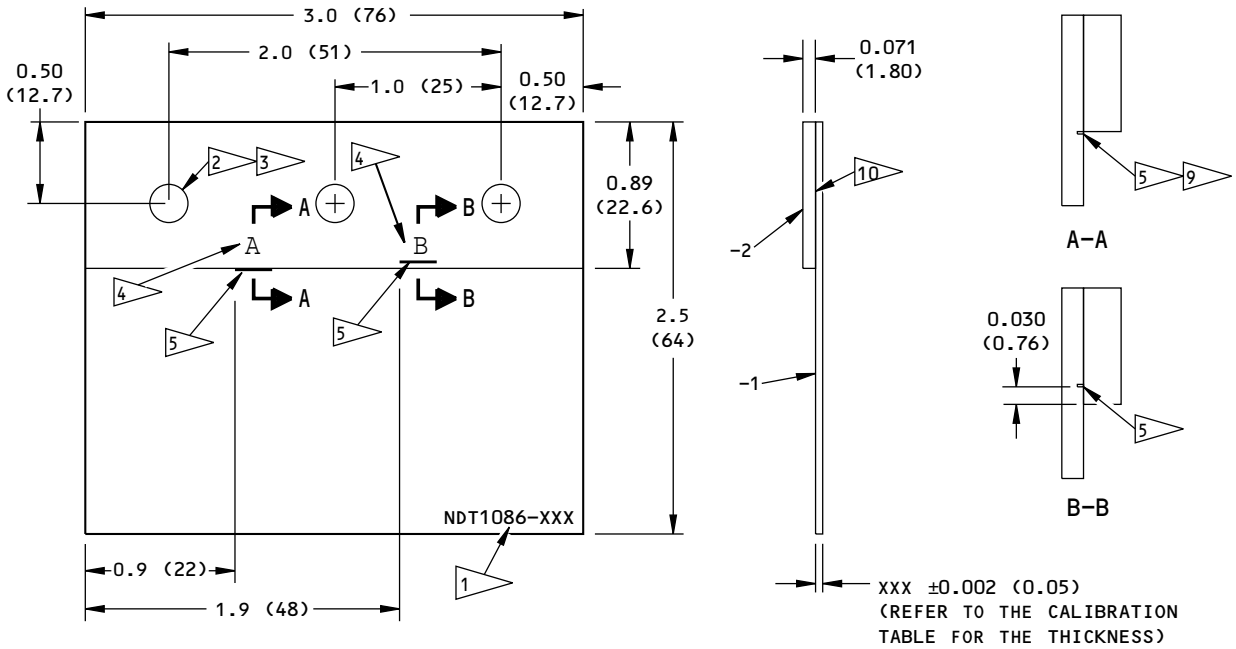

NOTES:

- 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.

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Reference Standard NDT1086-XXX
Figure 2

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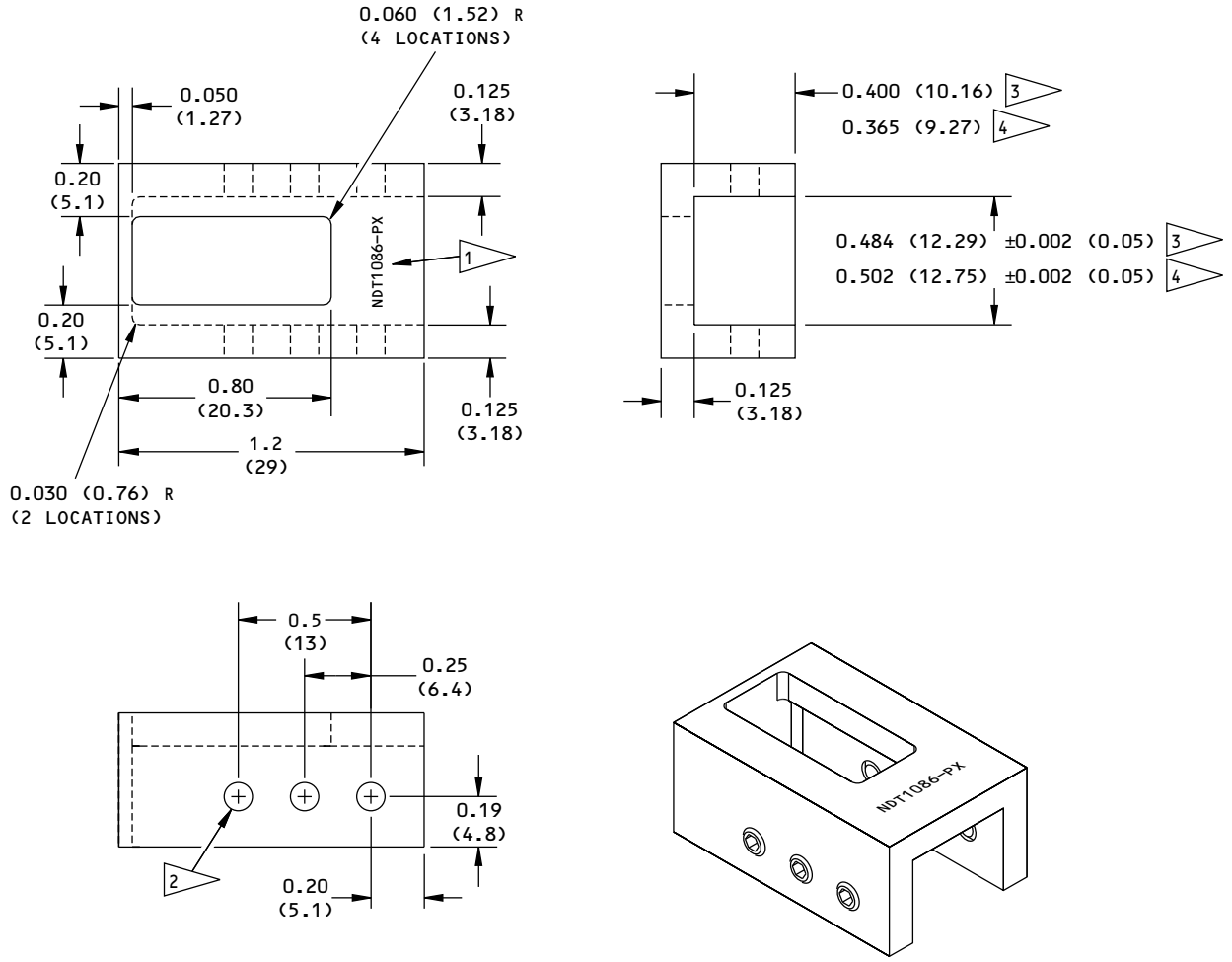

NOTES:

- 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

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Transducer Positioner NDT1086-P1 and-P2
Figure 3

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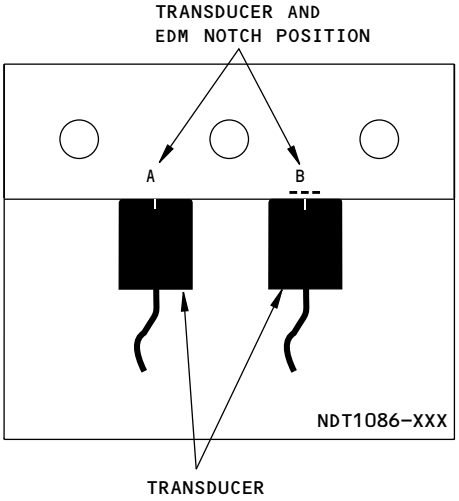
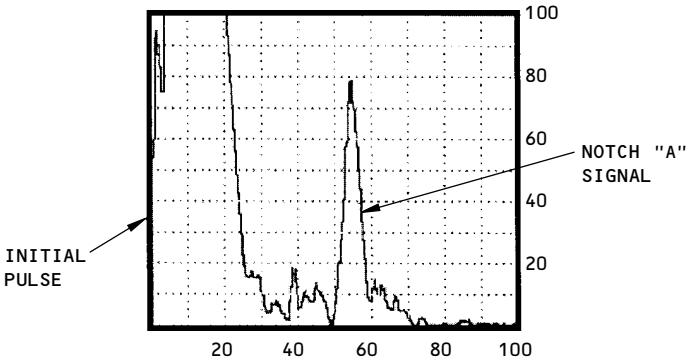
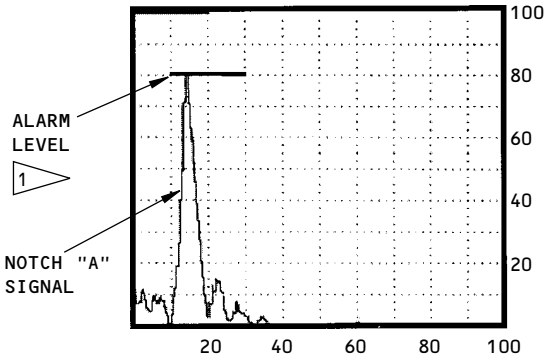


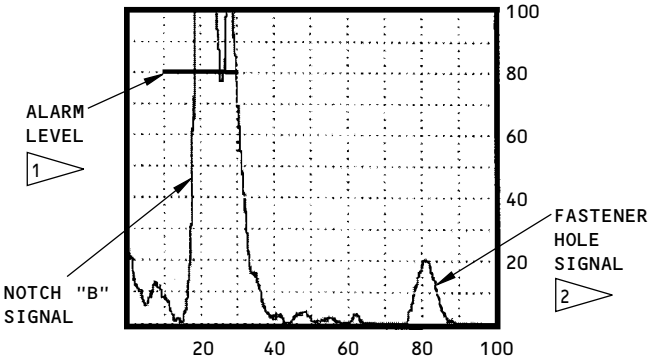
TRANSDUCER POSITIONS ON REFERENCE STANDARDS NDT1086-032 AND -040
DETAIL I



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.

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

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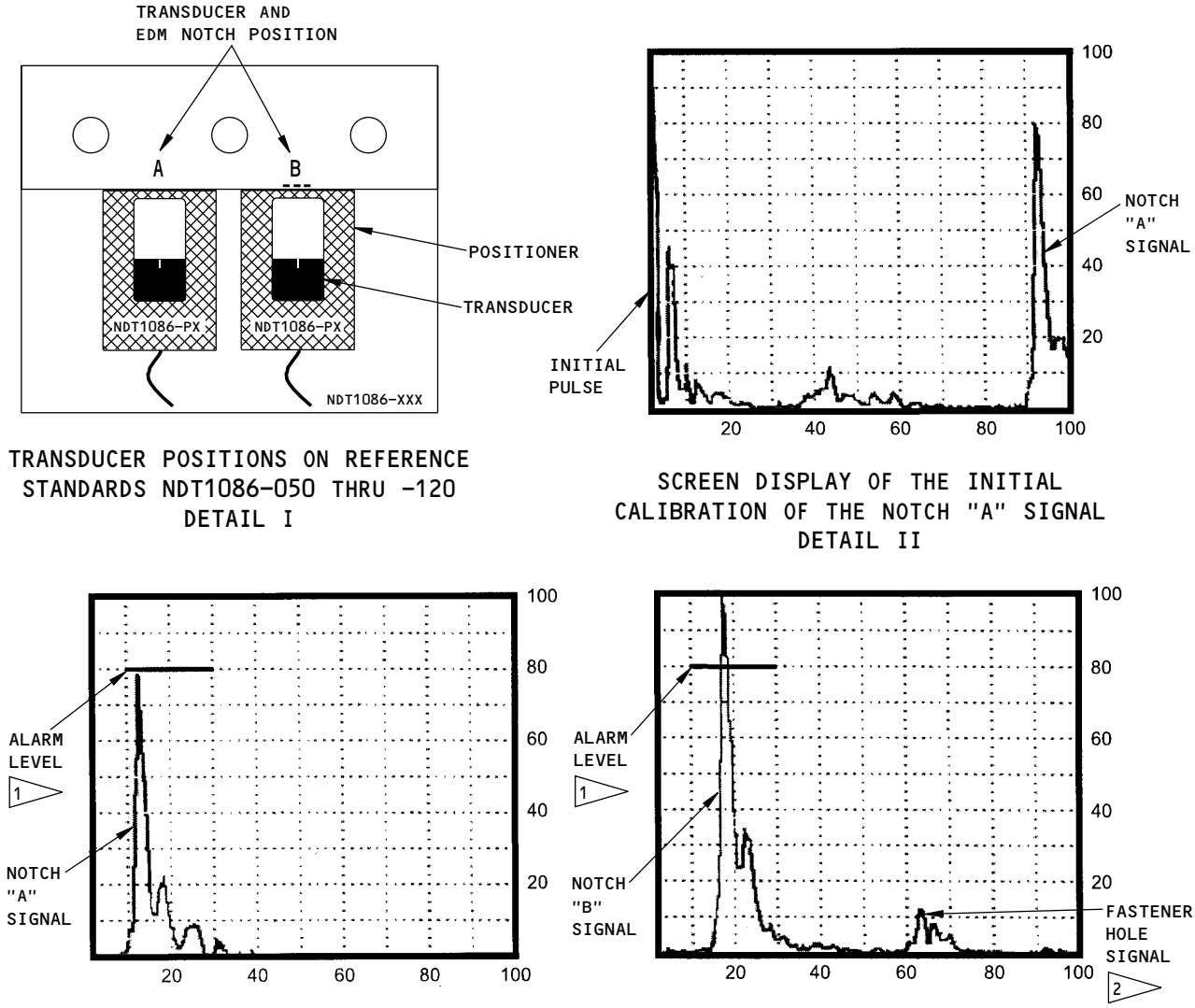

NOTES:

- 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.

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

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FUSELAGE SKIN SCRIBE LINE 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 Figure 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 1.02 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 Paragraph 4.

(2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

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:

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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.

(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 Figure 2 for a drawing of the reference standard. The XXX in the reference standard number is the reference standard thickness. Table 1 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 Paragraph 5.I. To do Paragraph 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. Prepare for the Inspection

A. Identify the inspection area.

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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 IT IS 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.

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 Paragraph 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.

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 Table 1 to identify the applicable reference standard to use for the different airplane skin thicknesses.

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Table 1: Calibration Data

Reference Standard	Skin Thickness Range (Nominal)	Wedge
		(a) RD Tech (b) GE
NDT1094-040, NDT1094-040-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

4. Instrument Calibration

NOTE: The instrument calibration instructions identified in Paragraph 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 Paragraph 2.C.(2).

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

NOTE: Make sure that your instrument has the software version identified in Paragraph 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 Paragraph 5.I. for special inspection instructions. See Detail I in Figure 6.

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.

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(2) Attach the applicable wedge to the probe for the skin thicknesses to be examined. See 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 Paragraph 4.A.(7)(a) thru Paragraph 4.A.(7)(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).

(b) If a setup file for this procedure has not been stored:

1) Go to the NDT manual in MyBoeingFleet and download the applicable setup file.

NOTE: The setup files in the NDT manual can only be used with the automated module (16:16 or 16:128). If the manual module (16:16 or 16:64) is used, it will be necessary to create a setup file as specified in Paragraph 4.A.(8).

2) If you do not download the setup file from the NDT manual, select File > File (F2) > Open (F8) or (keypad 4) and select Sample Listed Files (F3). Refer to Table 2 to identify the applicable setup file for the module used. Open the applicable default setup file and do Paragraph 4.A.(8)(a) thru Paragraph 4.A.(8)(h) to create a setup file.

Table 2: Default Setup Files

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

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

NOTE: The instructions in Paragraph 4.A.(7) and Paragraph 4.A.(8) identify the menu listed in the Main menu (blue button), followed by the submenu (buttons F2 thru F6), followed by the option (buttons F7 thru F12), and then followed by the parameters.

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.

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(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)

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 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 Paragraph 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.

<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

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<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)

<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.

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 Paragraph 4.A.(7)(b)1)j)<1><a> thru Paragraph 4.A.(7)(b)1)j)<1><i> 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

<d> Next (F8)

<e> Velocity (F9) > SW

<f> Press Next (F8) two times

<g> Set Beam Angle

- Min. Angle (F9) > 45 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 25 (when the SA00-N45S wedge is used).
- Max. Angle (F10) > 80 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 70 (when the SA00-N45S wedge is used).
- Focus Depth (F12) > 10.00

<h> Next (F8)

<i> Generate (F8)

<j> If the correct probe number is shown, go to Paragraph 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:

- Exit out of the Wizard (Reject button)
- Probe/Part > Select (F2) > Select (F9) > Defines
- Auto Detect (F12) > Off
- Select Probe (F10) > scroll through the list, select “10L16” or

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"10L16E5-5" and accept it (press Close).

- Select (F9) > Select Tx/Rx
- Do a check of the Select Probe (F10) option to make sure the correct probe number has been selected.

<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:

- Select (F9) > Defines
- Define Probe (F10) > New > Serial Number (F8) > enter in "10L16" or "10L16E5-5"
- Save (F6), automatically goes to Edit (F4) menu
- Freq (F7) > 10
- Probe Type (F9) > Angle Beam
- Element Qty. (F10) > 16
- Pitch (F11) > 0.30
- Save (F6)
- Close (Main Menu)
- Probe/Part > Select (F2) > Select (F9) > Select Tx/Rx
- 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 Paragraph 4.A.(7)(b)1)j)<1><c> thru Paragraph 4.A.(7)(b)1)j)<1><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)

(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

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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
   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.

(g) Reading menu

1) Result (F2)
   a) Field 1 (F8) > A%

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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 Paragraph 4.A.(8)(b)1)h).

<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:

- Auto Detect (F11) > Off
- 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.
- Do a check of the Probe (F10) option to make sure the correct probe number has been selected, press Next (F8) and go to Paragraph 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:

- Auto Detect (F11) > Off
- Select (F9) > Defines
- Define Probe (F10) > New (F3) > Serial Number (F8) > enter in “10L16-A00” or “10L16E5-5”

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- Save (F6), automatically goes to Edit (F4) menu
- Freq (F7) > 10
- Probe Type (F9) > Angle Beam
- Element Qty. (F10) > 16
- Pitch (F11) > 0.30
- Save (F6)
- Select and Close (F7)
- Select (F9) > Select Tx/Rx
- Do a check of the Probe (F10) option to make sure the correct probe number has been selected.
- Next (F8)

h) Wedge (F10) > Refer to Table 1 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 Paragraph 4.A.(8)(b)1)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: 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)

i) Select Continue Law Wizard (F9). This will let parameters be entered for the Focal Law menu.

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<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

(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

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i) Gate (F7) > I

j) Start (F9) > 0.0

k) Width (F10) > 1.20 ± 0.01

l) Threshold (F11) > 10

2) Sizing Curves (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.

(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 Paragraph 4.C.

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.

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(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 first element shown is 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)
   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 µs
   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).

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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

(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

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%

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(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)

<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 µs.

<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 Paragraph 4.B.(5)(i)2)a) and Paragraph 4.B.(5)(i)2)b) again, but use a POINT POS. of 20.0 µs 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 dBD (digital gain) in the gain window.

1) Set the gain value to 10.0 dBD.

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

(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.

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C. Use the reference standard identified in Table 1 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.

(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 Detail I in Figure 3.

(2) Put the probe at notch location “A” on the reference standard. See Detail I in Figure 3.

(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.

(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 Detail II in Figure 3. 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 Detail II in Figure 3.

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 Paragraph 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 Paragraph 4.D.(7)(a) thru Paragraph 4.D.(7)(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 Detail I in Figure 3.

(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 Paragraph 4.D.(7) again to identify the locations of the image to get a PA measurement of 0.75 ± 0.20 mm. See Detail III in Figure 3.

(11) Put the probe at notch “C” on the reference standard and maximize the signal on the sector scan display. See Detail IV in Figure 3.

(12) Set the beam cursor on the notch image.

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(13) If the signal is less than 95% of FSH, then adjust the signal height and make a note of the additional gain. Do Paragraph 4.D.(7) again to identify the locations of the image to get a PA measurement of -1.60 ± 0.20 mm. See Detail V in Figure 3.

(14) If additional gain was added in Paragraph 4.D.(10) or Paragraph 4.D.(13), record this gain setting and use it as the calibration gain level. If no gain was added, use the gain level recorded in Paragraph 4.D.(5).

E. Move the probe to a fastener location (see Detail IV in Figure 3) and do the steps that follow:

(1) Add sufficient gain to the calibration gain level set in Paragraph 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 Detail VI in Figure 3. The fastener position can change a small quantity for different skin thicknesses.

(3) Remove the gain added in Paragraph 4.E.(1) and set the gain level to the value recorded in Paragraph 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 Paragraph 5.I. for special inspection instructions. See Detail I in Figure 6.

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

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

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 Paragraph 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 Paragraph 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

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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 Figure 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 Paragraph 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 Figure 1 for the typical probe position.

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 Paragraph 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 Paragraph 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 Detail I in Figure 6.

(1) Adjust the instrument as specified in Paragraph 4.A. or Paragraph 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 Detail I in Figure 6.

(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 Paragraph 4.A.(7)(d)2)c).

(b) To LEG equal to 5 for the Phasor XS. See Paragraph 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.

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(a) For the Omniscan, see Paragraph 4.A.(7)(f)1)e) thru Paragraph 4.A.(7)(f)1)i) for instructions to change the gate.

(b) For the Phasor XS, see Paragraph 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 Paragraph 5.I.(2)), away from EDM notch D. See Detail II in Figure 6.

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

(7) Do Paragraph 4.D.(1) thru Paragraph 4.D.(7), but only use notch D to calibrate the instrument at a distance X from the EDM notch.

(8) Do Paragraph 5.D. to add the necessary gain.

(9) Put the transducer on the airplane surface behind the button head fasteners. See Detail III in Figure 6.

(10) Do Paragraph 5.H. to do the inspection, but make the scan with the probe at distance X away from the edge as shown in Detail I in Figure 6.

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 Paragraph 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 Paragraph 4.D.(14).

(b) If the inspection area is painted, make sure you add the additional gain specified in Paragraph 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.

(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).

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(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 Paragraph 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 Paragraph 4.D.(3) thru Paragraph 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 Paragraph 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.

(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 medium frequency eddy current (MFEC)(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 Paragraph 1.E.(4)). But, the MFEC 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. If a crack indication does not occur during this inspection, the possible crack signal is not caused by a crack and no more inspection is necessary.

2) If you cannot put the eddy current probe on the lower skin at the correct location to do the MFEC inspection identified in Paragraph 6.A.(4)(c)1), or if the lower skin thickness is more than 0.040 inch (1.02 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.

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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 all of the sealant from the outer surface of the inner skin at the location of the crack indication.

c) 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 Paragraph 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 Figure 5).

<b> Put the probe at probe position 1 (see Figure 5).

<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 Figure 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.

d) If there continues to be an ultrasonic indication, do a high frequency eddy current inspection as specified in Part 6, 51-00-00, Procedure 4 or Part 6, 51-00-00, Procedure 23 at the location of the crack indication.

<1> You must calibrate the HFEC instrument on a reference standard that has a 0.008 to 0.010 inch (0.20 to 0.25 mm) deep notch. Calibrate with one of the reference standards (or an equivalent) that follow:

<a> DAC GSET AL.01; Boeing NDT Standard Practices Manual (TP-MDC-93K0393)

<b> SRS-0824A; Olympus NDT (NDT Engineering)

<c> VMA 3RS-1.0; VM Products, Inc.

<d> RS0824-2024T3; Techna NDT

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<2> If a crack indication does not occur during this HFEC inspection, the signal is not caused by a crack and no more inspection is necessary. If a crack indication does occur during this HFEC inspection, the indication must be thought to be from a crack or a conductivity change.

<3> To help identify if an indication is from a crack or from a conductivity change, compare the horizontal width of the signals that occur on the instrument screen display when you move the probe across the possible crack in the inspection area and the simulated crack of the reference standard. Make sure you move the probe in a direction that is 90 degrees to the direction of the possible and simulated cracks.

<a> If the signal is from a crack, the width of the signal from the inspection area will be almost the same as the width of the notch signal from the reference standard.

<b> If the width of the signal from the inspection area is wider than the width of the notch signal from the reference standard, the signal is not a crack indication.

B. If an indication is found with one or each of the eddy current inspection procedures specified in Paragraph 6.A. of this procedure, the indication must be thought to be from a crack. If the eddy current procedures specified in Paragraph 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 Paragraph 6.D.

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 in Paragraph 4. and follow the steps in Paragraph 5. and Paragraph 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 Paragraph 6.A.(4)(c)2)b).

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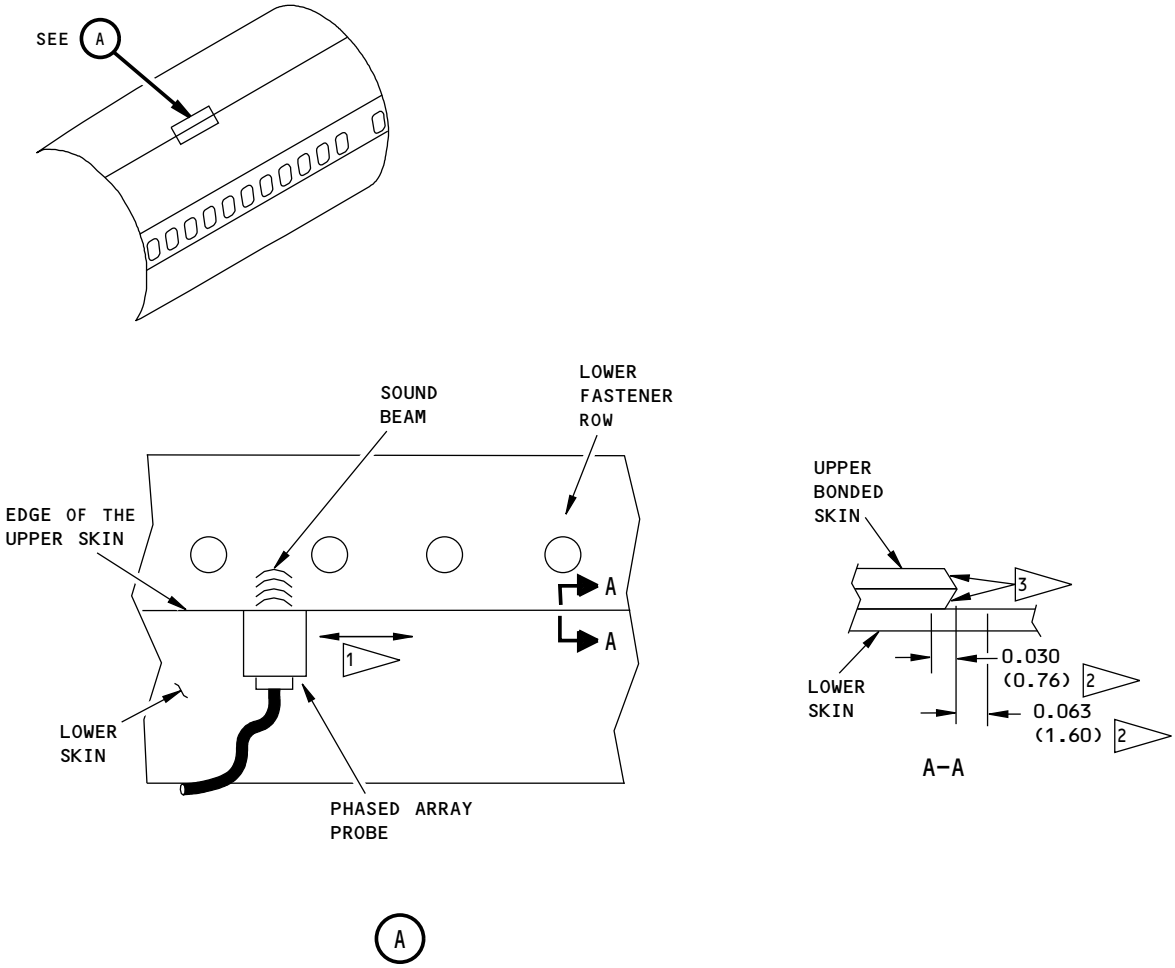

NOTES:

- 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

2129795 S0000458961_V1

Inspection Areas
Figure 1

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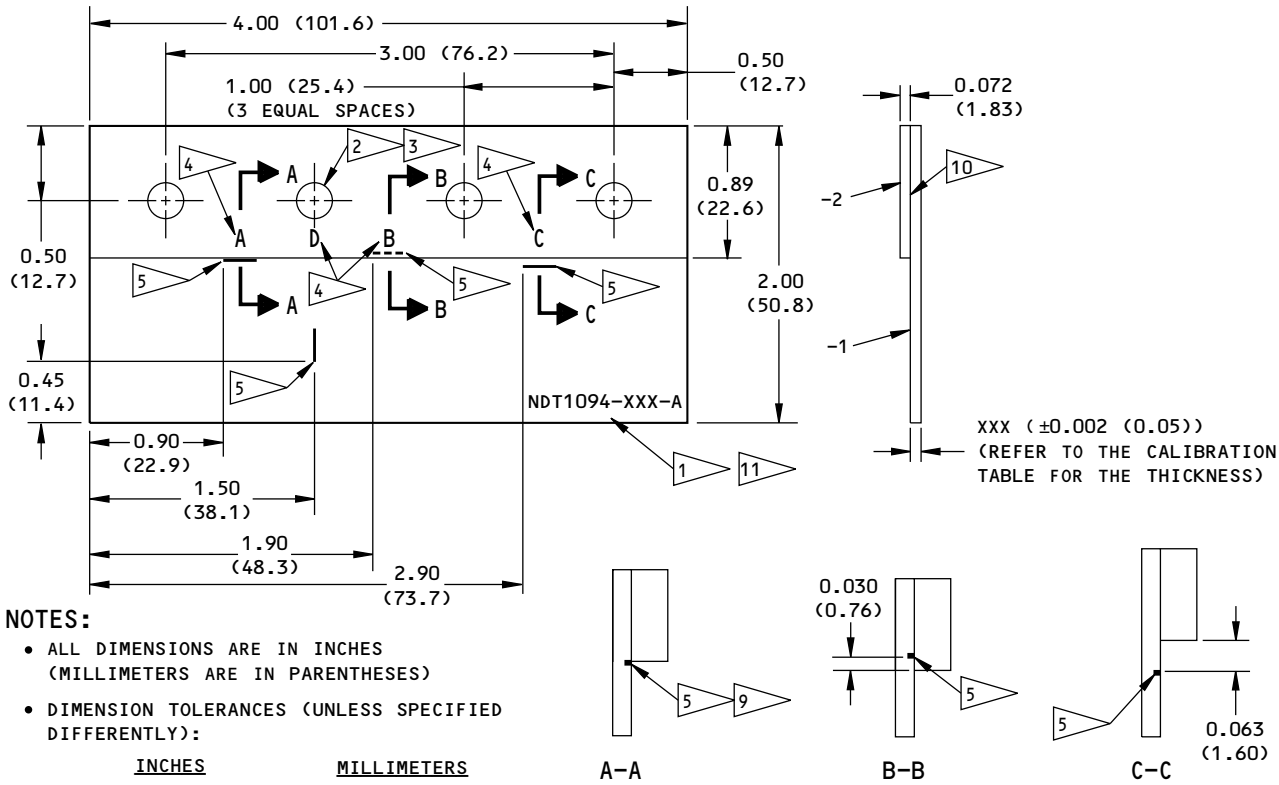

NOTES:

- 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.

1 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.

2 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)

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 NDT1094-040-A

7 0.015 (0.38) ±0.002 (0.05) IN NDT1094-050-A

8 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

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 SOPM 20-50-19. MAKE SURE THE SEALANT DOES NOT EXTEND BEYOND THE FAYING SURFACE.

11 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.

2129799 S0000458962_V1

Reference Standard NDT1094-XXX-A
Figure 2

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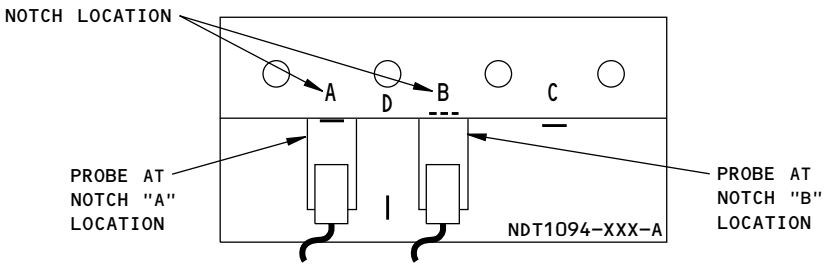
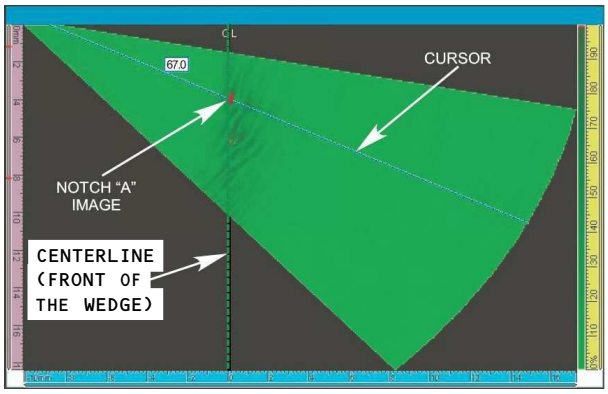
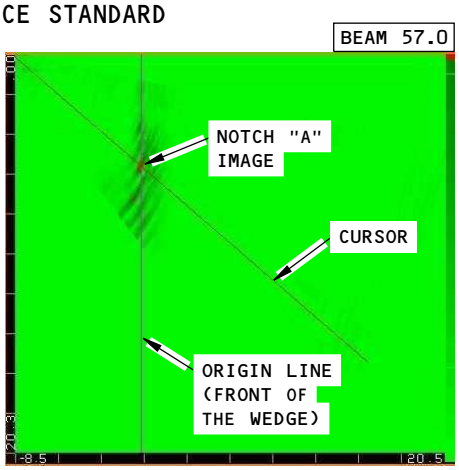


PROBE POSITION ON THE REFERENCE STANDARD
DETAIL I

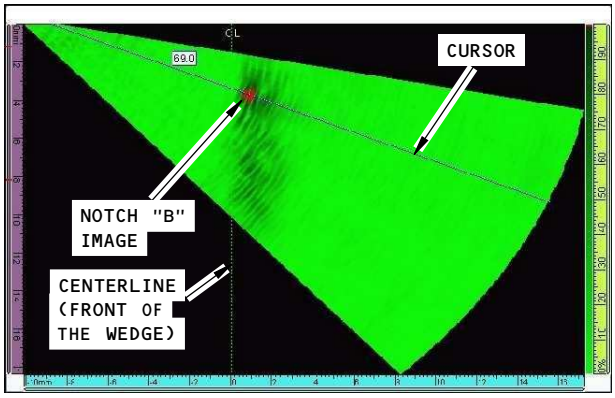


OMNISCAN MX SCREEN DISPLAY

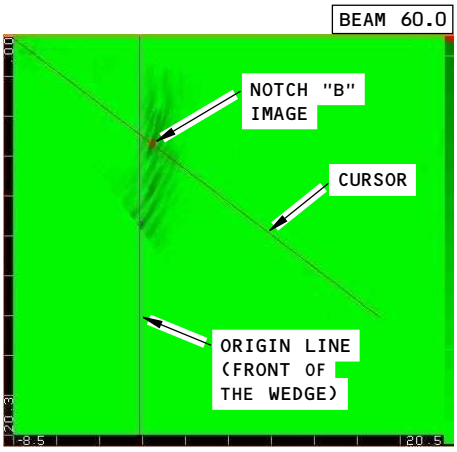


PHASOR XS SCREEN DISPLAY

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.

2129800 S0000458963_V1

Instrument Calibration
Figure 3 (Sheet 1 of 2)

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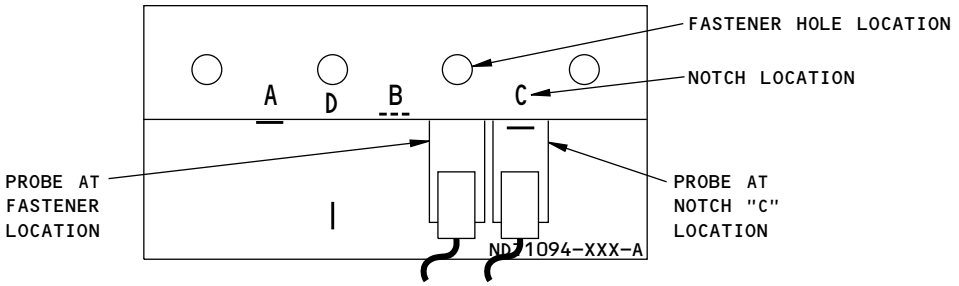
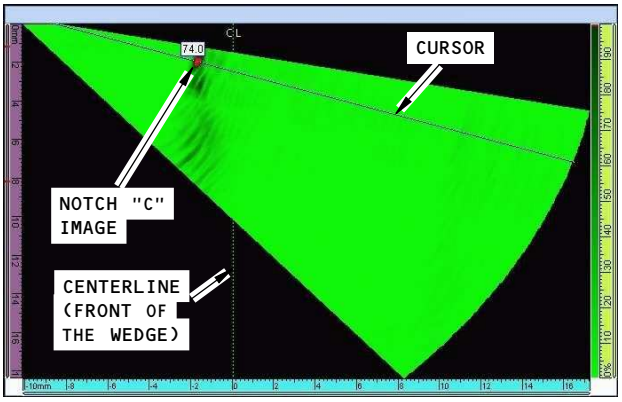
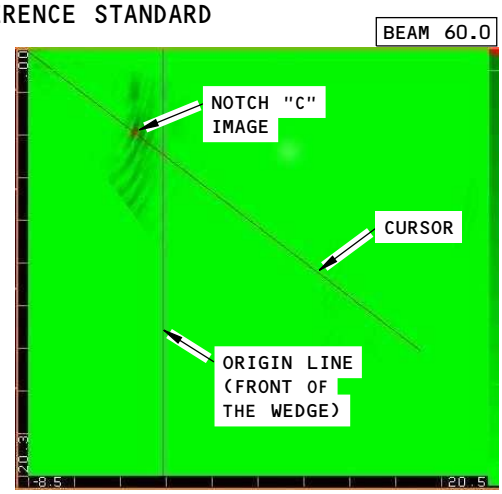


PROBE POSITION ON THE REFERENCE STANDARD
DETAIL IV

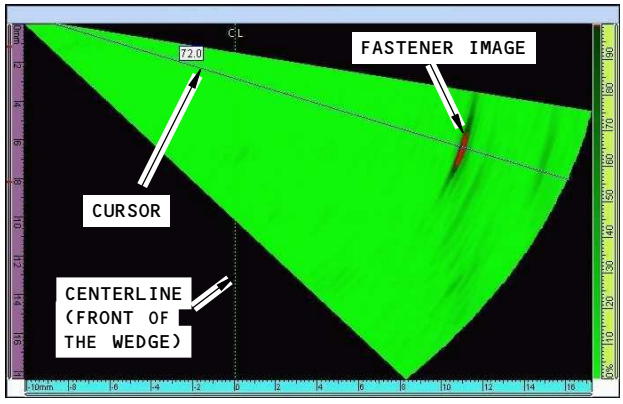


OMNISCAN MX SCREEN DISPLAY

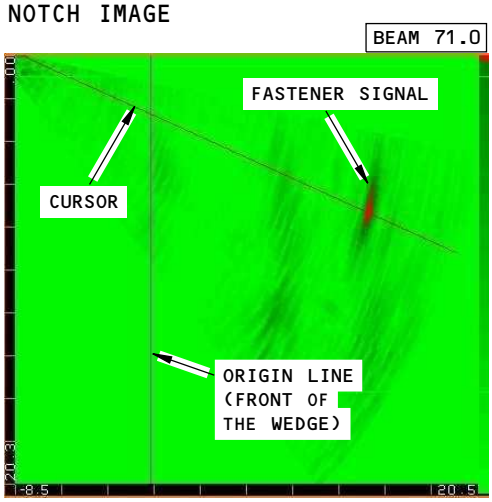


PHASOR XS SCREEN DISPLAY

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.

2129803 S0000458964_V1

Instrument Calibration
Figure 3 (Sheet 2 of 2)

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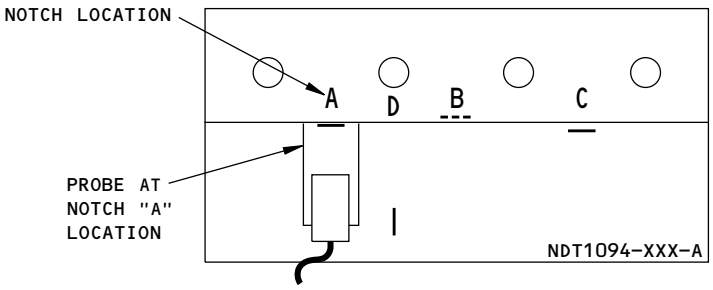
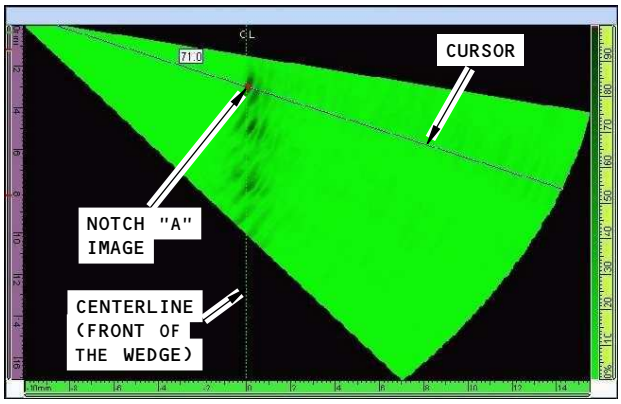
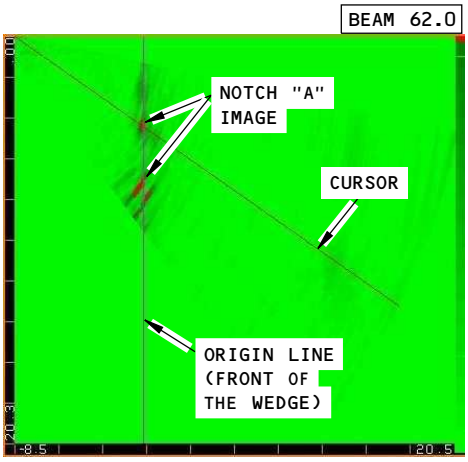


PROBE POSITION ON THE REFERENCE STANDARD
DETAIL I

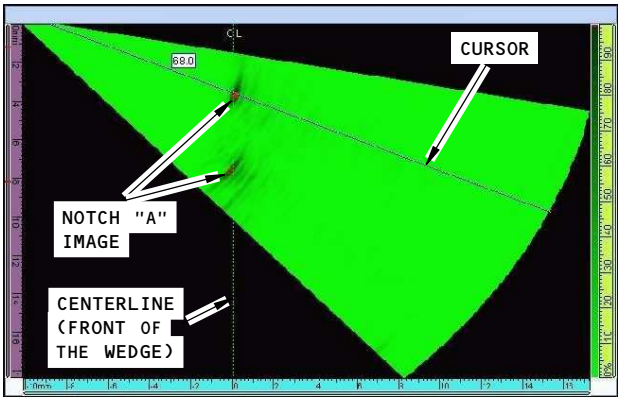


OMNISCAN MX SCREEN DISPLAY

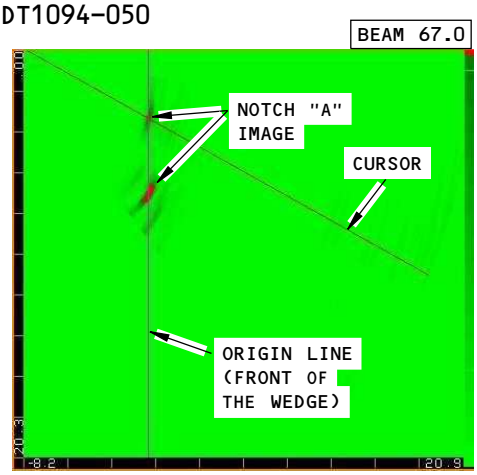


PHASOR XS SCREEN DISPLAY

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

2129805 S0000458965_V1

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 1 of 5)

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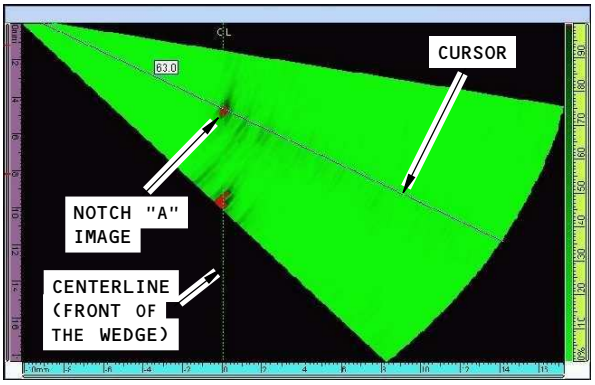
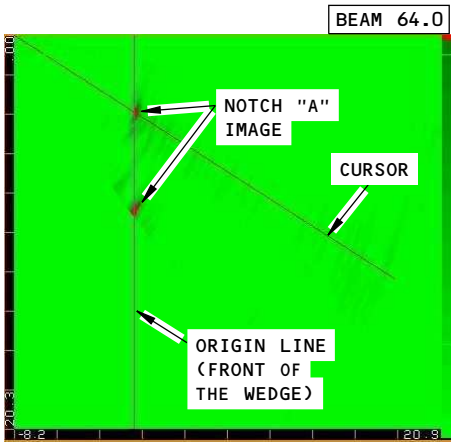
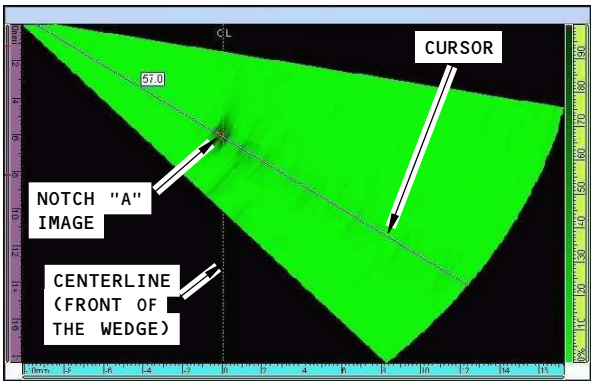


OMNISCAN MX SCREEN DISPLAY

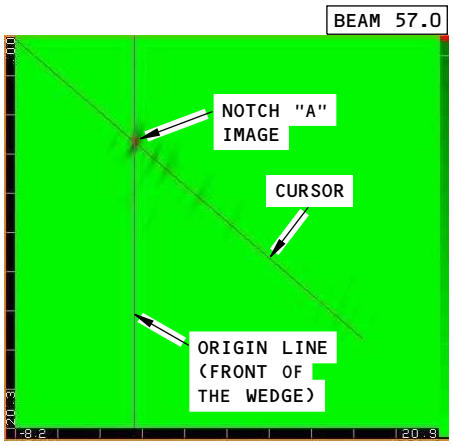


PHASOR XS SCREEN DISPLAY

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

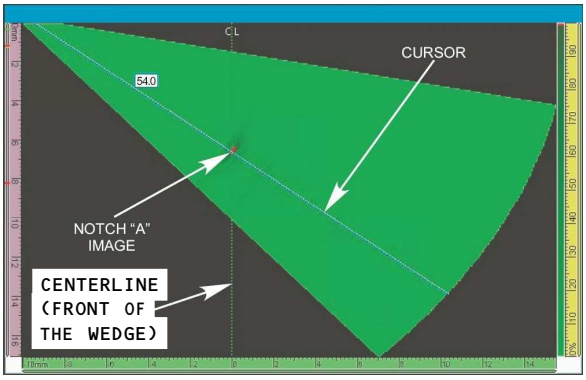


OMNISCAN MX SCREEN DISPLAY

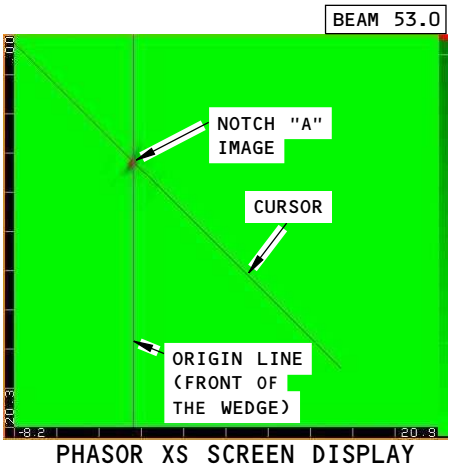


PHASOR XS SCREEN DISPLAY

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

2129806 S0000458966_V1

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 2 of 5)

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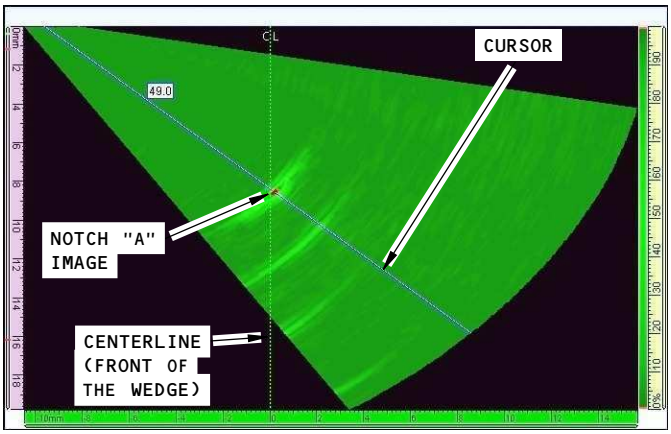
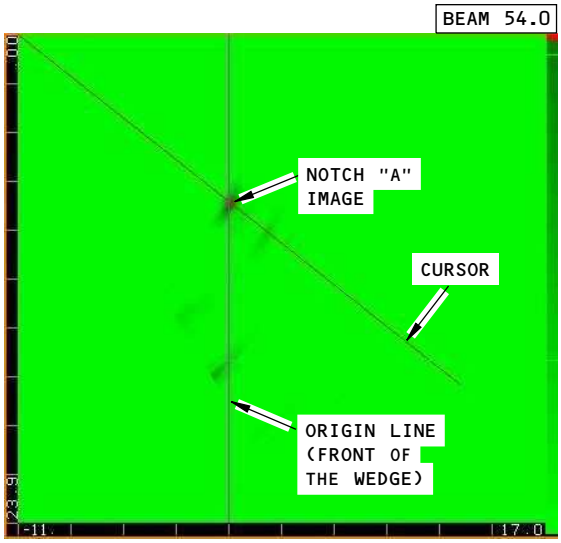
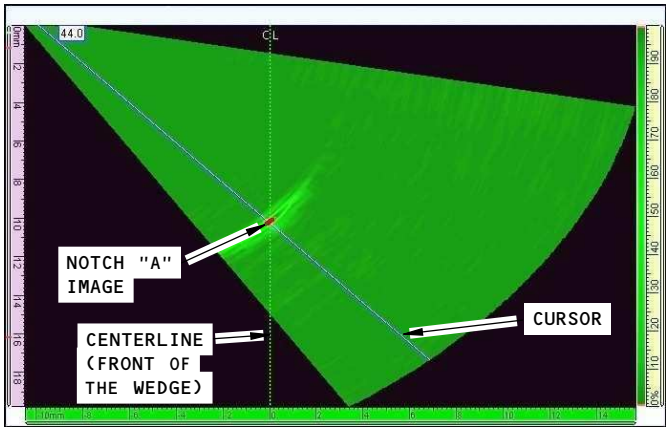


OMNISCAN MX SCREEN DISPLAY

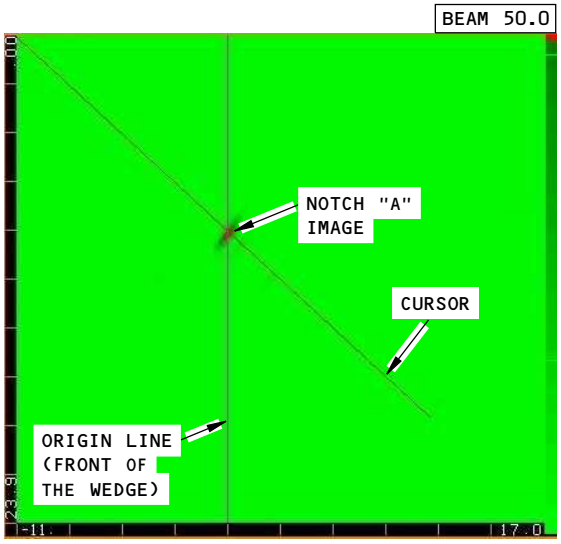


PHASOR XS SCREEN DISPLAY

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

2129807 S0000458968_V1

Reference Standard Sector Scan Screen Displays
Figure 4 (Sheet 3 of 5)

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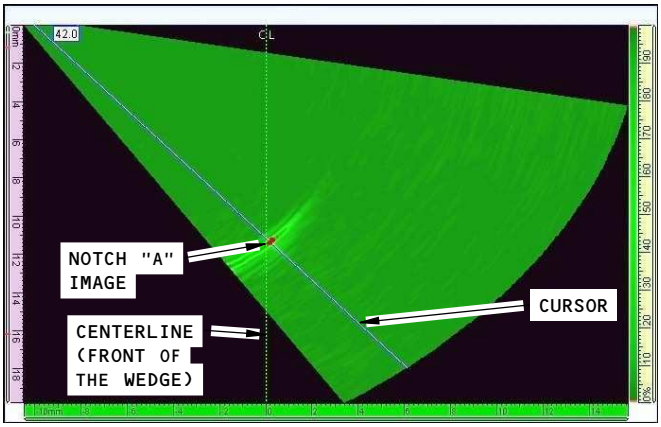
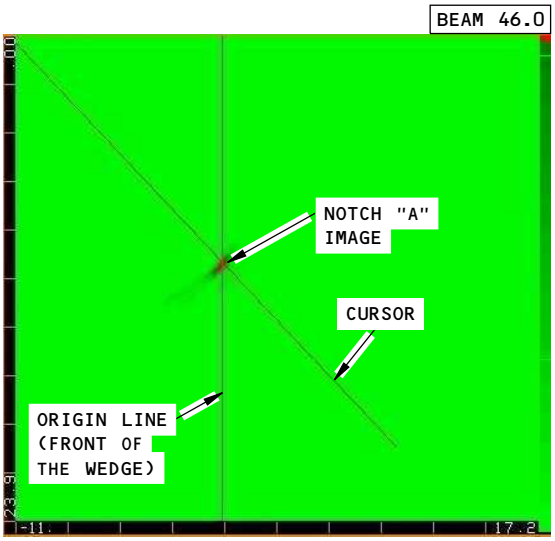
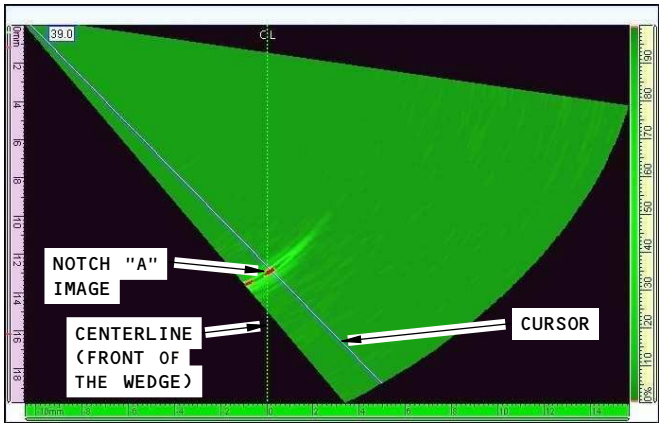


OMNISCAN MX SCREEN DISPLAY

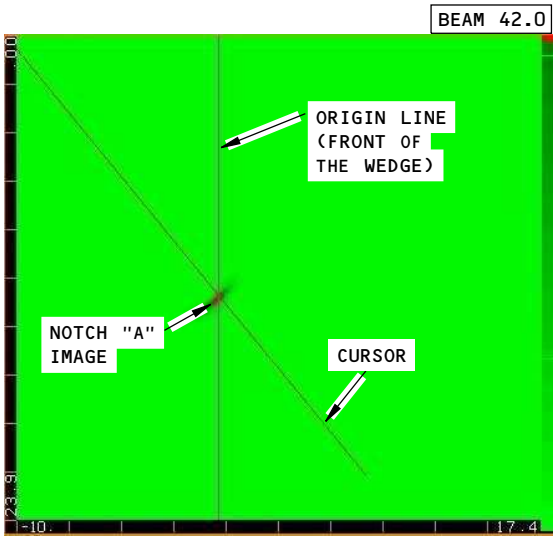


PHASOR XS SCREEN DISPLAY

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

2129809 S0000458969_V1

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

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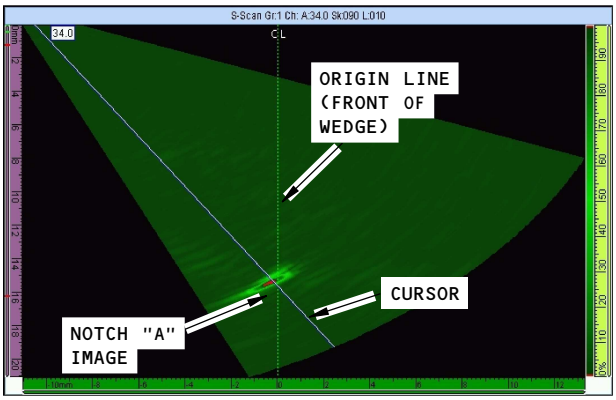
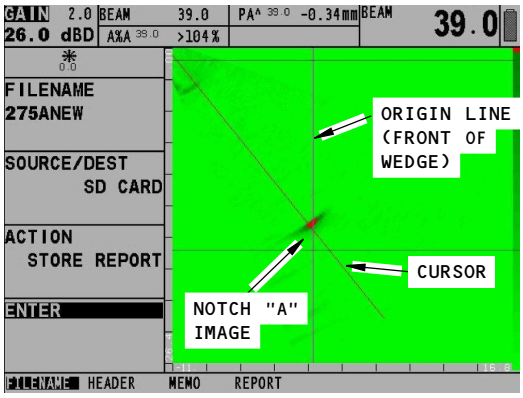


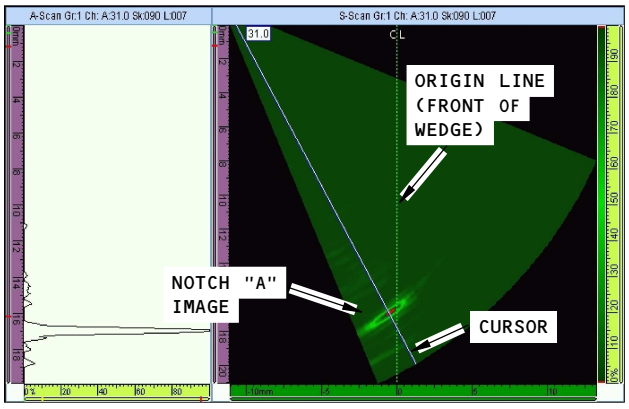
OMNISCAN MX SCREEN DISPLAY



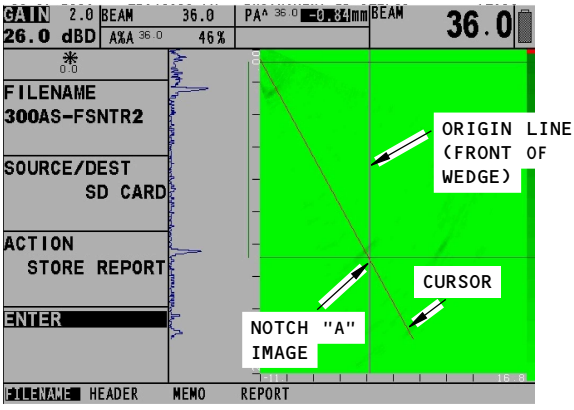
PHASOR XS SCREEN DISPLAY

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

2129810 S0000458970_V1

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

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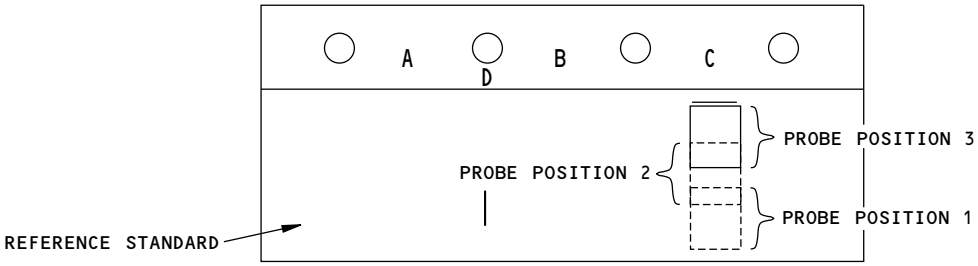
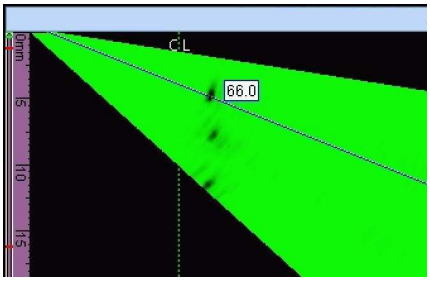
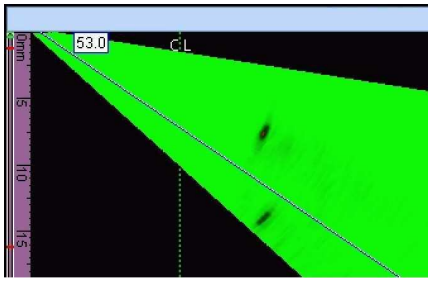
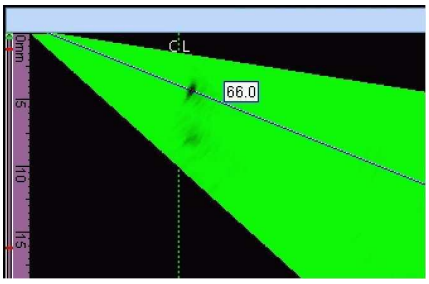




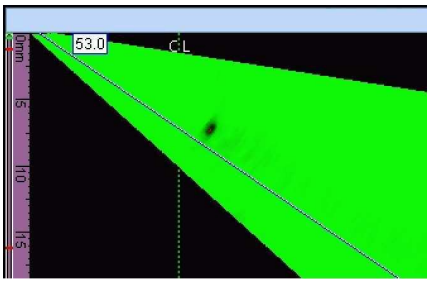
TYPICAL SIGNAL AT PROBE POSITION 1



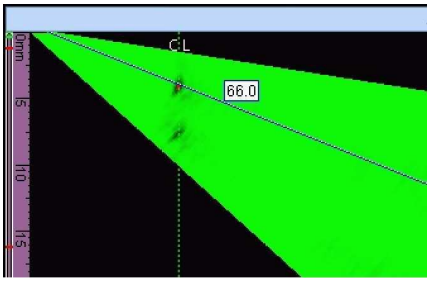
TYPICAL SIGNAL AT PROBE POSITION 1



TYPICAL SIGNAL AT PROBE POSITION 2

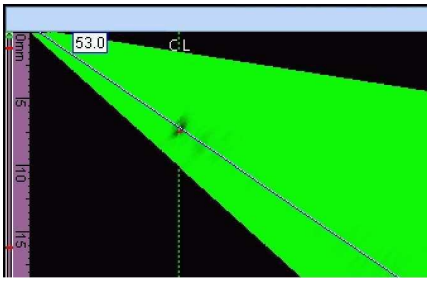


TYPICAL SIGNAL AT PROBE POSITION 2



TYPICAL SIGNAL AT PROBE POSITION 3

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



TYPICAL SIGNAL AT PROBE POSITION 3

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

2129812 S0000458971_V1

"Free-field" Calibration
Figure 5

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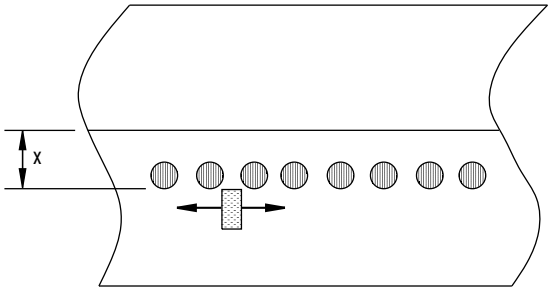
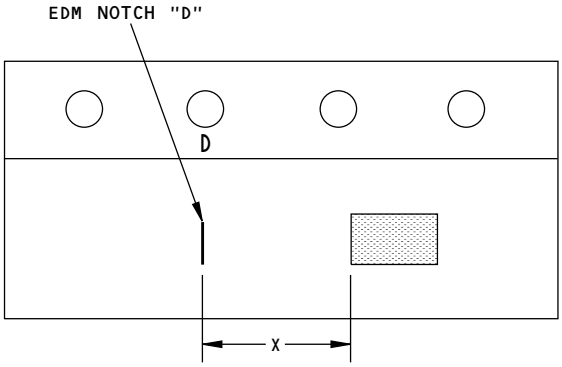
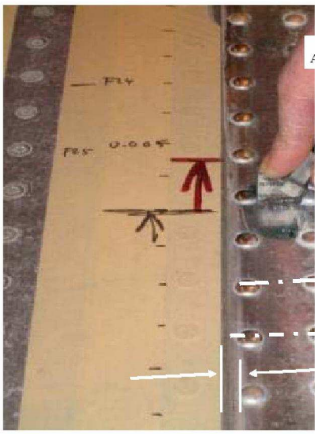


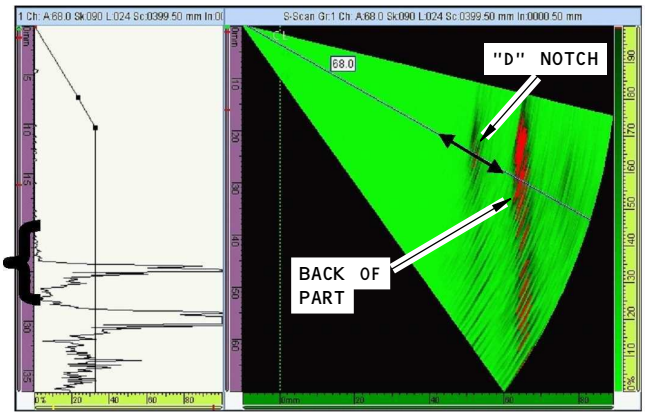
DETAIL I



DETAIL II

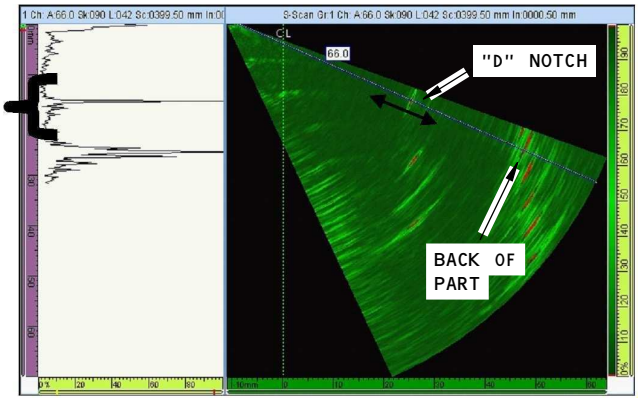


DETAIL III



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

2129815 S0000458972_V1

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

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PART 4 - ULTRASONIC

FUSELAGE SKIN - INTERNAL CRACKS AT DOUBLER EDGES WITH PHASED ARRAY

1. Purpose

A. Use this procedure to:

(1) Find cracks in the internal surface of the fuselage skin panels at the edges of the bonded internal doublers. See Figure 1 for the typical inspection areas.

(2) Make an analysis of crack signals found during a medium frequency eddy current (MFEC) inspection of fuselage skin panels.

CAUTION: THIS PROCEDURE IS SENSITIVE TO HUMAN FACTORS THAT CAN INCREASE THE RISK OF MISSED CRACKS FOR LARGE SCAN AREAS. IT IS RECOMMENDED TO USE PART 4, 53-30-12 TO SCAN LARGE AREAS.

B. For the inspection of the fuselage skin panels at the edges of the bonded internal doublers, refer to the Service Bulletin for the inspection areas to be examined. Service Bulletins 737-53A1301 and 737-53A1293 are related to this inspection.

C. This procedure examines painted or bare skin panels that are from 0.032 to 0.140 inch (0.81 to 3.56 mm) thick from the external surface of the airplane. The paint can be as thick as 0.007 inch (0.18 mm).

D. This procedure uses an ultrasonic phased array instrument that displays a color image of a sector type, S-Scan and an A-Scan display. Ultrasonic signals in the S-Scan display show as a red image against a green background.

E. This procedure looks for cracks that are:

(1) 0.200 inch (5.08 mm) long (or more).

(2) 0.010 inch (0.25 mm) deep (or more) skins that are from 0.032 to 0.045 inch (0.81 to 1.14 mm) thick.

(3) 0.015 inch (0.38 mm) deep (or more) in skins that are from 0.046 to 0.059 inch (1.17 to 1.50 mm) thick.

(4) 0.020 inch (0.46 mm) deep (or more) in skins that are from 0.060 to 0.140 inch (1.52 to 3.56 mm) thick.

(5) In an area approximately 0.060 inch (1.52 mm) on one or the other side of the doubler edge.

F. The full probe surface must touch the fuselage skin during each inspection. Areas with protruding head fasteners, or areas where repairs or other structure do not let the probe fully touch the surface above the edge of a chem-mill doubler cannot be examined with this procedure. See Figure 2 thru Figure 4 and Paragraph 1.F.(1) thru Paragraph 1.F.(3) for the minimum necessary clearances. The areas that follow can be examined with this procedure

(1) An external repair doubler with a horizontal edge that is 1.0 inch (25 mm) or more from the horizontal edge of a chem-mill doubler (see Figure 2).

(2) An external repair doubler with a vertical edge that is 1.0 inch (25 mm) or more from the vertical edge of a chem-mill doubler (see Figure 3).

(3) An external repair doubler with an edge that is 1.8 inches (46 mm) or more from the edge of a chem-mill doubler (see Figure 4).

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2. Equipment

A. General

(1) Use inspection equipment that can be calibrated on the reference standard as specified in Paragraph 4.

(2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

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)

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 2.25; 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 2.25 or higher. If the instrument has an older software version, contact GE Inspection Technologies, Customer Support Center or access the software from the GE inspection Technologies website 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.

(2) For the OmniScan MX, the RD Tech array probe assembly, use a 10L16 or 10L16E5-5 16-element phased array probe with a SA1-N60S5X5 or SA00-N60S wedge.

(3) For the Phasor XS, the GE array probe assembly, use a 115-000-411, 16 element phased array probe with a 360-141-129 wedge.

D. Reference Standard

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(1) For the inspection of the fuselage skin panels at the edges of the bonded internal doublers, use reference standard NDT1094-040 or NDT1094-040-A. See Figure 5 for a drawing of the reference standard.

(2) To make an analysis of crack signals that occurred during a MFEC inspection with procedure Part 6, 53-30-09, Part 6, 53-30-18, or Part 6, 53-30-23, use the reference standard specified in the applicable eddy current procedure. See Figure 2 for a drawing of the reference standard. The "XXX" in the reference standard number is the reference standard thickness. Table 1 identifies the reference standard thickness to be used to examine the different airplane skin thicknesses.

Table 1: Calibration Data

Reference Standard	Skin Thickness Range (Nominal)	Wedge
		(a) RD Tech (b) GE
NDT1094-040, NDT1094-040-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

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. Prepare for the Inspection

A. Identify the inspection area as follows:

(1) Refer to Part 6, 53-30-23 to identify the edge of the internal doubler.

(2) Make a mark, with an approved marker, on the surface where the eddy current signal is almost the same as the edge signal that occurred during calibration. You can use a template that is the shape of the internal doubler to help identify the edge of the doubler.

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 IT IS NECESSARY.

B. Remove paint if:

(1) It is specified by the maintenance documents.

(2) You must make an analysis of a crack signal that was found with MFEC inspection procedure Part 6, 53-30-23. Remove the paint as follows:

(a) Remove a 1.25 inch (31.8 mm) wide area of paint, primer and sealant from the inspection surface for the length of the area to be examined. Approximately 1 inch (25 mm) of the paint that is removed must be in the chem-mill recess area of the skin panel.

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C. If the maintenance documents do not specify paint removal for the inspection, make an estimate of the paint thickness 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 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 Paragraph 3.C.(1). 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 that will be examined. If the paint is more than 0.007 inch (0.18 mm) thick, it must be removed in that frame bay before you do this ultrasonic inspection.

E. Make sure the inspection area is clean.

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 Table 1 to identify the applicable reference standard to use for the different airplane skin thicknesses.

4. Instrument Calibration

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

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

NOTE: Make sure that your instrument has the software version identified in Paragraph 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.

A. Calibrate the OmniScan MX instrument as follows:

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(1) Make sure the ultrasonic module and phased array probe assembly are connected to the instrument as specified in the manufacturer's instructions.

(2) Energize the instrument.

(3) 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).

(4) 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 Table 2 to identify the applicable setup file for the module used. Open the applicable default setup file and do Paragraph 4.A.(6)(a) thru Paragraph 4.A.(6)(h) to create a setup file.

Table 2: Default 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

(5) The instructions in Paragraph 4.A.(6) will identify the menus and options, followed by the parameter to be put in.

NOTE: The first element in the Paragraph 4.A.(6) instructions is the menu listed in the Main menu (blue button), followed by the submenu (buttons F2 thru F6), followed by the option (buttons F7 thru F12), and then followed by the parameters.

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 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.

(6) To create a setup file, 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 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 Automated Module)

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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 Paragraph 4.A.(6)(b)1)h)

<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:

- Auto Detect (F11) > Off
- 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.
- Do a check of the Probe (F10) option to make sure the correct probe number has been selected, press Next (F8) and go to Paragraph 4.A.(6)(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:

- Auto Detect (F11) > Off
- Select (F9) > Defines
- Define Probe (F10) > New (F3) > Serial Number (F8) > enter in “10L16-A00” or “10L16E5-5”
- Save (F6), automatically goes to Edit (F4) menu
- Freq (F7) > 10
- Probe Type (F9) > Angle Beam
- Element Qty. (F10) > 16
- Pitch (F11) > 0.30
- Save (F6)
- Select and Close (F7)
- Select (F9) > Select Tx/Rx
- Do a check of the Probe (F10) option to make sure the correct probe number has been selected.
- Next (F8)

h) Wedge (F10) > 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 Automated Module)

<c> Go to Paragraph 4.A.(6)(b)1)i)

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<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> Select (F9) > Defines

<b> Define Wedge (F10) > New (F3) > Serial Number (F8) > enter in “SA00-N60S” or “SA1-N60S5X5” as applicable, for the wedge to be used.

<c> Save (F6), automatically goes to Edit (F4) menu

<d> Angle (F7) > 39.0

<e> Pri. offset (F10) > -14.32

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

<f> Height (F12) > 2.30

<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 Automated Module)

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) > 25

<b> Max. Angle (F10) > 80

<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 Automated Module)

2) General (F2)

a) Start (F8) > 0.00 ± 0.02

b) Range (F9) > 7.0 ± 0.5

3) Pulser (F3)

a) Voltage (F10) > 40 or lowest value available

4) Receiver (F4)

a) Filter (F8) > 10 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) > AS[C]

2) Overlay (F3)

a) Gate (F10) > On

3) Color (F5) > Load (F10) > Sample Listed Files (F3) > select ONDT_Alarm.pal and Open (F7)

a) End (F9) > 72%

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

1) Gate (F2)

a) Gate (F7) > A

b) Start (F9) > 0.50

c) Width (F10) > 4.0 ± 0.1

d) Threshold (F11) > 50

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) > 0.50 ± 0.1

l) Threshold (F11) > 10

2) Sizing Curves (F5)

a) Curve (F8) > None

(f) Measurements menu

1) Reading (F2)

a) Field 1 (F9) > A%

b) Field 2 (F10) > None

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 Paragraph 4.C.

B. Calibrate the Phasor XS instrument as follows:

(1) Connect the phased array probe assembly to the instrument as specified in the manufacturer's instructions.

(2) 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 de-energized.

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(3) If a dataset file for this procedure has been stored, recall the file FILES > FILENAME > ACTION > RECALL DATASET menu.

(4) 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 first element in the instructions that follow is the menu, followed by the submenu, followed by the function, and then followed by the parameter.

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 > REGIONAL > 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
   - c) OFFSET Z > 3.85 mm
   - d) ANGLE > 39.0 deg

3) OFFSET
   - a) PROBE DELAY > 0.000 µs

(c) PART menu defines the parameters for the test material

1) PLAN
   - a) MATERIAL > ALUMINUM
   - b) MAT THICKNESS >4.00 mm
   - c) VELOCITY S > 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 > 25.0 deg
   - b) ANGLE STOP > 80.0 deg
   - c) ANGLE STEP > 1.0 deg

3) APERTURE

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a) NUM OF STEPS > 1
b) FIRST ELEMENT > 1
c) APERTURE SIZE > 16
d) APERTURE STEP > 1

(e) DISPLAY menu defines the view of the screen display
1) VIEW
a) ANG CORRECTED > ON
b) ASCAN MODE > NORMAL
2) IMAGE
a) AMP COLR PALET > CUSTOM (50%red)

NOTE: The palette used for this procedure, “50%red”, was made by Boeing. Contact Boeing Service Engineering to get the palette file.

b) VIDEO REVERSE > NORMAL
3) BACKGRND > COLOR LEG > OFF
4) RESULTS1
a) READING 1 > A%A
b) READING 2 > OFF
c) READING 3 > OFF
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
2) PULSER
a) VOLTAGE > 50 V
b) WIDTH > 60 ns
3) RECEIVER
a) FREQUENCY > BB 0.6-6.5 MHz
b) ASCAN RECTIFY > FULLWAVE
4) GATEMODE
a) GATE SELECT > GATE A
b) TOF MODE > PEAK
c) LOGIC > POSITIVE
d) GATE DISPLAY > ON
5) GATE POS
a) GATE SELECT > GATE A
b) GATE START > 0.25 mm
c) GATE WIDTH > 4.0 mm

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d) GATE THRESHOLD > 50%

(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 > OFF

c) ORIGIN OFFSET > 0.00 mm

d) RIGHT KNOB > BEAM CURSOR

(i) Push and hold the GAIN STEP KEY to display the gain as dBD (digital gain) in the gain window.

1) Set the gain value to 0.0 dBD.

(j) 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.

(k) 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. Calibrate the equipment as follows:

(1) Use reference standard NDT1094-040 or NDT1094-040-A to examine the skin panels of the fuselage at the edges of the bonded internal doublers. To examine an area where a crack signal occurred during a Part 6, 53-30-23 MFEC inspection, use the applicable NDT1094-XXX reference standard that has the correct skin thickness range for the inspection area.

NOTE: This instrument calibration is done from the rear surface of the reference standard, with notch “A” used to set the sensitivity.

(2) Use a temporary marker to accurately make a mark on the rear surface of the reference standard to show the location of notch “A”.

(3) Apply a sufficient quantity of couplant on the rear surface of the reference standard at notch location “A”. See Detail I in Figure 6.

(4) Put the center of the probe on the line at notch location “A” on the back surface of the reference standard with the sound beam pointed at the notch and doubler. See Detail I in Figure 6.

(5) If necessary, move the probe a small distance forward and rearward and from side to side, along the surface, to get an image to occur on the S-Scan display. Adjust the gain as necessary.

(6) Set the cursor on the image in the S-Scan display to get a signal to show on the A-Scan display.

(7) Move the probe again a small distance to make sure you get the maximum notch signal to show on the A-Scan display. Hold the probe at this location and see where the mark that identifies the notch location is in relation to the probe wedge. Record this location or make a mark on the probe wedge to identify this location. Use this mark on the probe wedge as a reference point during the inspection to make sure the inspection area is fully examined.

(8) Adjust the instrument gain to put the notch signal on the A-Scan display at 50% of FSH. The notch image on the S-Scan will start to show red (smallest visible image). See Detail II in Figure 6 for the OmniScan screen display and Detail III in Figure 6 for the Phasor XS screen display.

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(9) Do a scan of notch “A” again to make sure you get the same results as shown in Paragraph 4.C.(8).

(10) Add 6 dB to put the notch signal at 100% of FSH. This will be the calibration gain used on a skin that is not painted.

(11) Save your final calibration set-up.

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

5. Inspection Procedure

A. Open the correct setup file. If a setup file has not been stored, follow the steps in Paragraph 4.A. if the OmniScan MX is used, or Paragraph 4.B. if the Phasor XS is used.

B. Calibrate the equipment on the reference standard as specified in Paragraph 4.C.

C. Add 6 dB of gain if the skin is painted. Do not remove this gain during the inspection and analysis.

D. Identify the inspection areas on the airplane to be examined. Make sure the edges of the doublers are identified correctly. Refer to Paragraph 3.A. to help identify the edge of the doubler.

E. Put a sufficient quantity of couplant on the inspection areas. Use the same couplant on the airplane that was used on the reference standard during calibration in Paragraph 4.

F. Put the probe on the inspection surface with the center of the probe wedge above the edge of the doubler and pointed in the direction of the doubler. See Figure 1 for the typical probe position. If the purpose of this inspection is to examine an area where a crack signal occurred during a Part 6, 53-30-23 MFEC inspection, put the probe wedge above the crack location at approximately the same position that was used during the instrument calibration with the applicable reference standard.

G. Make a scan of the inspection area as follows:

(1) Be sure to move the probe to and away from the inspection area sufficiently to fully examine the inspection area. Use the mark or location on the probe wedge that was identified in Paragraph 4.C.(7) to help make sure the inspection area is fully examined.

(2) Move the probe no more than half the width of the probe as you move the probe across and along the edge of the doubler.

(3) Do not move the probe faster than the speed set in Paragraph 4.D.

(4) As you move the probe, monitor the S-Scan display for red images that can occur and the A-Scan display for signals that are 50% of FSH or more. If a red image occurs on the S-Scan display and there is no signal on the A-Scan, set the beam cursor on the red image to get a signal to show on the A-Scan display.

(5) Make a mark, with an approved marker, at the area of an indication. Use the center of the probe wedge.

6. Inspection Results

A. To make an analysis of crack signals found during the inspection of the fuselage skin panels at the edges of the bonded internal doublers, do as follows:

(1) Ultrasonic signals that are 50% of FSH (or more) on the A-Scan and red images on the S-Scan display are possible cracks. These areas must be examined some more. Use the procedures that follow:

(a) Make sure you are at the correct gain level set in Paragraph 4.C.(8) with the added 6 dB of gain identified in Paragraph 4.C.(10).

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(b) If the inspection area is painted, make sure the 6 dB of gain is added as specified in Paragraph 5.C.

(c) If the inspection area is painted and the crack indication stays, remove the paint in the area of the indication, make sure the added 6 dB of painted surface gain identified in Paragraph 5.C. is removed, and examine the area again. If the indication goes away, no more inspections are necessary; the area does not have a crack.

(d) Refer to the Service Bulletin for more instructions about what to do at crack locations.

(2) To make an analysis of crack signals found during a MFEC inspection with procedure Part 6, 53-30-23, do as follows:

(a) All areas that cause ultrasonic crack signals to occur that are 50% of FSH (or more) on the A-Scan and red images on the S-Scan display must be rejected and no more analysis is necessary.

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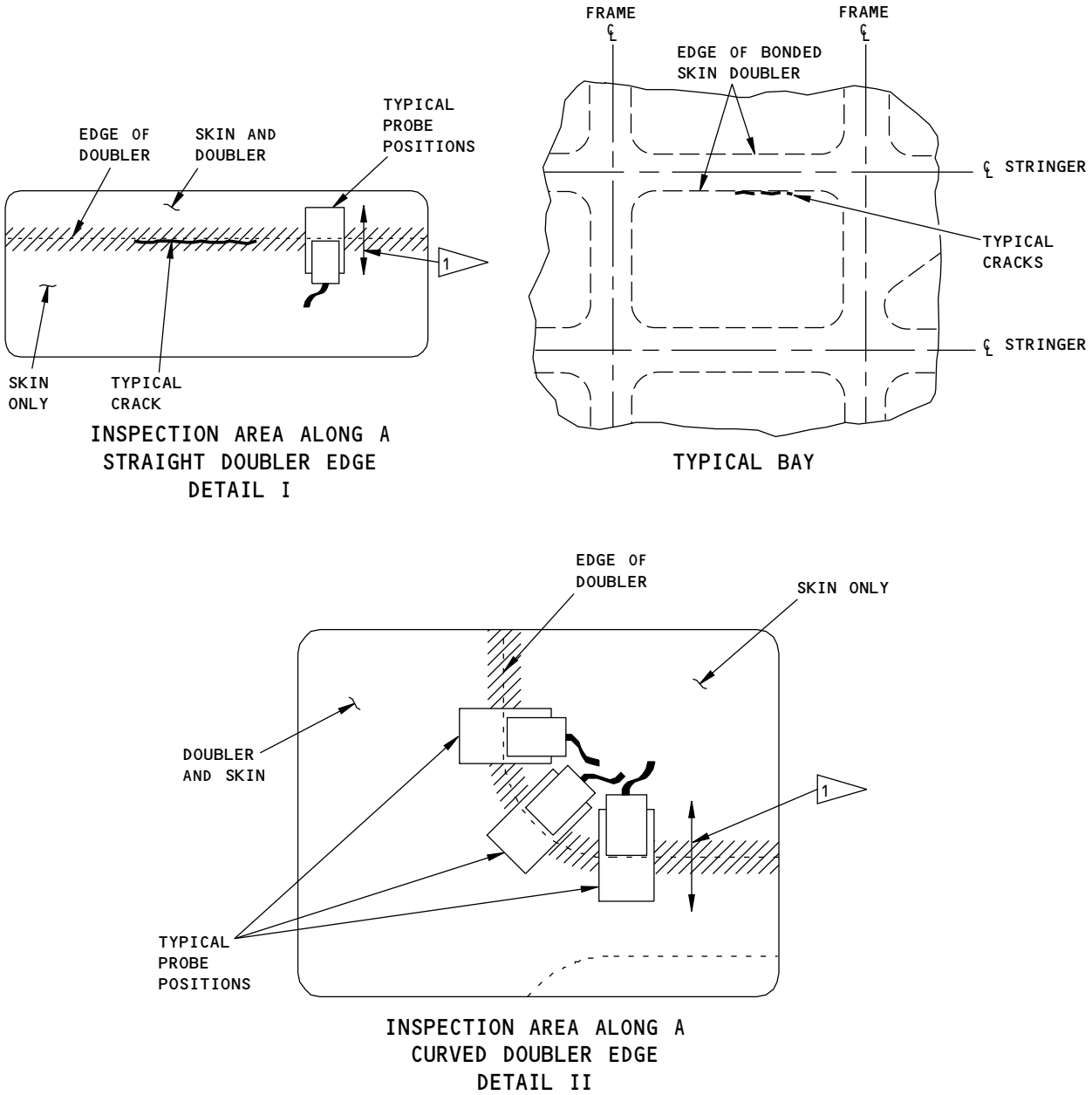

NOTES:

TYPICAL INSPECTION AREA ALONG THE EDGE OF A DOUBLER, AS SPECIFIED IN THE SERVICE BULLETIN.

1 PUT THE PROBE ON THE SKIN ONLY AREA WITH THE SOUND BEAM POINTED AT THE EDGE OF THE DOUBLER. MOVE THE PROBE FORWARD AND REARWARD ACROSS THE EDGE OF THE DOUBLER FOR THE FULL LENGTH OF THE PROBE AS YOU MAKE A SCAN ALONG THE EDGE OF THE DOUBLER.

2158072 S0000471350_V2

Inspection Area
Figure 1

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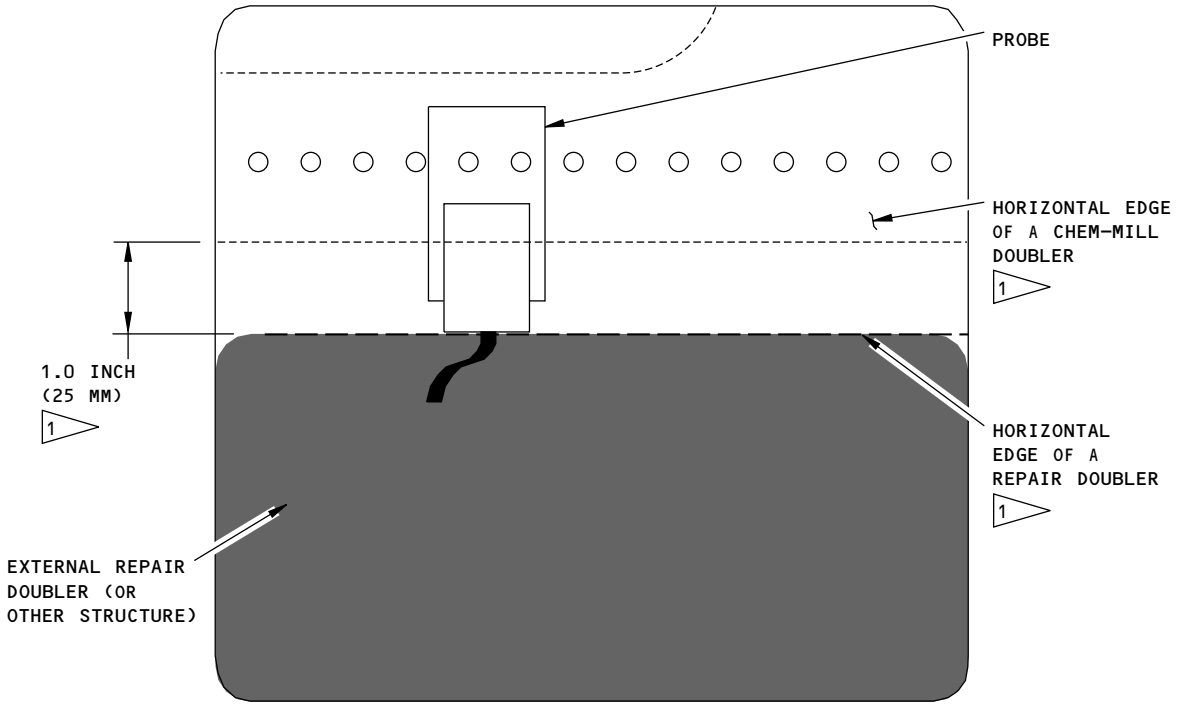

MINIMUM VERTICAL CLEARANCE NECESSARY TO EXAMINE THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER

NOTES

1. TO USE THIS PROCEDURE, THE DISTANCE BETWEEN THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER AND THE HORIZONTAL EDGE OF AN EXTERNAL REPAIR DOUBLER MUST BE 1.0 INCH (25 MM) OR MORE.

2507135 S0000590114_V1

Horizontal Edge Clearances from External Repair Doublers (or Other Structure) to Chem-Mill Doublers
Figure 2

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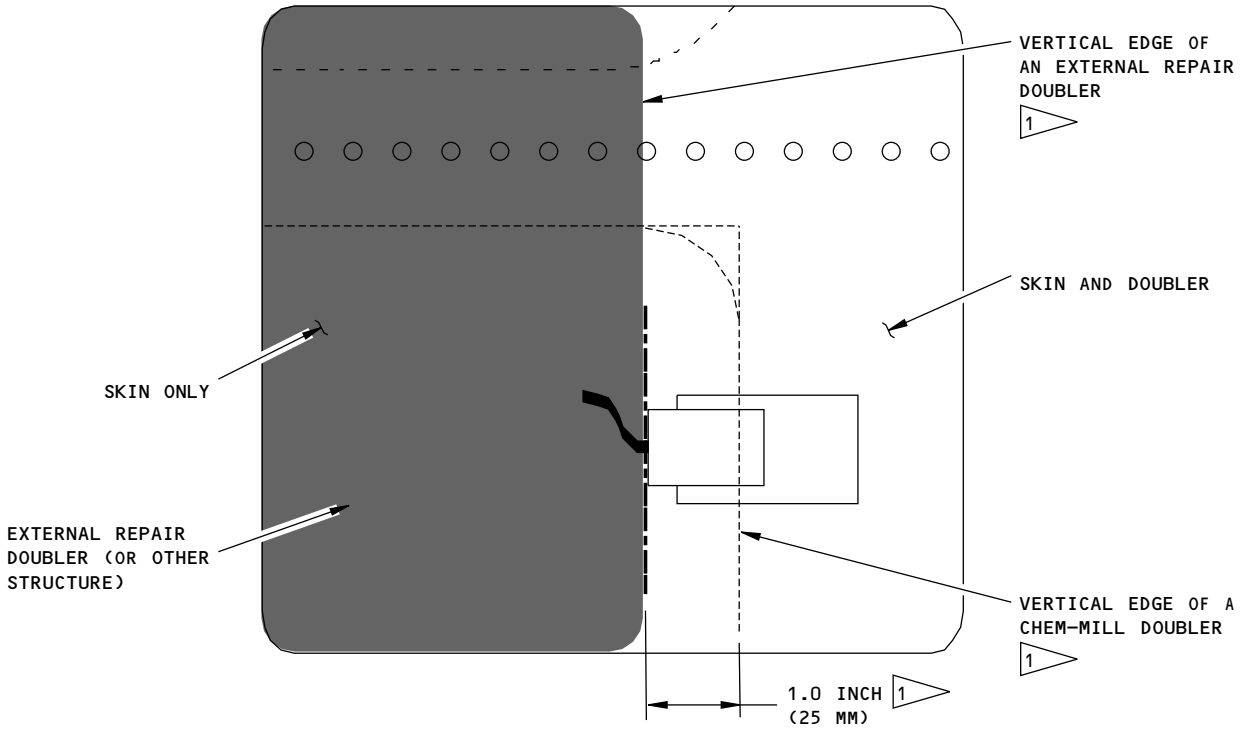

HORIZONTAL CLEARANCE NECESSARY TO EXAMINE THE VERTICAL EDGE OF A CHEM-MILL DOUBLER

NOTES

1 TO USE THIS PROCEDURE, THE DISTANCE BETWEEN THE VERTICAL EDGE OF A CHEM-MILL DOUBLER AND THE VERTICAL EDGE OF AN EXTERNAL REPAIR DOUBLER MUST BE 1.0 INCH (25 MM) OR MORE.

2507137 S0000590115_V1

Vertical Edge Clearances from External Repair Doublers (or Other Structure) to Chem-Mill Doublers
Figure 3

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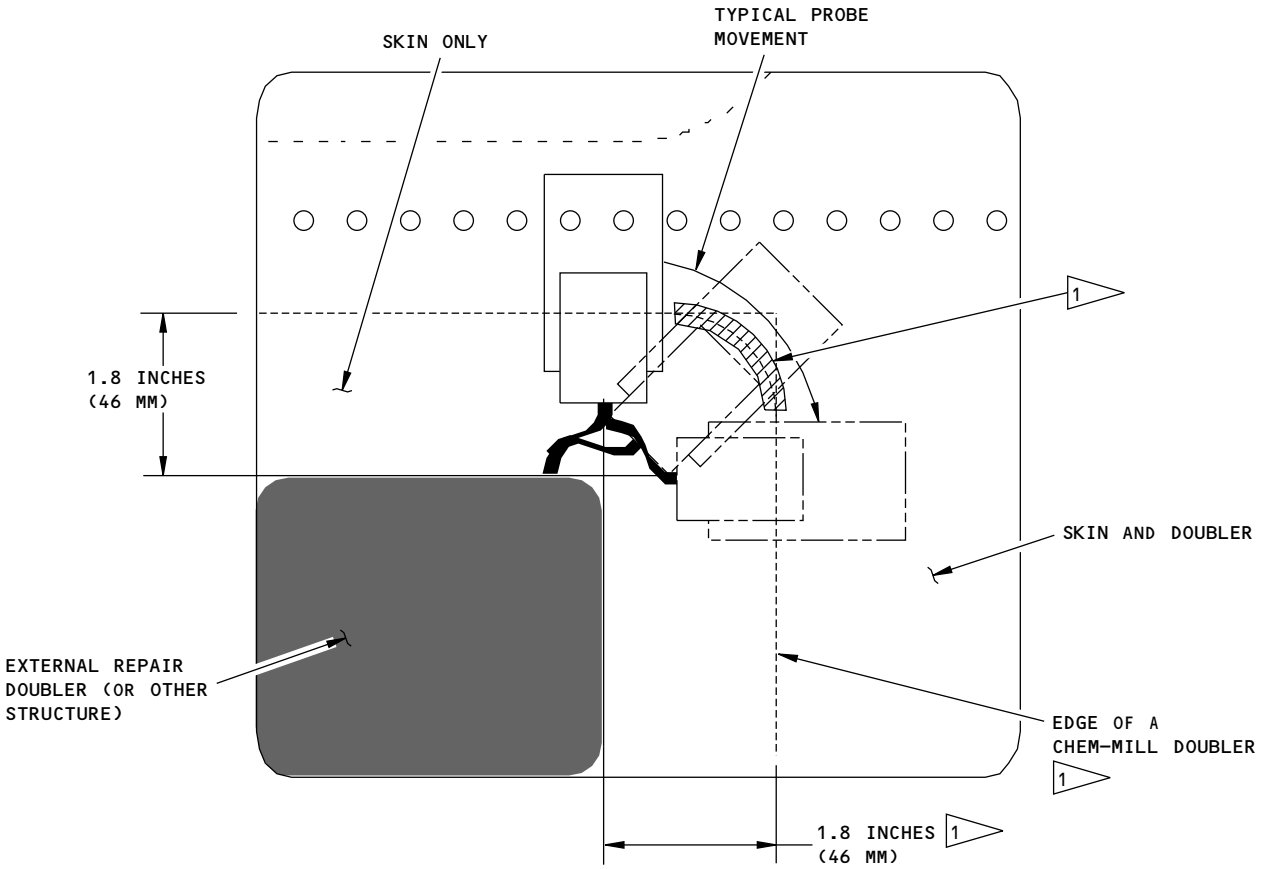

MINIMUM CLEARANCE NECESSARY TO EXAMINE THE RADIUS OF A CHEM-MILL DOUBLER

NOTE

1 TO USE THIS PROCEDURE, AN EXTERNAL REPAIR DOUBLER MUST BE 1.8 INCHES (46 MM) OR MORE FROM THE HORIZONTAL OR VERTICAL EDGES OF A CHEM-MILL DOUBLER.

2507138 S0000590116_V1

Radius Edge Clearances from External Repair Doublers (or Other Structure) to Chem-Mill Doublers
Figure 4

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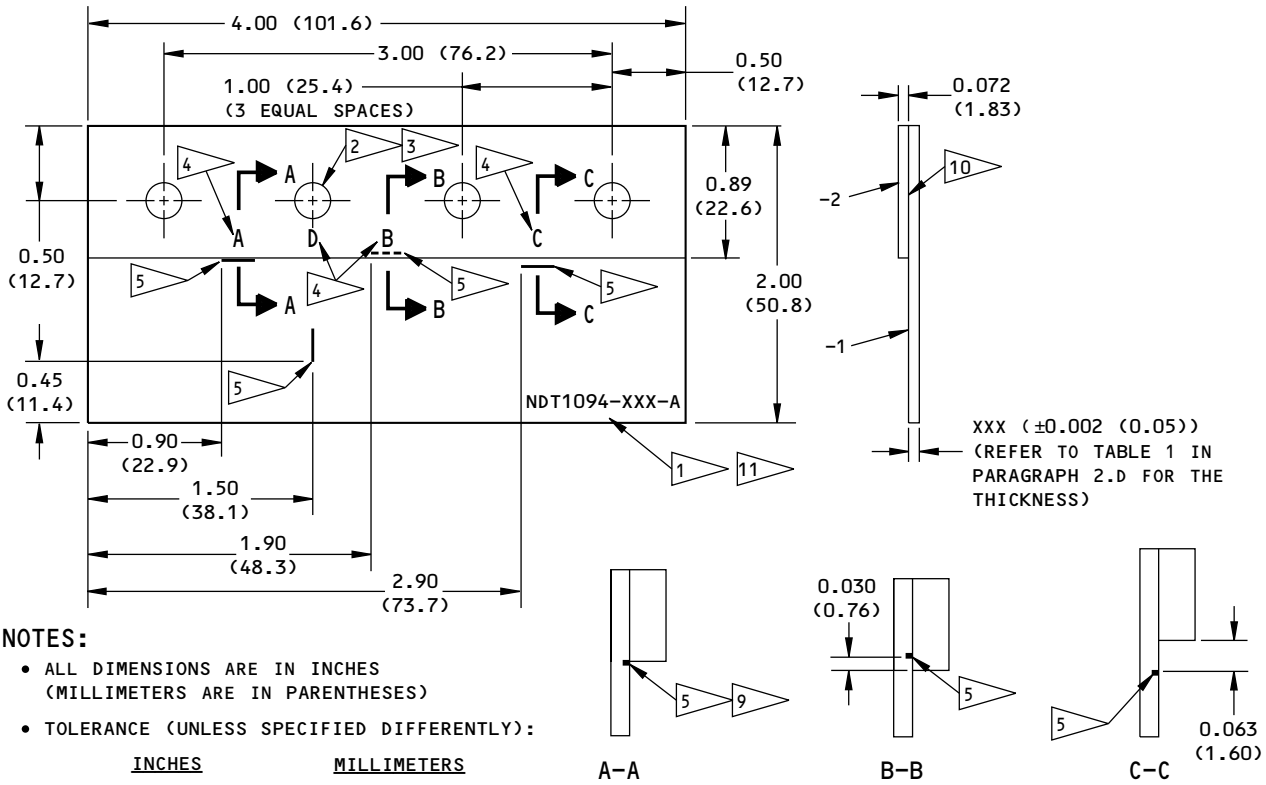

NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (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.

1 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.

2 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)

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 NDT1094-040-A

7 0.015 (0.38) ±0.002 (0.05) IN NDT1094-050-A

8 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

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 SOPM 20-50-19. MAKE SURE THE SEALANT DOES NOT EXTEND BEYOND THE FAYING SURFACE.

11 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.

2158079 S0000471351_V2

Reference Standard NDT1094-XXX-A
Figure 5

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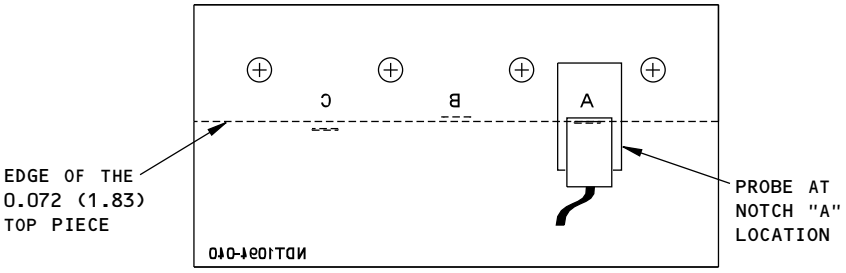
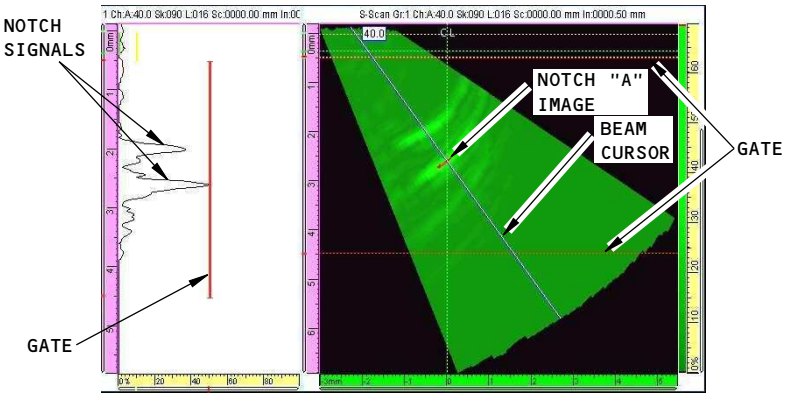
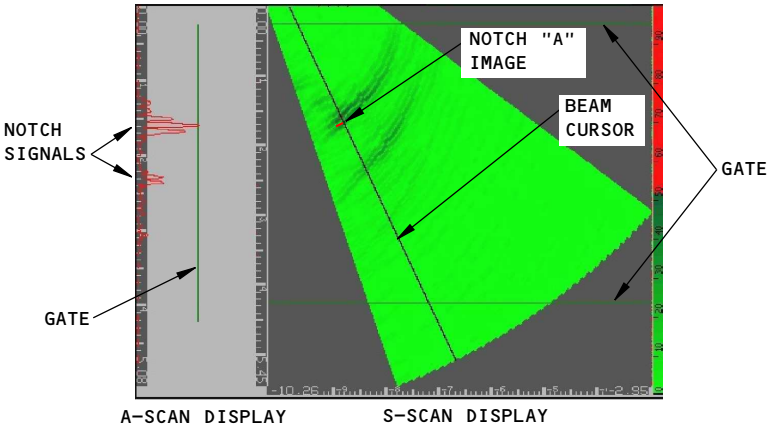


PROBE POSITION ON THE BACK
SIDE OF THE REFERENCE STANDARD
DETAIL I



OMNISCAN MX SCREEN DISPLAYS WITH THE CORRECT
GAIN SETTING OF THE "A" NOTCH IMAGE
DETAIL II



PHASOR XS SCREEN DISPLAY WITH THE CORRECT GAIN
SETTING OF THE "A" NOTCH IMAGE
DETAIL III

NOTE:

- THE SCREEN DISPLAYS IN DETAILS II AND III ARE EXAMPLES OF THE TYPICAL SECTOR SCAN DISPLAYS, WITH THE NOTCH IMAGES SHOWN TAKEN FROM THE NDT1094-040 REFERENCE STANDARD. THE IMAGES AND THE CURSOR ANGLE SHOWN IN DETAILS II AND III CAN BE DIFFERENT FOR YOUR PROBE AND WEDGE.

2158083 S0000471352_V1

Instrument Calibration
Figure 6

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FUSELAGE SKIN SCRIBE LINE CRACK INSPECTION - LOWER SKIN AT THE LAP JOINTS THAT HAVE MODIFIED UPPER SKINS (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 Figure 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 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 1.02 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 from 0.063 inches (1.60 mm) below the edge of the upper skin to a maximum of 0.350 inches (8.89 mm) behind the edge of the upper skin. See Figure 1.

2. Equipment

A. General

(1) Use inspection equipment that can be calibrated on the reference standard as specified in Paragraph 4.

(2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

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).

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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 2.51; 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 2.51 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.

(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 (3.59 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 NDT1096-XXX. See Figure 2 for a drawing of the reference standard. The XXX in the reference standard number is the reference standard thickness. Table 1 identifies the reference standard thickness to be used to examine the different airplane skin thicknesses.

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

3. Prepare for the Inspection

A. Identify the inspection area.

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

B. Remove paint only if it is specified by the maintenance documents. If paint removal is necessary, do the steps that follow:

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(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

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 Paragraph 3.C.(1). 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.

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 Table 1 that follows to identify the applicable reference standard to use for the different airplane skin thicknesses.

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Table 1: Calibration Data

Reference Standard	Skin Thickness Range (Nominal)	Wedge (a) RD Tech (b) GE
NDT1096-040	0.032 to 0.045 inch (0.81 to 1.14 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1096-050	0.046 to 0.059 inch (1.17 to 1.50 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1096-070	0.060 to 0.079 inch (1.52 to 2.01 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1096-090	0.080 to 0.099 inch (2.03 to 2.51 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1096-110	0.100 to 0.119 inch (2.54 to 3.02 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1096-130	0.120 to 0.140 inch (3.05 to 3.56 mm)	(a) SA00-N60S or SA1-N60SX5 (b) 360-141-129
NDT1096-155	0.141 to 0.170 inch (3.58 to 4.32 mm)	(a) SA00-N45S (b) 360-141-148
NDT1096-185	0.171 to 0.190 inch (4.34 to 4.83 mm)	(a) SA00-N45S (b) 360-141-148
NDT1096-215	0.191 to 0.220 inch (4.85 to 5.59 mm)	(a) SA00-N45S (b) 360-141-148
NDT1096-245	0.221 to 0.250 inch (5.61 to 6.35 mm)	(a) SA00-N45S (b) 360-141-148
NDT1096-275	0.251 to 0.280 (6.38 to 7.11 mm)	(a) SA00-N45S (b) 360-141-148
NDT1096-300	0.281 to 0.310 (7.13 to 7.87 mm)	(a) SA00-N45S (b) 360-141-148

4. Instrument Calibration

NOTE: The instrument calibration instructions identified in Paragraph 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 Paragraph 2.C.(2).

NOTE: The instrument calibration instructions identified in Paragraph 4.B. are for the Phasor XS instrument, software version 2.51 or higher, and the phased array probe assemblies identified in Paragraph 2.C.(3).

NOTE: Make sure that your instrument has the software version identified in Paragraph 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.

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.

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(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 Paragraph 4.A.(7)(a) thru Paragraph 4.A.(7)(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).

(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 Table 2 to identify the applicable setup file for the module used. Open the applicable default setup file and do Paragraph 4.A.(8)(a) thru Paragraph 4.A.(8)(h) to create a setup file.

Table 2: Default Setup Files

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

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

NOTE: The instructions in Paragraph 4.A.(7) and Paragraph 4.A.(8) identify the menu listed in the Main menu (blue button), followed by the submenu (buttons F2 thru F6), followed by the option (buttons F7 thru F12), and then followed by the parameters.

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 follow:

(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

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b) Next (F8)

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 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 Paragraph 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.

<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)

<j> Close (Main Menu)

<k> Probe/Part > Select (F2) > Select (F9) > Select Tx/Rx

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<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 Paragraph 4.A.(7)(b)1)j)<1><a> thru Paragraph 4.A.(7)(b)1)j)<1><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

<d> Next (F8)

<e> Velocity (F9) > SW

<f> Press Next (F8) two times

<g> Set Beam Angle

- Min. Angle (F9) > 45 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 23 (when the SA00-N45S wedge is used).
- Max. Angle (F10) > 80 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 70 (when the SA00-N45S wedge is used).
- Focus Depth (F12) > 10.00

<h> Next (F8)

<i> Generate (F8)

<j> If the correct probe number is shown, go to Paragraph 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:

- Exit out of the Wizard (Reject button)
- Probe/Part > Select (F2) > Select (F9) > Defines
- Auto Detect (F12) > Off
- Select Probe (F10) > scroll through the list, select “10L16” or “10L16E5-5” and accept it (press Close).
- Select (F9) > Select Tx/Rx
- Do a check of the Select Probe (F10) option to make sure the correct probe number has been selected.

<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:

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- Select (F9) > Defines
- Define Probe (F10) > New > Serial Number (F8) > enter in “10L16” or “10L16E5-5”
- Save (F6), automatically goes to Edit (F4) menu
- Freq (F7) > 10
- Probe Type (F9) > Angle Beam
- Element Qty. (F10) > 16
- Pitch (F11) > 0.30
- Save (F6)
- Close (Main Menu)
- Probe/Part > Select (F2) > Select (F9) > Select Tx/Rx
- 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 Paragraph 4.A.(7)(b)1)j)<1><c> thru Paragraph 4.A.(7)(b)1)j)<1><j>.

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

1) Selection (F2)

a) Display (F7) > S

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)

(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 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 36.0 ± 1.0 (when the SA00-N45S wedge is used).

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.

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1) Gate (F2)
   a) Gate (F7) > A
   b) Start (F8)>1.20 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 6.30 (when the SA00-N45S wedge is used).
   c) Width (F9) > 10.0 +/- 0.1 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 18.0 +/- 0.1 (when the SA00-N45S wedge is used).
   d) Threshold (F10) > 95
   e) Gate (F7) > B
   f) Start (F8) > 0.0
   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 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 6.30 (when the SA00-N45S wedge is used).
   l) Threshold (F10) > 10
2) DAC/TCG (F5)

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

   a) Curve (F8) > TCG
   b) Mode (F7) > Edit
      <1> Add (F11)
      <2> Point (F8) > 2
      <3> Position (F9) > 16.0 ± 0.1
      <4> Gain (F10) > 12.0
      <5> Add (F11)
      <6> Point (F8) > 3
      <7> Position (F9) > 25 ± 0.1
      <8> Gain (F10) > 20.0

(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 follow:

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(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 Paragraph 4.A.(8)(b)1)h).

<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:

- Auto Detect (F11) > Off
- 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.
- Do a check of the Probe (F10) option to make sure the correct probe number has been selected, press Next (F8) and go to Paragraph 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:

- Auto Detect (F11) > Off
- Select (F9) > Defines
- Define Probe (F10) > New (F3) > Serial Number (F8) > enter in “10L16-A00” or “10L16E5-5”
- Save (F6), automatically goes to Edit (F4) menu
- Freq (F7) > 10
- Probe Type (F9) > Angle Beam
- Element Qty. (F10) > 16
- Pitch (F11) > 0.30
- Save (F6)
- Select and Close (F7)
- Select (F9) > Select Tx/Rx

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- Do a check of the Probe (F10) option to make sure the correct probe number has been selected.
- Next (F8)

h) Wedge (F10) > Refer to Table 1 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 Paragraph 4.A.(8)(b)1)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: 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)

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). 23 (when the SA00-N45S wedge is used).

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<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 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 36.0 +/- 1.0 (when the SA00-N45S wedge is used).

3) Pulser (F3)

a) Voltage (F10) > 40 or lowest value available

4) Receiver (F4)

a) Filter (F8) > 15 MHz

b) Video Filter (F10) > On

(d) Display menu defines the view of the screen display.

1) Selection (F2)

a) Display (F7) > S

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 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 6.30 (when the SA00-N45S wedge is used).

c) Width (F10)>10.0 +/- 0.01 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 18.0 +/- 0.01 (when the SA00-N45S wedge is used).

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 (when the SA00-N60S or SA1-N60S5X5 wedge is used). 6.30 (when the SA00-N45S wedge is used).

l) Threshold (F11) > 10

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2) Sizing Curves (F5)

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

a) Curve (F8) > TCG

b) Mode (F7) > Edit

<1> Add (F11)

<2> Point (F8) > 2

<3> Position (F9) > 16.0 +/- 0.1

<4> Gain (F10) > 12.0

<5> Add (F11)

<6> Point (F8) > 3

<7> Position (F9) > 25 +/- 0.1

<8> Gain (F10) > 20.0

(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 Paragraph 4.C.

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.

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(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 first element shown is 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 specifies the parameters for the probe and wedge. Set the applicable 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)
   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 µs
   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 S> 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). 23 (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).

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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

(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). 3.0 (when the 360 141-148 wedge is used).

2) PULSER

a) VOLTAGE > 50 V

b) WIDTH > 60 µs

c) PRF VALUE > AUTO HIGH

3) RECEIVER > FREQUENCY > HIGH PASS 5MHz

4) GATEMODE

a) GATE SELECT > GATE A

b) TOF MODE > PEAK

c) LOGIC > POSITIVE

d) GATE DISPLAY > OFF

5) GATE POS

a) GATE SELECT > GATE A

b) GATE START > 1.00 mm (when the 360-141-129 wedge is used). 6.00 mm (when the 360-141-148 wedge is used).

c) GATE WIDTH > 12.00 mm (when the 360-141-129 wedge is used). 24.00 mm (when the 360-141-148 wedge is used).

d) GATE THRESHOLD > 95%

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(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).

<2> 23.0 -> 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 µs.

<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 Paragraph 4.B.(5)(i)2)a) and Paragraph 4.B.(5)(i)2)b) again, but use a POINT POS. of 20.0 µs 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 dBD (digital gain) in the gain window.

1) Set the gain value to 10.0 dBD.

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

(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.

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C. Use the reference standard identified in Table 1 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.

(1) Apply a sufficient quantity of couplant on the inspection surface of the reference standard at the “A”, “B”, “C” and “D” EDM notch locations and a fastener location. See Detail I in Figure 3.

(2) Put the probe at notch location “A” on the reference standard. See Detail I in Figure 3.

(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.

(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 image from the notch 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 Detail II in Figure 3. 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 Detail II in Figure 3.

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 ±0.5 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: It can be necessary to adjust the Pri. offset value of the wedge, as identified in Paragraph 4.A.(7)(b)1)i)<2><g> and Paragraph 4.A.(7)(b)1)i)<3><g> or Paragraph 4.A.(8)(b)1)h)<2><e>, if the PA measurement is not correct. This adjustment will move the CL line.

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 +/- 0.5 mm. If an adjustment is necessary, refer to Paragraph 4.B.(5)(h) and make the adjustment to the ORIGIN OFFSET parameter.

(c) Multiple notch images can occur from the same notch at different angles. Use the largest notch image.

(d) Use the data from Paragraph 4.D.(7)(a) thru Paragraph 4.D.(7)(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 Detail I in Figure 3.

(9) Set the beam cursor on the notch image.

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(10) If the signal is less than 95% of FSH, adjust the signal height and make a note of the additional gain. Do Paragraph 4.D.(7) again to identify the locations of the image to get a PA measurement of 3.8 ±0.5 mm. See Detail III in Figure 3.

(11) Put the probe at notch “C” on the reference standard and maximize the signal on the sector scan display. See Detail IV in Figure 3.

(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 Paragraph 4.D.(7) again to identify the locations of the image to get a PA measurement of 8.9 ±0.5 mm. See Detail V in Figure 3.

(14) Put the probe at notch ‘‘D’’ on the reference standard and maximize the signal on the sector scan display. See Detail IV in Figure 3.

(15) Set the beam cursor on the notch image.

(16) If the signal is less than 95% of FSH, adjust the signal height and make a record of the additional gain. Do Paragraph 4.D.(7) again to identify the locations of the image to get a PA measurement of -1.6 ±0.5 mm. See Detail VI in Figure 3.

(17) If additional gain was added in Paragraph 4.D.(10), Paragraph 4.D.(13) or Paragraph 4.D.(16), record this gain setting and use it as the calibration gain level. If no gain was added, use the gain level recorded in Paragraph 4.D.(5).

E. Move the probe to a fastener location that has approximately the same fastener to edge distance. See Detail IV in Figure 3, for a typical probe position at a fastener location. Do the steps that follow:

(1) Add sufficient gain to the calibration gain level set in Paragraph 4.D.(17) 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 Detail VI in Figure 3. The fastener position can change a small quantity for different skin thicknesses.

(3) Remove the gain added in Paragraph 4.E.(1) and set the gain level to the value recorded in Paragraph 4.D.(17).

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.

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

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

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

(1) To examine airplane skins without paint.

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(a) Make a note of the calibration gain level that was set in Paragraph 4.D.(17). 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 Paragraph 4.D.(17) 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 to use a combination of analog gain (dBA) and digital gain (dBD) to add the additional gain necessary.

E. Refer to Figure 4 for examples of sector scan screen displays of calibration notch "A" of reference standards NDT1096-070, NDT1096-110, NDT1096-155, NDT1096-215 and NDT1096-275.

F. Refer to Figure 5 for examples of sector scan screen displays that show notch images “B” and “C” from reference standard NDT1096-155. The screen displays show multiple notch images and the difference in the location and angle between the “B” and “C” notches.

G. Put a sufficient quantity of couplant on the inspection areas. Use the same couplant on the airplane that was used on the reference standard during the calibration in Paragraph 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.

H. 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 Figure 1 for the typical probe position.

I. 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 Paragraph 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 Paragraph 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.

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6. **Inspection Results**

A. Red images on the sector scan display that occur at the approximate angle (±5 degrees) and at PA distances between -2.0 to 9.0 mm (the same locations 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 Paragraph 4.D.(17).

(b) If the inspection area is painted, make sure you add the additional gain specified in Paragraph 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.

(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 Paragraph 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 Paragraph 4.D.(3) thru Paragraph 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 Paragraph 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.

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(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 "D" (0.00 to -2.0 mm), examine the area with high frequency eddy current as specified in Part 6, 53-30-22.

(c) If the red image in the sector scan display is between the PA distances set for notches "A" and "C" (0.00 to 9.0 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 Paragraph 1.D.(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 Paragraph 6.A.(4)(c)1), or if the lower skin thickness is more than 0.040 inch (1.02 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 Paragraph 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 Figure 5).

<b> Put the probe at probe position 1 (see Figure 6).

<c> Move the probe toward EDM notch D 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 Figure 6).

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<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, Procedure 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 Paragraph 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 Paragraph 6.A.(4)(c)1) and Paragraph 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 Paragraph 6.A. of this procedure, the indication must be thought to be from a crack. If the eddy current procedures specified in Paragraph 6.A. cannot be done, the ultrasonic indication must be thought to be from a crack.

C. It is not necessary to examine the red areas on the sector scan that occur outside of the PA distances of -2.0 to 9.0 mm.

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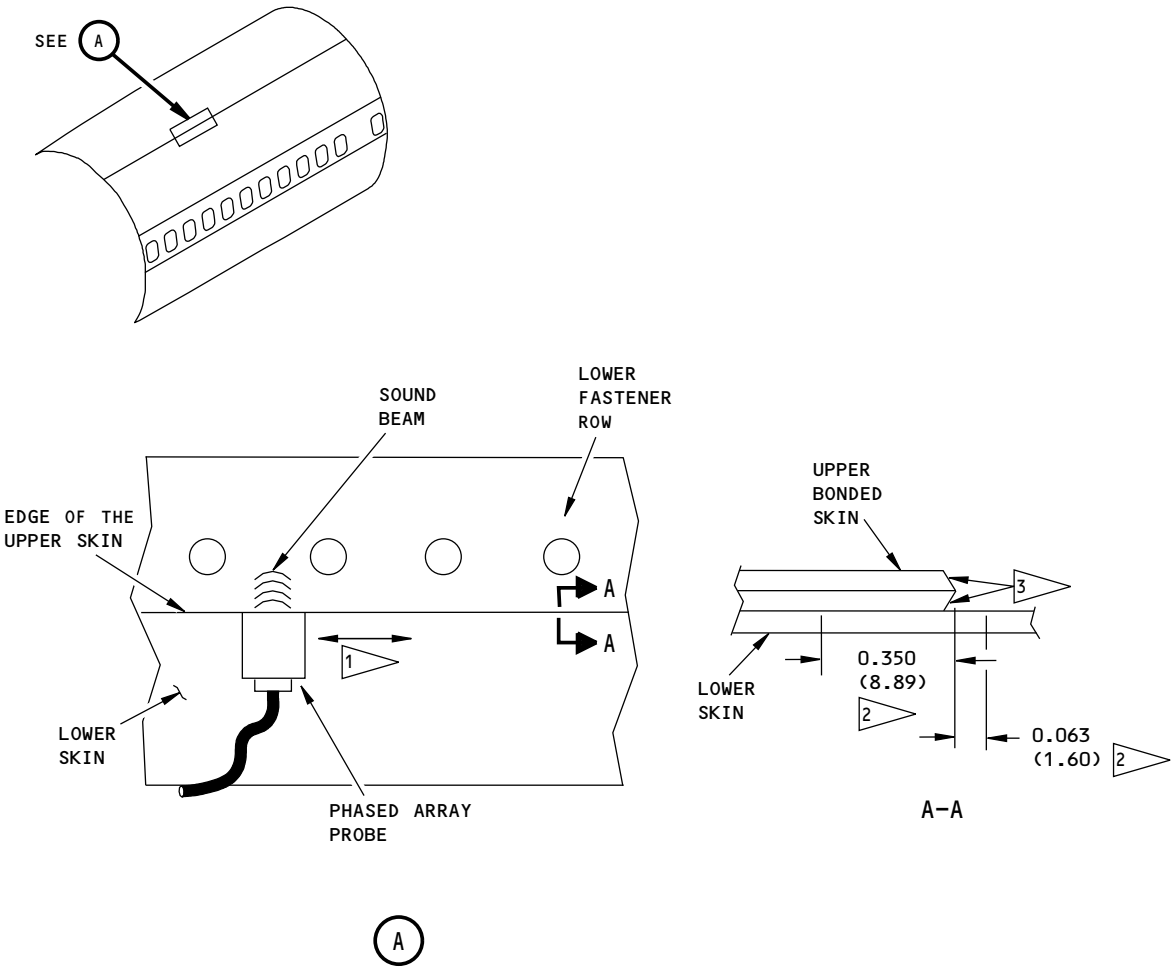

NOTES:

- 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

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Inspection Areas
Figure 1

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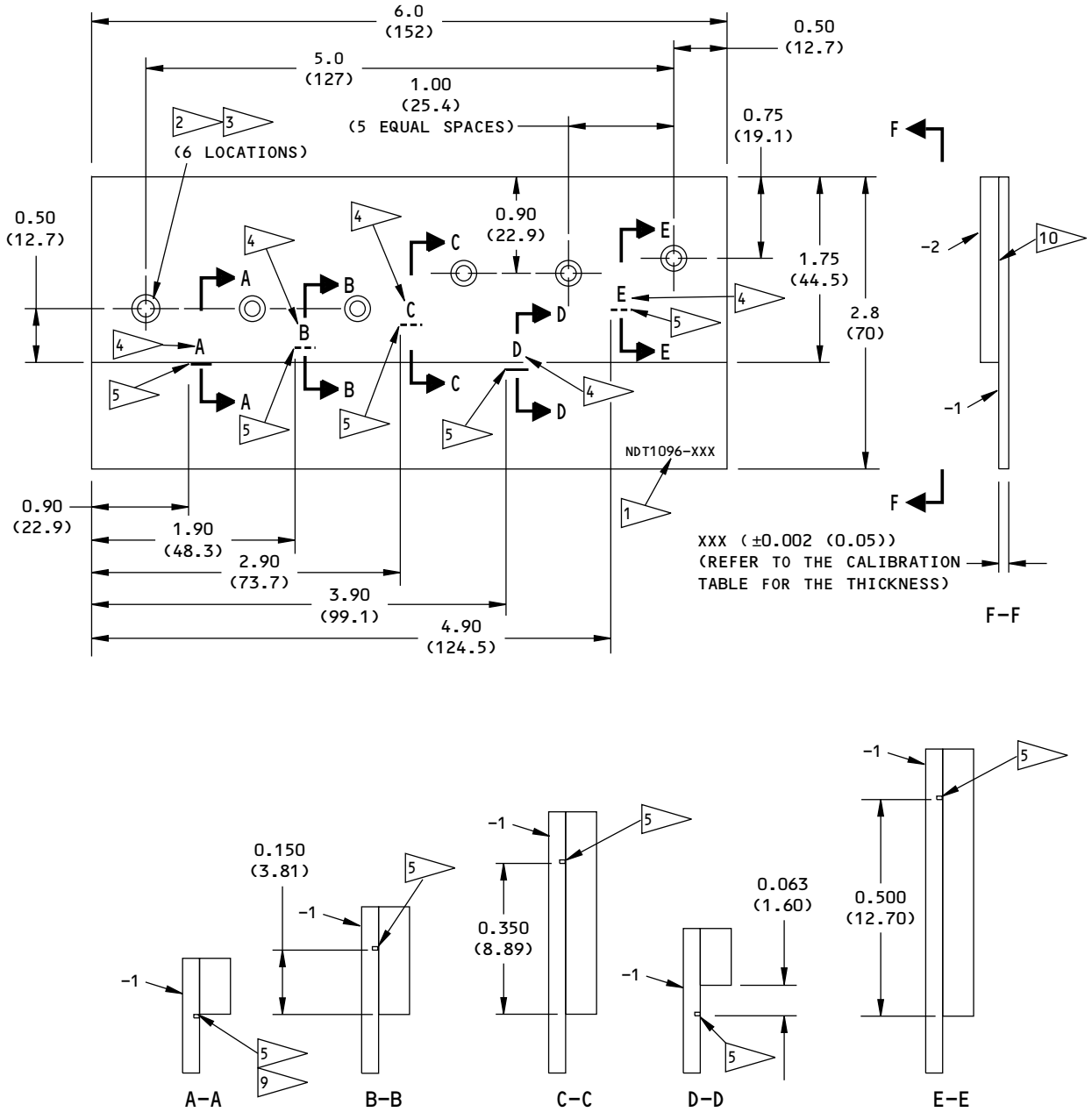

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Reference Standard NDT1096-XXX
Figure 2 (Sheet 1 of 2)

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NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (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.

1 ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER, NDT1096-XXX, AT APPROXIMATELY THIS LOCATION. XXX IDENTIFIES THE BOTTOM PIECE THICKNESS, IN THOUSANDTHS OF AN INCH.
EXAMPLE: NDT1096-050 USES A -1 BOTTOM PIECE THAT IS 0.050 INCH (1.27) THICK.

2 BACR15GF5D RIVET (6 LOCATIONS). USE A RIVET LENGTH FOR THE TOTAL REFERENCE STANDARD THICKNESS AS FOLLOWS:
-4 FOR A THICKNESS UP TO 0.100 (2.54)
-5 FOR A THICKNESS BETWEEN 0.100 TO 0.150 (2.54 TO 3.81)
-6 FOR A THICKNESS BETWEEN 0.150 TO 0.200 (3.81 TO 5.08)
-7 FOR A THICKNESS BETWEEN 0.200 TO 0.250 (5.08 TO 6.35)
-8 FOR A THICKNESS BETWEEN 0.250 TO 0.300 (6.35 TO 7.62)

3 USE ONLY SUFFICIENT 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 NDT1096-040

7 0.015 (0.38) ±0.002 (0.05) IN NDT1096-050

8 0.020 (0.51) ±0.002 (0.05) IN NDT1096-070, -090, -110, -130, -155, -185, -215, -245, -275, -300

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 SOPM 20-50-19. MAKE SURE THE SEALANT DOES NOT EXTEND OUT FROM THE FAYING SURFACE.

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Reference Standard NDT1096-XXX
Figure 2 (Sheet 2 of 2)

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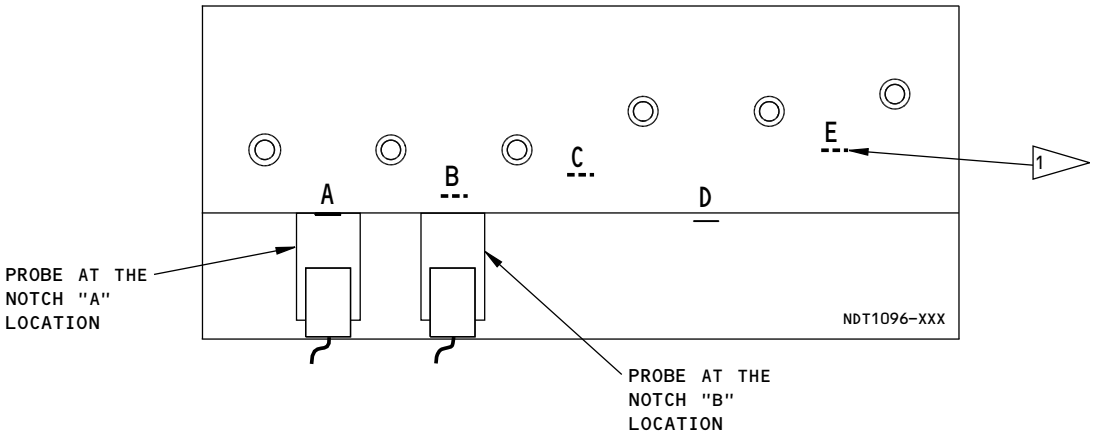

PROBE POSITIONS ON THE REFERENCE STANDARD
DETAIL I

NOTES:

- DETAILS II, III, V, VI AND VII ARE EXAMPLES OF TYPICAL SECTOR SCAN SCREEN DISPLAYS FOR NOTCHES "A" THRU "D" AND AN IMAGE OF A FASTENER FROM THE NDT1096-040 REFERENCE STANDARD. THE IMAGES AND BEAM CURSOR ANGLES MUST BE APPROXIMATELY THE SAME FOR YOUR PROBE AND WEDGE.
- FIGURE 4 HAS EXAMPLES OF SECTOR SCAN SCREEN DISPLAYS OF NOTCH "C" FROM REFERENCE STANDARDS NDT1096-070, NDT1096-110, NDT1096-155, NDT1096-215, NDT1096-245 AND NDT1096-275.
- THE SCREEN DISPLAYS IN DETAILS II, III, V AND VI SHOW THE LOCATION OF THE NOTCH IMAGES AT OR NEAR THE SAME BEAM CURSOR ANGLE. THIS IS TYPICAL FOR THICKNESSES BETWEEN 0.032 TO 0.060 INCH (0.81 TO 1.52 MM). AS THE THICKNESS INCREASES, THE NOTCHES WILL OCCUR AT DIFFERENT BEAM CURSOR ANGLES.

1 THIS NOTCH IS NOT USED IN THIS PROCEDURE AT THIS TIME. IT HAS BEEN ADDED FOR FUTURE CALIBRATION

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Instrument Calibration
Figure 3 (Sheet 1 of 6)

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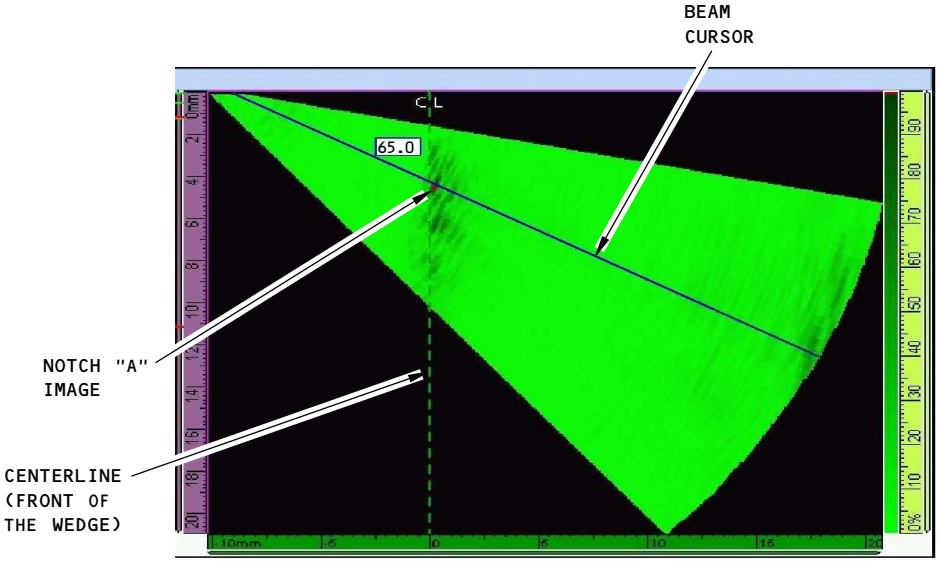
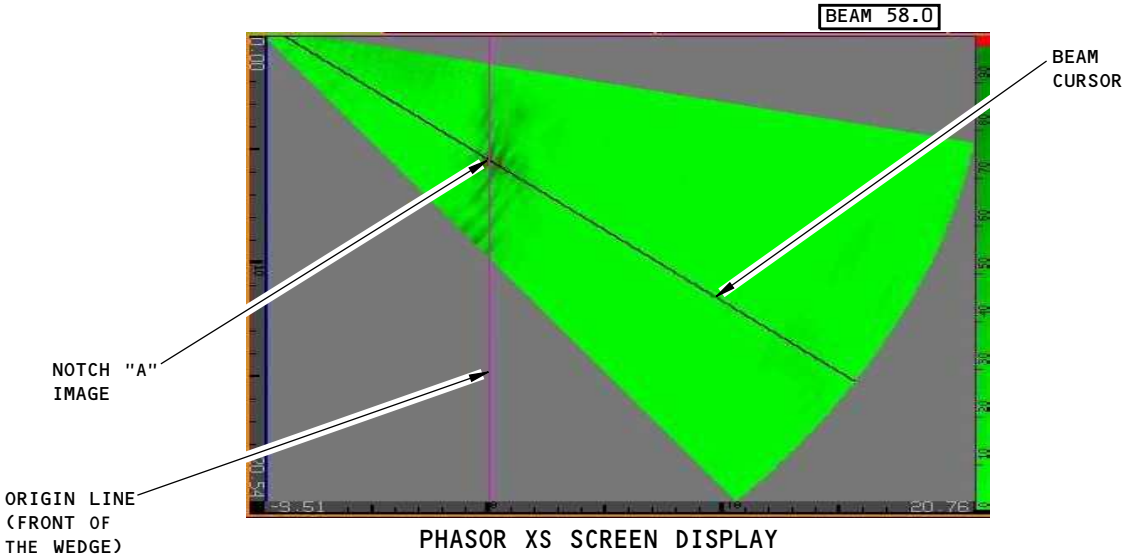


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "A"
DETAIL II

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Instrument Calibration
Figure 3 (Sheet 2 of 6)

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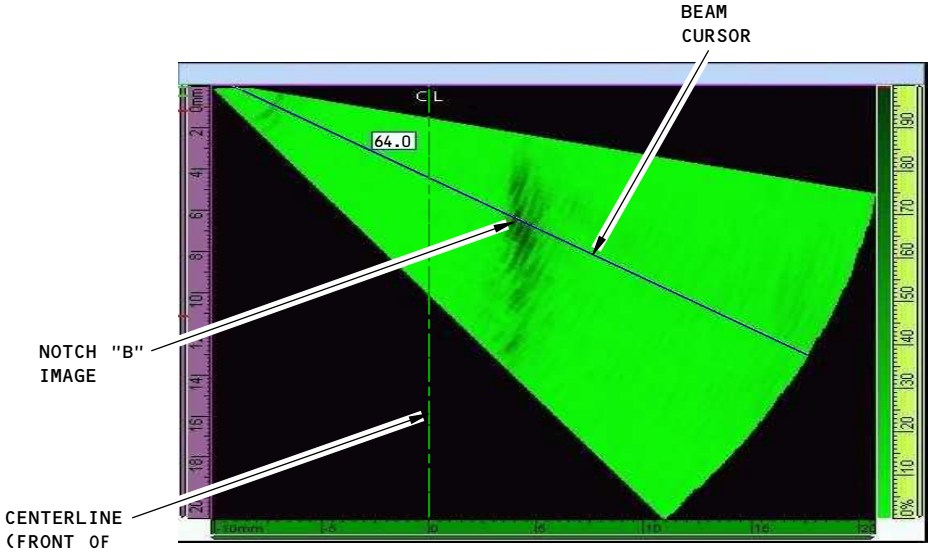
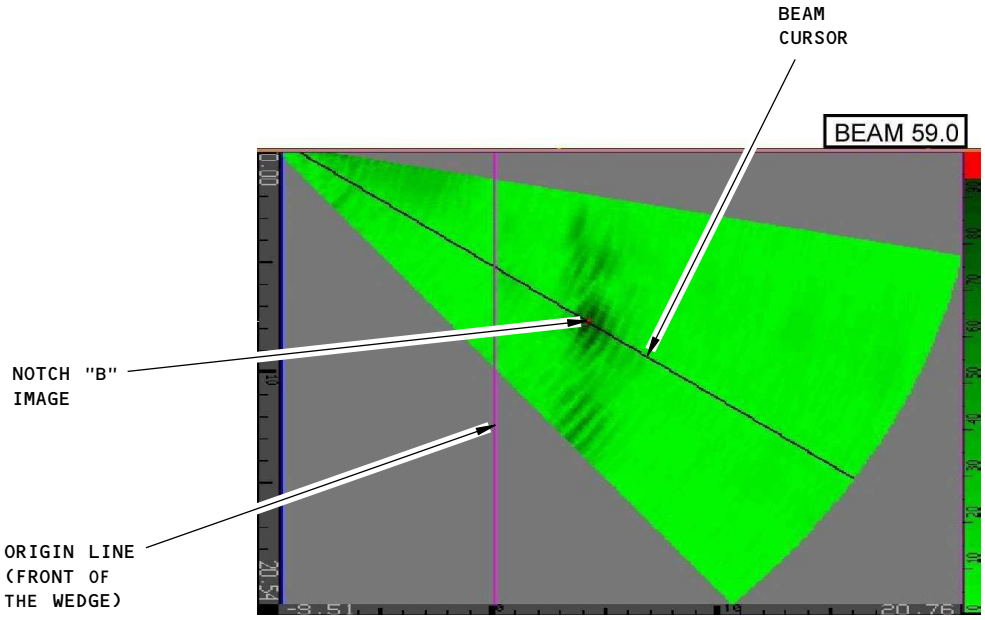


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "B"
DETAIL III

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Instrument Calibration
Figure 3 (Sheet 3 of 6)

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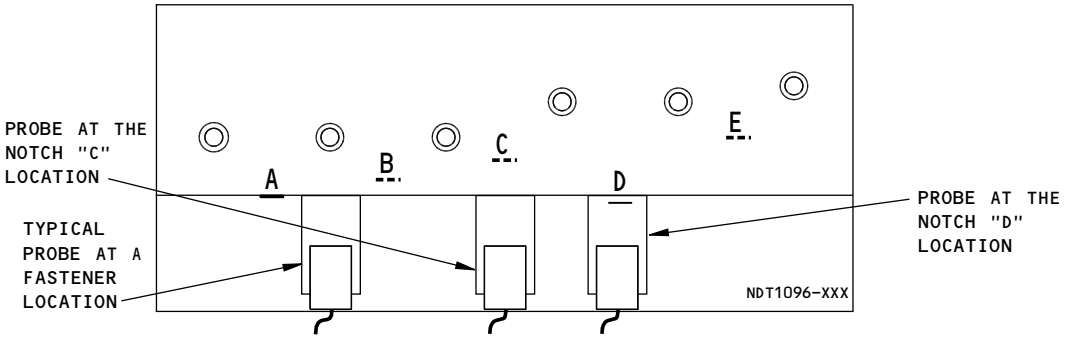
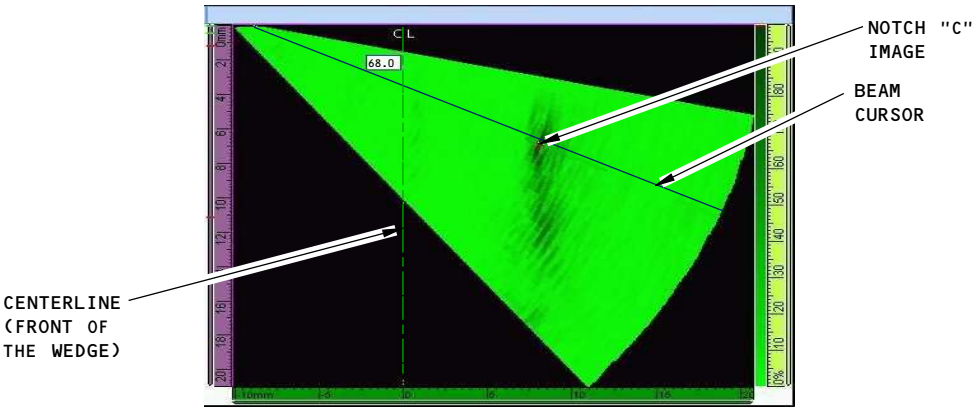
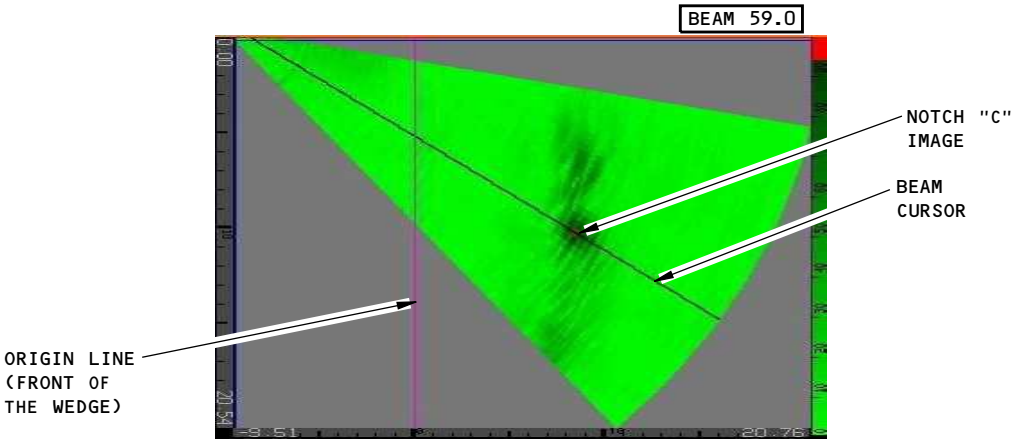


PROBE POSITIONS ON THE REFERENCE STANDARD
DETAIL IV



OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C"
DETAIL V

2130033 S0000458980_V1

Instrument Calibration
Figure 3 (Sheet 4 of 6)

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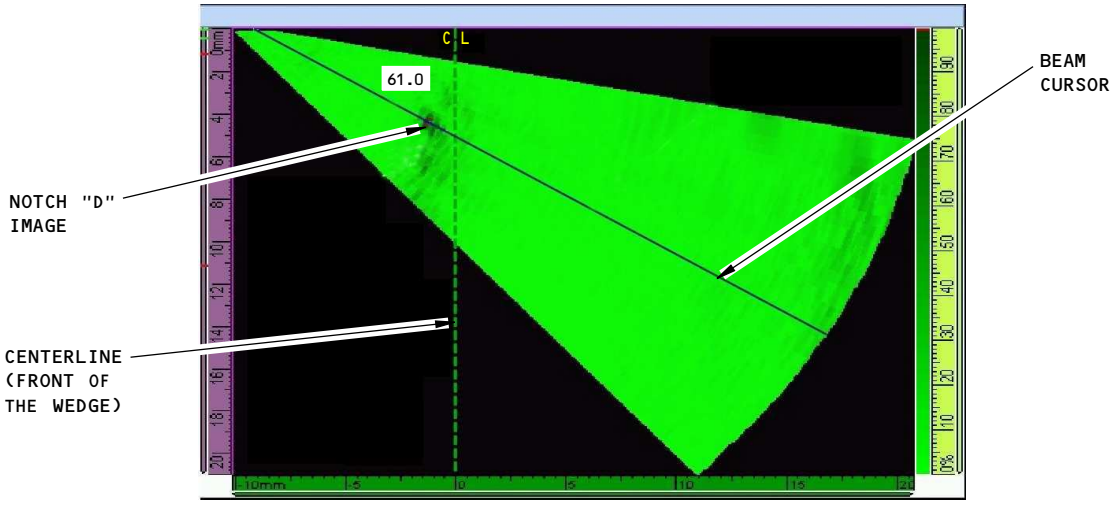
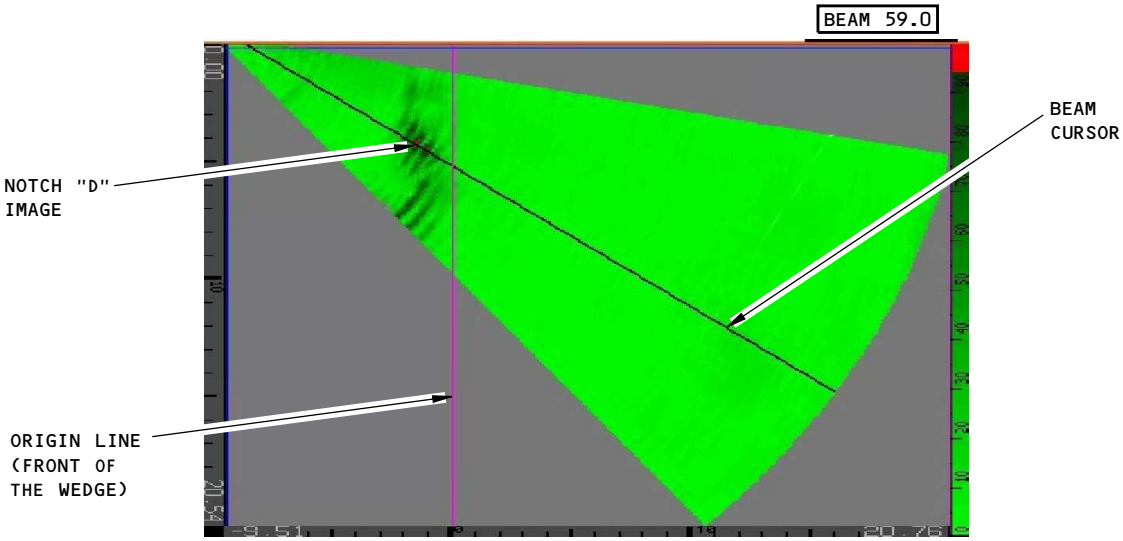


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "D"
DETAIL VI

2130036 S0000458981_V1

Instrument Calibration
Figure 3 (Sheet 5 of 6)

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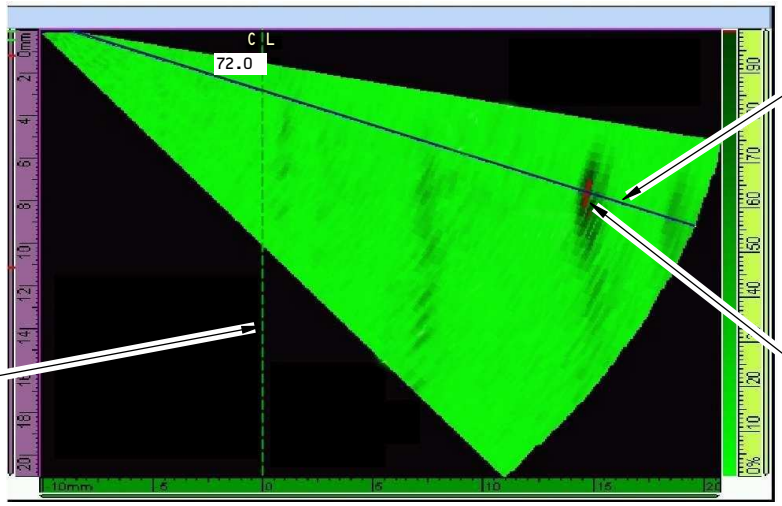
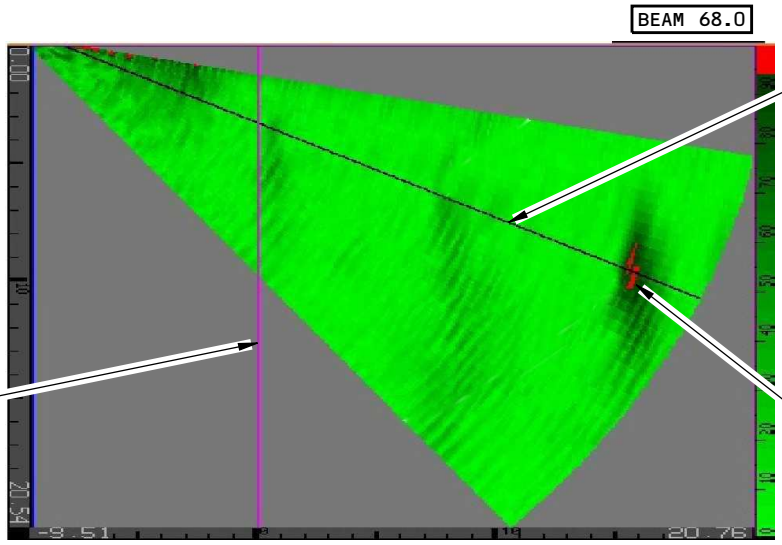


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF THE FASTENER
DETAIL VII

2130037 S0000458982_V1

Instrument Calibration
Figure 3 (Sheet 6 of 6)

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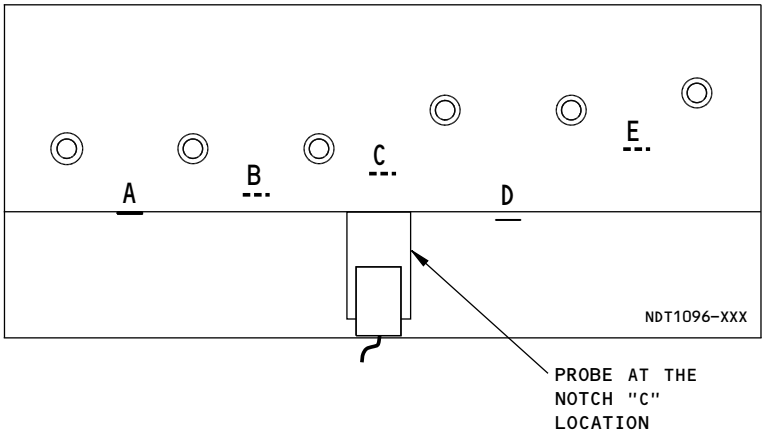

PROBE POSITION ON THE REFERENCE STANDARD FOR NOTCH "C"
DETAIL I

NOTES:

- THE NOTCH IMAGES SHOWN IN DETAILS II THRU VII ARE WITH THE INSTRUMENT GAIN SET EQUAL TO THE CALIBRATION GAIN. THE IMAGES AND BEAM CURSOR ANGLES SHOWN IN DETAILS II THRU VII CAN BE DIFFERENT WITH YOUR PROBE AND WEDGE.

1 DO NOT USE A MULTIPLE NOTCH SIGNAL FOR THE INSTRUMENT CALIBRATION IF IT IS NOT FULLY ON THE SECTOR SCAN

2130038 S0000458983_V1

Sector Scan Screen Displays of Notch "C" for Different Reference Standards
Figure 4 (Sheet 1 of 7)

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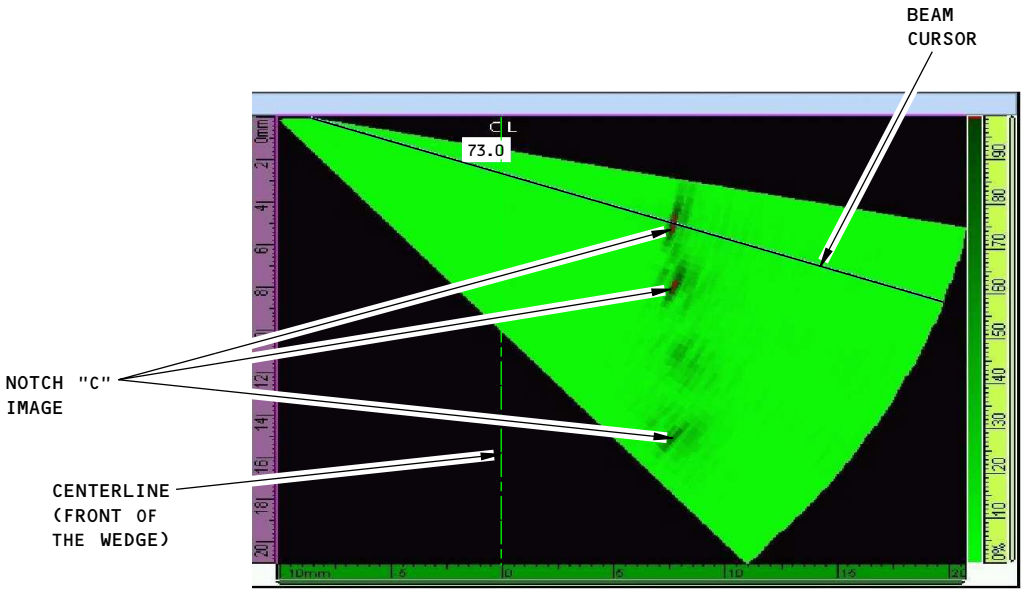
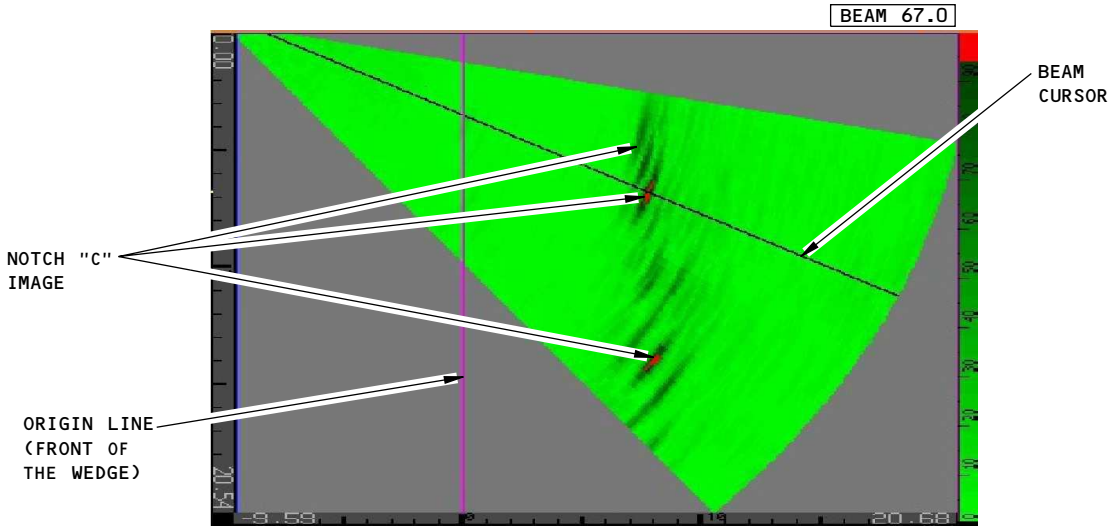


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C" FROM
REFERENCE STANDARD NDT1096-070
DETAIL II

2130039 S0000458984_V1

Sector Scan Screen Displays of Notch "C" for Different Reference Standards
Figure 4 (Sheet 2 of 7)

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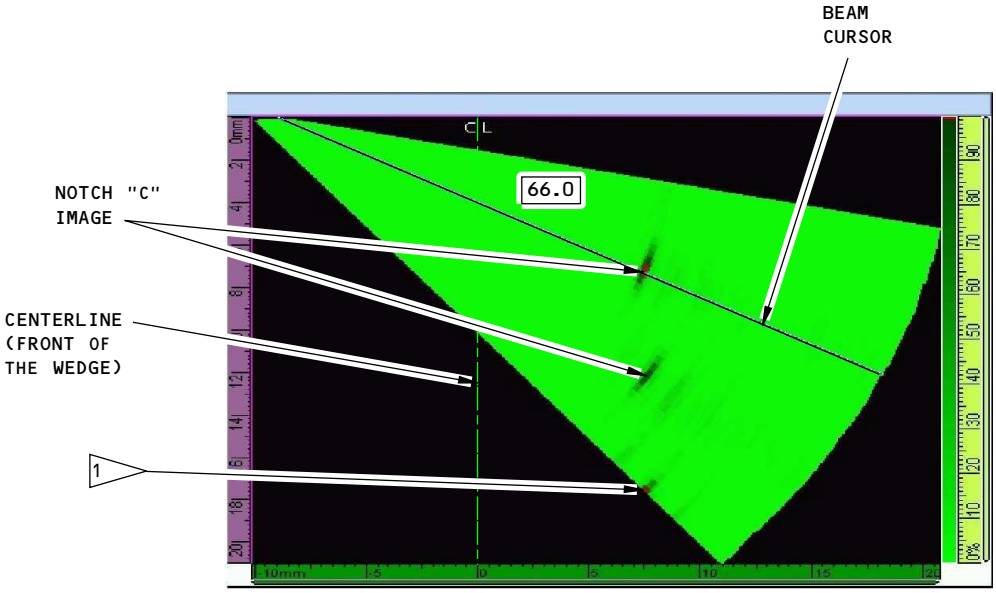

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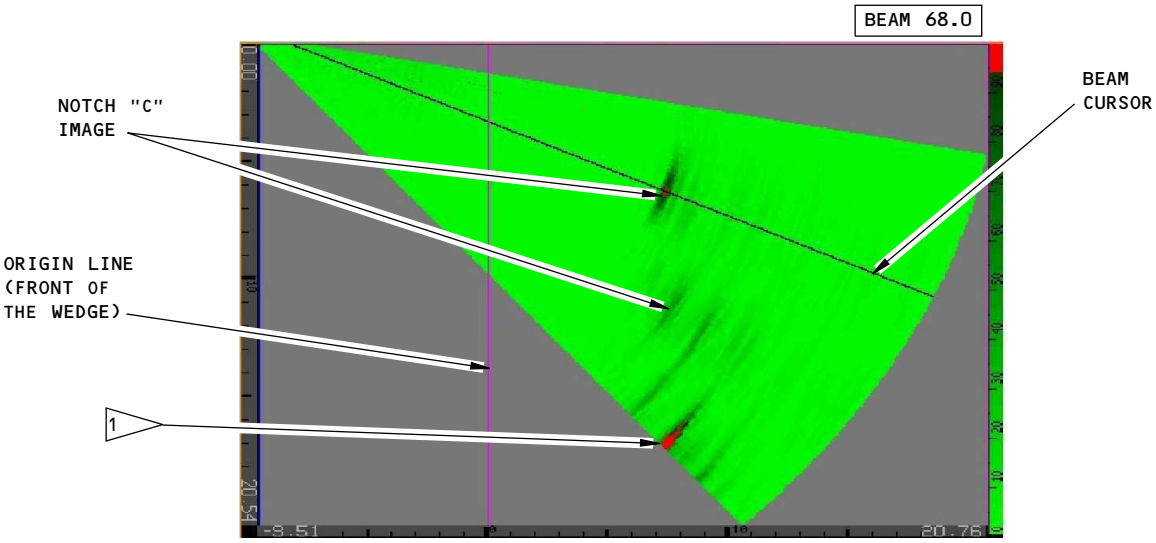

PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C" FROM
REFERENCE STANDARD NDT1096-110
DETAIL III

2130040 S0000458985_V1

Sector Scan Screen Displays of Notch "C" for Different Reference Standards
Figure 4 (Sheet 3 of 7)

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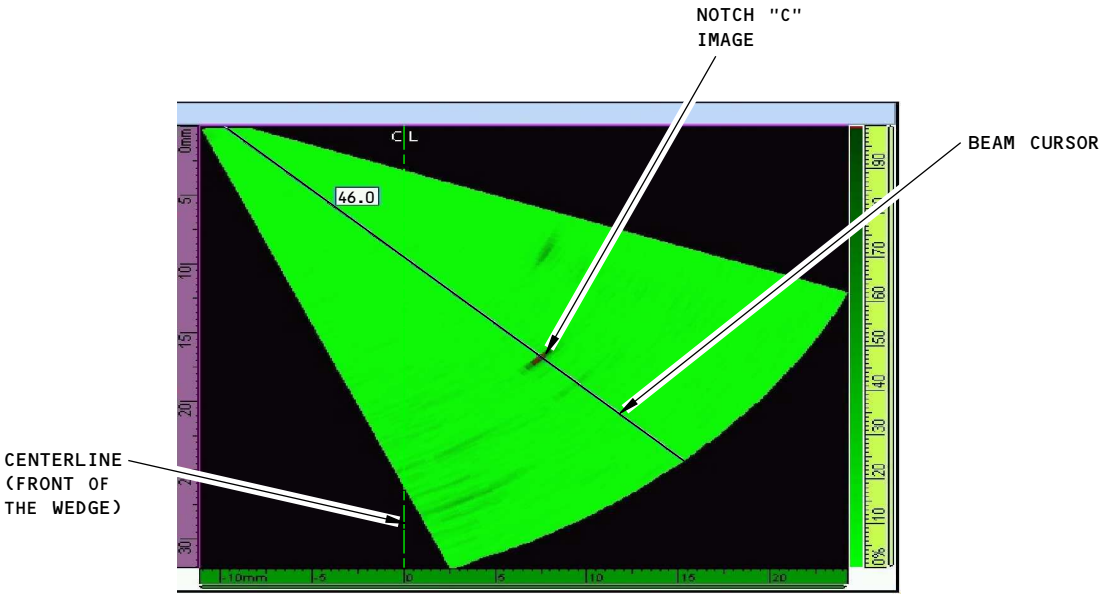

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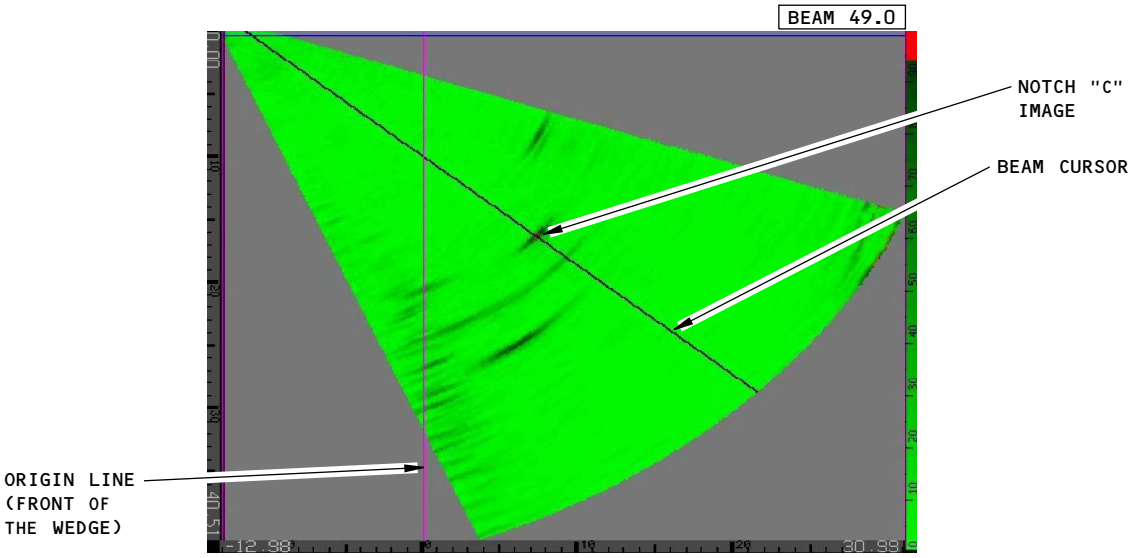

PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C" FROM REFERENCE STANDARD NDT1096-155
DETAIL IV

2130041 S0000458986_V1

Sector Scan Screen Displays of Notch "C" for Different Reference Standards
Figure 4 (Sheet 4 of 7)

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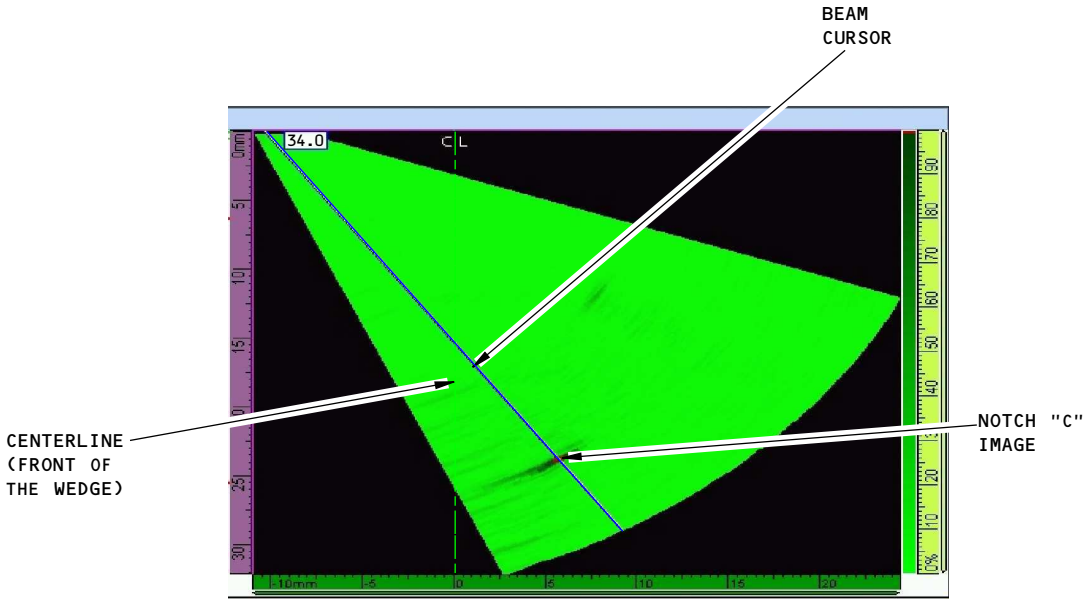
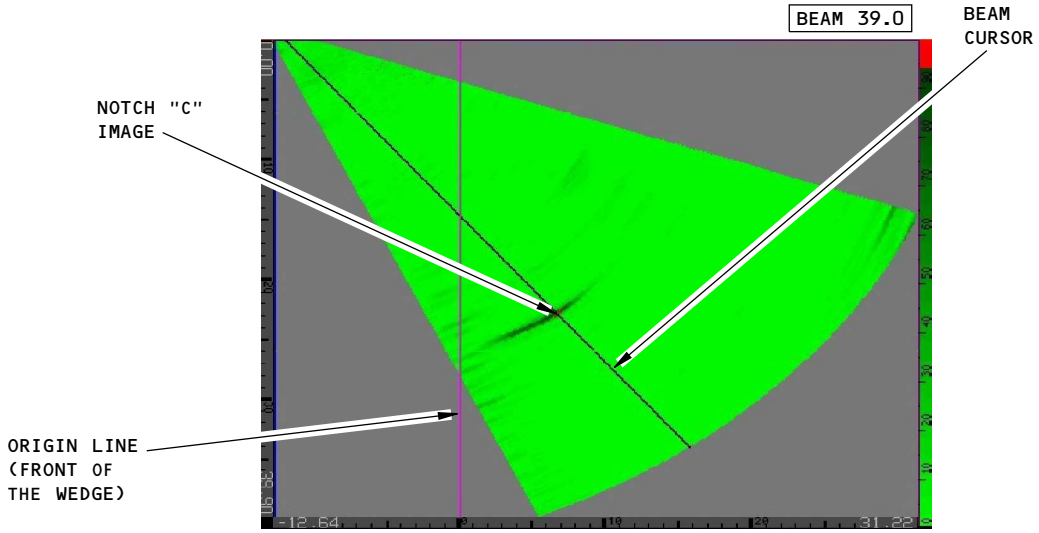


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C" FROM REFERENCE STANDARD NDT1096-215
DETAIL V

2130042 S0000458987_V1

Sector Scan Screen Displays of Notch "C" for Different Reference Standards
Figure 4 (Sheet 5 of 7)

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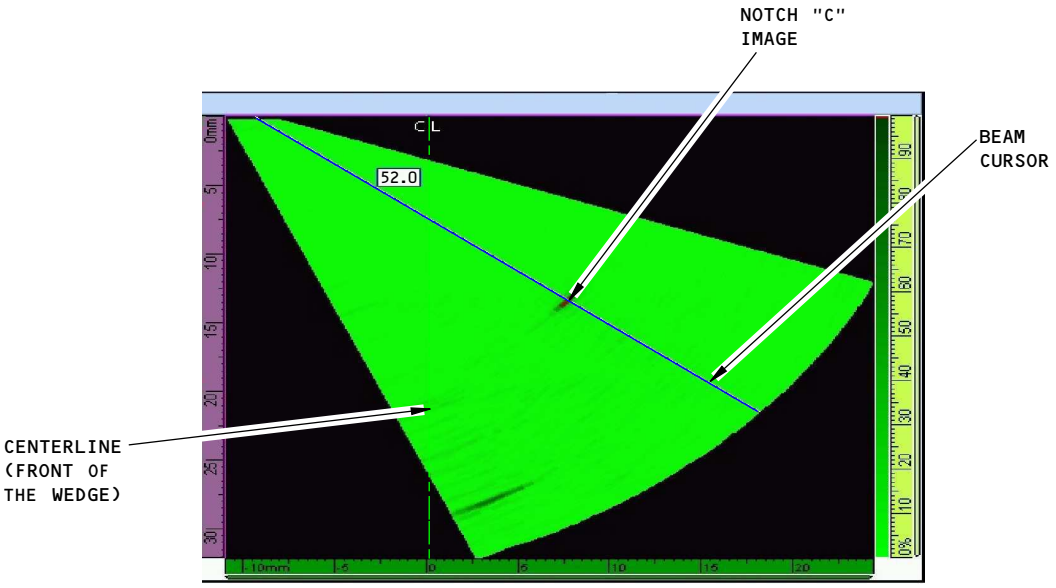

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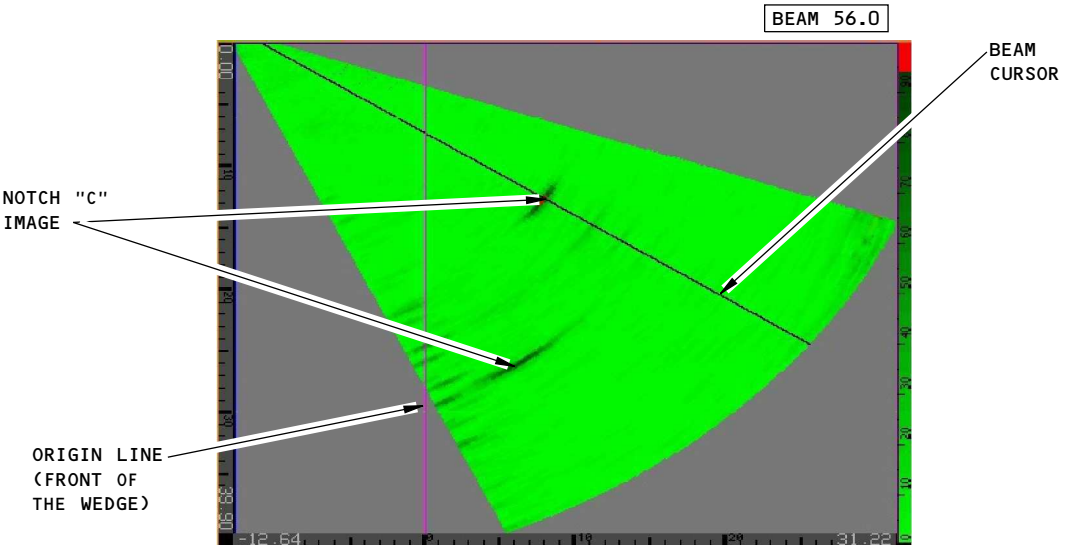

PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C" FROM REFERENCE STANDARD NDT1096-245
DETAIL VI

2130043 S0000458988_V1

Sector Scan Screen Displays of Notch "C" for Different Reference Standards
Figure 4 (Sheet 6 of 7)

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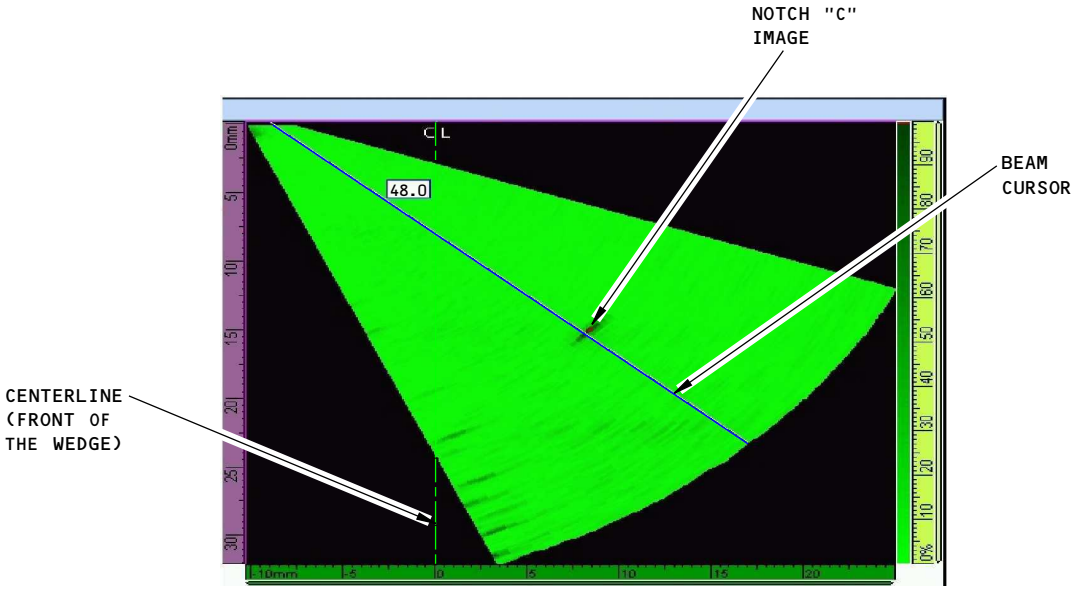
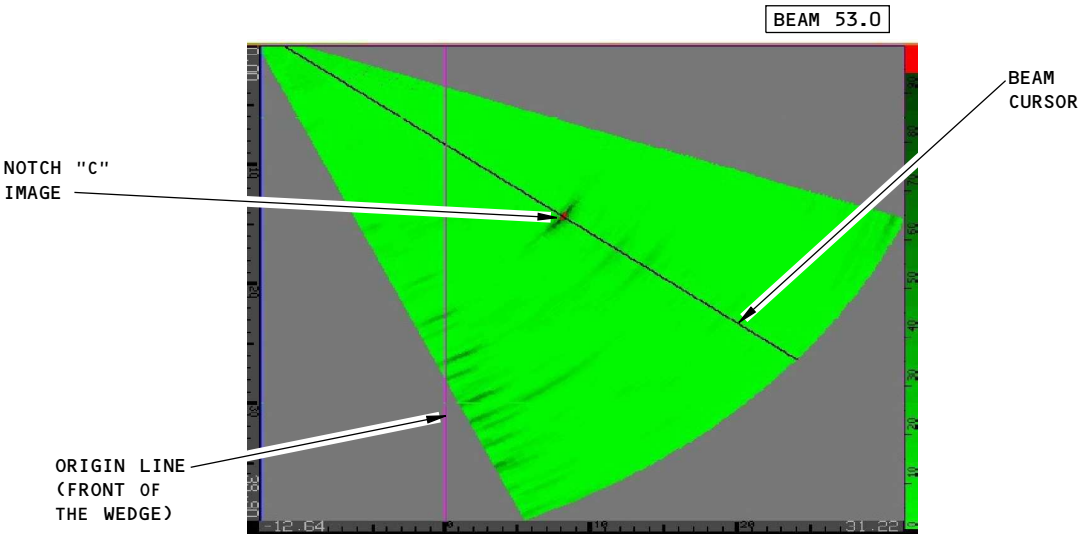


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C" FROM REFERENCE STANDARD NDT1096-275
DETAIL VII

2130044 S0000458989_V1

Sector Scan Screen Displays of Notch "C" for Different Reference Standards
Figure 4 (Sheet 7 of 7)

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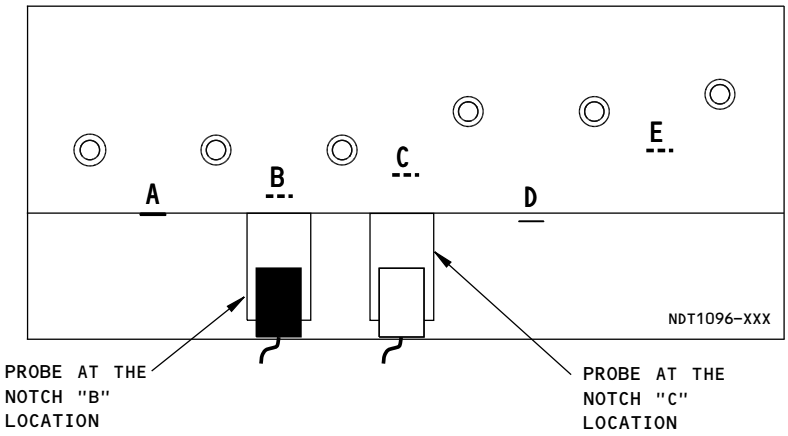

PROBE POSITIONS ON THE REFERENCE STANDARD
DETAIL I

NOTES:

- THE SCREEN DISPLAYS SHOWN IN DETAILS II AND III ARE EXAMPLES OF NOTCHES "B" AND "C" IN REFERENCE STANDARD NDT1096-155. THE SCREEN DISPLAYS SHOW THE LOCATION OF THE NOTCHES IN RELATION TO THE CENTERLINE (FRONT OF THE WEDGE).
- THE SCREEN DISPLAYS IN DETAILS II AND III SHOW MULTIPLE NOTCH IMAGES FROM THE SAME NOTCH. MULTIPLE NOTCH IMAGES WILL OCCUR AT DIFFERENT BEAM CURSOR ANGLES. USE THE LARGEST NOTCH IMAGE TO SET THE CALIBRATION GAIN AND TO HELP MAKE AN ANALYSIS FOR POSSIBLE CRACKS.

2130045 S0000458990_V1

Examples of Notch "B" and "C" Images from the Reference Standard
Figure 5 (Sheet 1 of 3)

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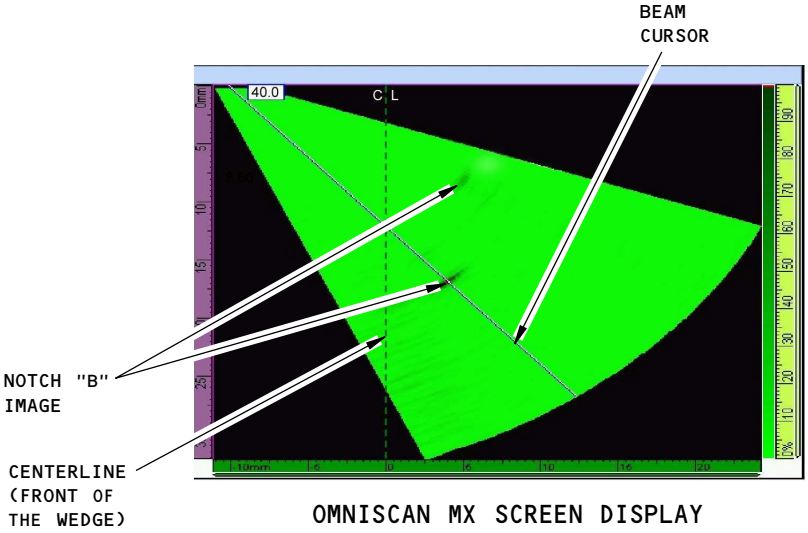
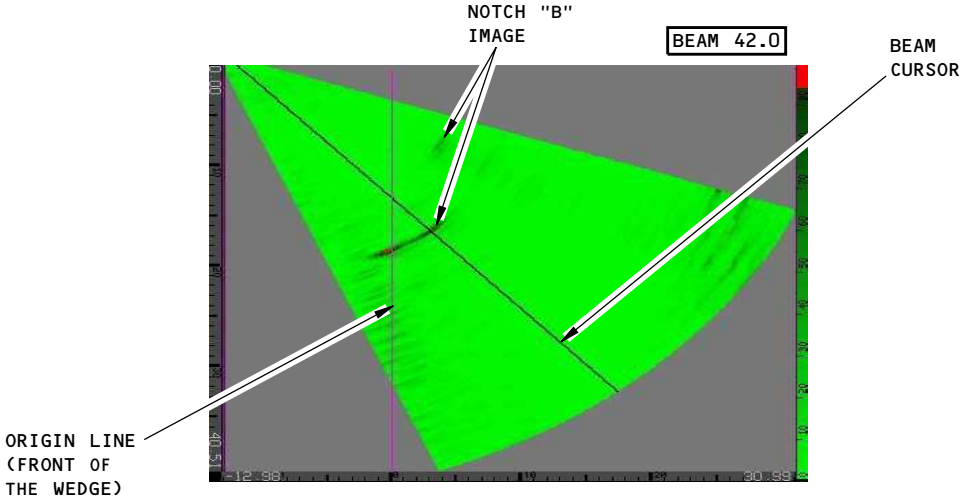


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "B"
DETAIL II

2130046 S0000458991_V1

Examples of Notch "B" and "C" Images from the Reference Standard
Figure 5 (Sheet 2 of 3)

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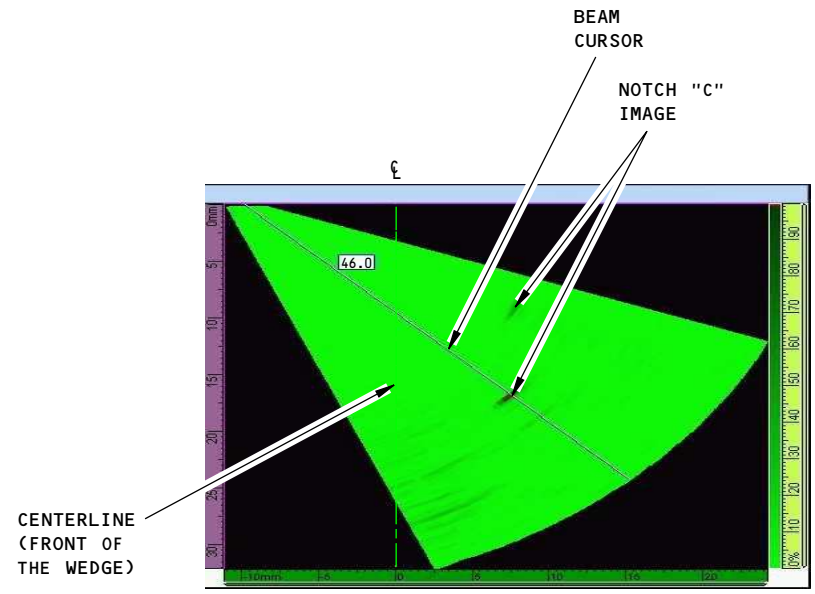
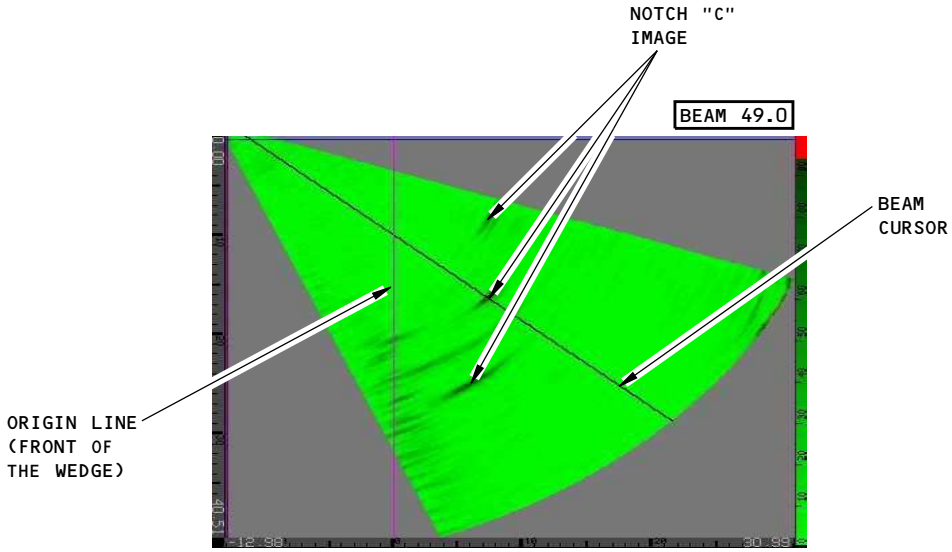


OMNISCAN MX SCREEN DISPLAY



PHASOR XS SCREEN DISPLAY

SCREEN DISPLAYS OF NOTCH "C"
DETAIL III

2130047 S0000458992_V1

Examples of Notch "B" and "C" Images from the Reference Standard
Figure 5 (Sheet 3 of 3)

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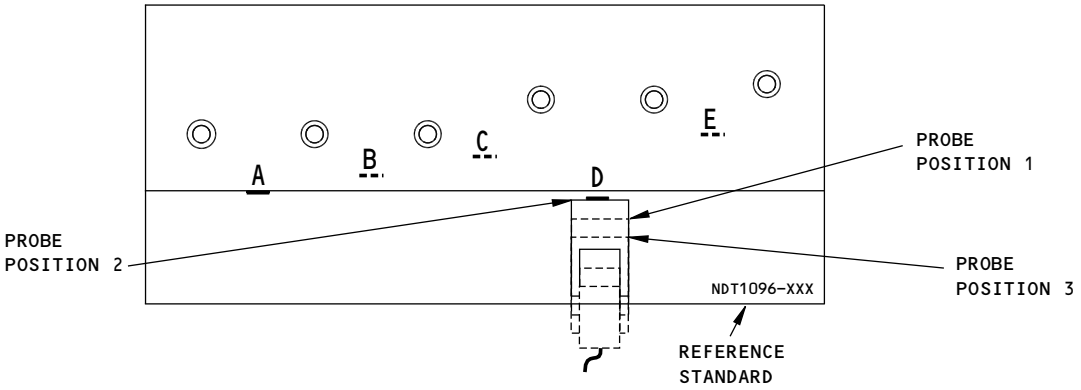

2130048 S0000458993_V1

"Free-field" Calibration
Figure 6 (Sheet 1 of 2)

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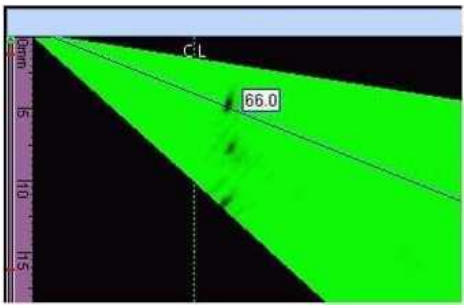
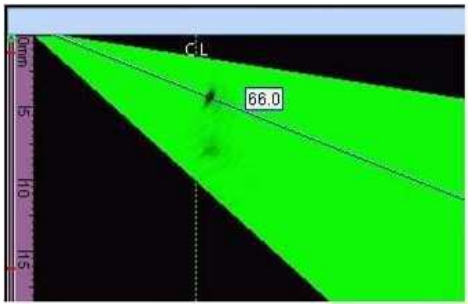
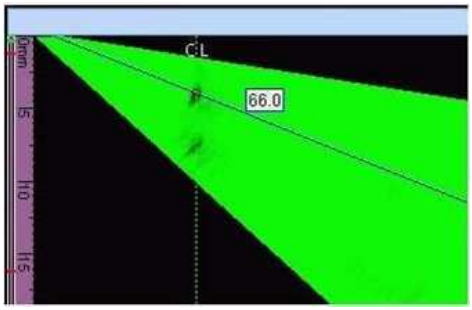


TYPICAL SIGNAL AT PROBE POSITION 1

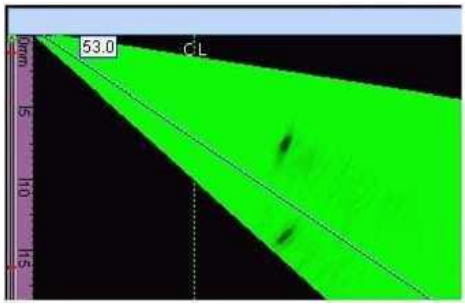


TYPICAL SIGNAL AT PROBE POSITION 2

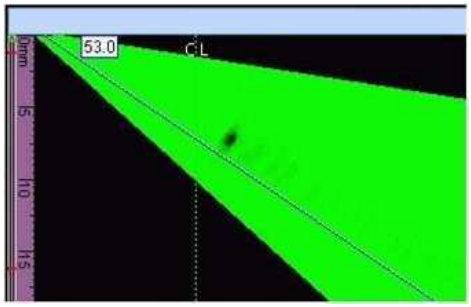


TYPICAL SIGNAL AT PROBE POSITION 3

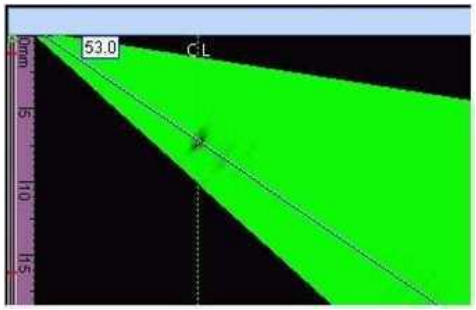
TYPICAL SCREEN IMAGES FOR
"FREE-FIELD" CALIBRATION
(REFERENCE STANDARD NDT1096-070 SHOWN)



TYPICAL SIGNAL AT PROBE POSITION 1



TYPICAL SIGNAL AT PROBE POSITION 2



TYPICAL SIGNAL AT PROBE POSITION 3

TYPICAL SCREEN IMAGES FOR
"FREE-FIELD" CALIBRATION
(REFERENCE STANDARD NDT1096-130 SHOWN)

2130049 S0000458994_V1

"Free-field" Calibration
Figure 6 (Sheet 2 of 2)

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FUSELAGE SKIN CRACK ANALYSIS AT CHEM-MILL AREAS

1. Purpose

A. Use this procedure to:

(1) Make an analysis of possible cracks at the chem-mill edges of aluminum chem-mill skins. The possible cracks are initially found with a low frequency eddy current inspection procedure that examines a wide area with a sliding probe. See Figure 1 for inspection area examples. This procedure is done from the external surface of the airplane.

(2) Make an analysis of crack signals found during a medium frequency eddy current (MFEC) inspection of fuselage skin panels with procedure Part 6, 53-30-23.

B. This procedure can help find cracks at the chem-mill edges of skins with recess areas that are between 0.036 and 0.045 inches (0.91 and 1.14 mm) thick.

C. This procedure looks for cracks that are:

(1) On the inner surface of the skin.

(2) 0.2 inches (5 mm) long or more.

(3) 0.010 inch (0.25 mm) deep or more, measured from the far surface in skins that are from 0.032 to 0.045 inch (0.81 to 1.14 mm) thick.

(4) 0.015 inch (0.38 mm) deep (or more) in skins that are from 0.046 to 0.059 inch (1.17 to 1.50 mm) thick.

(5) 0.020 inch (0.46 mm) deep (or more) in skins that are from 0.060 to 0.140 inch (1.52 to 3.56 mm) thick.

D. Refer to the applicable LFEC or MFEC inspection report to identify the areas where an ultrasonic shear wave analysis is necessary.

E. See Figure 4 for the inspection details.

2. Equipment

A. General

(1) Use inspection equipment that can be calibrated on the reference standard as specified in Paragraph 4.

(2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

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) USM Go; GE

(b) Masterscan 380, Sonatest

C. Transducer

(1) Use a transducer that has the properties that follow:

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(a) Puts a 60 degree shear wave into aluminum.

NOTE: A transducer that puts a 45 or 70 degree shear wave into aluminum is also permitted to use if it agrees with the necessary conditions in this inspection procedure.

(b) Has a maximum length of 1.0 inch (25.4 mm) and a maximum width of 0.38 inch (9.5 mm). Smaller transducers apparently give better sensitivity to the reference notch than larger transducers do.

(c) Has a top or side-mounted connector.

(d) Can satisfactorily do the instrument calibration instructions given in Paragraph 4.

(e) Has a signal-to-noise ratio of 5 to 1 when the reference notch signal is set at 80% of full screen height (FSH).

(2) The transducers that follow were used to help prepare this procedure.

(a) 57A3086; Staveley/Olympus

(b) SUS 1015; NDT Engineering/Olympus

(c) SA-6010S; Olympus

(d) SUS 1020-1; 0.55 inch (14 MM) wide; NDT Engineering Corp./Olympus

(e) XAB-6087; Xactex Corp.

(f) SUS 1020; 0.25 inch (6.4 mm) wide; NDT Engineering Corp./Olympus

(g) TEK-5000-1; Techna NDT

D. Reference Standard

(1) For the inspection of the chem-mill edges of the fuselage chem-mill skins, use reference standard NDT1094-040 or NDT1094-040-A. See Figure 2 for data about the reference standard.

(2) To make an analysis of crack signals that occurred during a MFEC inspection with procedure Part 6, 53-30-23, use the applicable NDT1094-XXX or NDT1094-XXX-A reference standard. See Figure 2 for a drawing of the reference standard. The “XXX” in the reference standard number is the reference standard thickness. Table 1 identifies the reference standard thickness to be used to examine the different airplane skin thicknesses.

Table 1: Calibration Data

Reference Standard	Skin Thickness Range (Nominal)	Wedge
		(a) RD Tech (b) GE
NDT1094-040, NDT1094-040-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

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Table 1: Calibration Data (Continued)

Reference Standard	Skin Thickness Range (Nominal)	Wedge
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

E. Couplant - Use a couplant that will not damage 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.

3. Prepare for the 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 IT IS NECESSARY.

A. Remove a 1.25 inch wide area of paint, primer and sealant from the inspection surface for the length of the area to be examined. Approximately 1 inch (25 mm) of the paint that is removed must be in the chem-mill recess area of the skin panel. See Figure 4, Detail I.

B. Do Paragraph 3.A. at all locations where a crack signal was found with MFEC inspection procedure Part 6, 53-30-23.

4. Instrument Calibration

NOTE: The transducer is put on the rear surface of the reference standard during calibration. Notch “A” and the reference standard identification will be on the far side.

A. Set the instrument frequency to 10 MHz if a broadband instrument is not used.

B. Get the reference standard that is necessary for the skin thickness to be examined. For the inspection of the chem-mill edges of the fuselage chem-mill skins, use reference standard NDT1094-040 or NDT-1094-040-A.

C. Apply a sufficient quantity of couplant on the inspection surface of the reference standard at the transducer position 1 (TP1) location. See Figure 3, Detail I.

D. Put the transducer on the inspection surface of the reference standard at TP1. See Figure 3, Detail I.

E. Adjust the instrument controls (Gain, Delay, Range, and Velocity) as necessary to get a signal from notch “A” to show on the screen display.

(1) To start, set the Range control to 1.0 inch (25 mm) and the shear wave velocity for aluminum material [0.123×10^5 in/μsec (0.313×10^5 cm/μsec)]. This will make sure that the notch signal occurs on the instrument display.

F. Slowly move the transducer to and away from notch “A” and, at the same time, turn the transducer to the left and right a small quantity to get a maximum signal from the notch.

G. Adjust the instrument gain to set the maximum signal from notch “A” to 80% of full screen height (FSH). See Figure 3, Detail II.

H. Adjust the instrument delay and range controls to set the front edge of the notch signal to 40% of FSW with the front edge of the initial pulse set to 0% of FSW. See Figure 3, Detail II.

I. Set the audible alarm to 40% of FSH as shown in Figure 3, Detail II.

NOTE: It is optional to set the audible alarm.

J. 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 to less than 60% of FSH.

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K. Make a record of the gain that was used to set the notch signal to 80% of FSH.

L. Add 6 dB of gain.

5. Inspection Procedure

A. Calibrate the instrument as specified in Paragraph 4.

B. Put a sufficient quantity of couplant on the inspection area. Refer to Figure 4. Use the same couplant on the airplane that was used on the reference standard during the calibration in Paragraph 4.

NOTE: Too much couplant on or in front of the transducer can cause crack type indications to occur. Do not let too much couplant get on or in front of the transducer during a scan.

C. To examine the chem-mill areas of the fuselage skin, put the transducer on the chem-mill recess area, where the paint has been removed, with the front of the transducer pointed to the inspection area. See Figure 4 for the typical transducer position. To examine an area where possible cracks were found during a MFEC inspection with procedure Part 6, 53-30-23, put the transducer at the location where a crack signal occurred (with the paint removed), with the front of the transducer pointed at the crack location.

D. Make a scan of the inspection area and monitor the instrument screen display at all times. During the scan:

(1) Make sure the transducer is pointed in the correct direction during the complete scan of the inspection area.

(2) Make sure to fully examine the inspection area. Refer to Figure 4, Section A-A.

(3) Do not move the transducer faster than the maximum scan speed identified during calibration in Paragraph 4.J.

(4) Remove couplant from the front of the transducer as necessary to prevent signals that can occur from the couplant.

6. Inspection Results

A. To make an analysis of possible cracks at the chem-mill edges of the fuselage chem-mill skins, do as follows:

(1) Signals that are 40% of FSH or higher that occur between 35 and 50% 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 with an approved marker to identify the areas that cause crack indications to occur.

NOTE: Crack signals can occur after 50% of FSW if the transducer is moved away from the inspection area.

(2) Remove all couplant from the inspection surface and the transducer. Then use only a small quantity of couplant to see if the signal occurs again.

(3) Do a check of the instrument calibration to make sure the sensitivity is correct. When you do this, also see how the signal from the notch in the reference standard compares to the signal you get on the airplane.

(4) Signals that are less that 40% of FSH are not crack indications.

B. To make an analysis of crack signals found during a MFEC inspection with procedure Part 6, 53-30-23, do as follows:

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(1) All areas that cause ultrasonic crack signals that occur between 35 and 50% of FSW and are 50% of FSH (or more) on the A-Scan and red images on the S-Scan display must be rejected and no more analysis is necessary.

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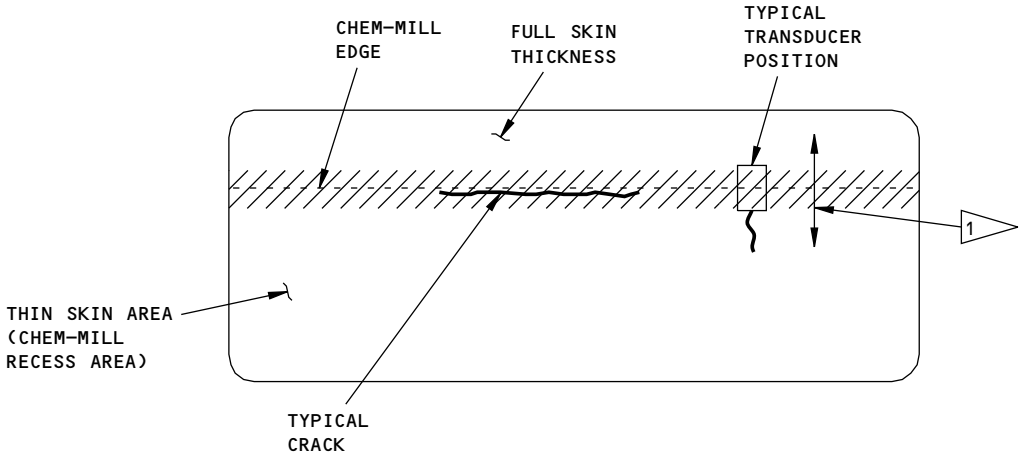
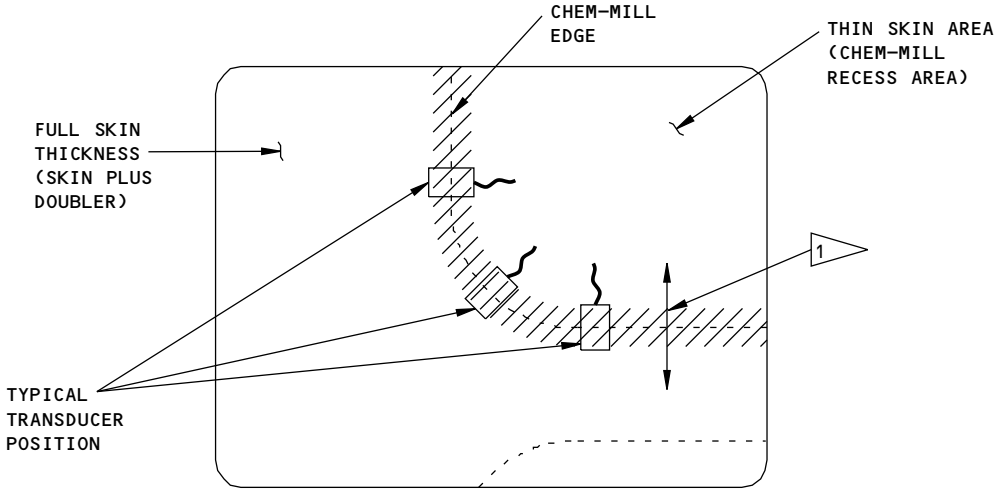


INSPECTION AREA ALONG A STRAIGHT CHEM-MILL EDGE
DETAIL I



INSPECTION AREA ALONG A CURVED CHEM-MILL EDGE
DETAIL II

NOTES:

TYPICAL INSPECTION AREA ALONG THE CHEM-MILL EDGE AS SPECIFIED IN THE SERVICE BULLETIN.

1 PUT THE TRANSDUCER ON THE THIN SKIN AREA WITH THE SOUND BEAM POINTED AT THE CHEM-MILL EDGE. MOVE THE TRANSDUCER FORWARD AND REARWARD ACROSS THE EDGE OF THE DOUBLER FOR THE FULL LENGTH OF THE TRANSDUCER AS YOU MAKE A SCAN ALONG THE EDGE OF THE DOUBLER.

2229709 S0000497120_V1

Inspection Areas
Figure 1

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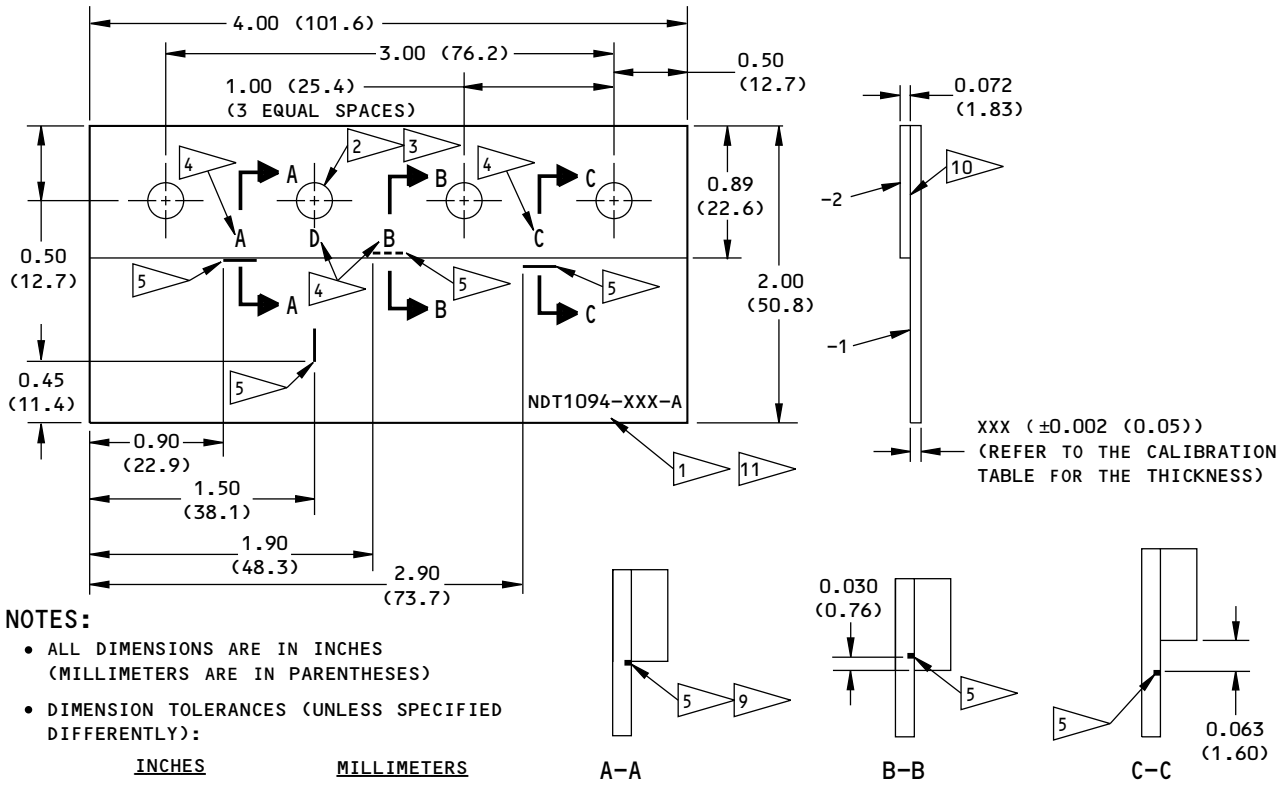

NOTES:

- 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.

1 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.

2 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)

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 NDT1094-040-A

7 0.015 (0.38) ±0.002 (0.05) IN NDT1094-050-A

8 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

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 SOPM 20-50-19. MAKE SURE THE SEALANT DOES NOT EXTEND BEYOND THE FAYING SURFACE.

11 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.

2229724 S0000497121_V2

Reference Standard NDT1094-040-A
Figure 2

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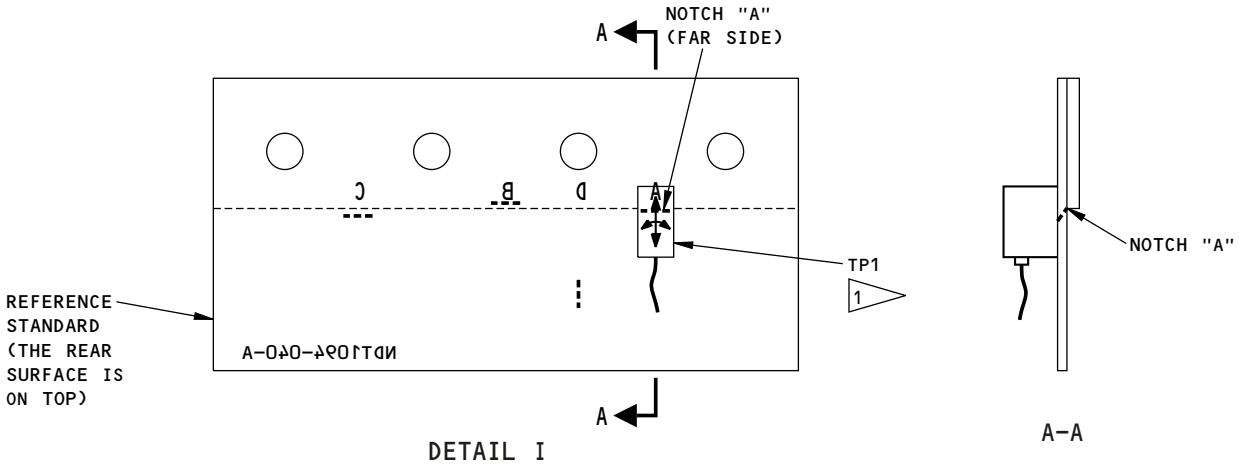

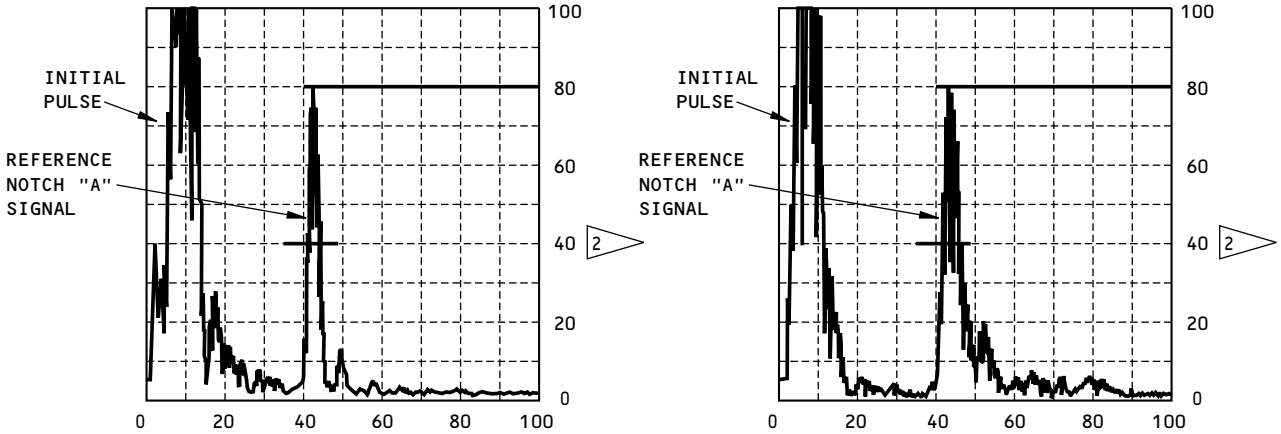

EXAMPLE SCREEN DISPLAY OF THE INSTRUMENT CALIBRATION WITH TRANSDUCER SA-6010S

EXAMPLE SCREEN DISPLAY OF THE INSTRUMENT CALIBRATION WITH TRANSDUCER SUS-1015

DETAIL II

NOTES:

- THE REAR SURFACE OF THE REFERENCE STANDARD IS UP (ON TOP) FOR THIS INSTRUMENT CALIBRATION.
- USE THE INSTRUMENT CONTROLS TO SET THE MAXIMUM SIGNAL FROM REFERENCE NOTCH "A" TO 40% OF FSW AND 80% OF FSH.
- TO HELP DURING THE INSTRUMENT CALIBRATION, MAKE AN ACCURATE LINE ON THE TOP SURFACE OF THE REFERENCE STANDARD AT THE LOCATION OF REFERENCE NOTCH "A".

1 TO GET A MAXIMUM SIGNAL FROM THE REFERENCE NOTCH, MOVE THE TRANSDUCER TO AND AWAY FROM THE NOTCH AND, AT THE SAME TIME, TURN THE TRANSDUCER TO THE LEFT AND RIGHT A SMALL QUANTITY (APPROXIMATELY ±2°).

2 REJECT LEVEL: SIGNALS THAT ARE 40% OR MORE OF FSH THAT OCCUR BETWEEN 35 AND 50% OF FSW ARE POSSIBLE CRACKS AND MORE ANALYSIS IS NECESSARY.

2230266 S0000497123_V1

Instrument Calibration
Figure 3

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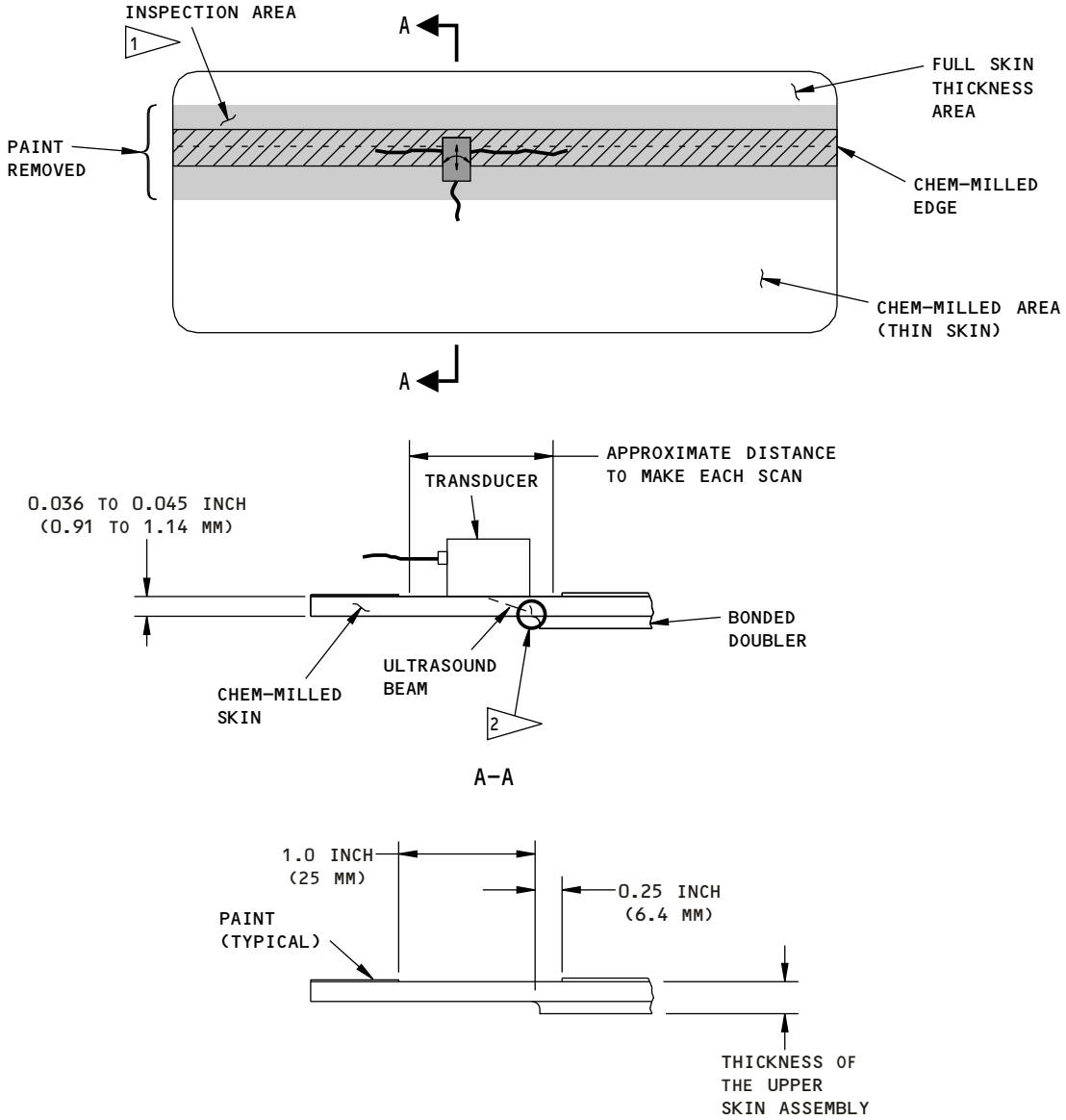

NOTES:

INSPECTION AREA

- REMOVE THE PAINT AT EACH INSPECTION AREA AS SHOWN IN DETAIL I
- TO EXAMINE EACH INSPECTION AREA, THE TRANSDUCER MUST BE PUT ON THE CHEM-MILLED AREA OF THE SKIN AND POINT TO THE INSPECTION AREA

1 THE INSPECTION AREAS CAN BE DIFFERENT FOR DIFFERENT OPERATORS

2 THE INSPECTION AREA IS AT THE EDGE OF THE CHEM-MILLED AREA, WHERE THE MATERIAL INCREASES IN THICKNESS.

2230193 S0000497124_V1

Inspection Details
Figure 4

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PART 4 - ULTRASONIC

AFT PRESSURE PANEL OF THE APU ENCLOSURE

1. **Purpose**
   A. Use this procedure to examine the aft pressure panel of the APU enclosure for cracks. The aft pressure panel is examined at 17 fastener hole locations. See Figure 1 for the inspection area.
   B. 737 Damage Tolerance Rating (D626A001-DTR):
      (1) Item: 53-80-17-6
2. **Equipment**
   A. General
      (1) All ultrasonic test instruments are permitted for use if they can be calibrated on the reference standard as specified in Paragraph 4.
      (2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.
   B. Instrument
      (1) The pulse echo ultrasonic instruments that follow were used to help prepare this procedure.
         (a) USN 60; GE Inspection Technologies
         (b) USM Go; GE Inspection Technologies
   C. Transducer
      (1) Use a transducer that:
         (a) Operates at 5 MHz.
         (b) Causes a 60 degree shear wave to occur in aluminum.
         (c) Has a maximum length of 0.375 inch (9.53 mm).
      (2) The transducer that follows was used to help prepare this procedure.
         (a) XA-605T; Techna NDT
   D. Reference Standard
      (1) Use reference standard NDT3147 to help calibrate the equipment. See Figure 2 for data about reference standard NDT3147.
   E. Couplant
      (1) Use couplant that is permitted for use with the airplane structure.
3. **Prepare for the Inspection**
   A. Identify the inspection area shown in Figure 1.
   B. Remove sealant or loose paint and clean the area that the transducer will touch.
4. **Instrument Calibration**
   A. Connect the transducer to the instrument.
   B. Put couplant on the reference standard at transducer position 1 as shown in Figure 3, Detail A.
   C. Set the initial pulse at 0% of full screen width (see Figure 3, Detail C).
   D. Put the transducer on the reference standard at transducer position 1 (see Figure 3, Detail A).

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E. Adjust the transducer to get a signal from the hole.

F. Adjust the hole signal to put it at 50% of full screen width (see Figure 3, Detail C).

G. Move the transducer to transducer position 2 (see Figure 3, Detail B) and turn the transducer as you monitor the signal that occurs from the EDM notch. Keep the transducer as near to the scribe line as possible.

NOTE: Do not move the transducer across the scribe line.

H. Adjust the gain to put the notch signal at 80 percent of full screen height.

I. Move the transducer back to transducer position 1 and monitor how the signal moves back to 50% of full screen width and the hole signal increases.

J. Move the transducer to the side of the hole without a notch. Make sure that a notch signal does not occur when you turn the transducer.

5. Inspection Procedure

A. Find the inspection area on the aft pressure panel of the APU enclosure. See Figure 1.

B. Calibrate the equipment as specified in Paragraph 4.

C. Put couplant on the surface of the aft pressure panel at the approximate transducer locations shown in Figure 1.

NOTE: Because the fasteners are behind the BS 1030 frame, it can be necessary to mark the aft pressure panel at each fastener location before you do the inspection. Put a flat tool through the space between the aft pressure panel and the BS 1030 frame at the center of each fastener and make a small mark on the aft pressure panel or the aft edge of the BS 1030 frame as shown in Figure 1.

D. Put the transducer on the aft pressure panel at one of the 17 fastener locations as shown in Figure 1.

E. Point the transducer to transmit sound at the fastener hole.

F. Turn the transducer to get a signal from the hole. If you cannot get a signal from the fastener hole, increase the gain until you get a signal that is 30% of full screen height.

G. Turn the transducer away from the hole to examine each side of the fastener hole as shown in Figure 1 and monitor the screen display for crack signals.

H. Do Paragraph 5.C. thru Paragraph 5.G. again for all 17 fastener locations shown in Figure 1.

6. Inspection Results

A. Signals that are 40 percent (or more) of full screen height and are immediately to the right of the hole signal can be crack indications.

B. If you get a crack indication, remove the couplant from the surface of the aft pressure panel in front of the transducer and do the scan again. Too much couplant on the surface can cause an incorrect crack indication to occur.

C. Compare the signal from the crack indication with the signal you get from the EDM notch in the reference standard. Put the transducer the same distance from the hole on the reference standard that it was from the hole on the airplane.

(1) A signal that is almost the same as the one you got from the EDM notch in the reference standard is a crack indication.

D. Remove the fastener to do an open hole eddy current inspection as specified in Part 6, 51-00-00, Procedure 16, to make sure there is a crack.

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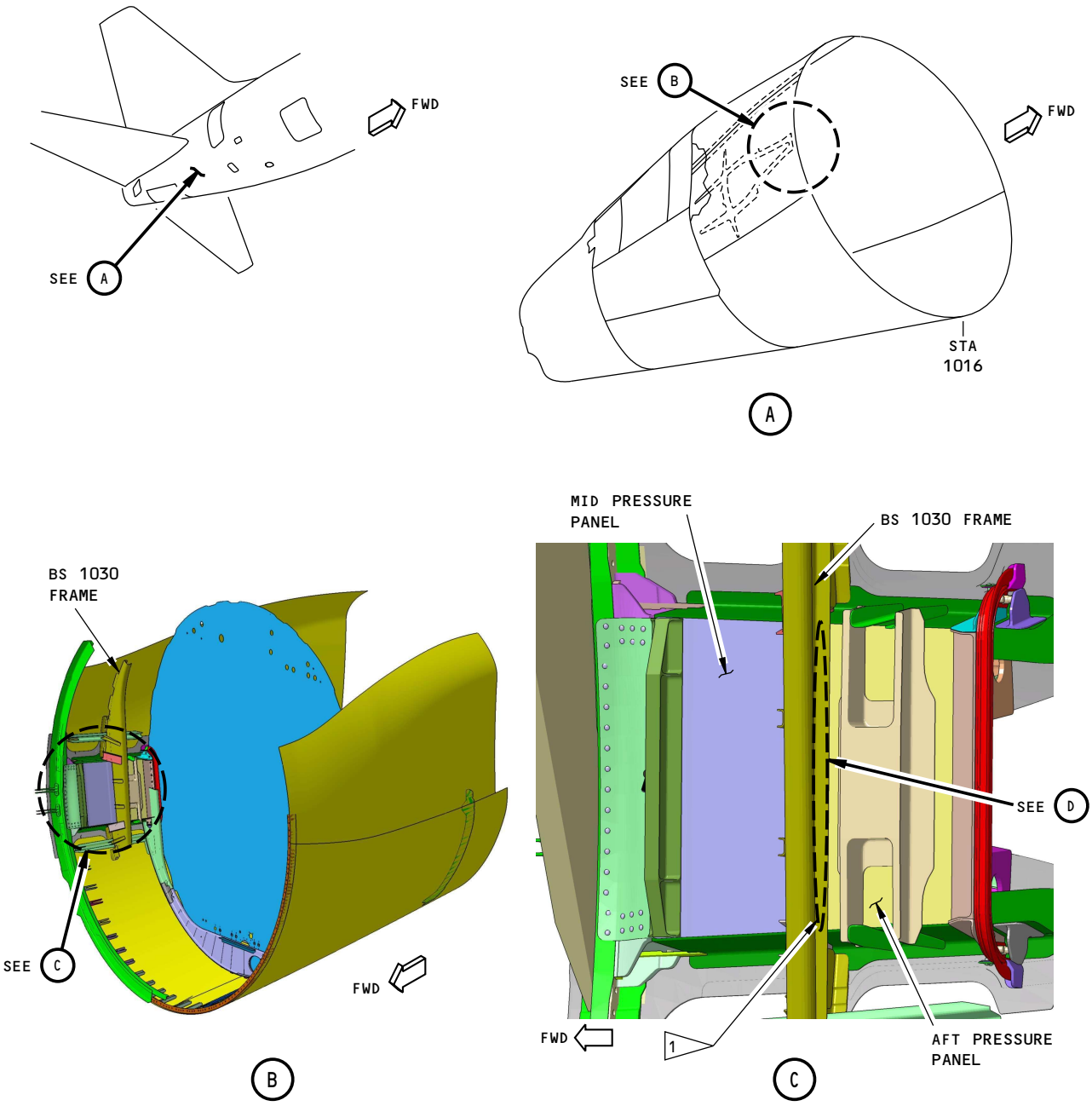

NOTES

- EXAMINE THE AFT PRESSURE PANEL OF THE APU ENCLOSURE FOR CRACKS THAT ARE BEHIND THE BS 1030 FRAME.

1 DTR CHECK FORM ITEM 53-80-17-6 INSPECTION AREA

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Inspection Area
Figure 1 (Sheet 1 of 4)

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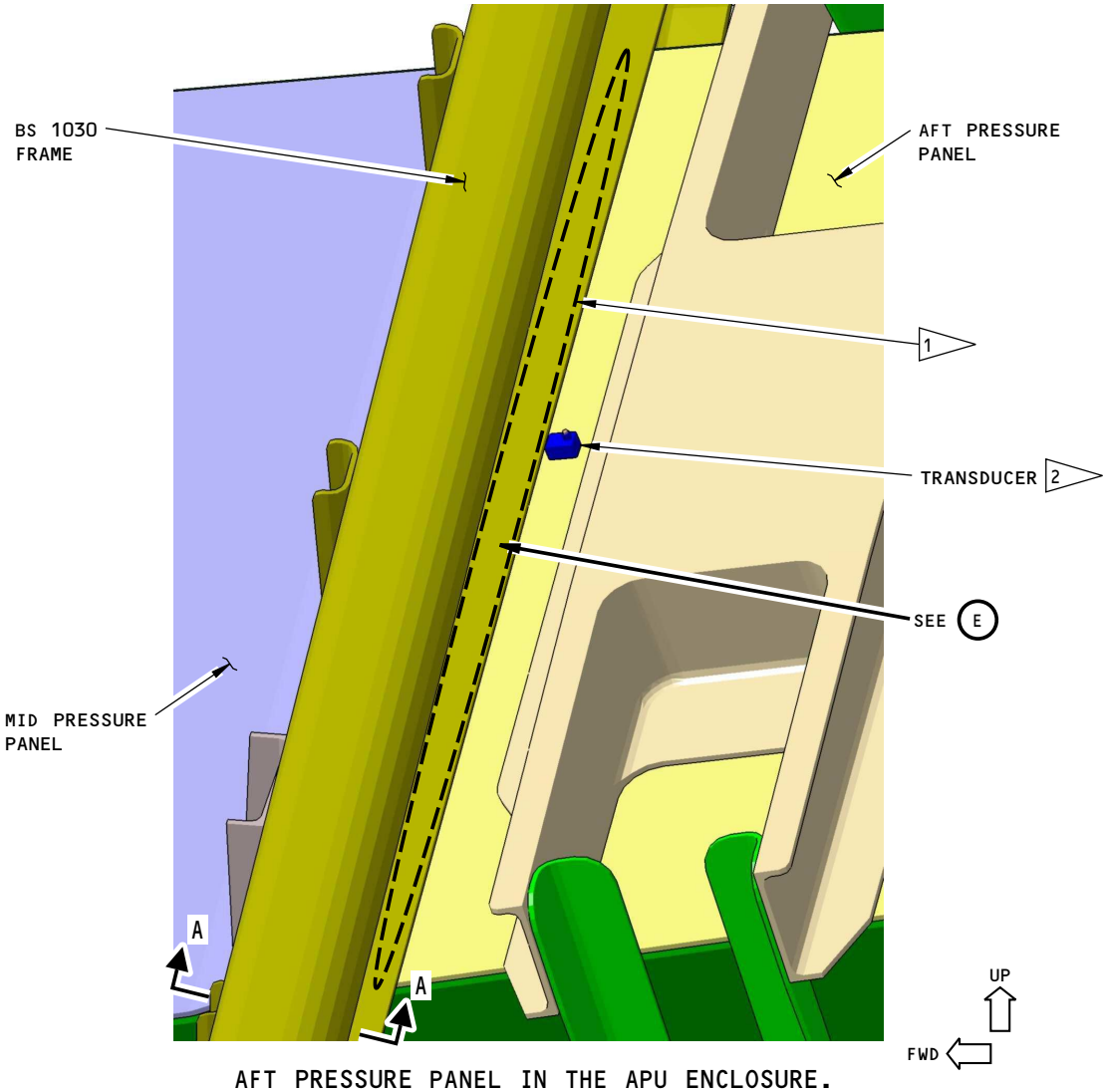

AFT PRESSURE PANEL IN THE APU ENCLOSURE.
THE FASTENER LOCATIONS ARE BEHIND THE BS 1030 FRAME

D

NOTE

2 EXAMINE THE AFT PRESSURE PANEL FOR CRACKS AT THE 17 FASTENER LOCATIONS THAT ARE BEHIND THE BS 1030 FRAME. USE A MICRO ULTRASONIC TRANSDUCER AS SHOWN. KEEP THE TRANSDUCER AS NEAR TO THE EDGE OF THE BS 1030 FRAME AS POSSIBLE.

2399494 S0000554594_V1

Inspection Area
Figure 1 (Sheet 2 of 4)

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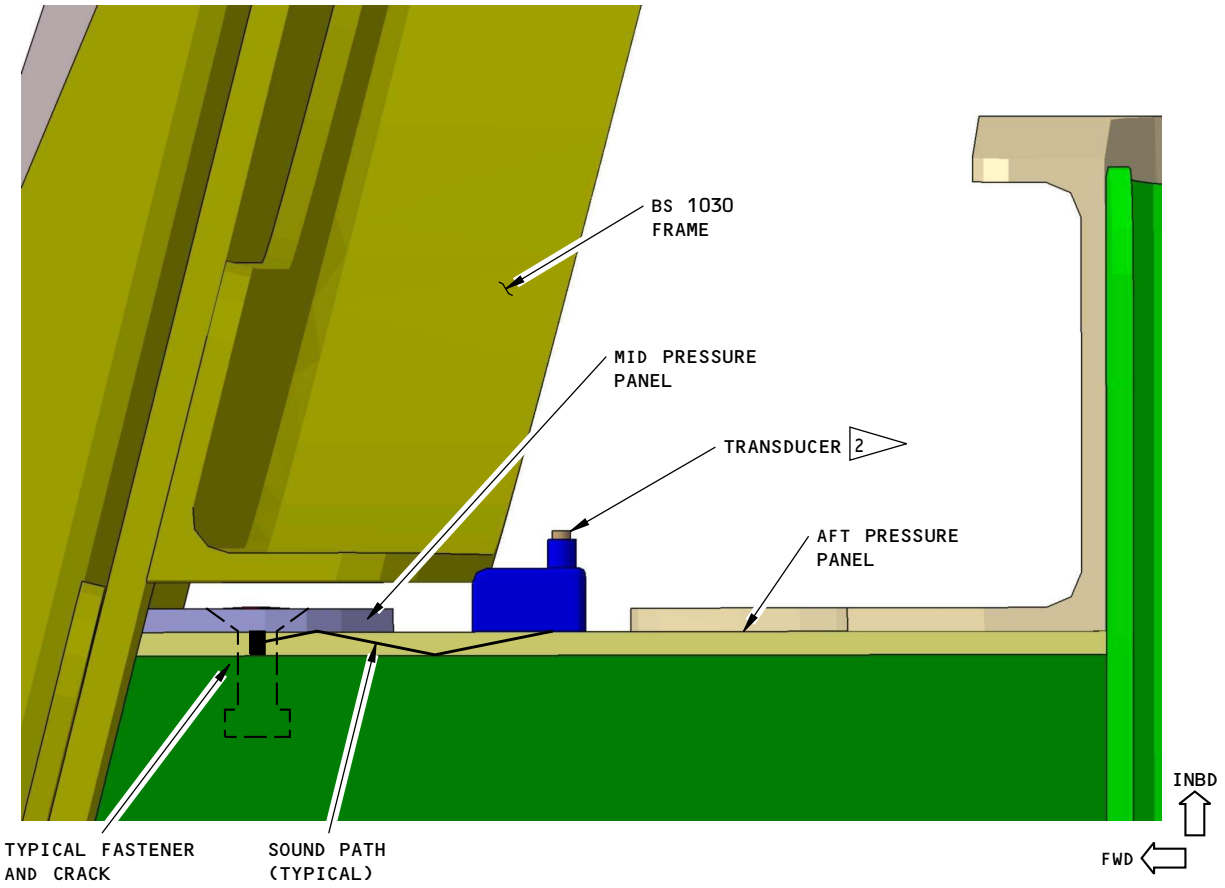

TYPICAL FASTENER HOLE CRACK AND ULTRASONIC TRANSDUCER POSITION

A-A

2399496 S0000554595_V1

Inspection Area
Figure 1 (Sheet 3 of 4)

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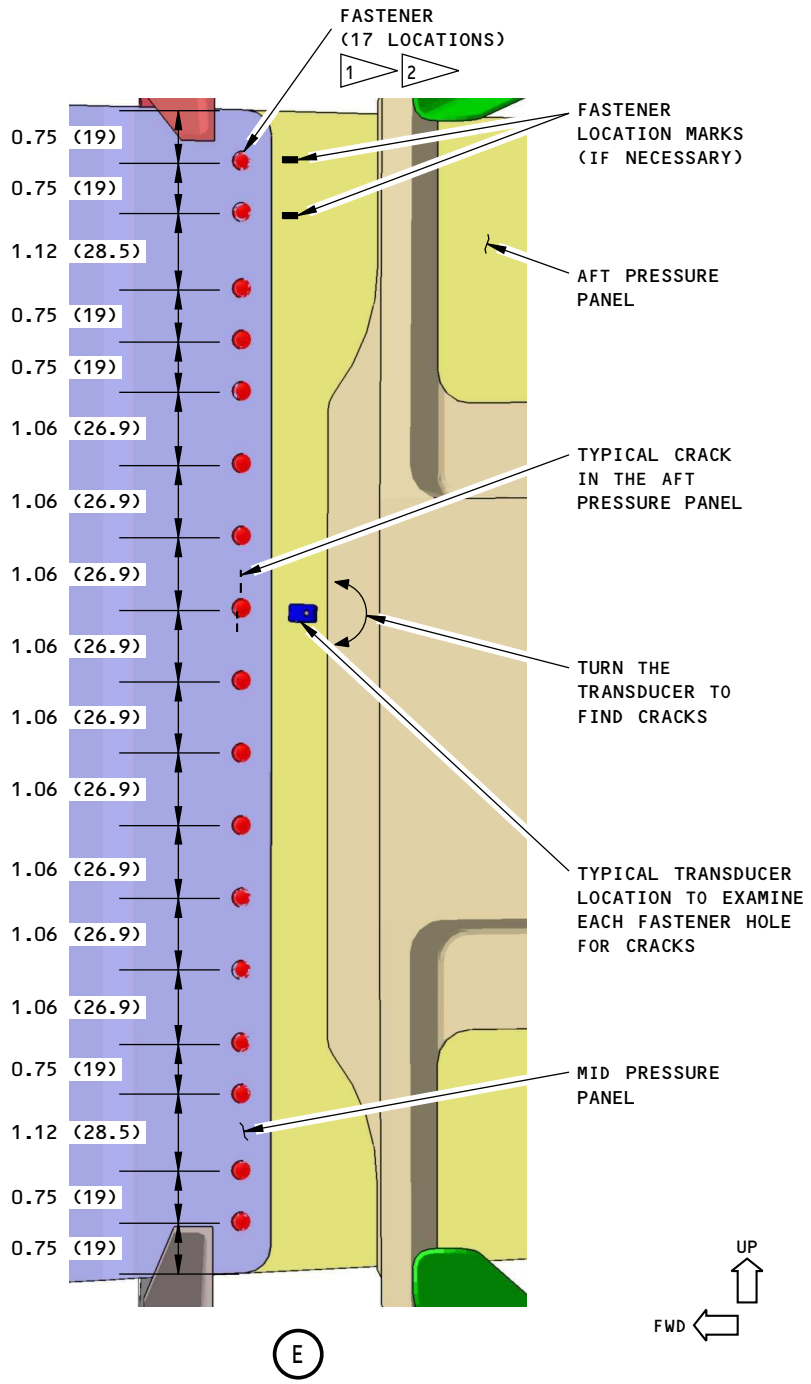

NOTES

- THE BS 1030 FRAME IS NOT SHOWN TO SHOW FASTENERS
- ALL DIMENSIONS ARE IN INCHES
  (MILLIMETERS ARE IN PARENTHESES)

2399525 S0000554596_V1

Inspection Area
Figure 1 (Sheet 4 of 4)

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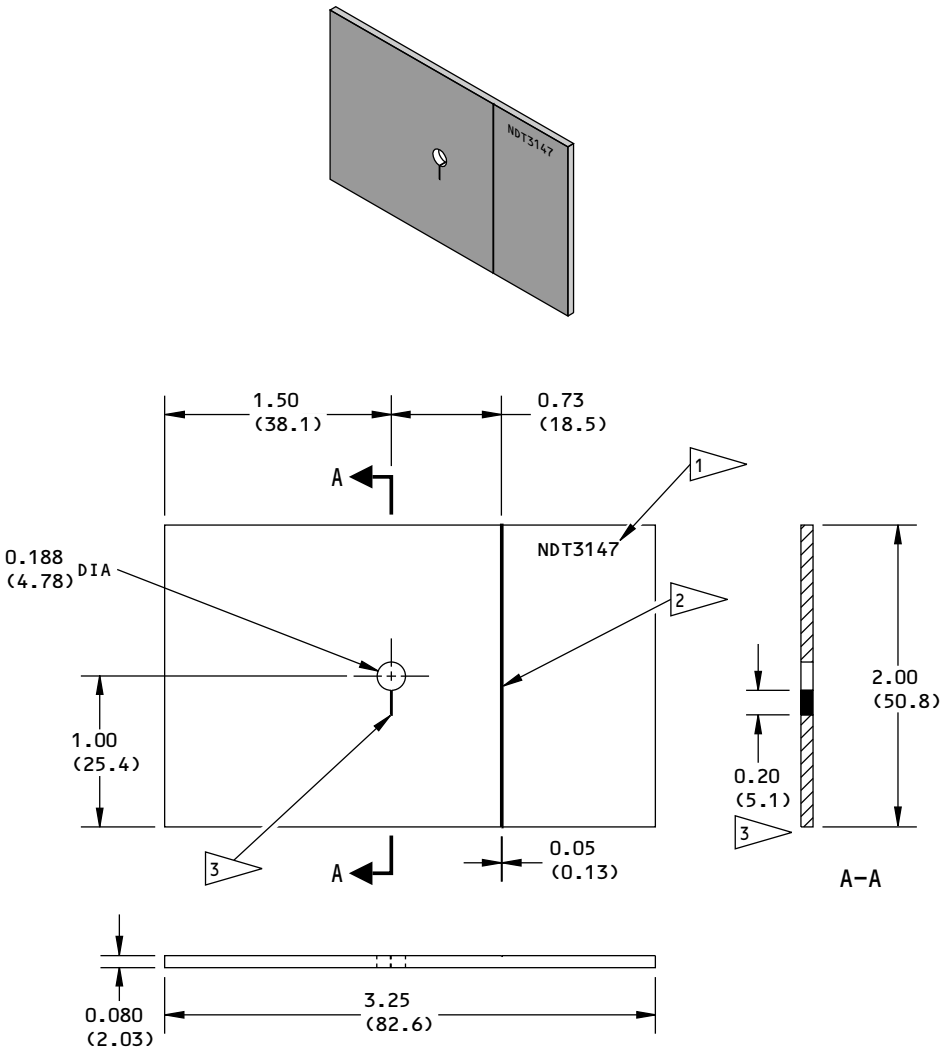

NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (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: 2024-T3/T4 ALUMINUM

1 ETCH OR STAMP THE REFERENCE STANDARD NUMBER, NDT3147, AT APPROXIMATELY THIS LOCATION

2 ETCH A SCRIBE LINE AT THE LOCATIONS SHOWN TO A MAXIMUM DEPTH OF 0.005 (0.13)

3 EDM NOTCH:
LENGTH: 0.20 (5.1)
DEPTH: THROUGH THE THICKNESS
WIDTH: 0.012 (0.30) MAXIMUM

2399546 S0000554598_V1

Reference Standard NDT3147
Figure 2

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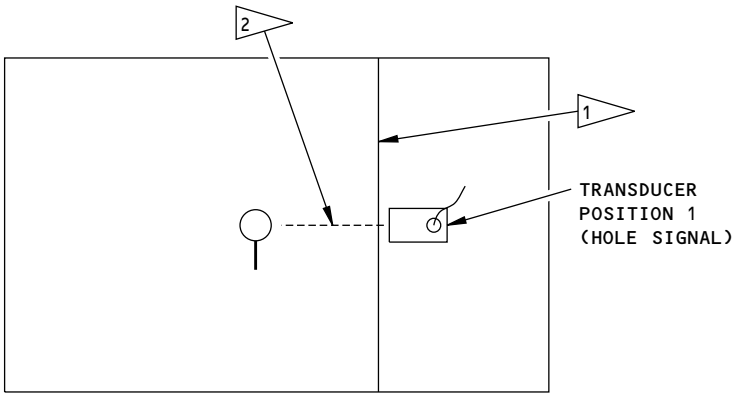
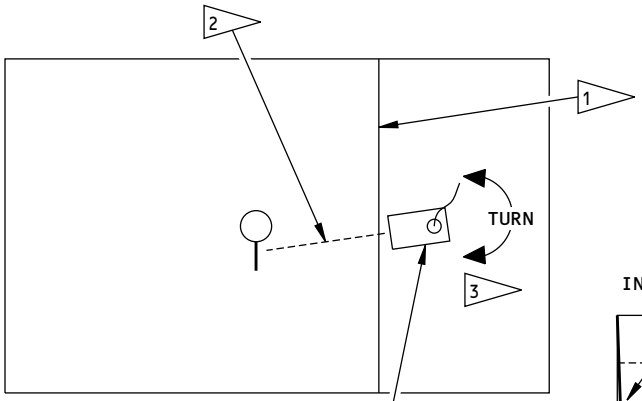
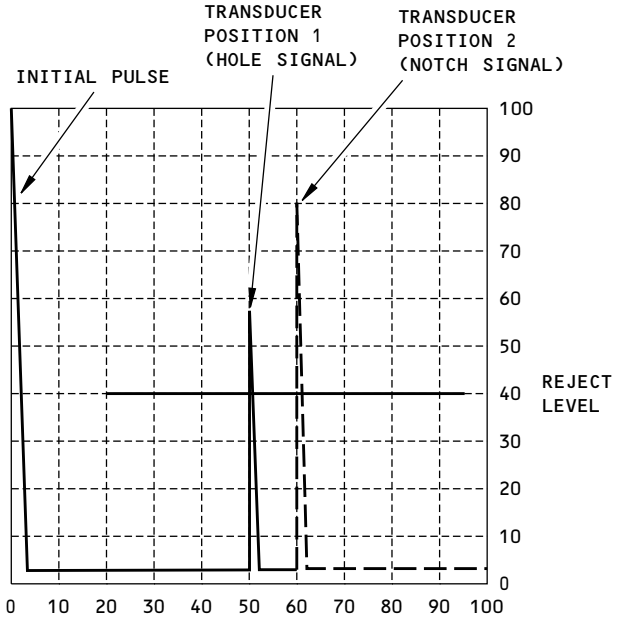


DETAIL A



TRANSDUCER POSITION 2
(NOTCH SIGNAL)

DETAIL B



DETAIL C

NOTES

1. KEEP THE TRANSDUCER AS NEAR TO THE SCRIBE LINE AS POSSIBLE DURING CALIBRATION. MAKE SURE THE TRANSDUCER DOES NOT GO ACROSS THE SCRIBE LINE
2. SOUND PATH
3. TURN THE TRANSDUCER A SMALL QUANTITY TO FIND THE HOLE AND CRACK SIGNALS.

2399578 S0000554599_V1

Instrument Calibration with Reference Standard NDT3147
Figure 3

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FUSELAGE SKIN LAP SPLICE AND CIRCUMFERENTIAL SPLICE BOND INSPECTIONS (HFBT)

1. Purpose

A. Use this high frequency (resonance mode) bond test (HFBT) procedure to examine the fuselage skin lap splices and circumferential splices for disbonds between the upper skin and the bonded doubler. To use this procedure, the maximum thickness that the skin or the bonded doubler can be is 0.080 inches (2.03 mm).

(1) This inspection can find a 1.0 x 3.0 inch (25 x 76 mm) or larger disbond between the skin and the bonded doubler.

(2) This procedure uses a bondtester in the resonance (high frequency) mode.

(3) This procedure uses reference standards NDT3230 and NDT3233.

(a) Use reference standard NDT3230 to examine a maximum skin or a bonded doubler thickness of 0.055 inches (1.40 mm).

(b) Use reference standard NDT3233 to examine a maximum skin or a bonded doubler thickness of 0.080 inches (2.03 mm).

(4) See Figure 1 and Service Bulletin 737-53A1349 for the skin lap splice and the circumferential splice inspection areas.

2. Equipment

A. General

(1) Use the Olympus NDT Bondmaster 1000, 1000+ or 1000e+ and one of the specified probe combinations or the NDT Systems Bondascope 3100 and one of the specified Bondascope 3100 or Bondmaster 1000 series probe combinations, that can be calibrated on the reference standard as specified in Paragraph 4. Other ultrasonic bondtesters can be used to do this inspection if they can be calibrated on the reference standard as specified in Paragraph 4.

(2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

B. Instrument

(1) Use a resonance bondtester that operates from 155 to 160 kHz.

(2) The bondtesters and probes that follow were used to help prepare this procedure.

(a) Bondmaster 1000 Series (resonance mode) instrument with probe number Sonic S-PR-4, 165 kHz and cable part number SBM-CR-P7; made by Olympus NDT.

(b) Bondascope 3100 (resonance mode) instrument with Bondascope 3100 probe number L3165 and cable part number BF11-S6; made by NDT Systems.

NOTE: A Sonic S-PR-4, 165 kHz and cable part number SBM-CR-P6; made by Olympus NDT, can be used with the Bondascope 3100 instrument.

C. Reference Standard

(1) Use reference standard NDT3230 or NDT3233 to help calibrate the instrument. See Figure 2 for data about these reference standards.

D. Couplant

(1) Use a thin viscosity couplant. Water with a small quantity of gel couplant works best.

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3. **Prepare for the Inspection**

A. See Service Bulletin 737-53A1349 and Figure 1 for the inspection areas to be examined.

B. Clean the inspection surfaces.

(1) Remove dirt, grease or sealant.

C. Make the inspection surfaces smooth if they are rough and only remove paint if it is loose.

4. **Instrument Calibration**

NOTE: The calibration instructions for the Bondmaster 1000 Series and the Bondascope 3100 instruments are given in this procedure. Refer to the applicable manufacturer's instructions to calibrate other bondtester instruments.

A. Calibrate the Bondmaster 1000 Series instrument (resonance mode) as follows:

(1) Connect the probe to the instrument and energize the instrument.

(2) Push the PROGRAM pad to get a stored setup file for this procedure, if one is available.

(3) If a setup file for this procedure has not been stored, do the steps that follow to make a setup file.

(a) Push the SETUP pad to display SETUP1 and set the instrument controls as follows:

1) H GAIN: -8.0

2) V GAIN: -6.0

3) FREQ: 156 (This is automatically set with the probe connected to the instrument. Do not adjust).

(b) Push the SETUP pad to go to SETUP2 and set the instrument controls as follows:

1) H POS: 50%

2) V POS: 20%

3) REF DOT: ON

4) FITER: 25

(c) Push the RUN pad.

(d) Put a sufficient quantity of couplant on the reference standard at Probe Positions (PP) 1, 2 and 3. See Figure 3, Detail I.

(e) Put the probe on the reference standard at PP1 and push the NULL pad. This dot position shows a total bonded condition between the upper skin/doubler and the lower skin/doubler at a lap splice or the upper skin/doubler and the strap/frame at a circumferential splice.

(f) Remove the probe from the reference standard (probe in air) and remove the couplant from the face of the probe and monitor the position of the dot on the screen display.

(g) Push the ANGLE pad and rotate the dot position to 30% of full screen height (FSH) and between 80 and 100% of full screen width (FSW). Adjust the H GAIN, if necessary, to move the dot between 80 and 100% of FSW.

(h) Put the probe on the reference standard at PP2 and monitor the dot position on the screen display. This dot position shows a disbonded condition between the upper skin and the upper doubler at a lap splice or a circumferential splice.

(i) If necessary, adjust the V GAIN to set the dot position to 80% of FSH. The FSW location of the dot can occur between 20 and 50% of FSW.

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(j) Do Paragraph 4.A.(3)(e) thru Paragraph 4.A.(3)(h) again to make sure the dot positions are correct. Make small adjustments to the V and H GAIN and the ANGLE instrument controls if necessary to get dot positions that are almost the same as shown in Figure 3, Detail II.

(k) Put the probe on the reference standard at PP3 and monitor the dot position on the screen display. This dot position shows a disbonded/void condition between the upper skin/doubler and the lower skin/doubler at a lap splice or the upper skin/doubler and the strap/frame at a circumferential splice.

(l) Store the dot positions on the screen display as follows:

1) Put the probe on the reference standard at PP1 and push the NULL pad.

2) Push the ST DOT pad to store 1.

3) Do steps 1) and 2) again at PP2, PP3, and with the probe in air, to store dot positions 2 thru 4.

(m) Push the ALARM pad and set the instrument controls as follows:

1) ALARM: ON.

2) ±: POSITIVE.

3) SIZ/POS: set the instrument controls as follows:

a) TOP: 100%

b) BOTTOM: 50%

c) LEFT: 10%

d) RIGHT: 90%

4) Save the calibration to the instrument program as specified in the manufacturer's instructions.

B. Calibrate the Bondascope 3100 instrument (resonance mode) as follows:

(1) Connect the probe to the instrument and energize the instrument.

(2) Select probe L3165 – Resonance and push the Encoding Menu Knob (EMK) or the ENTER pad. The EMK and the ENTER pad do the same function.

(3) Select a Setup file for this procedure, if one is available.

(4) If a Setup file has not been stored, select Defaults and do the steps that follow to make a Setup file.

(a) The Sweep Setup screen will be displayed and will show the probe number and the instrument frequency. The frequency is automatically set for the probe that is connected to the instrument.

(b) Push the RF DOT pad.

(c) Turn the EMK or push the right arrow pad to FREQ and push the ENTER pad.

(d) Turn the EMK to set the FREQ to 156 and push the MENU/ESC pad.

(e) Turn the EMK or push the right arrow pad to POS and push the ENTER pad. The default dot position, with the probe in the air, is 50% of full screen width (FSW) and 50% of full screen height (FSH).

(f) Turn the EMK or push the right arrow pad to YPOS and push the ENTER pad.

(g) Turn the EMK to set the dot position to 20% of FSH and push the MENU/ESC pad two times.

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(h) Put a sufficient quantity of couplant on the reference standard at Probe Positions (PP) 1, 2 and 3. See Figure 3, Detail I.

(i) Put the probe on the reference standard at PP1 and push the NULL pad. This dot position shows a total bonded condition between the upper skin/doubler and the lower skin/doubler at a lap splice or the upper skin/doubler and the strap/frame at a circumferential splice.

(j) Remove the probe from the reference standard (probe in air) and remove the couplant from the face of the probe and monitor the position of the dot on the screen display.

(k) Turn the EMK or push the right arrow pad to ROT and push the ENTER pad.

(l) Turn the EMK to move the dot position to 30% of FSH and between 80 and 100% of FSW and push the MENU/ESC pad. Adjust the GAIN, if necessary, to move the dot between 80 and 100% of FSW.

(m) Put the probe on the reference standard at PP2 and monitor the dot position on the screen display. This dot position shows a disbonded condition between the upper skin and the upper doubler at a lap splice or a circumferential splice.

(n) Adjust the GAIN to set the dot position to 80% of FSH. The FSW location of the dot can occur between 20 and 50% of FSW.

(o) Do paragraphs Paragraph 4.B.(4)(i) thru Paragraph 4.B.(4)(n) again to make sure the dot positions are correct. Make small adjustments to the GAIN, Xscl and ROT instrument controls if necessary to get dot positions that are almost the same as shown in Figure 3, Detail II.

(p) Push the GATE pad and the MENU/ESC pad and turn the EMK or push the right arrow pad to STORE.

(q) Put the probe on the reference standard at PP1 and push the NULL pad.

(r) Push the ENTER pad. A circle gate will show around the dot along with a number 1.

(s) Turn the gate to the off position as follows as it will not be used at this dot position.

1) Turn the EMK or push the right arrow pad to GATE and push the ENTER pad.
2) Turn the EMK to set the GATE to OFF.

(t) Turn the EMK or push the right arrow pad to STORE.

(u) Put the probe on the reference standard at PP2 and push the ENTER pad to show a circle gate around the dot and a number 2.

(v) Turn the EMK or push the right arrow pad to GATE and push the ENTER pad.

(w) Turn the EMK to set the GATE to RECT. Set the dimensions of the rectangle gate as follows:

1) Turn the EMK or push the right arrow pad to WID and push the ENTER pad.
2) Turn the EMK to set the gate width to approximately 4 major divisions on each side of the dot position.
3) Turn the EMK or push the right arrow pad to HT and push the ENTER pad.
4) Turn the EMK to set the bottom of the gate to 50% of FSH.
5) Turn the EMK or push the right arrow pad to ALM and push the ENTER pad.
6) Turn the EMK to set the ALARM to IN.

(x) Push the MENU/ESC pad and Turn the EMK or push the right arrow pad to STORE.

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(y) Put the probe on the reference standard at PP3 and monitor the dot position on the screen display. This dot position shows a disbonded/void condition between the upper skin/doubler and the lower skin/doubler at a lap splice or the upper skin/doubler and the strap/frame at a circumferential splice.

(z) Push the ENTER pad to show a circle gate around the dot and a number 3.

(aa) Turn the EMK or push the right arrow pad to GATE and push the ENTER pad and set the gate to OFF.

(ab) Put the probe in air and push the MENU/ESC pad.

(ac) Turn the EMK or push the right arrow pad to STORE and push ENTER to show a circle gate around the dot and a number 4.

(ad) Turn the EMK or push the right arrow pad to GATE and push the ENTER pad and set the gate to OFF.

(ae) Push the SETUP pad and SAVE to save the calibration.

5. Inspection Procedure

A. Identify the inspection areas shown in Figure 1 and the Service Bulletin for the skin and doubler thicknesses.

B. Calibrate the instrument as specified in Paragraph 4. Use Paragraph 4.A. if the Bondmaster 1000 Series instrument. Use Paragraph 4.B. if the Bondascope 3100 instrument is used.

C. Apply sufficient couplant to the inspection areas.

D. Put the probe on the inspection area at a typical position as shown in Figure 1 for the lap and circumferential splices.

E. Monitor the screen display for the dot position to be at dot position 1 (approximately) as shown in Figure 3.

NOTE: The differences between the reference standard and the different airplane skin/doubler/strap thicknesses will cause small changes in the dot positions.

F. Move the probe along the inspection area at different locations and monitor the screen display for changes in the dot position.

G. Identify locations that have the same skin/doubler/strap thicknesses in the inspection area that show a stable dot position at or near dot position 1 and push NULL.

H. Slowly make a scan along the inspection area as shown in Figure 1. Make sure to examine areas that have the same skin/doubler/strap thicknesses. During the scan, do the steps that follow:

(1) Monitor the instrument display for a signal that looks almost the same as the upper skin to doubler disbond signal that you got from the reference standard during calibration.

NOTE: A skin/doubler thickness change will cause the dot position to go up from dot position 1 if the probe is moved to a thinner area or go down if the probe is moved to a thicker area.

NOTE: A disbond/void between the upper skin/doubler and the lower skin/doubler will cause the dot to be in approximately the same screen location as dot position 3.

(2) Make a record of all areas that cause a disbond signal to occur or mark the surface with a grease pencil or felt tip marker.

I. Do Paragraph 5.C. thru Paragraph 5.H. again at all remaining inspection areas.

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6. **Inspection Results**

A. An area that gives a signal that looks the same or larger than the signal you got from the disbond area of the reference standard is a possible disbond.

B. Compare a disbond signal to the signal you get from an area that has the same skin thickness but does not have a doubler and is away from the skin lap splice or circumferential splice. Also compare the disbond signal to the signal that you get from the reference standard. Do a check of the engineering drawing and/or Service Bulletin 737-53A1349 to identify the skin and doubler thicknesses and the configuration of the doubler. Make sure that the area (that has the same skin thickness but no doubler) that you are going to compare the disbond signal with, does not have something bonded to its internal surface, such as sound damping material.

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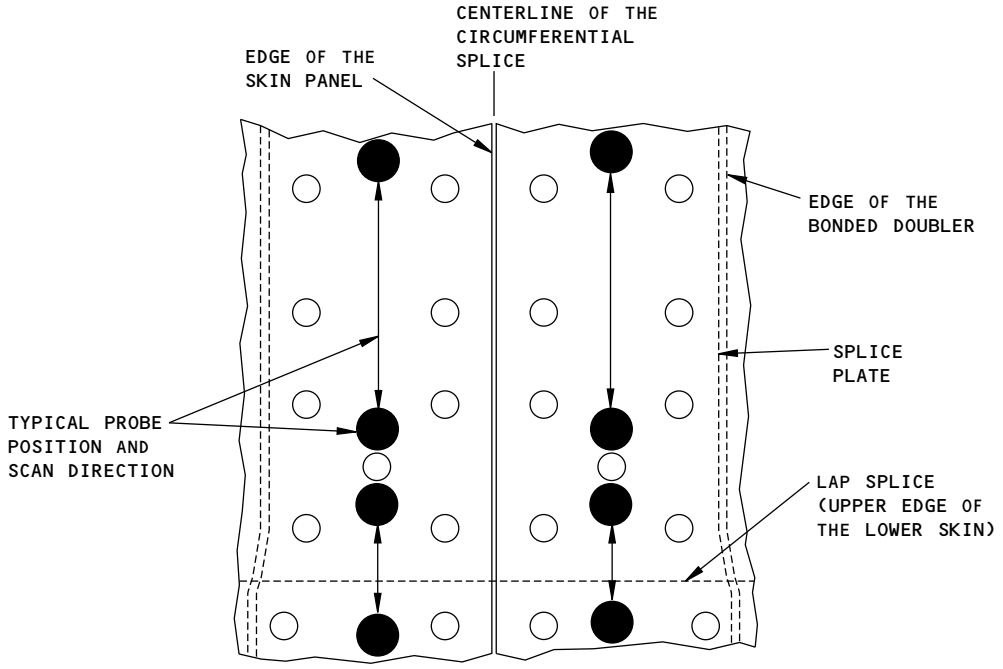
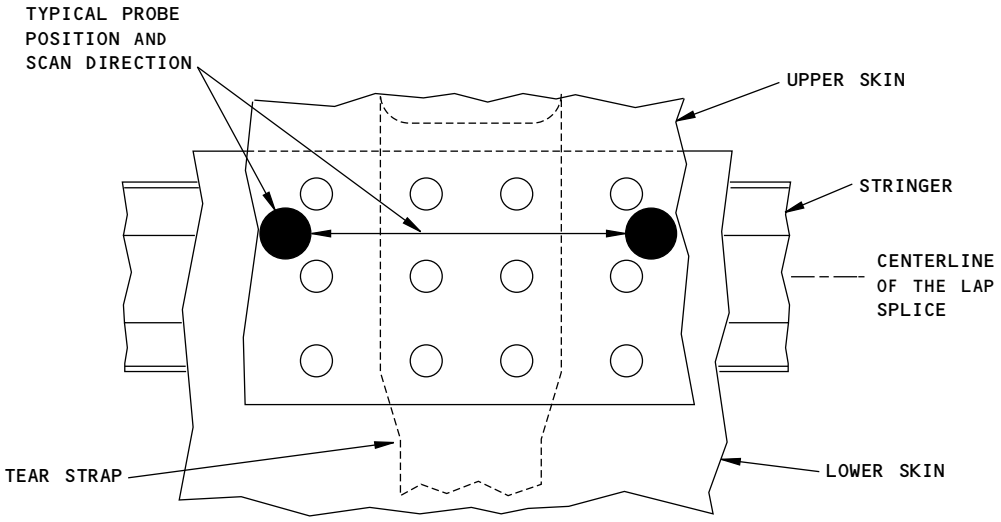


TYPICAL
CIRCUMFERENTIAL SPLICE INSPECTION



TYPICAL
LAP SPLICE INSPECTION

2350616 S0000536418_V1

Inspection Area
Figure 1

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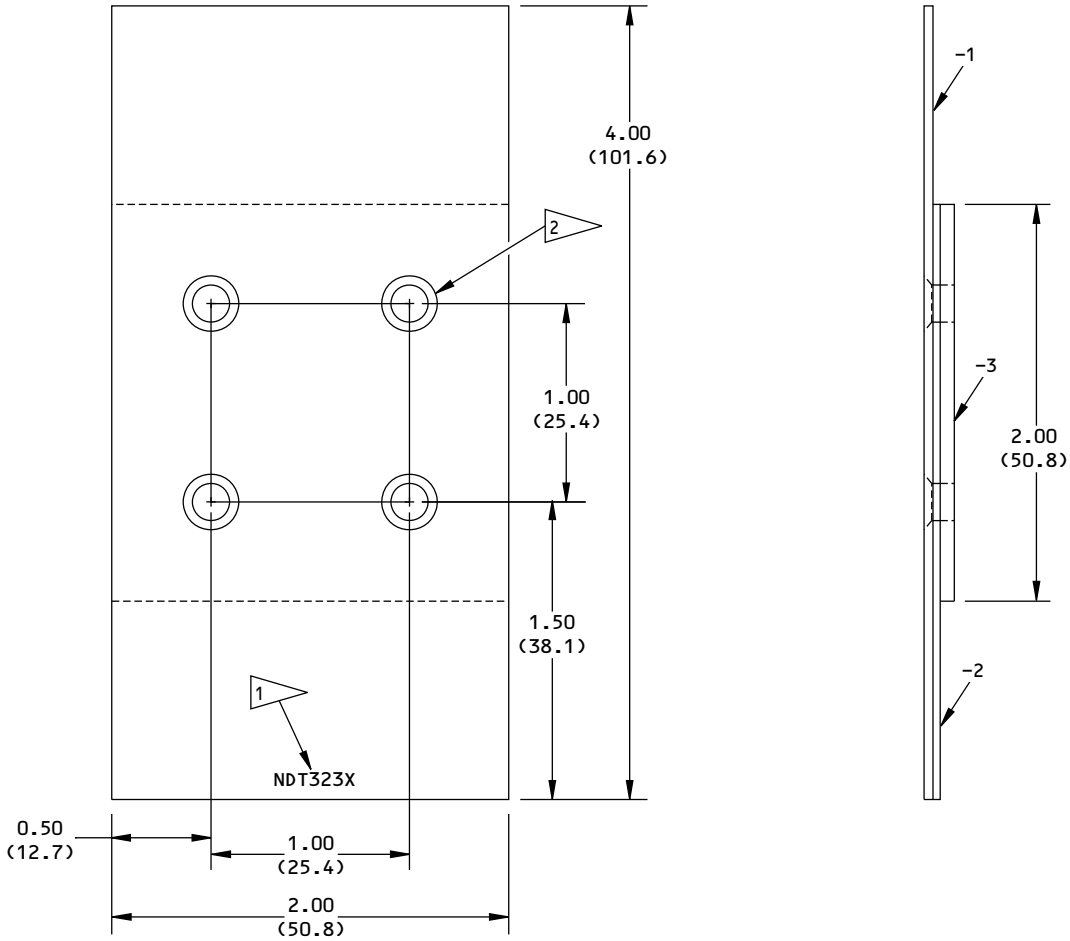

NOTES

- ALL 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

- MATERIAL: 2000 SERIES AIRCRAFT ALUMINUM
- SURFACE ROUGHNESS: 63 Ra OR BETTER
-

PART LIST		
REFERENCE STANDARD	PART	THICKNESS
NDT3230	-1	0.045 (1.14)
	-2	0.036 (0.91)
	-3	0.071 (1.80)
NDT3233	-1	0.071 (1.80)
	-2	0.063 (1.60)
	-3	0.071 (1.80)

- BOND THE -1 AND -2 PARTS TOGETHER WITH BMS 5-101, TYPE II, GRADE 5 ADHESIVE AND CURE AT 250° FOR 90 MINUTES AS SPECIFIED IN SRM 51-70-10 (737-300 THRU -800).
- APPLY BMS 5-95 SEALANT (OR AN EQUIVALENT) BETWEEN THE BONDED -1 AND -2 PIECES AND THE -3 PIECE.

1 ETCH THE APPLICABLE REFERENCE STANDARD NUMBER, NDT3230 OR NDT3233, AT APPROXIMATELY THIS LOCATION.

2 DRILL AND COUNTERSINK FOR A BACR15GF6D4 RIVET (4 LOCATIONS). INSTALL THE RIVETS SUFFICIENTLY TO HOLD THE PARTS TOGETHER, BUT NOT TO CAUSE DAMAGE TO THE PARTS.

2350928 S0000536419_V3

Reference Standards NDT3230 and NDT3233
Figure 2

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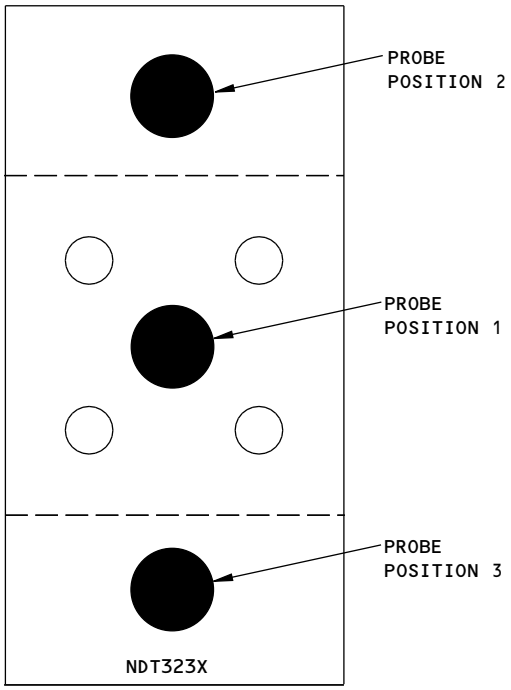
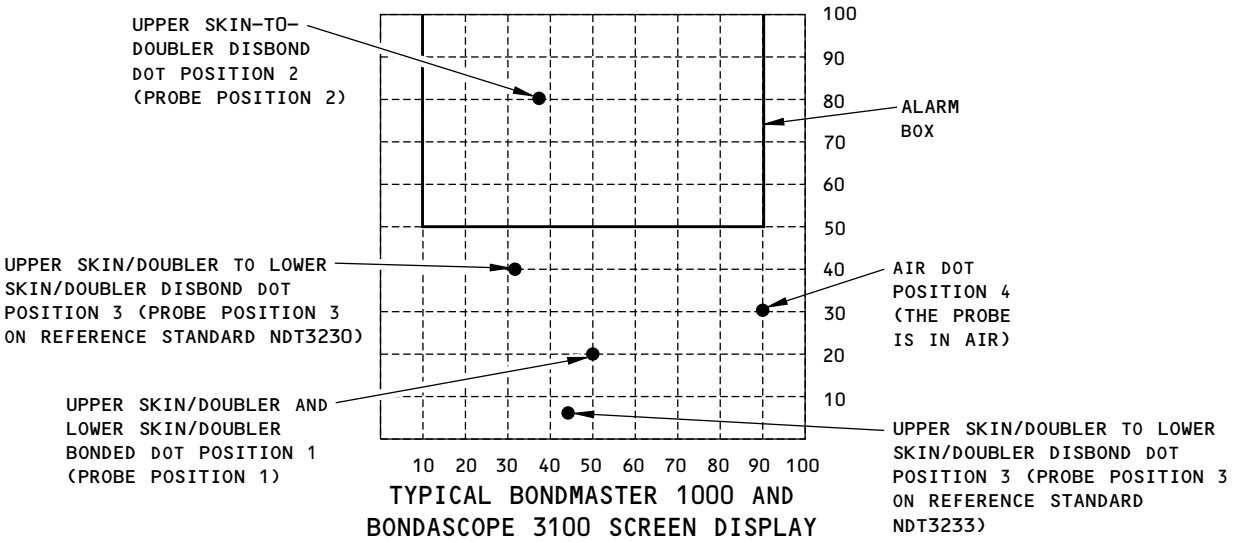


PROBE POSITIONS ON THE
REFERENCE STANDARD

DETAIL I



TYPICAL BONDMASTER 1000 AND
BONDASCOPE 3100 SCREEN DISPLAY

DETAIL II

NOTES

- THE DETAIL II SCREEN DISPLAY IS AN EXAMPLE. THE LOCATION OF DOT POSITIONS 2 THRU 4 ON THE SCREEN DISPLAY CAN CHANGE A SMALL QUANTITY WITH OTHER INSTRUMENT AND PROBE MIXES.

2350656 S0000536421_V2

Instrument Calibration
Figure 3

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FUSELAGE SKIN - INTERNAL CRACKS AT THE EDGES OF CHEM-MILL DOUBLERS WITH THE WIDE AREA PHASED ARRAY PROBE

1. Purpose

A. Use this procedure to:

(1) Find cracks in the internal surface of the fuselage skin panels at the edges of the chem-mill doublers. See Figure 1 thru Figure 3 for the typical inspection areas.

(2) Do a check of the fuselage skin to make sure that the crack indications found by other NDT procedures are also found to be cracks by this procedure.

B. Refer to the applicable Service Bulletins for the inspection areas to be examined.

C. This procedure examines painted or bare skin panels that are from 0.032 to 0.140 inch (0.81 to 3.56 mm) thick. The inspection is done from the external surface of the fuselage skin. The paint thickness must be 0.007 inch (0.18 mm), or less.

D. This procedure uses an ultrasonic phased array instrument that gives color C-Scan, S-Scan and A-Scan displays. Ultrasonic signals in the C-Scan are displayed with a rainbow pallet.

E. The full probe surface must touch the fuselage skin during each inspection. Areas with protruding head fasteners, or areas where repairs or other structure do not let the probe fully touch the surface above the edge of a chem-mill doubler cannot be examined with this procedure. See Figure 4 thru Figure 6 for the necessary clearances. The inspection areas that follow must be examined as specified in Part 4, 53-30-07, because they cannot be examined with this procedure:

(1) Areas that have protruding fasteners.

(2) An external repair doubler with a horizontal edge that is less than 1 inch (25 mm) from the horizontal edge of a chem-mill doubler (see Figure 4).

(3) An external repair doubler with a vertical edge that is less than 1 inch (25 mm) from the vertical edge of a chem-mill doubler (see Figure 5).

(4) An external repair doubler with an edge that is less than 2 inches (50 mm) from the edge of a chem-mill doubler (see Figure 6).

(5) A 1 inch (25.4 mm) distance from the edge of an external repair doubler (see flagnote 2 in Figure 4 and Figure 5).

2. Equipment

A. General

(1) Use inspection equipment that can be calibrated on the reference standard as specified in Paragraph 4.

(2) Refer to Part 1, 51-01-00, for data about the equipment manufacturers.

B. Instrument

(1) Use an ultrasonic phased array instrument that:

(a) Can operate a 64 element linear array.

(b) Operates at 5 MHz.

(c) Has a C-Scan type display.

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(2) The instrument that follows was 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 (16:128); software version MXU-2.0RX (X =7 or higher)

2) Manual OmniScan MX PA module (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 does not have the correct software version, ask Olympus NDT Canada for a new software version and technical aid to install it.

C. Probe

(1) Use an array probe that operates at a frequency of 5 MHz and has 64 elements in a linear configuration.

(a) Use a wedge that angles the probe to put a 55 degree shear wave in aluminum and has holes for water couplant.

(2) The probe and wedge that follow were used to help prepare this procedure.

(a) Probe 5L64-38.4X10-A12-P-2.5-OM; Olympus Scientific Solutions

(b) Wedge SA12-N55S-IHC; Olympus Scientific Solutions

D. Reference Standards

(1) Use reference standard NDT3237-XXX-XXX, or an equivalent, to help calibrate the instrument. See Figure 7 for data about reference standard NDT3237-XXX-XXX.

(2) Use a steel or an aluminum IIW calibration block, or an equivalent, to help calibrate the sensitivity of the probe elements.

E. Probe Positioner

(1) Use probe positioner NDT3237-P1, to help move the probe around the radius of a chem-mill doubler. See Figure 8 for data about probe positioner NDT3237-P1.

F. Couplant

(1) Use a couplant that will not damage the airplane structure. It is recommended to use water as the couplant for the wedge and/or a light weight couplant with a low viscosity.

G. Encoder

(1) Use an encoder that:

(a) will not get damaged by water and will connect to the SA12-N55S-IHC wedge.

(b) has a resolution of 12 counts for each millimeter (304.8 counts for each inch).

(2) The encoder used to help prepare this procedure is the Olympus ENC1-2.5-DE mini encoder. It has a cable that is 8.2 feet (2.5 meters) long, can be used with water, has a DE15 connector for the Omni San MX, and includes a bracket kit.

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3. **Prepare for the Inspection**

A. Identify and get access to all of the inspection areas shown in Figure 1 thru Figure 6.

B. Clean the inspection surfaces.

(1) Remove dirt or grease from the inspection surfaces.

(2) Remove paint only if it is loose.

C. Identify the vertical edges of the chem-mill doublers as specified in Part 6, 53-30-23.

(1) Use an approved marker to put marks on the inspection surface at the center of the probe where the eddy current signal occurs as shown by probe position 2 in Figure 9. Do this as many times as necessary to identify the edges of the vertical doublers.

4. **Instrument Calibration**

A. Calibrate the OmniScan MX instrument as follows:

NOTE: Use the hole in the side of the IIW calibration block to normalize the probe elements as shown in Figure 10.

NOTE: Use reference standard NDT3237-XXX-XXX to help calibrate the equipment to examine the fuselage skin at the edges of the chem-mill doublers.

B. Make sure the ultrasonic module and the phased array probe, wedge and encoder are connected to the instrument as specified in the manufacturer's instruction manual.

C. Energize the instrument.

D. Open the stored setup file, 5L64 Chem-Mill Edge, from the User Listed Files. Load the setup file and go to Paragraph 4.G.

NOTE: You must do the sensitivity and normalization each time you load the stored setup file.

E. If the 5L64 Chem-Mill Edge setup file has not been stored, do the steps that follow:

(1) Open the Phased Array file from the User List of Files and set the equipment parameters as specified in Figure 11.

NOTE: Use the equipment manufacturer's instruction manual to find the menus and options to set the equipment parameters.

F. Save the setup file as 5L64 Chem-Mill Edge.

NOTE: Do a check of all the equipment parameters that were input to make sure they are correct. If it is necessary to change a parameter, make sure to save the setup file again.

G. Normalize the probe elements as specified by the manufacturer's instruction manual or do the steps that follow:

NOTE: If you use the manufacturer's instruction manual, go to Sensitivity Calibration, Angle-Beam Scan Using Side-drilled hole.

NOTE: The instructions in Paragraph 4.G. and Paragraph 4.H. identify the menus > options, followed by the parameter to be input.

(1) Put the probe on the IIW calibration block as shown in Figure 10.

(2) Make sure the Select Main Menu Display is set to A-S-[C] (A-Scan S-Scan [C-Scan]).

NOTE: It is satisfactory for the operator to use alternative views of the display to help with calibration.

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(3) Set Overlay> UT Unit to True Depth.

(4) Select Main Menu Wizard and Calibration. This is a calibration wizard that makes it necessary to do steps in the correct sequence.

(5) Set Type>Ultrasound

(6) Set Mode to Sensitivity.

(7) Push Start

(8) Set Ref. Amplitude (%) to 80.0

(9) Set Tolerance (%) to 5.0

(10) Push Next.

(11) Push Next.

(12) Set Start (mm) to 12.0. This will start the red A gate so the side hole signal from the IIW calibration block will move across the gate below or later in time of flight. See Figure 10.

(13) Set Width (mm) to 8.0. This will set the width of the red A gate to make the side hole signal from the IIW calibration block occur in the middle of the gate. The gate will then contain the complete signal from the side hole of the IIW calibration block. Move the probe forward and rearward to get the side hole signal from the IIW calibration block to make sure the A gate contains the complete signal from the side hole. See Figure 10.

(14) Set Threshold (%) to 25.

(15) Push Next.

(16) Set Comp. Gain to 0

(17) Push Apply

(18) Push Next.

(19) Put the probe on the IIW calibration block and make sure the probe will not tilt when you move it forward and back. Use a straightedge as a probe guide or put the IIW calibration block on its side. Move the probe forward and rearward above the side hole to make the envelope. See Figure 10.

(20) Push Calibrate.

(21) Again, move the probe forward and rearward above the side hole of the IIW calibration block to see if the envelope is correctly calibrated.

(a) If the calibration is correct, the envelope will occur between the red dotted lines as shown in Figure 10. If this occurs, go to Paragraph 4.G.(22).

(b) If the calibration is incorrect, clear the envelope (push Clear Env), and go to Paragraph 4.G.(19).

(22) When the calibration is correct, push Accept. The calibration for normalization is now complete.

(23) Change the parameters that follow:

(a) Open Main Menu and push Display >Display is set to C.

(b) Open Main Menu and push Gates/Alarms>Start is set to 0.00mm

(c) Gates/Alarms>Width to 2.7mm

(d) Gates/Alarms>Threshold to 0%

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(24) Connect the encoder to the probe as specified in the manufacturer's instructions. Set the parameters that follow to engage the encoder:

(a) Open the Main Menu, push Scan, select Inspection and set Scan to Encoder 1.

(b) Set Max Scan Speed to 75.0 mm

(c) Push Encoder and set Type to Quad

(d) Set Resolution to 12.0

(e) Set Origin to 0.0

(f) Push Area and set Scan End to 600.0 mm

(g) Set Resolution to 0.050 mm

(h) Open the Main Menu, push Display > Zoom and set Display to Uncorrected C-Scan

(i) Set Type to Start

(j) Set Range Scan to 200

H. Calibrate the equipment to do the inspection as follows:

(1) Get the NDT3237-XXX-XXX reference standard that is applicable for the skin thickness to be examined as identified in Table 1 of Figure 7.

(2) Make sure Display is set to "C".

(3) Apply a sufficient quantity of couplant to the areas of the reference standard that the probe will touch. See Detail I in Figure 12.

(4) Put the probe on the reference standard at probe position 1. Probe position 1 is where the centerline of the fastener row is in the center of the two indication lines labeled "FSTNR" on the probe label. Keep the fastener row centerline between the two indication lines labeled "FSTNR" on the probe wedge and keep equal pressure on the encoder as you make the scan. See Detail I in Figure 12.

(5) Push the Start Button and make a scan to probe position 2. See Figure 12, Detail I.

NOTE: The encoder will record data until it gets to its Range limit. Push the Start Button, as necessary, to set the scan range to zero.

(6) To make sure the calibration gain is set correctly, do the steps that follow:

(a) If the reference notch B image starts to show red (from 1 to 4 red pixels), (see Figure 12, Detail II), go to Paragraph 4.H.(6)(c).

(b) If the reference notch B image does not start to show red (from 1 to 4 red pixels), adjust the instrument gain by 1 dB and do Paragraph 4.H.(3) thru Paragraph 4.H.(6) again until the notch image shows red (from 1 to 4 pixels). See Figure 12, Detail II.

(c) Notch A must not show red pixels. If notch A shows red pixels, remove 1 dB and do Paragraph 4.H.(3) thru Paragraph 4.H.(6) again.

(d) Record the calibration gain where notch B shows red and notch A does not show red.

(7) Disengage the encoder and make a scan around the radius EDM notches of the reference standard. Use probe positioner NDT3237-P1 to help follow the radius.

NOTE: To disengage the encoder, open the Main Menu, push Scan, select Inspection and set Scan>Time.

(8) Put probe positioner NDT3237-P1 on the surface of reference standard NDT3237-XXX-XXX in the position shown in Figure 13, Detail I.

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(9) Apply a sufficient quantity of couplant on the reference standard in the areas that the probe will touch. See Figure 13, Detail I.

(10) Put the probe on the skin only area with the sound beam pointed at the edge of the doubler at position 1 as shown in Figure 13, Detail I. Make sure the front and side of the probe are against the radius and side edges of probe positioner NDT3237-P1. Make some scans from probe position 1 to probe position 2 as shown in Figure 13, Detail I. During the scans:

(a) Always keep the front edge of the probe wedge against the probe positioner.

(b) Monitor the reference notch images during each scan around the radius. Change the scan speeds to find the maximum scan speed that can be used. The maximum scan speed occurs when the notch signals start to show red as shown in Figure 13, Detail II.

(11) Engage the encoder as follows:

(a) Open the Main Menu, push Scan and select Inspection> Scan> Encoder1

(b) Set the parameters that follow:

1) Push Display > Zoom and set Display to Uncorrected C-Scan

2) Set Type to Start

3) Set Range Scan to 200

4) Do a check of the equipment settings to make sure that no other parameters have changed.

5. Inspection Procedure

A. Calibrate the equipment as specified in Paragraph 4. on the applicable reference standard. Table 1 in Figure 7 identifies the reference standard to use for the skin thickness to be examined.

B. Make a scan on the reference standard to identify the maximum scan speed that can be used to find the notch and fastener locations.

C. Make sure the gain is set to the calibration gain that was recorded in Paragraph 4.H.(6)(d) and then add 6 dB of gain to examine the airplane.

D. Apply a sufficient quantity of couplant to the areas that the probe will touch. Use the same couplant on the airplane that was used on the reference standard during calibration. See Figure 1 thru Figure 3 for the typical inspection areas.

I **NOTE:** Refer to Paragraph 1.E. and Figure 4 thru Figure 6 to identify areas that must be examined as specified in Part 4, 53-30-07.

E. Examine the fuselage skin for internal cracks at the edges of the chem-mill doublers as follows:

(1) For the horizontal edges of a chem-mill doubler:

(a) Make sure that the fastener centerline is between the “FSTNR” indication lines on the probe wedge.

(b) Keep the fasteners between the “FSTNR” indication lines as you make a scan to examine the fuselage skin at the horizontal edge of a chem-mill doubler. See Figure 1 for the typical probe position.

(2) For the vertical edges of a chem-mill doubler:

(a) Make sure that the chem-mill edge mark put on the fuselage skin in Paragraph 3.C. is in the center of the “CME” indication lines on the probe wedge.

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(b) Keep the chem-mill edge mark between the “CME” indication lines as you make a scan to examine the fuselage skin at the vertical edge of a chem-mill doubler. See Figure 3 for the typical probe position.

(3) For the radius edges of a chem-mill doubler:

(a) Align the radius probe positioner on the airplane as shown in Figure 2.

(b) Put the probe on the inspection area. Make sure the front and the applicable side of the probe wedge touch the probe positioner.

(c) Make a scan from probe position 1 to probe position 2 as shown in Figure 2. During the scan:

1) Make sure to keep the front of the probe wedge against the probe positioner.

2) Do not move the probe faster than the maximum scan speed identified in Paragraph 4.H.(10).

3) As you move the probe, monitor the C-scan for red images that occur between the vertical screen positions identified in Figure 2, Detail I.

(4) Use an approved marker to make marks on the fuselage skin at the locations that cause red indications to occur.

6. Inspection Results

A. Do the steps that follow to help make an analysis of the areas that cause crack indications to occur during the inspection:

(1) Set the gain to the value recorded in Paragraph 4.H.(6)(d).

(2) Make a scan at the marked indication areas to make sure that you have a crack signal.

(a) If the signal on the display has red, reject the area as an area that has a crack. See Figure 12, Detail II. Refer to the Service Bulletin for more instructions about what to do for areas that cause crack indications to occur.

(b) If the signal on the display is not red, do the steps that follow:

1) Remove paint from the inspection area. Then do a scan in the area again with the gain recorded in Paragraph 4.H.(6)(d).

2) If the signal on the display is red, reject the area as an area that has a crack. See Figure 12, Detail II. Refer to the Service Bulletin for more instructions about what to do for areas that cause crack indications to occur.

3) If the signal on the display is not red, the area is satisfactory and no more analysis is necessary.

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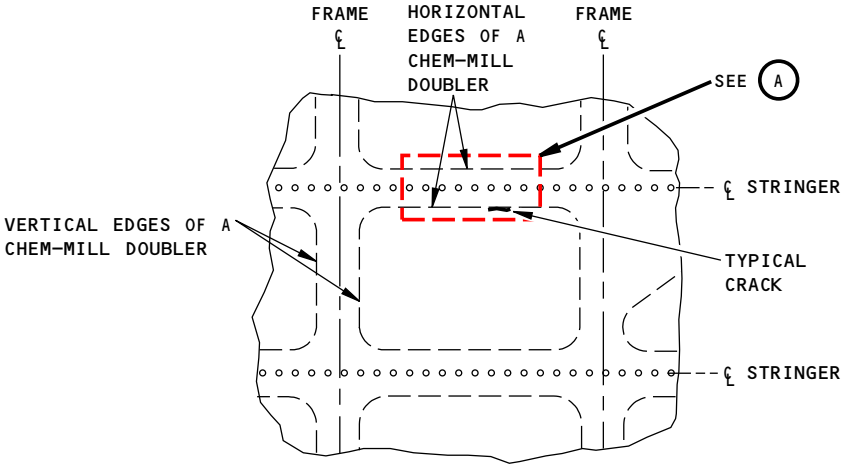
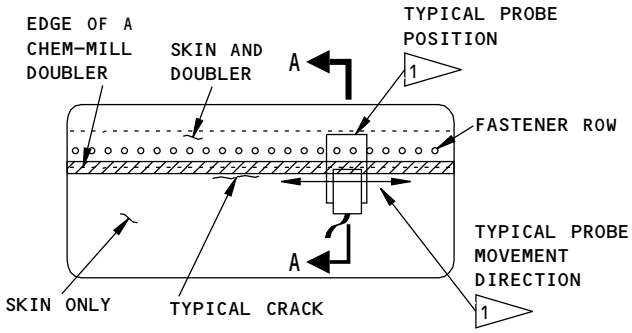
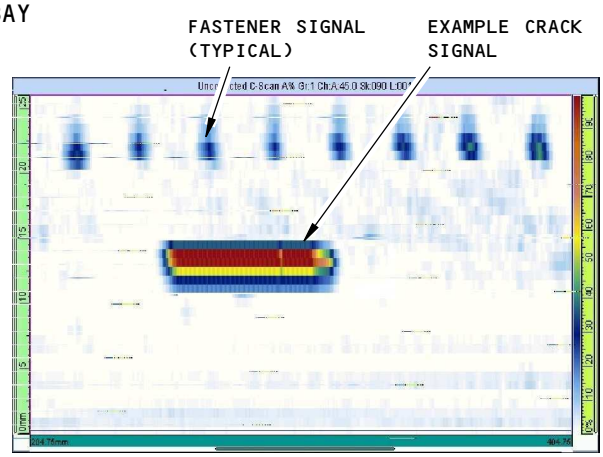


TYPICAL BAY

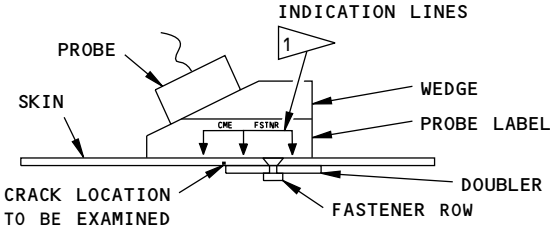


INSPECTION ALONG THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER

A



EXAMPLE SCREEN DISPLAY FOR AN INSPECTION AT THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER
DETAIL I



PROBE INSPECTION POSITION (TURNED 90 DEGREES)

A-A

NOTES

TYPICAL INSPECTION AREA ALONG THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER (SEE THE SERVICE BULLETIN FOR THE INSPECTION AREAS).

1 PUT THE PROBE ON THE SKIN AS SHOWN. MAKE SURE TO KEEP THE FASTENER ROW BETWEEN THE TWO INDICATION LINES ON THE PROBE LABEL DURING THE SCAN. MOVE THE PROBE IN THE LONGITUDINAL DIRECTION SHOWN. SEE FIGURE 12 FOR THE PROBE LABEL DIMENSIONS.

2387087 S0000548309_V1

Inspections at the Horizontal Edges of Chem-Mill Doublers
Figure 1

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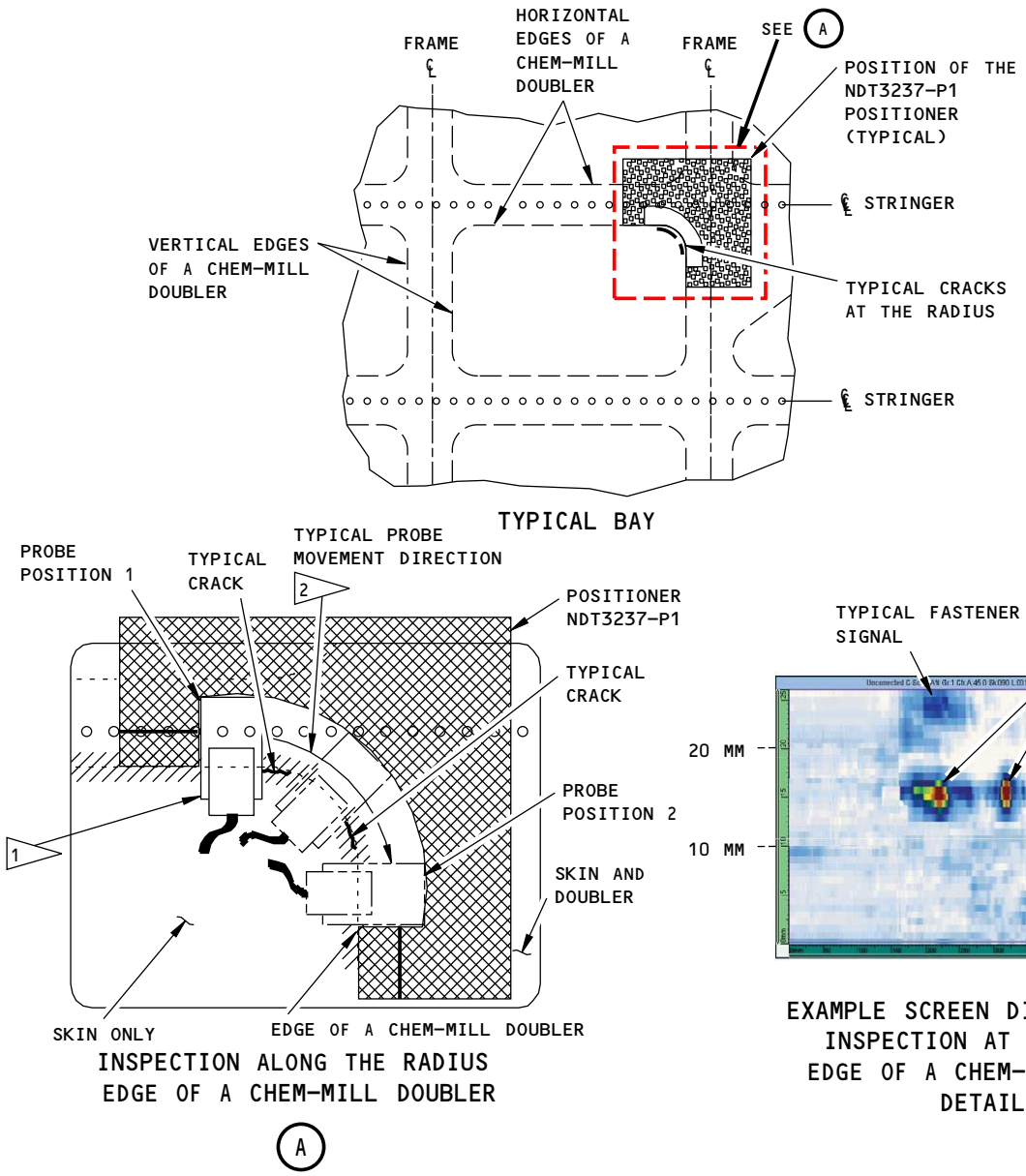

NOTES

TYPICAL INSPECTION AREA AT THE RADIUS EDGE OF A CHEM-MILL DOUBLER (SEE THE SERVICE BULLETIN FOR THE INSPECTION AREAS).

1 PUT THE PROBE ON THE SKIN AT PROBE POSITION 1 AS SHOWN. MAKE SURE THE FRONT OF THE PROBE IS IN TOUCH WITH THE RADIUS EDGE OF POSITIONER NDT3237-P1 AND THE SIDE OF THE PROBE IS IN TOUCH WITH THE SIDE OF POSITIONER NDT3237-P1.

2 MOVE THE PROBE THROUGH THE FULL RADIUS FROM PROBE POSITION 1 TO PROBE POSITION 2. KEEP THE FRONT EDGE OF THE PROBE IN TOUCH WITH THE RADIUS OF POSITIONER NDT3237-P1 DURING THE SCAN.

3 CRACK SIGNALS WILL OCCUR BETWEEN 10 AND 20 MM ON THE VERTICAL AXIS OF THE SCREEN DISPLAY.

2387297 S0000548310_V1

Inspections at the Radius Edges of Chem-Mill Doublers
Figure 2

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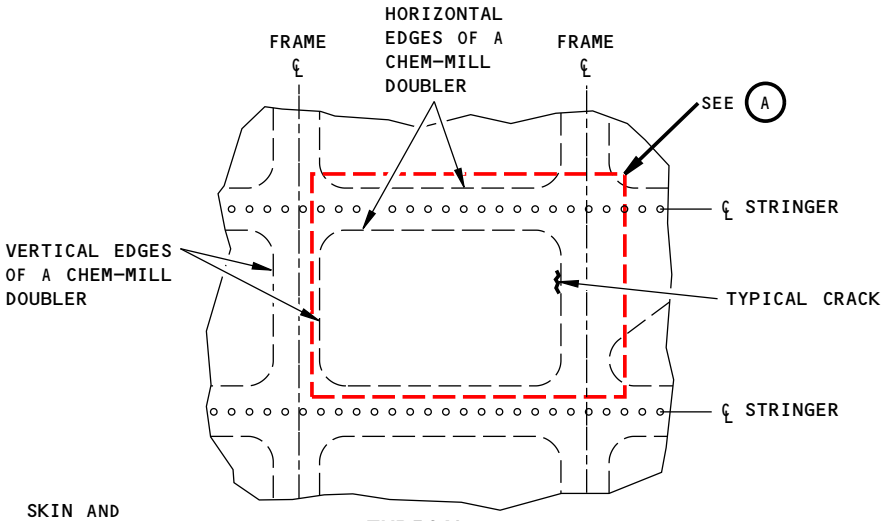
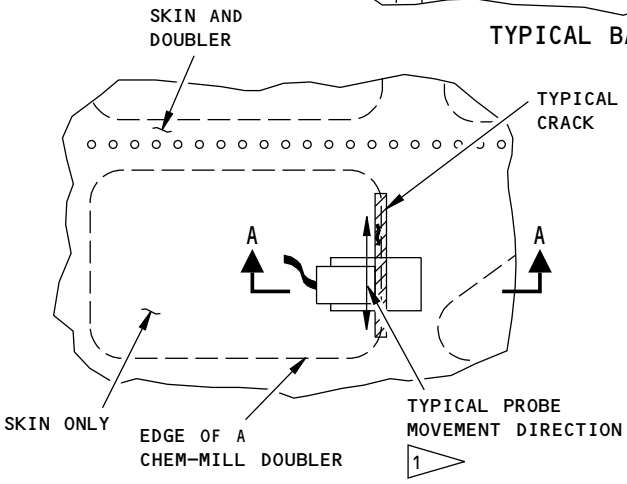
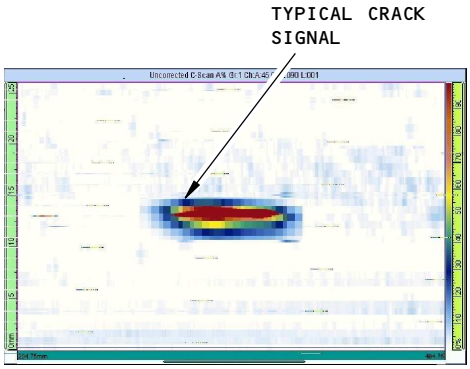


TYPICAL BAY

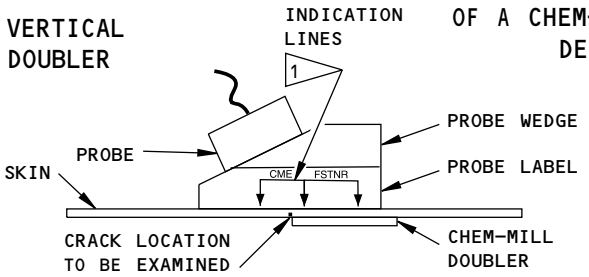


INSPECTION ALONG THE VERTICAL EDGE OF A CHEM-MILL DOUBLER

A



EXAMPLE SCREEN DISPLAY FOR AN INSPECTION AT THE VERTICAL EDGE OF A CHEM-MILL DOUBLER
DETAIL I



PROBE INSPECTION POSITION

A-A

NOTES

TYPICAL INSPECTION AREA ALONG THE VERTICAL EDGE OF A CHEM-MILL DOUBLER (SEE THE SERVICE BULLETIN FOR THE INSPECTION AREAS).

1 PUT THE PROBE ON THE SKIN AS SHOWN. MAKE SURE TO KEEP THE VERTICAL MARK ON THE FUSELAGE SKIN BETWEEN THE TWO INDICATION LINES ON THE PROBE LABEL DURING THE SCAN. MOVE THE PROBE IN THE VERTICAL DIRECTION SHOWN. SEE FIGURE 12 FOR THE PROBE LABEL DIMENSIONS.

2387313 S0000548311_V1

Inspections at the Vertical Edges of Chem-Mill Doublers
Figure 3

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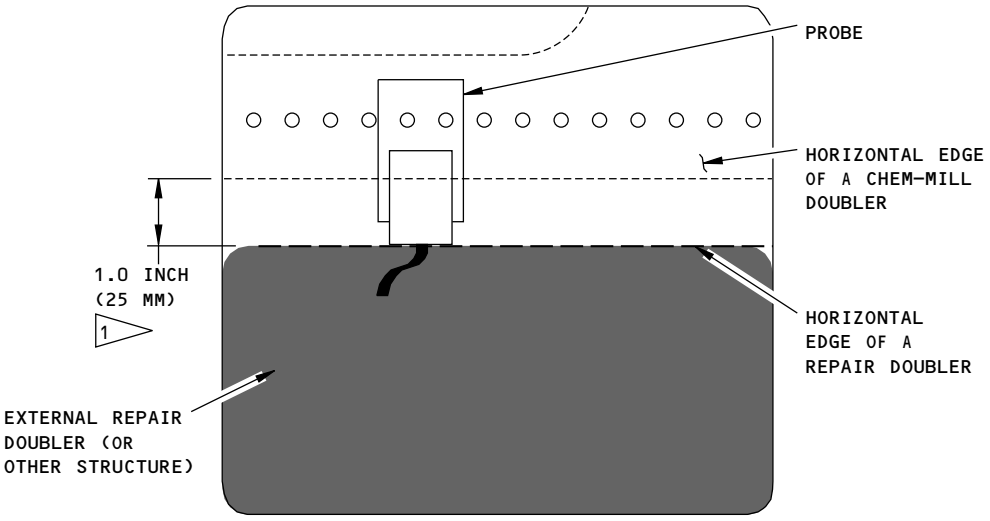
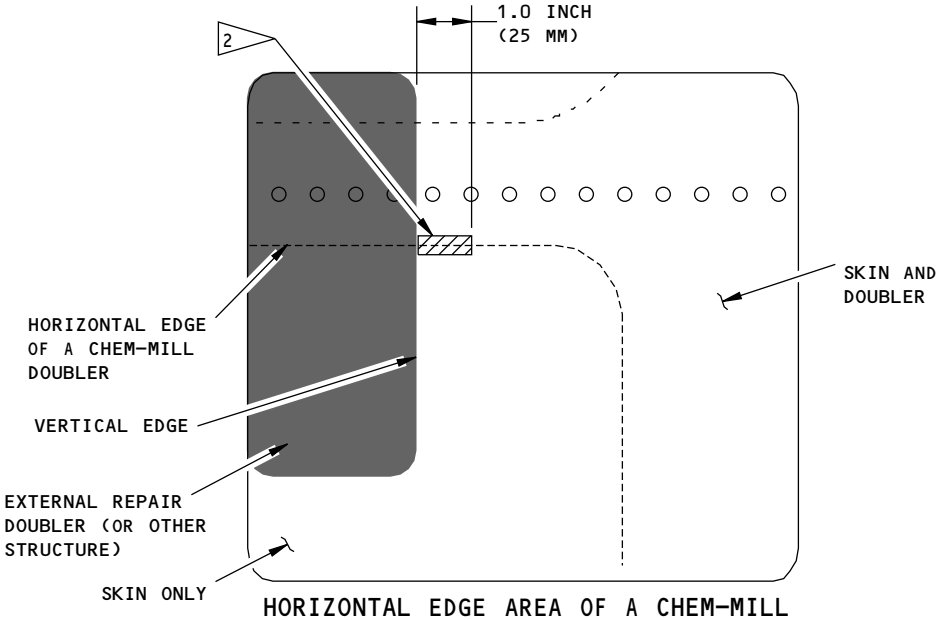


VERTICAL CLEARANCE NECESSARY TO EXAMINE THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER



HORIZONTAL EDGE AREA OF A CHEM-MILL DOUBLER TO BE EXAMINED WITH PART 4, 53-30-07

NOTES

1. TO USE THIS PROCEDURE, THE DISTANCE BETWEEN THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER AND THE HORIZONTAL EDGE OF AN EXTERNAL REPAIR DOUBLER MUST BE 1.0 INCH (25 MM) OR MORE.
2. IF AN EXTERNAL REPAIR DOUBLER IS INSTALLED ACROSS THE HORIZONTAL EDGE OF A CHEM-MILL DOUBLER, IT IS NECESSARY TO USE PART 4, 53-30-07 TO EXAMINE THE 1.0 INCH (25 MM) DISTANCE FROM THE VERTICAL EDGE OF THE EXTERNAL REPAIR DOUBLER

2387330 S0000548313_V1

Horizontal Edge Clearances from External Repair Doublers (or Other Structure) to Chem-Mill Doublers
Figure 4

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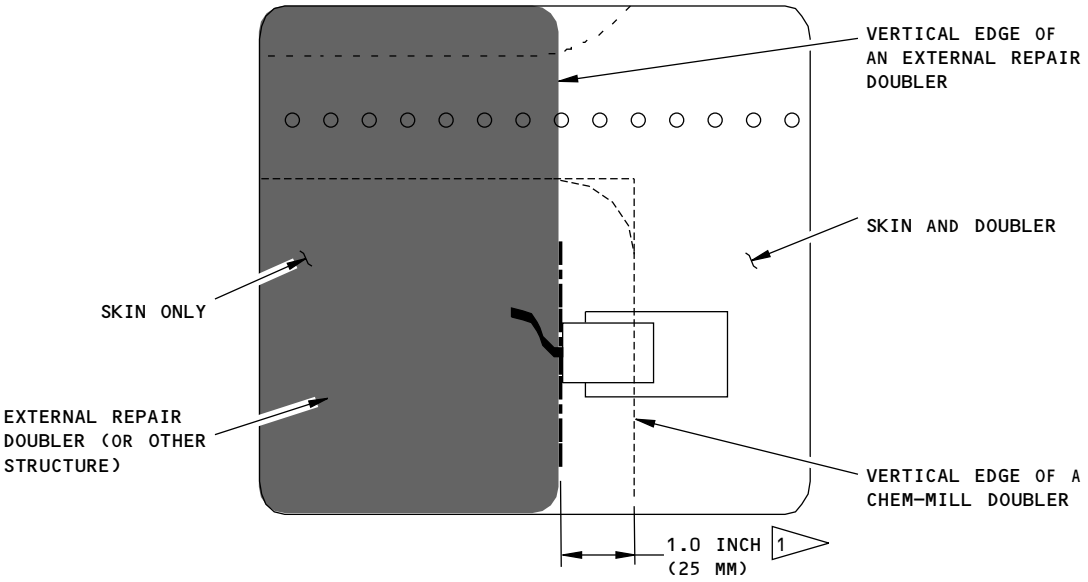
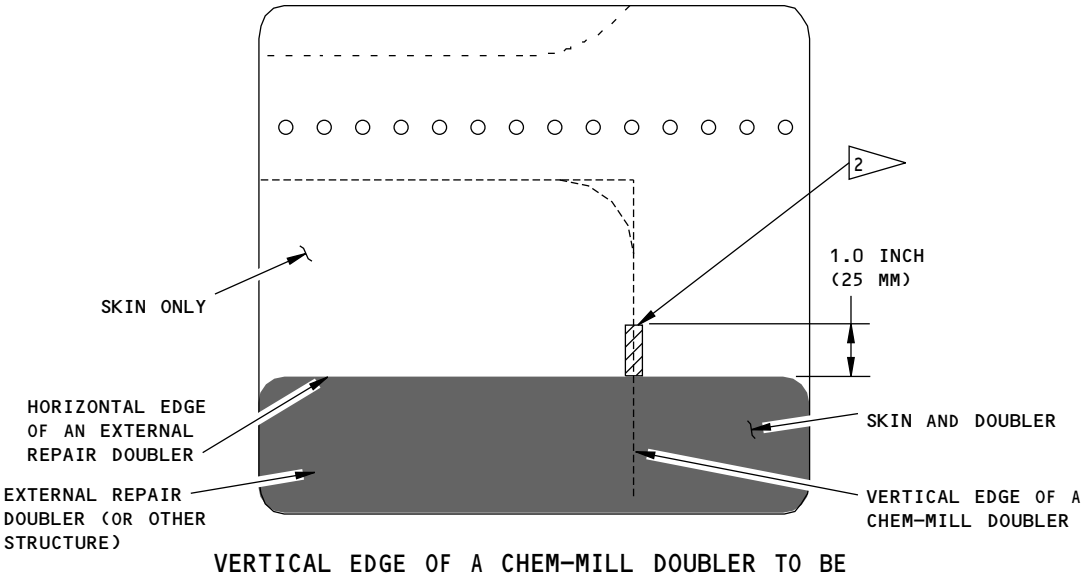


HORIZONTAL CLEARANCE NECESSARY TO EXAMINE THE VERTICAL EDGE OF A CHEM-MILL DOUBLER



VERTICAL EDGE OF A CHEM-MILL DOUBLER TO BE EXAMINED WITH PART 4, 53-30-07

NOTES

1. TO USE THIS PROCEDURE, THE DISTANCE BETWEEN THE VERTICAL EDGE OF A CHEM-MILL DOUBLER AND THE VERTICAL EDGE OF AN EXTERNAL REPAIR DOUBLER MUST BE 1.0 INCH (25 MM) OR MORE.
2. IF AN EXTERNAL REPAIR DOUBLER IS INSTALLED ACROSS THE VERTICAL CHEM-MILL DOUBLER, IT IS NECESSARY TO USE PART 4, 53-30-07 TO EXAMINE THE 1.0 INCH (25 MM) DISTANCE FROM THE HORIZONTAL EDGE OF THE EXTERNAL REPAIR DOUBLER.

2387376 S0000548314_V1

Vertical Edge Clearances from External Repair Doublers (or Other Structure) to Chem-Mill Doublers
Figure 5

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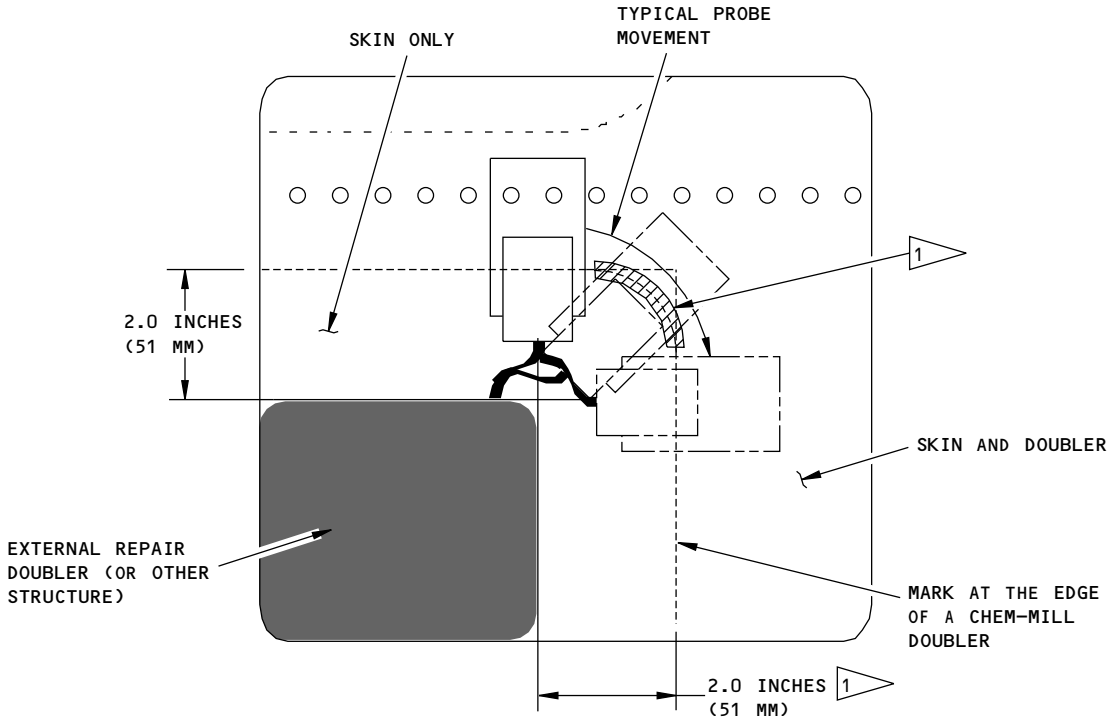

MINIMUM CLEARANCE NECESSARY TO EXAMINE THE RADIUS OF A CHEM-MILL DOUBLER

NOTE

1 IF AN EXTERNAL REPAIR DOUBLER IS LESS THAN 2.0 INCHES (51 MM) FROM THE HORIZONTAL OR VERTICAL EDGES OF A CHEM-MILL DOUBLER, IT IS NECESSARY TO USE PART 4, 53-30-07 TO EXAMINE THE FULL LENGTH OF THE RADIUS

2387388 S0000548315_V1

Radius Edge Clearances from External Repair Doublers (or Other Structure) to Chem-Mill Doublers
Figure 6

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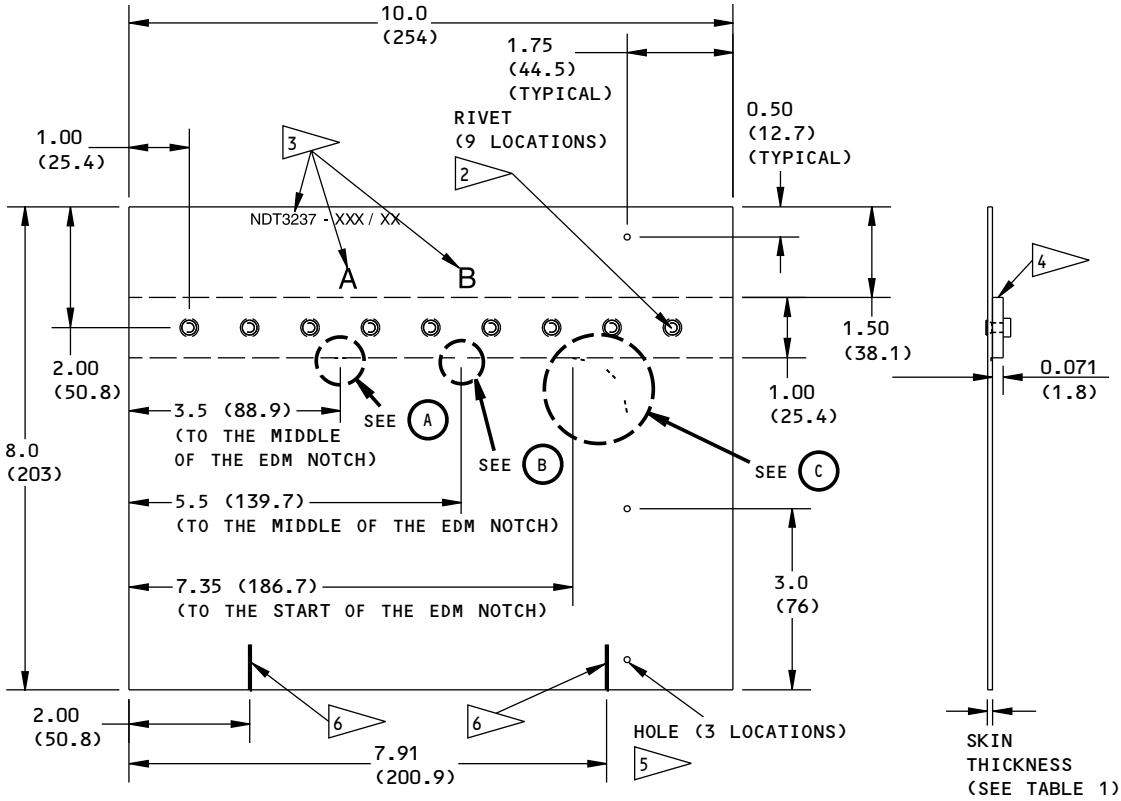

NOTES

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

INCHES	MILLIMETERS	ANGLES
X.XXX = ±0.005	X.XX = ±0.10	±1 °
X.XX = ±0.025	X.X = ±0.5	
X.X = ±0.050	X = ±1	

- SURFACE ROUGHNESS: 63 Ra OR BETTER
- MATERIAL: 2024 SERIES OR 7075 SERIES ALUMINUM (CLAD OR BARE)

1 EDM NOTCH: WIDTH: 0.010 (0.25) MAXIMUM
DEPTH: SEE TABLE 1
LENGTH: 0.200 (5.10)

2 USE BACR15GF5 OR BACR15CE5 RIVETS AT ALL LOCATIONS WITH A FLUSHNESS TOLERANCE OF +0.002 (0.05) TO -0.001 (0.03). SPOTFACE THE RIVET HEADS IF NECESSARY.

3 ETCH OR STAMP THE REFERENCE STANDARD NUMBER, NDT3237-XXX/XXX, AND THE LETTERS AT THE APPROXIMATE LOCATIONS SHOWN

4 USE THE HOT BOND PROCEDURE, OR APPLICABLE ADHESIVE TO BOND THE DOUBLER TO THE SKIN

5 MILL OR MACHINE APPROXIMATELY 0.10 (2.5) DIAMETER FLAT BOTTOM HOLES TO DEPTHS OF APPROXIMATELY 0.005 (0.13) AT THE 3 LOCATIONS SHOWN. FILL THE HOLES WITH BLACK PAINT OR EPOXY.

6 ETCH OR MACHINE 0.75 (19.1) LONG AND 0.020 (5) WIDE (MAXIMUM) LOCATION MARKS TO DEPTHS OF APPROXIMATELY 0.005 (0.13)

2387511 S0000548316_V1

Reference Standard NDT3237-XXX/XXX
Figure 7 (Sheet 1 of 2)

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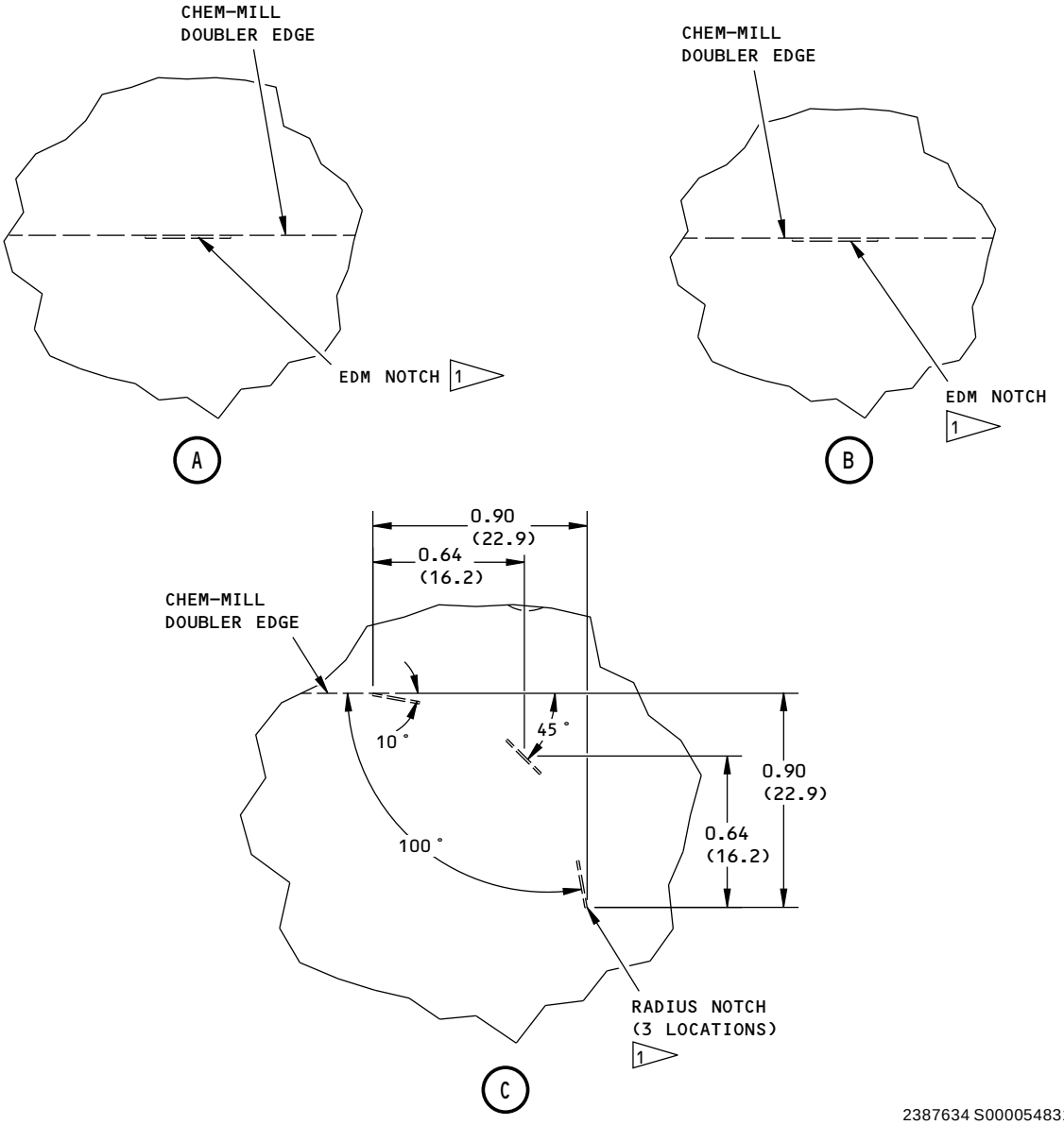
TABLE 1			
REFERENCE STANDARD NUMBER	SKIN THICKNESS	NOTCH DEPTH	SKIN THICKNESS INSPECTION RANGE
NDT3237 - 0.040 / 0.010 (NDT3237 - 1.01 / 0.25)	0.040 (1.01)	0.010 (0.25)	0.032 - 0.045 (0.81 - 1.14)
NDT3237 - 0.050 / 0.015 (NDT3237 - 1.27 / 0.38)	0.050 (1.27)	0.015 (0.38)	0.045 - 0.059 (1.14 - 1.50)
NDT3237 - 0.130 / 0.020 (NDT3237 - 3.30 / 0.51)	0.130 +0.002/-0.007 (3.30 +0.05/-0.18)	0.020 (0.51)	0.060 - 0.140 (1.52 - 3.56)



2387634 S0000548318_V2

Reference Standard NDT3237-XXX/XXX
Figure 7 (Sheet 2 of 2)

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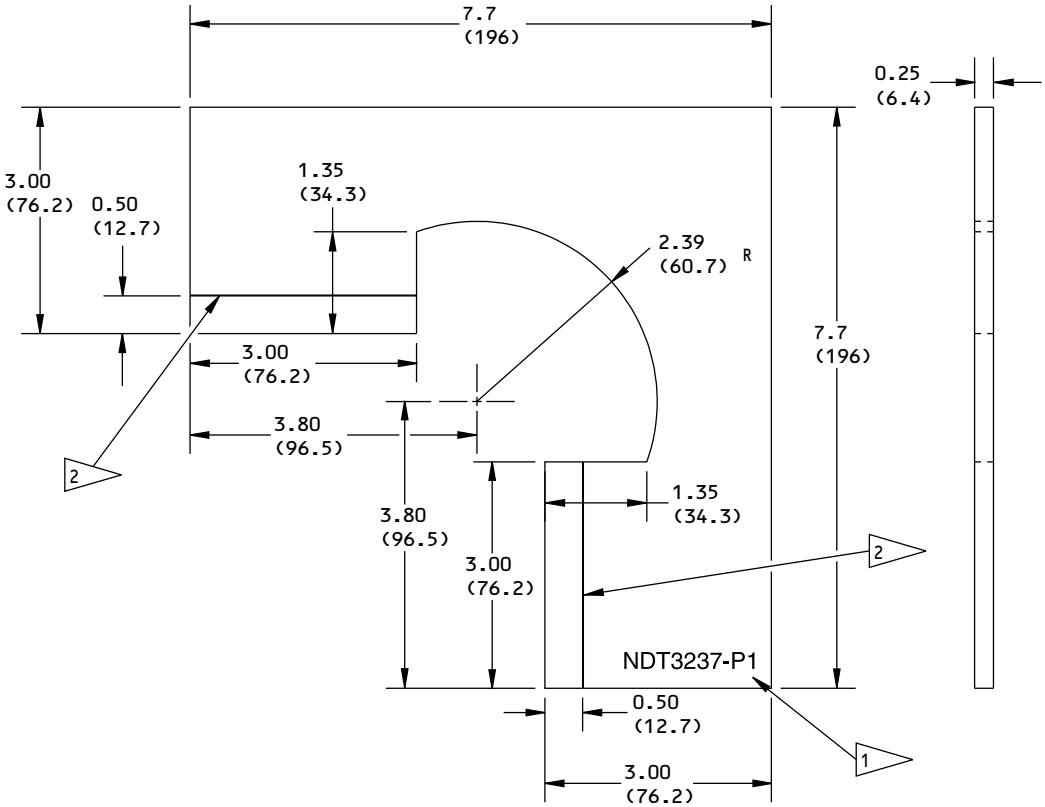

NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (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

- MATERIAL: PLEXIGLASS, ACRYLIC OR AN EQUIVALENT (CLEAR)

1 ETCH OR STAMP THE PROBE POSITIONER NUMBER, NDT3237-P1, AT APPROXIMATELY THIS LOCATION

2 ETCH OR LASER CUT A LINE ON THE PROBE POSITIONER AT THIS LOCATION

2387639 S0000548317_V1

Probe Positioner NDT3237-P1
Figure 8

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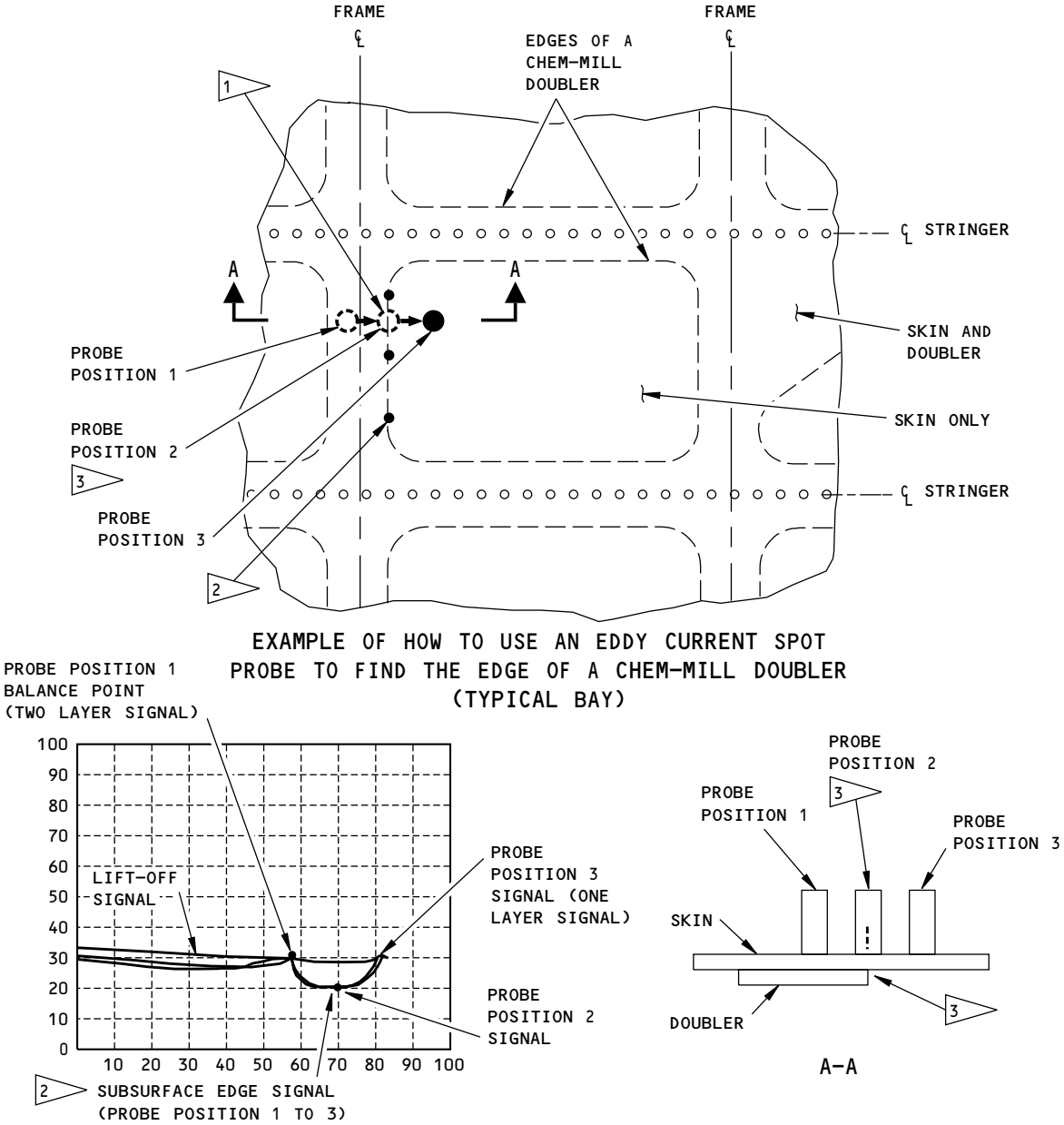

NOTES

1. MOVE THE EDDY CURRENT SPOT PROBE FROM THE SKIN AND DOUBLER AREA TO THE SKIN ONLY AREA AND MONITOR THE SCREEN DISPLAY TO SEE WHERE TO PUT THE MARKS ON THE FUSELAGE SKIN THAT SHOW THE LOCATION OF THE SUBSURFACE DOUBLER EDGE.
2. USE AN APPROVED MARKER TO MAKE A MARK ON THE SKIN WHERE THE SUBSURFACE EDGE SIGNAL IDENTIFIES THE LOCATION OF THE SUBSURFACE (DOUBLER) EDGE. THE EDGE OF A CHEM-MILL DOUBLER WILL BE WHERE THE SUBSURFACE EDGE SIGNAL IS BETWEEN THE SIGNAL AT PROBE POSITION 1 AND PROBE POSITION 3.
3. AT PROBE POSITION 2, THE EDGE OF A CHEM-MILL DOUBLER WILL BE BELOW THE CENTER OF THE PROBE.

2387657 S0000548319_V1

Find the Edges of a Chem-Mill Doubler with an Eddy Current Spot Probe
Figure 9

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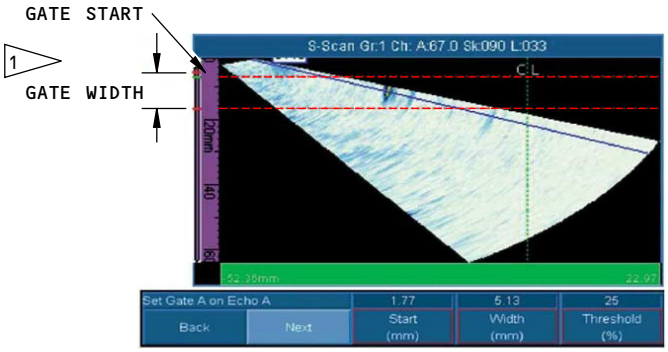
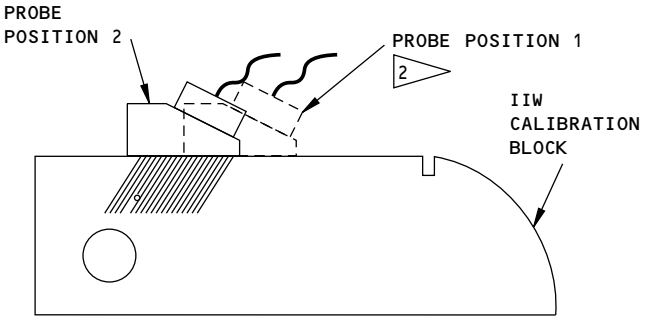
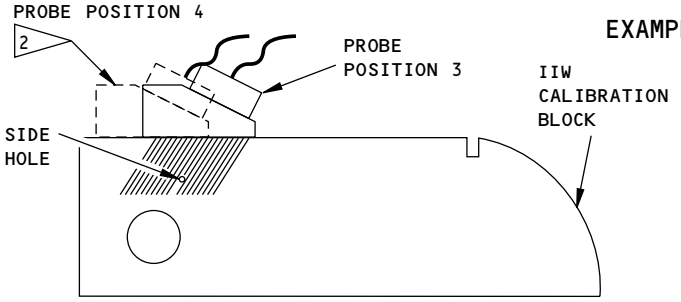


GATE FOR THE CALIBRATION SCAN
DETAIL I

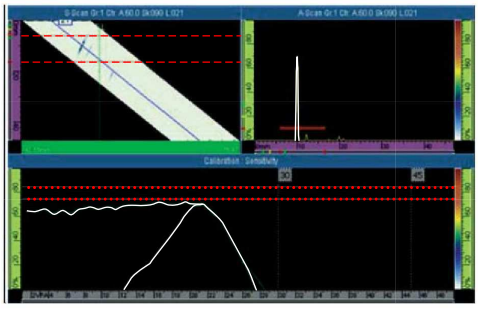


PROBE MOVEMENT DURING THE CALIBRATION SCAN

AMPLITUDE GRAPH
EXAMPLE SCREEN DISPLAY AT PROBE POSITION 2



PROBE MOVEMENT DURING THE CALIBRATION SCAN



AMPLITUDE GRAPH
EXAMPLE SCREEN DISPLAY AT PROBE POSITION 3

NOTES

1. IT IS NECESSARY TO ADJUST THE GATE TO INCLUDE THE FULL SIGNAL FROM THE SIDE HOLE.
2. IT IS NECESSARY TO MOVE THE PROBE FROM POSITION 1 TO POSITION 4 TO COMPLETE THE CALIBRATION SCAN FOR SENSITIVITY

2387693 S0000548320_V1

Probe Calibration (Sensitivity)
Figure 10

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UT SETTING	
GENERAL	
GAIN	20-25
START	0.06
RANGE	49 MM 1
WEDGE DELAY	0
VELOCITY	3100 M/S

PULSER	
PULSER	1
TX/RX	PE
FREQ (MHz)	5
VOLTAGE	80
PW (NS)	AUTO
MAX PRF	50

ALARM	
ALARM	1
GROUP A	1
CONDITION	NONE
OPERATOR	AND
GROUP A	1

DISPLAY	
SECTION	
DISPLAY	AS[C]
C-SCAN 1	A%

PROBE/PART	
SELECT	
GROUP MODE	1
SELECT	TX/RX
PROBE	5L64-A12
WEDGE	SA12-N55S
AUTO DETECT	ON

PARTS	
GEOMETRY	PLATE
THICKNESS	50 MM
MATERIAL	ALUMINUM

RECEIVER	
RECEIVER	1
FILTER	NONE
RECTIFIER	FW
VIDEO FILTER	ON
AVERAGING	1
REJECT (%)	0

BEAM	
SCAN OFFSET	0
ANGLE	45
SKEW ANGLE	0
BEAM DELAY	20.78
GAIN OFFSET	0

GATES/ALARM	
GATE	
GATE A	A
PARAMETERS	POSITION
START	0.00 MM
WIDTH	2.7
THRESHOLD	0%

ZOOM	
DISPLAY	UNCORRECTED C-SCAN
TYPE	START
RANGE SCAN	200
START INDEX	0
RANGE INDEX	26.14

POSITION	
SCAN OFFSET	0
INDX OFFSET	0
SKEW	90 DEGREES

APERTURE	
ELEMENT QTY	16
FIRST ELEMENT	1
LAST ELEMENT	52
ELEMENT STEP	1
WAVE TYPE	SW

ADVANCED	
DB REF	OFF
POINTS ONLY	320
SCALE FACTOR	14
SUM GAIN	AUTO

GATE	
GATE	A
PARAMETERS	POSITION
START	0.01
WIDTH	2.71
THRESHOLD	0

COLOR	
SELECT	AMPLITUDE
START	0%
END	100%

CHARACTERIZE	
FFT	OFF
GAIN	CURRENT
START	0
WIDTH	2.7 MM

BEAM	
MIN. ANGLE	45
MAX. ANGLE	0
ANGLE STEP	0.1
FOCUS DEPTH	1.0 MM

AREA	
SCAN START	0
SCAN END	600 MM 2
SCAN RESOLUTION	0.50 MM
INDEX START	0
INDEX END	0
ENCODER TOLERANCE	0

PREFERENCES	
PREF	
UNITS	MM

2387731 S0000548321_V2

Equipment Parameters
Figure 11 (Sheet 1 of 2)

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FOCAL LAW	
CONFIGURATION	
LAW CONFIG	LINEAR
LAWS	
AUTO PROGRAM	ON

SCAN	
ENCODER	
ENCODER	1
POLARITY	NORMAL 3
TYPE	QUAD
RESOLUTION	12.0 STEP/MM
ORIGIN	0

START	
START MODE	RESET ALL

INSPECTION	
TYPE	ONE LINE SCAN
SCAN	ENCODER 1
INDEX	OFF
MAX. SCAN SPEED	75.0 MM/SEC

DATA	
STORAGE	LAST
INSPECTION DATE	ALL A & C SCANS

NOTES

- ONLY THE EQUIPMENT PARAMETERS NECESSARY TO DO THIS PROCEDURE ARE IDENTIFIED. ALL OTHER EQUIPMENT PARAMETERS WILL BE AUTOMATICALLY SET BY THE EQUIPMENT

1 THIS IS A CALIBRATION VALUE. LARGER OR SMALLER VALUES ARE PERMITTED AFTER CALIBRATION. SEE FIGURE 12, FLAGNOTE 1

2 THIS IS A MINIMUM VALUE. LARGER VALUES ARE PERMITTED IF THE NECESSARY MEMORY IS NOT MORE THAN THE EQUIPMENT CAPACITY

3 THIS PARAMETER CAN BE SET TO "NORMAL" OR "INVERSE" AND RELATES TO THE SCAN DIRECTION. IF THIS PARAMETER IS CHANGED DURING AN INSPECTION, YOU MUST DO THE CALIBRATION AGAIN

2387769 S0000548322_V2

Equipment Parameters
Figure 11 (Sheet 2 of 2)

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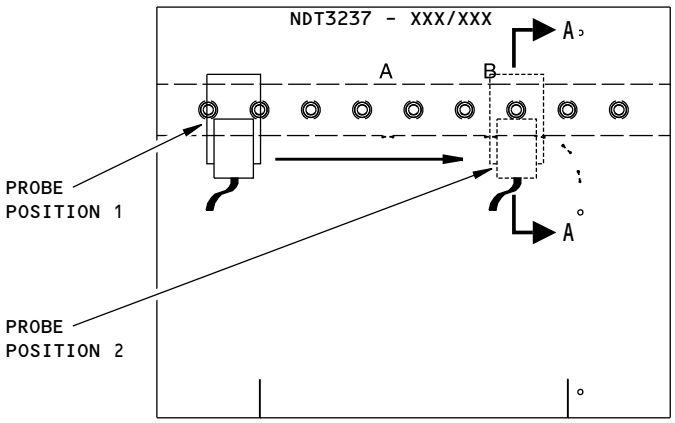
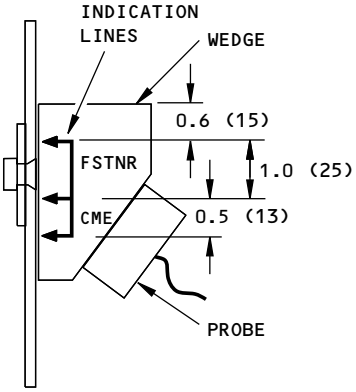
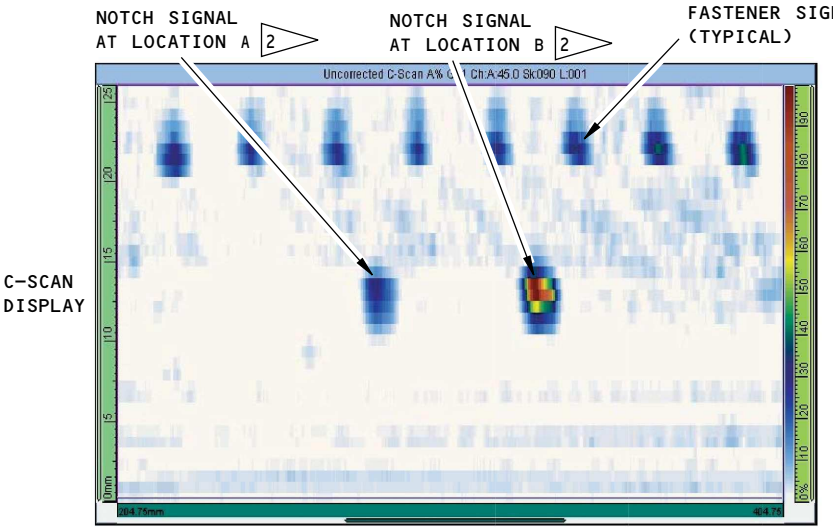


CALIBRATION PROBE POSITIONS
DETAIL I 1



PROBE LABEL DIMENSIONS TO
ATTACH TO THE PROBE WEDGE
A-A 3



OMNISCAN MX SCREEN DISPLAY WITH THE CORRECT GAIN SETTING OF
THE NOTCH SIGNAL FOR THE APPLICABLE REFERENCE STANDARD
DETAIL II 1

NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)

1 THE SCREEN DISPLAY IN DETAIL II IS AN EXAMPLE OF THE TYPICAL C-SCAN DISPLAY DURING CALIBRATION FOR LONGITUDINAL AND VERTICAL EDGES. THE IMAGE SHOWN IS TAKEN FROM THE NDT3237-040-010 REFERENCE STANDARD CALIBRATION. THE IMAGE SHOWN IN DETAIL II CAN BE DIFFERENT FOR YOUR PROBE, WEDGE AND REFERENCE STANDARD. IT IS NECESSARY FOR THE C-SCAN SIGNAL TO DISPLAY THE FASTENER SIGNALS AND THE CALIBRATION NOTCH SIGNALS

2 THE SIGNAL FROM CALIBRATION NOTCH B ON THE SCREEN DISPLAY MUST CONTAIN AT LEAST 1 RED PIXEL IN THE C-SCAN IMAGE. A C-SCAN IMAGE THAT CONTAINS FROM 1 TO 4 RED PIXELS IS RECOMMENDED. NOTCH A ON THE REFERENCE STANDARD MUST NOT HAVE RED PIXELS ON THE C-SCAN IMAGE

3 IT IS NECESSARY TO MAKE LABELS THAT ATTACH TO EACH SIDE OF THE PROBE WEDGE WITH THE DIMENSIONS SHOWN. THE INDICATION LINES ARE NECESSARY TO CORRECTLY POSITION THE PROBE ABOVE THE FASTENER ROW AND CHEM-MILL EDGE DURING A SCAN

2387819 S0000548323_V2

Calibration for Longitudinal and Vertical Edges
Figure 12

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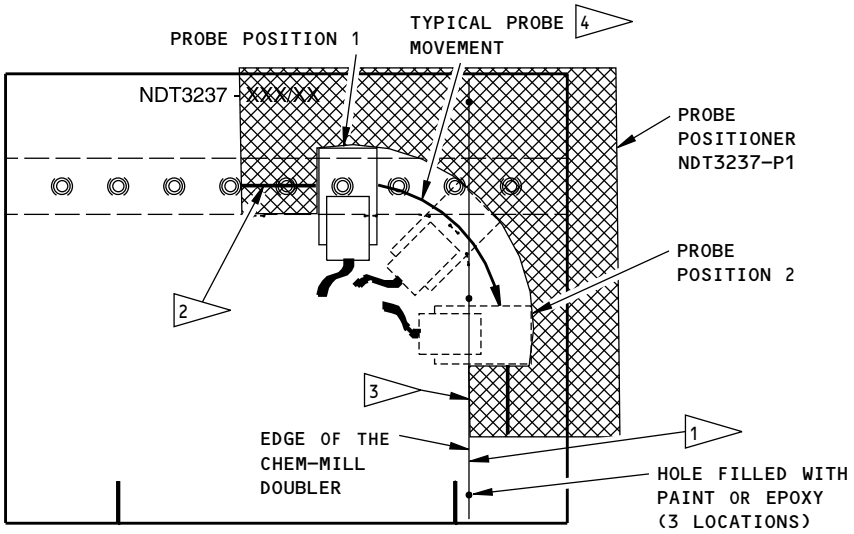
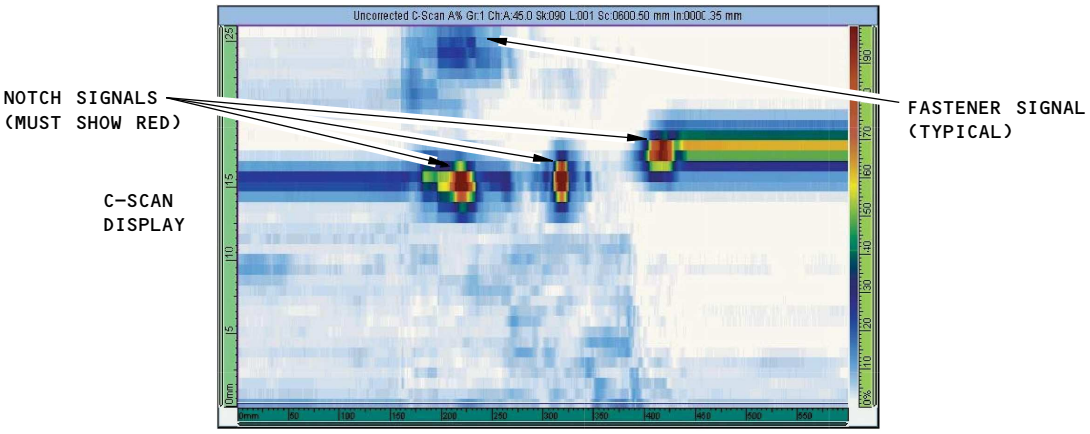


CALIBRATION PROBE POSITIONS FOR RADIUS EDGE INSPECTIONS
DETAIL I



OMNISCAN MX SCREEN DISPLAY WITH THE CORRECT GAIN SETTING OF THE RADIUS NOTCH SIGNALS FOR THE APPLICABLE REFERENCE STANDARD

DETAIL II 5

NOTES

1. USE AN APPROVED MARKER TO MAKE A LINE THAT GOES THROUGH THE THREE HOLES IN THE REFERENCE STANDARD. THIS LINE SIMULATES THE CHEM-MILL EDGE THAT WAS FOUND WITH MFEC.
2. PUT THIS LINE ON PROBE POSITIONER NDT3237-P1 ABOVE THE CENTERLINE OF THE FASTENER ROW TO ALIGN THE HORIZONTAL SIDE OF THE POSITIONER.
3. ALIGN THE VERTICAL EDGE OF PROBE POSITIONER NDT3237-P1 WITH THE STRAIGHT LINE THAT WAS MADE ON THE REFERENCE STANDARD.
4. MOVE THE PROBE FROM PROBE POSITION 1 TO PROBE POSITION 2. MAKE SURE TO KEEP THE FRONT EDGE OF THE PROBE AGAINST PROBE POSITIONER NDT3237-P1 DURING THE COMPLETE SCAN.
5. THE SCAN IMAGE FROM A RADIUS INSPECTION DOES NOT USE AN ENCODER. THE SPEED OF THE SCAN IS CONTROLLED BY THE INSPECTOR. THE IMAGE CAN CHANGE FOR DIFFERENT SCAN SPEEDS.

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Calibration for the Radius Edges of Chem-Mill Doublers
Figure 13

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