PART 6 - EDDY CURRENT

FORWARD AND AFT CARGO DOORS

1. Purpose

A. Use this procedure to do subsurface eddy current inspections to find cracks in the skin-doubler and the outer flange of the "T" stiffener chord of the forward and aft cargo doors. See Figure 1 for the inspection areas.

NOTE: For airplanes after line number 2414, the skin and doubler configuration changed to a chem-milled single skin thickness without a doubler.

B. This procedure uses a specially designed sliding probe and an impedance plane display instrument to examine cargo door skins with Alodine or anodized fasteners.

C. You cannot do this procedure at a location where the fastener is magnetic (steel) or if a fastener has a protruding head. If a fastener is magnetic or has a protruding head, do one of the procedures that follow:

(1) Do an external low frequency eddy current (LFEC) inspection as specified in Part 6, 51-00-00, Procedure 9 and use the specifications that follow:

(a) Refer to Paragraph 2.C.(2) for probe specifications.

(b) Refer to Paragraph 2.D.(2) for reference standard specifications.

(c) Refer to Paragraph 4.C. for calibration specifications.

(2) Do an open hole inspection as shown in Part 6, 51-00-00, Procedure 16.

D. The probe must be correctly aligned with the fastener centerline to do this procedure correctly. For correct alignment, the use of a probe guide is mandatory. If two inspectors do the inspection, a probe guide is not mandatory if one inspector carefully monitors the probe alignment.

E. This inspection procedure also has instructions that use a ring probe procedure as an alternative to the sliding probe. The ring probe procedure can also be used for magnetic fasteners and to make an analysis of crack signals that were found with the sliding probe.

F. 737 Supplemental Structural Inspection Document (D6-37089 for -100/-200 airplanes; D6-82669 for -300/-400/-500 airplanes) Reference:

(1) Item: F-1

G. Service Bulletin reference:

(1) 737-52A1079

(2) 737-52A1100

(3) 737-52A1153

(4) 737-52-1154

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 eddy current instrument that:

(a) Has an impedance plane display.

(b) Operates at a frequency range of 2.5 to 3.0 kHz.

(c) Has a permanent screen adjustment (screen persistence). The permanent screen adjustment is necessary so that signals stay on the screen until manually erased.

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

(a) Phasec 2D, 2200; Hocking Krautkramer

(b) Nortec 2000D, 2000D+, 19e; Staveley Instruments

(c) B300; Elotest

C. Probes

(1) It is necessary to use a specially designed probe to do this procedure. To get the correct results from this procedure, it is necessary to use the sliding probe that follows:

(a) TEK-1527; Techna NDT

(2) For magnetic steel fasteners or to use as an alternative inspection, a ring probe with an inside diameter between 0.33 inch (8.4 mm) and 0.36 inch (9.1 mm). The probe that follows is permitted:

(a) TEK-4067 or RDP7-2K-1; Techna NDT

NOTE: Other 0.33 to 0.36 inch (8.4 to 9.1 mm) inside diameter ring probes that can operate at 2.5 to 3.0 kHz can be used.

D. Reference Standard

(1) Use reference standard NDT3118. See Figure 3.

(2) For magnetic steel fasteners, use reference standard NDT3118 (see Figure 3) and replace the non-magnetic steel bolts with magnetic steel bolts as found on the airplane.

E. Special Tools

(1) Use a flexible, nonconductive probe guide to align the sliding probe on the reference standard during calibration and on the airplane during the inspections.

(2) A magnet to identify magnetic type fasteners.

(3) A flashlight to see that the fastener is centered in the ring probe (if a ring probe is used).

3. Prepare for the Inspection

A. Identify all of the inspection areas. See Figure 1.

B. Do a check of all the fastener locations with a magnet to find and identify magnetic fasteners on the airplane. Also identify the 5/32 inch (3.97 mm) diameter rivets, the 3/16 inch (4.76 mm) diameter rivets and the 3/16 inch (4.76 mm) diameter nonmagnetic bolts.

C. Clean the inspection area.

(1) Remove sealant as necessary. Use care to prevent damage to the surface of the skin if sealant removal is necessary. See the Airplane Maintenance Manual for additional instructions if necessary.

(2) Remove paint if it is loose or if the fasteners cannot be seen.

4. Instrument Calibration

A. To examine the aluminum rivet locations, calibrate the instrument as follows:

(1) Set the frequency to 2.5 to 3.0 kHz.

(2) Set the instrument to permanent screen persistence.

(3) For 5/32 inch (3.97 mm) diameter rivets, put the probe on the reference standard at position 1 as shown in Detail I in Figure 2. For 3/16 inch (4.76 mm) diameter rivets, put the probe on the reference standard at position 3 as shown in Detail III in Figure 2. Align the centerline of the probe with the centerline of the rivet row.

(4) Put the nonconductive probe guide on the reference standard, against the probe and aligned with the centerline of the rivet row as shown in Detail I and III in Figure 2.

(5) Balance the instrument.

(6) Set the balance point to 30 percent of full screen height and 70 percent of full screen width as shown in Detail II in Figure 2.

(7) Tilt the probe and adjust the phase control (lift-off) so that the signal moves horizontally to the left as shown in Detail II in Figure 2.

(8) For 5/32 inch (3.97 mm) diameter rivets, move the probe across the rivets from Position 1 to Position 2 as shown in Detail I in Figure 2. For 3/16 inch (4.76 mm) diameter rivets, move the probe across the rivets from position 3 to 4 as shown in Detail III in Figure 2.

(9) For 5/32 inch (3.97 mm) diameter rivets, move the probe at position 2 to get a maximum signal from the notch. For 3/16 inch (4.76 mm) diameter rivets, move the probe at position 4 to get a maximum signal from the notch.

(10) Adjust the instrument vertical and horizontal gain or gain ratio so that the maximum notch signal is 40 percent of full screen height above the balance point as shown in Detail II, flagnote 2 in Figure 2.

(11) Set the alarm to alarm at 20 percent of full screen height above the balance point.

B. To examine the non-magnetic bolt locations, calibrate the instrument as follows:

(1) Do Paragraph 4.A.(1) thru Paragraph 4.A.(5) again, but use probe position 5 shown in Detail IV in Figure 2.

(2) Set the balance point to 30 percent of full screen height and 70 percent of full screen width as shown in Detail V in Figure 2.

(3) Tilt the probe and adjust the phase control (lift-off) so that the signal moves horizontally to the left as shown in Detail V in Figure 2.

(4) Move the probe across the bolts from Position 5 to Position 6 as shown in Detail IV in Figure 2.

(5) Move the probe at position 6 to get a maximum signal from the notch.

(6) Adjust the instrument vertical and horizontal gain or gain ratio so that the maximum notch signal is 40 percent of full screen height above the balance point as shown in Detail V, flagnote 3 in Figure 2.

(7) Set the alarm to alarm at 20 percent of full screen height above the balance point.

(8) Do Paragraph 4.B.(4) again and monitor the typical signal from the fastener without a notch as shown in Detail V, flagnote 1 in Figure 2.

(a) Make sure the signal from the fastener without a notch is no higher than 5 percent above the balance point. Adjust the gain and phase as necessary.

C. To examine the magnetic bolt locations, calibrate the instrument as follows:

NOTE: Replace the nonmagnetic bolts in reference standard NDT3118 with magnetic bolts that have the same diameters as the fasteners to examine.

(1) Set the frequency to 2.5 to 3.0 kHz and calibrate the instrument as specified in Part 6, 51-00-00, Procedure 9, paragraph 5.

(2) Do the calibration as shown in Paragraph 4.D., but use probe positions 5 and 6 where the nonmagnetic bolts are installed.

D. Calibrate the instrument to use the ring probe inspection on rivets and nonmagnetic bolts as follows:

NOTE: Refer to Part 6, 51-00-00, Procedure 9, paragraph 5, for general instructions on the calibration of impedance plane display instruments with a ring probe. See Paragraph 2.C.(2) for ring probe data.

(1) Set the frequency between 2.5 and 3.0 kHz and calibrate the instrument as specified in Part 6, 51-00-00, Procedure 9, paragraph 5. But for this inspection, set the notch signal 4 divisions (40% of full screen height) above the balance point as shown in Figure 5.

(a) Refer to the calibration instructions in Figure 5 for the different probe positions on the reference standard. Make sure to balance the ring probe at the applicable fastener type and diameter.

5. Inspection Procedure

A. Inspection Procedure with the Sliding Probe

(1) Identify the fastener locations on the airplane in the inspection areas shown in Figure 1. Do a check of all the fastener locations with a magnet to find and identify magnetic fasteners.

(2) Calibrate the instrument as specified in Paragraph 4.A. to examine aluminum rivets, and Paragraph 4.B. to examine locations with nonmagnetic steel bolts.

NOTE: To examine locations with magnetic steel bolts use Part 6, 51-00-00, Procedure 9, paragraph 6, “Inspection Procedure”, but for this inspection, set the notch signal 4 divisions (40% of full screen height) above the balance point. See Figure 5.

NOTE: See Paragraph 2.D.(2) for instructions on fastener replacement in the reference standard when magnetic bolts are examined.

(3) Put the probe on the outer surface of the airplane skin, equally between two fasteners and aligned so that the centerline of the probe is aligned with the centerline of the fastener row.

(4) Put a probe guide on the skin to help keep the centerline of the probe aligned with the centerline of the fasteners during the inspection.

(5) Balance the instrument.

(6) Tilt the probe to do a check of the lift-off signal. It can be necessary to make a small adjustment of the instrument phase control to get the lift-off signal that occurred during calibration.

(7) Do a scan of all the same fastener locations identified in Figure 1 as follows:

(a) For all of the same type of fasteners, make a scan across each fastener head with the probe against the guide during the complete scan inspection. Small adjustments in the probe guide can be necessary when fasteners are not aligned with each other.

NOTE: When the probe is not correctly centered with the fastener, the fastener signal can go upscale above the balance point. See Detail I in Figure 4 for an example screen display for when a probe is not centered with a rivet row. See Detail II in Figure 4 for an example screen display of when the probe is not centered with the bolt row.

(b) Monitor the screen display for a vertical signal that is equal to or above the alarm level.

(c) Make a mark, with an approved marker, at all the locations where the signal is equal to or above the alarm level. Refer to Paragraph 6. to do more analysis of all the marked fastener locations.

(8) Do Paragraph 5.A.(3) thru Paragraph 5.A.(7) again for the remaining fasteners to be examined.

B. Alternative Inspection Procedure with the Ring Probe (for rivets and nonmagnetic bolts)

(1) Make sure the calibration is done on the same diameter and type of fastener that is to be examined on the cargo door. The three types of fasteners that can be on the cargo door are 5/32 inch (3.97 mm) diameter rivets, 3/16 inch (4.76 mm) diameter rivets and 3/16 inch (4.76 mm) diameter bolts.

(2) Refer to Part 6, 51-00-00, Procedure 9, paragraph 6, for the ring probe inspection procedure.

(3) Refer to Figure 1 for the fasteners to be examined in the inspection areas.

6. Inspection Results

A. A vertical signal that is equal to or more than the alarm level is a sign of a possible crack. Do more analysis as follows:

(1) Make sure the fastener type and dimension is the same as that used during calibration. If the fastener is different, calibrate for the correct fastener and examine the fastener location again.

NOTE: For locations that have magnetic steel bolts, refer to Part 6, 51-00-00, Procedure 9, paragraph 7, for the “Inspection Results”.

(2) Make sure the probe center is aligned with the center of the fastener and do the scan again.

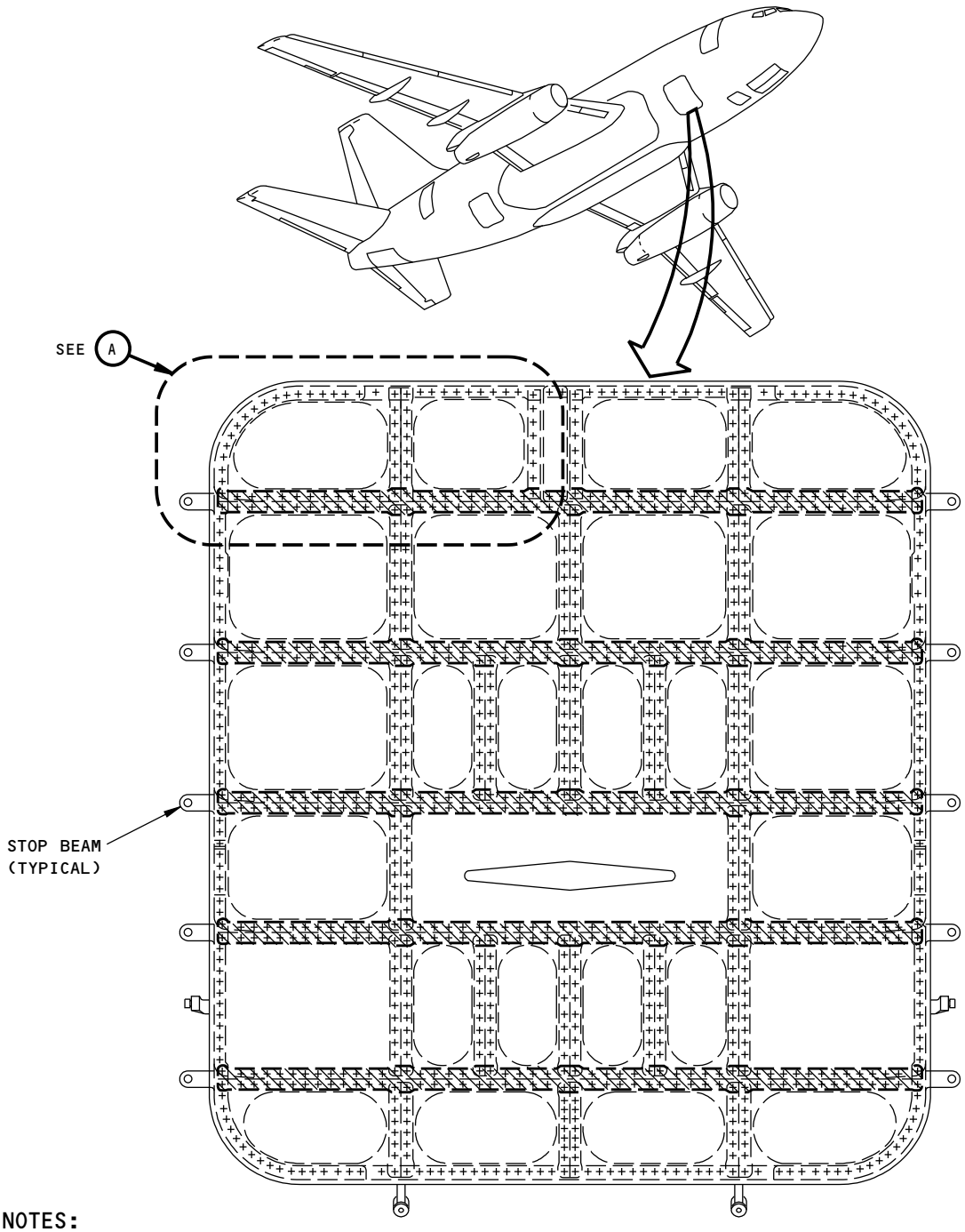
(3) The signal could be caused by a crack in a skin doubler. These signals will usually be higher than signals from cracks in the “T” chord.

(4) If the signal is caused by a crack at the fastener location, then the signal will look as shown in Detail II in Figure 2 for rivet locations, and as shown in Detail V in Figure 2 for bolt locations.

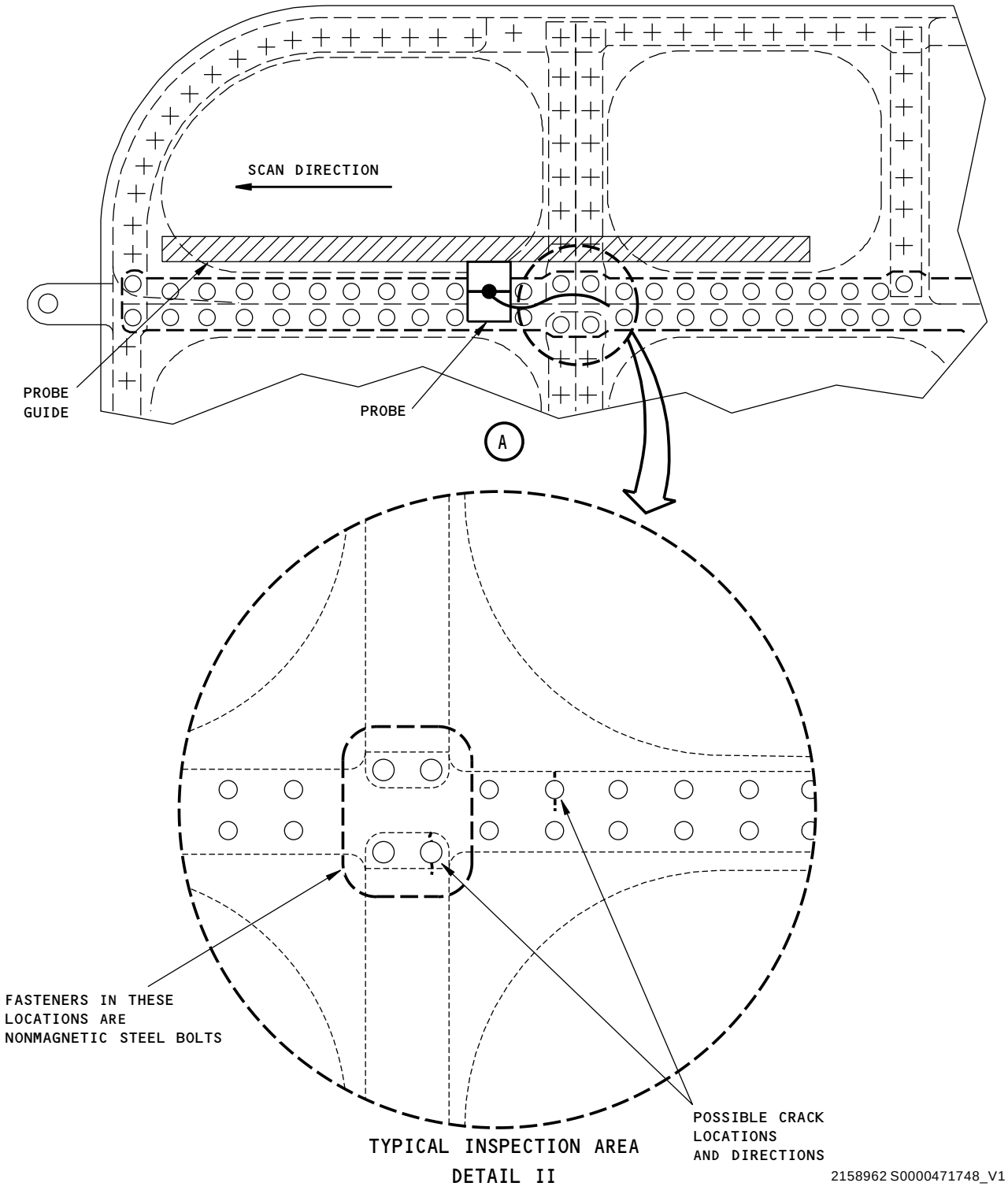
(a) Do an internal high frequency eddy current (HFEC) inspection as specified in Part 6, 51-00-00, Procedure 23.

(b) If you cannot make sure of the results with HFEC, then remove the fastener and do an open hole inspection as specified in Part 6, 51-00-00, Procedure 16, to make sure of the results.

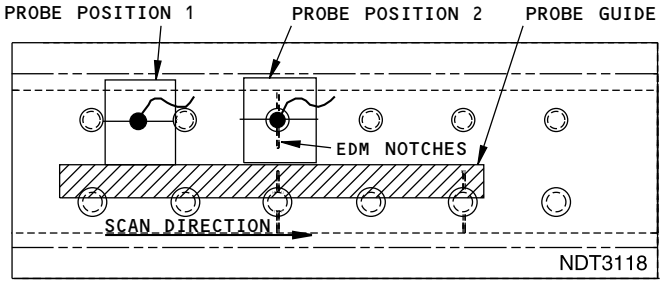
(c) As an alternative analysis, you can use the ring probe inspection in Paragraph 5.B. If you get a crack signal with the ring probe, do Paragraph 6.A.(4)(a) or Paragraph 6.A.(4)(b).



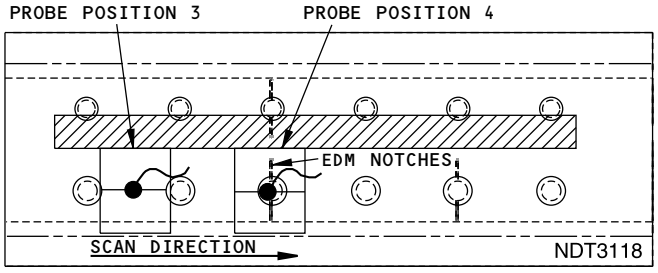
Inspection Area
Figure 1 (Sheet 1 of 2)



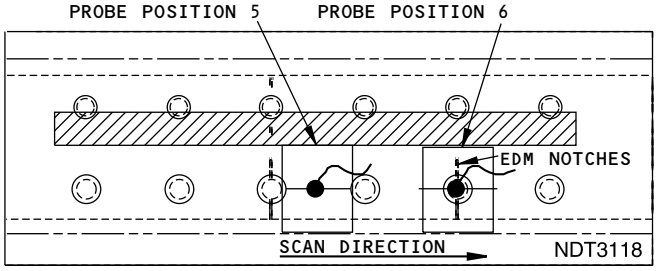
Inspection Area
Figure 1 (Sheet 2 of 2)



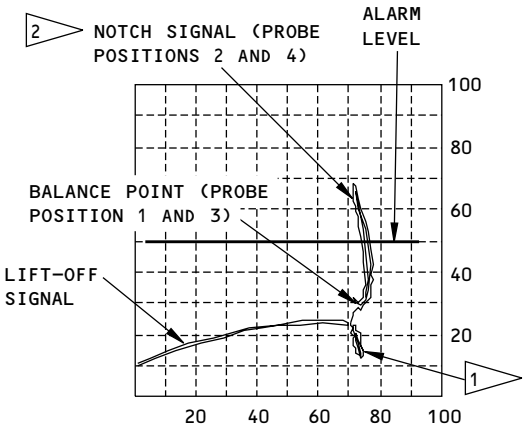
CALIBRATION SCANS ARE SHOWN ON THE 5/32 INCH (3.97 mm) DIAMETER RIVETS
DETAIL I



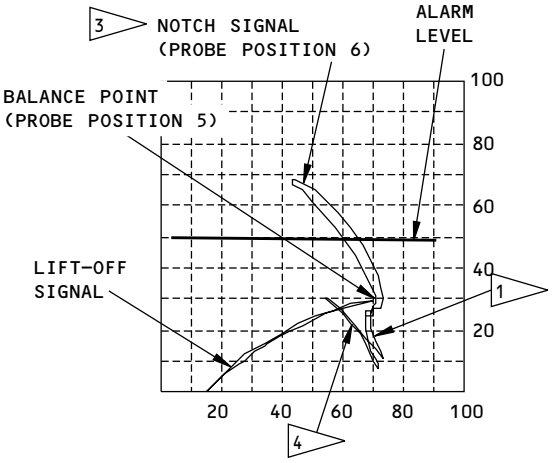
CALIBRATION SCANS ARE SHOWN ON THE 3/16 INCH (4.76 mm) DIAMETER RIVETS
DETAIL III



CALIBRATION SCANS ARE SHOWN ON THE 3/16 INCH (4.76 mm) DIAMETER NONMAGNETIC BOLTS
DETAIL IV



SCREEN DISPLAY FOR CALIBRATION ON 5/32 INCH (3.97 mm) DIAMETER RIVETS (ALODINE)
DETAIL II



SCREEN DISPLAY FOR CALIBRATION ON 3/16 INCH (4.76 mm) DIAMETER BOLTS
DETAIL V

NOTES:

- THE SCREEN DISPLAYS SHOWN IN DETAILS II AND V USED 10 dB MORE VERTICAL GAIN THAN HORIZONTAL GAIN (3:1). DIFFERENT INSTRUMENTS AND PROBES CAN CAUSE THE SIGNALS TO LOOK DIFFERENT.

1 TYPICAL SIGNAL OF A FASTENER LOCATION WITHOUT A NOTCH. THESE FASTENER SIGNALS CAN OCCUR DIFFERENTLY WHEN YOU DO THE CALIBRATION.

2 SIGNAL OF A RIVET LOCATION WITH A NOTCH (TYPICAL CRACK SIGNAL IN THE "T" STIFFENER CHORD). DO THE CALIBRATION ON THE 5/32 INCH (3.97 mm) DIAMETER RIVETS WHEN 5/32 INCH (3.97 mm) DIAMETER RIVETS ARE TO BE EXAMINED (FROM PROBE POSITIONS 1 TO 2). DO THE CALIBRATION ON 3/16 INCH (4.76 mm) DIAMETER RIVETS WHEN 3/16 INCH (4.76 mm) DIAMETER RIVETS ARE TO BE EXAMINED. (FROM PROBE POSITIONS 3 TO 4).

3 SIGNAL OF A BOLT LOCATION WITH A NOTCH (TYPICAL CRACK SIGNAL IN THE "T" STIFFENER CHORD) FROM PROBE POSITION 5 TO 6. DO THE CALIBRATION ON THE 3/16 INCH (4.76 mm) DIAMETER BOLTS WHEN 3/16 INCH (4.76 mm) DIAMETER BOLTS ARE EXAMINED.

4 THIS IS A TYPICAL SIGNAL THAT IS SEEN WHEN THE PROBE IS NOT ALIGNED WITH THE CENTER OF THE FASTENER. THE MORE OFF CENTER THE PROBE IS, THE HIGHER THIS SIGNAL CAN OCCUR. WHEN YOU SEE THIS TYPE OF SIGNAL DURING CALIBRATION OR DURING THE INSPECTION, CENTER THE PROBE ON THE FASTENER AND DO THE SCAN AGAIN.

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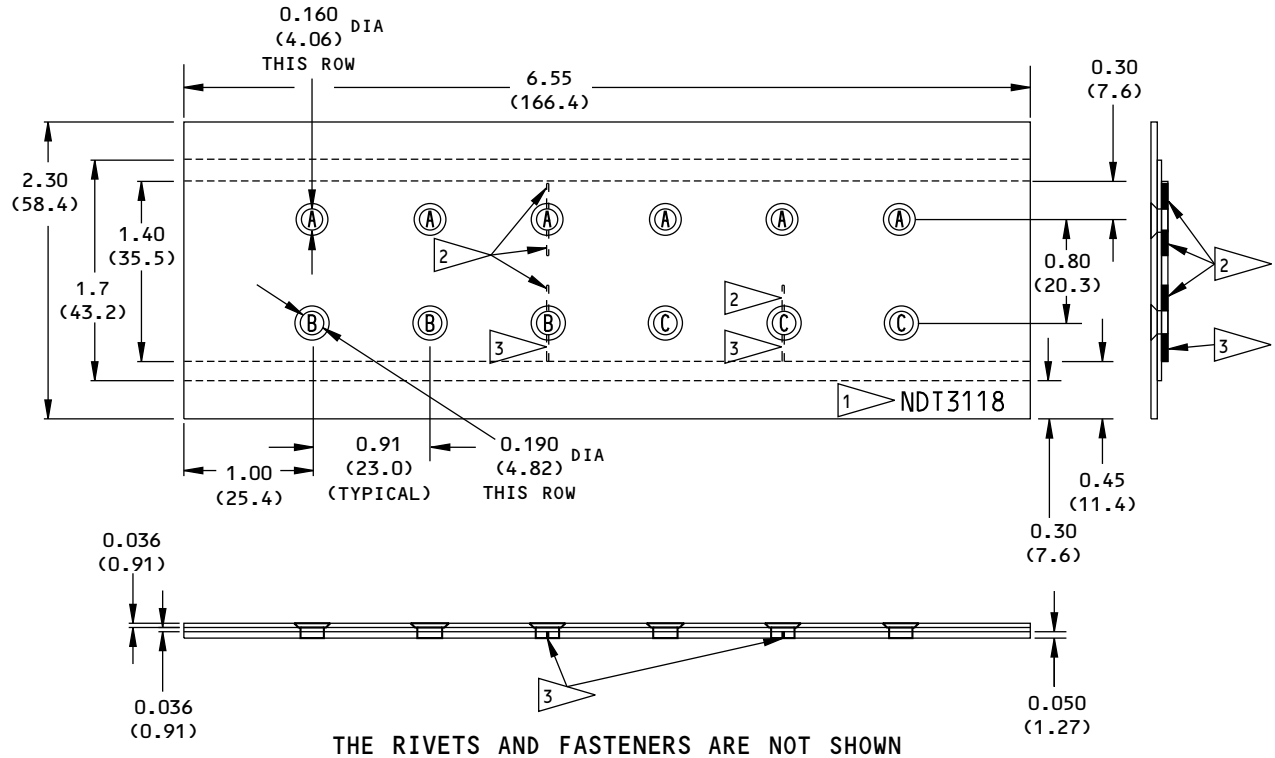
Instrument Calibration
Figure 2



THE RIVETS AND FASTENERS ARE NOT SHOWN INSTALLED. SEE THE FASTENER INSTALLATION INSTRUCTIONS FOR THE FASTENER CODES.

NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- MATERIAL: 2024-T3 CLAD-ALL LAYERS
- 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

- EDM NOTCHES (ALL 8 NOTCHES ARE THROUGH THE THICKNESS IN THE BOTTOM LAYER. THE MAXIMUM NOTCH WIDTH IS 0.015 (0.38)):
- FASTENERS TO INSTALL (SEE FASTENER CODES A, B, C, ABOVE FOR THE FASTENER TYPE AND LOCATION)
  - "A" = BACR15GF5D5 RIVETS (6 LOCATIONS)
  - "B" = BACR15GF6D5 RIVETS (3 LOCATIONS)
  - "C" = BACB30FN6A2 BOLTS WITH BACC30M6 COLLARS (3 LOCATIONS)

1. ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER, NDT3118.
2. 0.200 (5.08) LONG NOTCH (4 LOCATIONS)
3. NOTCH FROM THE HOLE TO THE EDGE OF THE PART (2 LOCATIONS)

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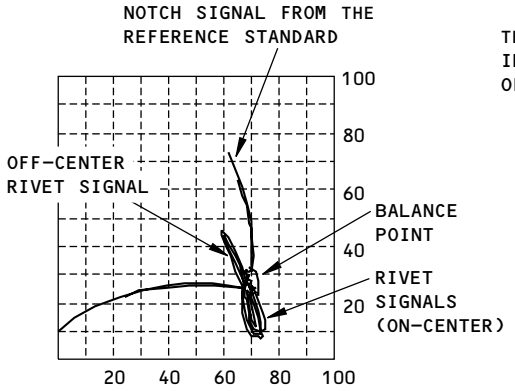
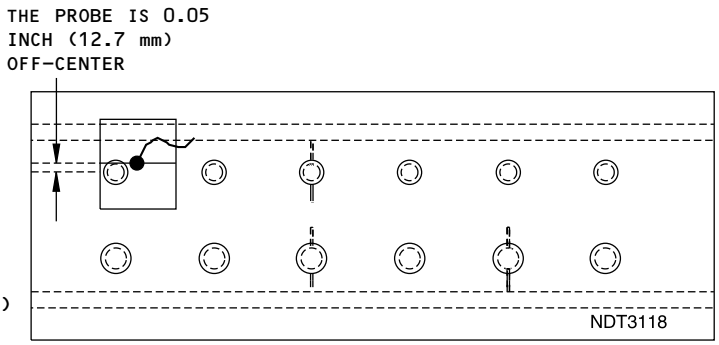
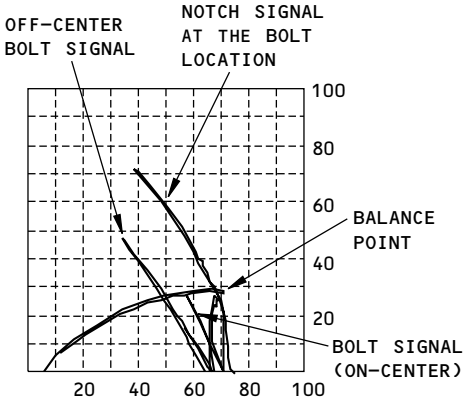
Reference Standard NDT3118
Figure 3



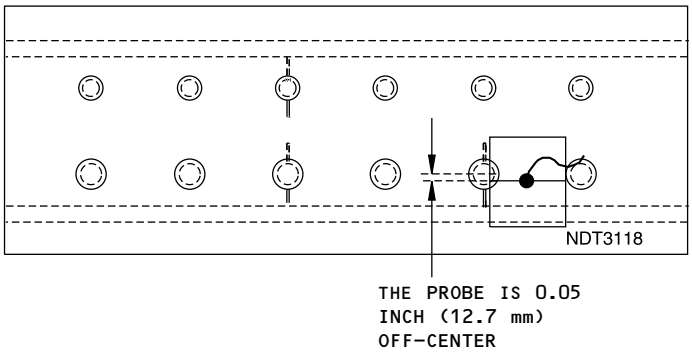
SCREEN DISPLAY WHEN THE PROBE IS NOT CORRECTLY ALIGNED WITH THE CENTER OF THE RIVET ROW



EXAMPLE OF A SCREEN DISPLAY THAT CAN OCCUR WHEN THE PROBE IS NOT CORRECTLY ALIGNED WITH THE CENTER OF THE RIVET ROW. THIS "OFF-CENTER" SIGNAL CAN OCCUR WITH 5/32 INCH (3.97 mm) DIAMETER AND 3/16 INCH (4.76 mm) DIAMETER RIVETS. WHEN YOU SEE THIS SIGNAL, CENTER THE PROBE ON THE RIVET AND DO THE SCAN AGAIN.
DETAIL I



SCREEN DISPLAY THAT CAN OCCUR WHEN THE PROBE IS NOT CORRECTLY ALIGNED WITH THE CENTER OF THE BOLT ROW



NOTE: ADJUST THE LIFT-OFF ANGLE SO THAT THE END POINT OF THE BOLT SIGNAL IS AT THE SAME HEIGHT AS THE BALANCE POINT. SEE THESE TWO SIGNALS IN THE DETAIL II SCREEN DISPLAY.

EXAMPLE OF A SCREEN DISPLAY THAT CAN OCCUR WHEN THE PROBE IS NOT CORRECTLY ALIGNED WITH THE CENTER OF THE BOLT ROW. WHEN YOU SEE THIS "OFF-CENTER" SIGNAL, CENTER THE PROBE ON THE BOLT AND DO THE SCAN AGAIN.
DETAIL II

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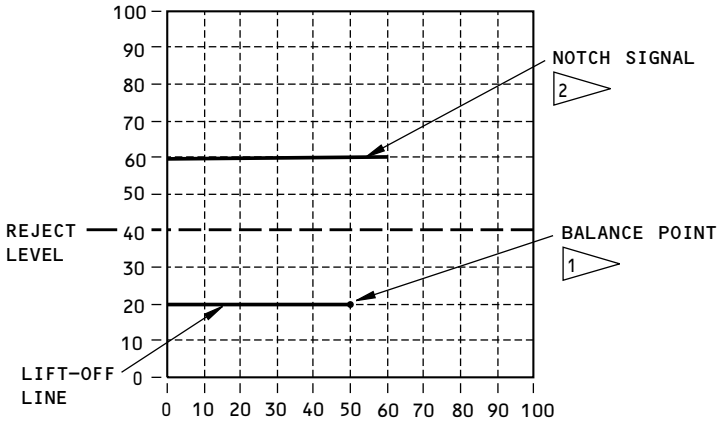
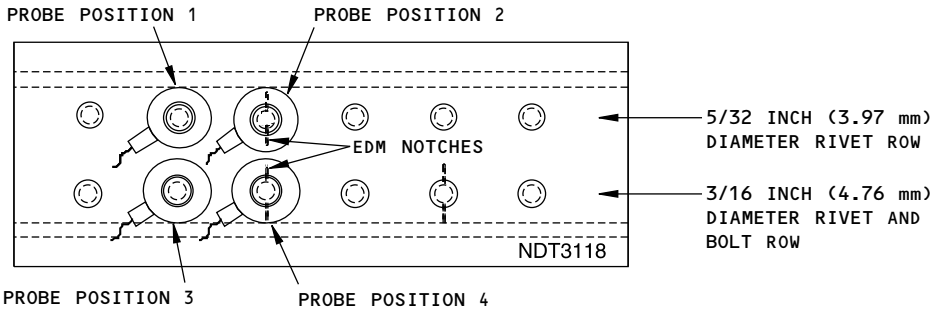
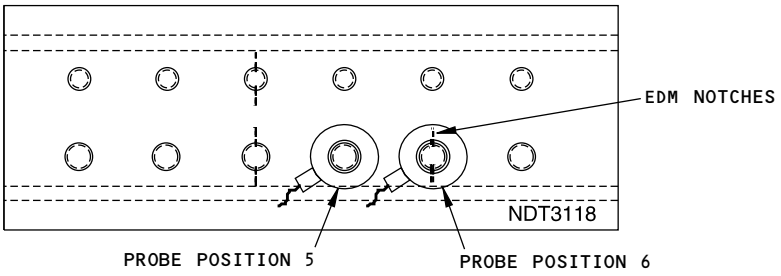
Example Screen Displays when a Probe is not Correctly Aligned with a Fastener Row
Figure 4



IMPEDANCE PLANE DISPLAY
DETAIL I



PROBE POSITIONS FOR CALIBRATION ON 5/32 INCH (3.97 mm) DIAMETER RIVETS AND 3/16 INCH (4.76 mm) DIAMETER RIVETS
DETAIL II



PROBE POSITIONS FOR CALIBRATION ON 3/16 INCH (4.76 mm) DIAMETER BOLTS
DETAIL III

NOTES:

- REFER TO PART 6, 51-00-00, PROCEDURE 9 FOR CALIBRATION AND INSPECTION INSTRUCTIONS WITH A RING PROBE BUT SET THE CALIBRATION SIGNALS AS SHOWN ABOVE.
- USE THE SAME CALIBRATION SIGNAL SEPARATION (40 PERCENT OF FULL SCREEN HEIGHT) AS SHOWN ABOVE FOR ALL RIVETS AND FASTENERS (MAGNETIC AND NONMAGNETIC).

1 THE BALANCE POINT SIGNAL FROM PROBE POSITIONS 1, 3, OR 5

2 THE NOTCH SIGNAL FROM PROBE POSITIONS 2, 4, OR 6

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Calibration Signals with the Optional Ring Probe Inspection
Figure 5