PART 6 - EDDY CURRENT

LONGITUDINAL LAP JOINT COUNTERSINK INSPECTION WITHOUT FASTENER REMOVAL

1. **Purpose**

   A. To detect cracks in the critical row of fasteners (the upper row) of longitudinal skin lap joints, without removal of fasteners, using high frequency eddy current.

   B. The cracks characteristically originate on the inner surface of the outer skin at the edge of the countersink and propagate outward along the faying surface. See Figure 7 for an illustration of a typical crack. This inspection is capable of detecting cracks 0.050 inch (0.127 cm) or longer beneath the countersunk fastener heads in skin materials 0.063 inch (0.160 cm) thick or less.

   NOTE: A comparable procedure for use with fasteners removed is described in Part 6, 53-30-01.

2. **Equipment**

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

   A. Any eddy current instrument capable of operating at 100 kHz and satisfying the performance requirements of this procedure may be used. The following equipment was used during development of this procedure:

      (1) Magnatest ED-520; Magnaflux Corporation

      (2) MIZ-10A; Zetec Inc.

   B. Probe - Use one of the following or similar probe:

      (1) Absolute spring-loaded surface probe, 0.375-inch (0.952 cm) OD case. P/N FLEX-EC I, USEC Laboratory

      (2) Twin coil differential probe, 0.375-inch (0.952 cm) OD. P/N SS37-25, NDT Product Engineering.

      NOTE: Twin coil differential probe requires the use of an instrument with differential capability. This probe reduces noise or spurious meter needle movement while maintaining sensitivity and requires less critical alignment over fasteners.

   C. Probe Holder - Manufacture per Figure 2.

   D. Probe Holder Guide - Manufacture probe holder guide as shown in Figure 3.

   E. Optical Center - Manufacture optical center as shown in Figure 4.

   F. Reference Standard - Manufacture Reference Standard 497 per Figure 1.

3. **Preparation for Inspection**

   A. Ensure inspection area is clean.

   NOTE: It may be necessary to remove paint from around fasteners to ensure accurate visual centering of probe holder guide.

4. **Instrument Calibration**

   A. Absolute Probe with Magnaflux ED-520.

      (1) Perform initial calibration per Part 6, 51-00-01.

      (2) Insert optical center into probe holder guide.

      (3) Moisten probe holder guide suction cups.

      (4) Place probe holder guide with optical center on reference standard and center over fastener without a simulated defect. Ensure that suction cups on probe holder are secured to reference standard.

      (5) Remove optical center from probe holder guide and replace with probe and probe holder.

(6) Adjust probe in holder to contact reference standard.

(7) Adjust balance control to bring meter needle on scale.

(8) Rotate probe holder 360 degrees. Ensure meter needle movement does not exceed 10 percent of full scale.

(9) Remove probe and probe holder from guide and center guide over fastener with sawcut per Paragraph 4.A.(2) thru Paragraph 4.A.(5).

(10) Rotate probe holder over sawcut and adjust instrument sensitivity to obtain a 40 percent of full scale meter deflection.

(11) Final adjust by slightly readjusting balance and liftoff control such that sawcut and a small amount of liftoff give opposite deflections of the needle.

B. Twin Coil Differential Probe with MIZ-10A.

(1) Perform initial calibration per manufacturer's instructions, using a frequency of 100 kHz.

(2) Set up on reference standard per Paragraph 4.A.(2) thru Paragraph 4.A.(5).

(3) Align the twin coils in plane shown in Figure 6.

(4) Adjust probe position to obtain approximately 0.010 inch (0.025 cm) clearance from reference standard. See Figure 5.

(5) Balance instrument and position meter needle to midscale.

(6) Rotate probe holder 360 degrees. Ensure meter response does not exceed 10 percent of full scale.

(7) Remove probe and probe holder from guide and center guide over fastener with sawcut per Paragraph 4.A.(2) thru Paragraph 4.A.(5).

(8) Rotate probe holder 360 degrees and note meter response. Adjust sensitivity to obtain a 40 percent of full scale positive or negative meter response from sawcut.

NOTE: As coils approach sawcut, one coil will give a negative response followed by the second which will give a positive response, or vice versa depending on the direction of rotation. The positive and negative response of the coils can vary slightly depending on how well they are matched to each other.

5. Inspection Procedure

A. Moisten probe holder guide suction cups.

B. Select fastener(s) to be inspected. Align probe guide with the rivet head using optical center and attach guide to the fuselage lap joint by means of the suction cups. See Figure 7.

NOTE: Accurate alignment of the probe holder guide over fastener head is essential. Remove paint if circumference of rivet head is obscured.

C. Remove optical center from probe holder guide and insert probe holder into probe holder guide. If necessary, adjust meter needle to midscale by using balance control only.

NOTE: If using twin coil differential probe, align twin coil tips as shown in Figure 6.

D. Rotate probe holder through 360 degrees. Note meter needle deflection for crack indication.

E. Periodically recheck instrument with reference standard.

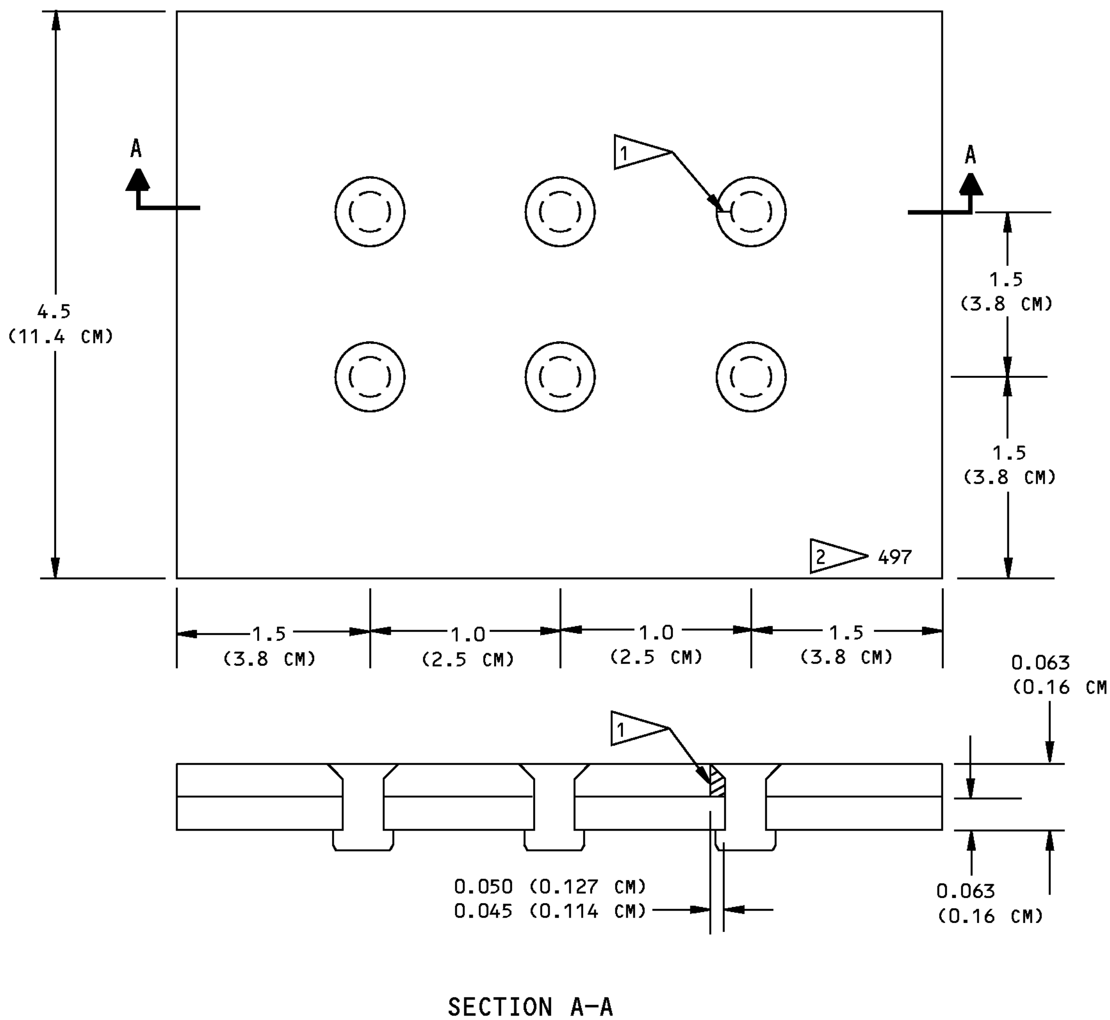
F. Repeat Paragraph 5.A. thru Paragraph 5.D. for each fastener in the critical area.

6. Inspection Results

A. Any location producing a 40 percent of full scale minimum meter response from the established baseline is a potential crack location requiring further investigation.

NOTE: Because of the small amount of probe movement during each scan, the meter response is slower than usually identified with detection of surface cracks.

Spurious indications could be encountered if the probe holder guide is not centered over fastener head.



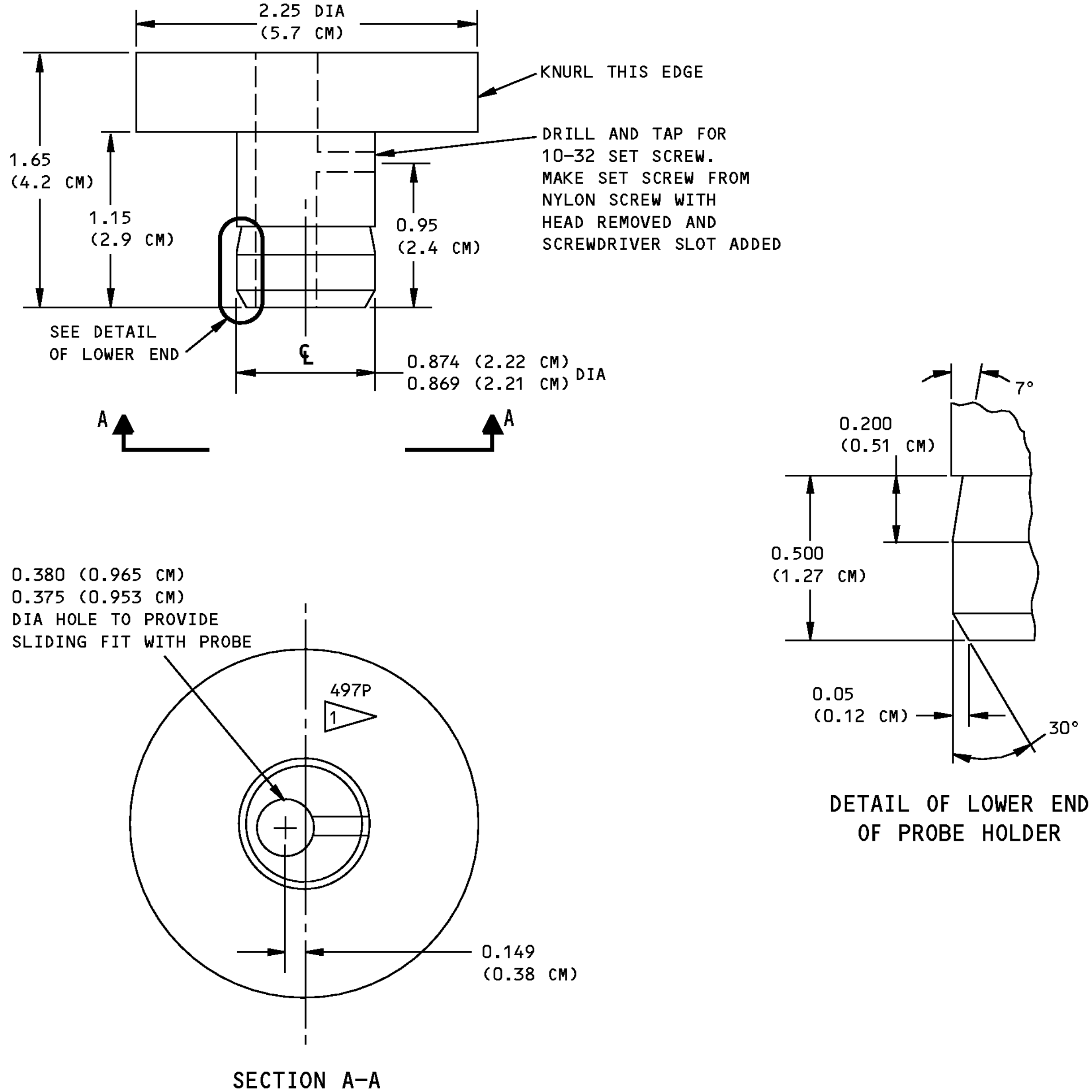
NOTES

- ALL DIMENSIONS ARE IN INCHES (CENTIMETERS IN PARENTHESIS)
- TOLERANCE: X.X ± 0.05 (0.13 CM), X.XXX ± 0.005 (0.013 CM)
- MATERIAL: 2024-T3 OR T4 ALUMINUM
- FASTENERS: BACR15CE6D() RIVETS (6 PLACES)

[1] JEWELER'S SAWCUT 0.030 (0.080 CM) MAX WIDTH

[2] ETCH OR STEEL STAMP WITH 497

Reference Standard
Figure 1

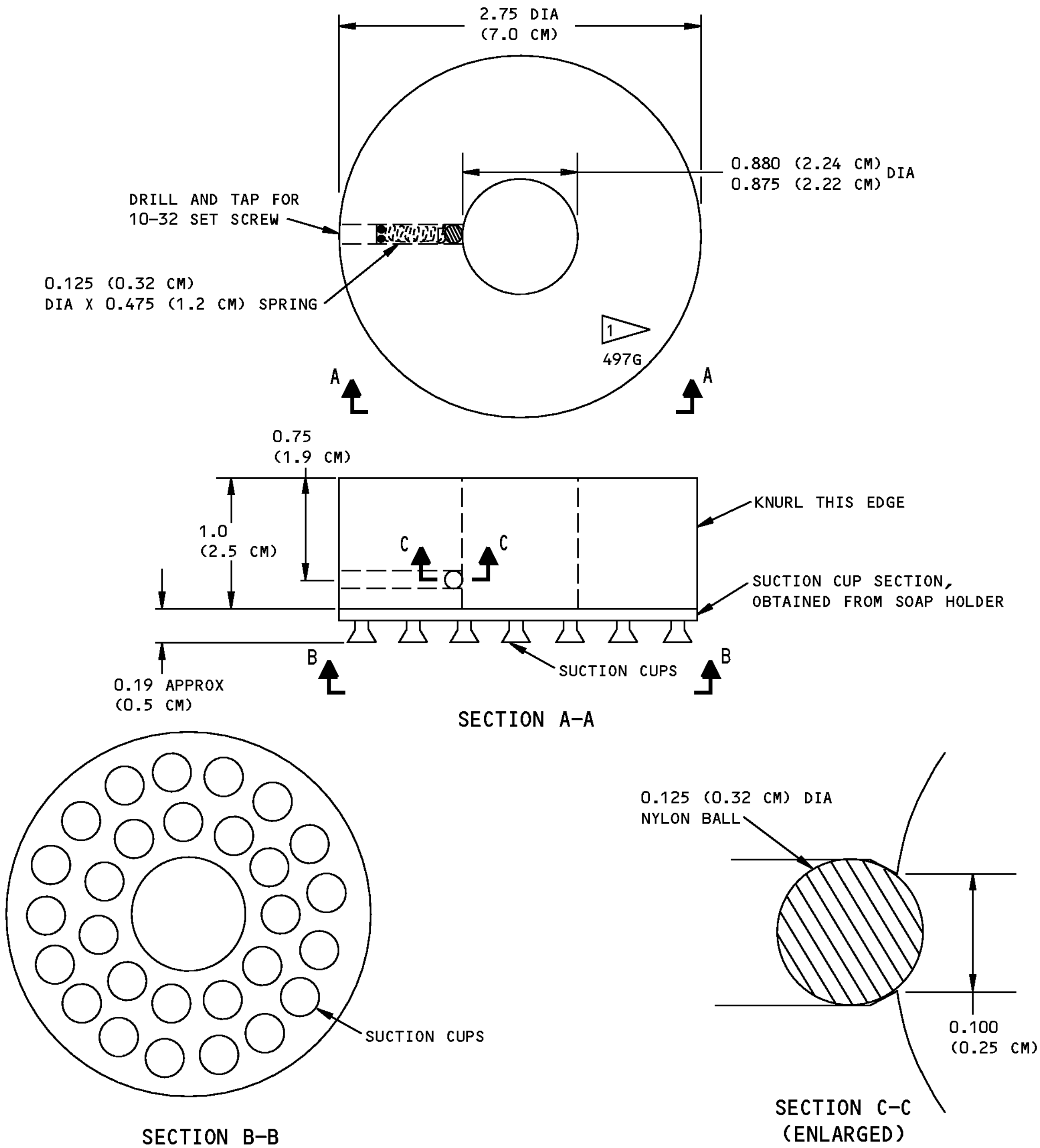


NOTES

- ALL DIMENSIONS ARE IN INCHES (CENTIMETERS IN PARENTHESIS) EXCEPT AS NOTED
- MATERIAL: PLEXIGLASS OR EQUIVALENT
- SEE PART I, 51-01-00, FOR MANUFACTURING AND ORDERING INFORMATION

[1] ETCH WITH 497P

Probe Holder
Figure 2

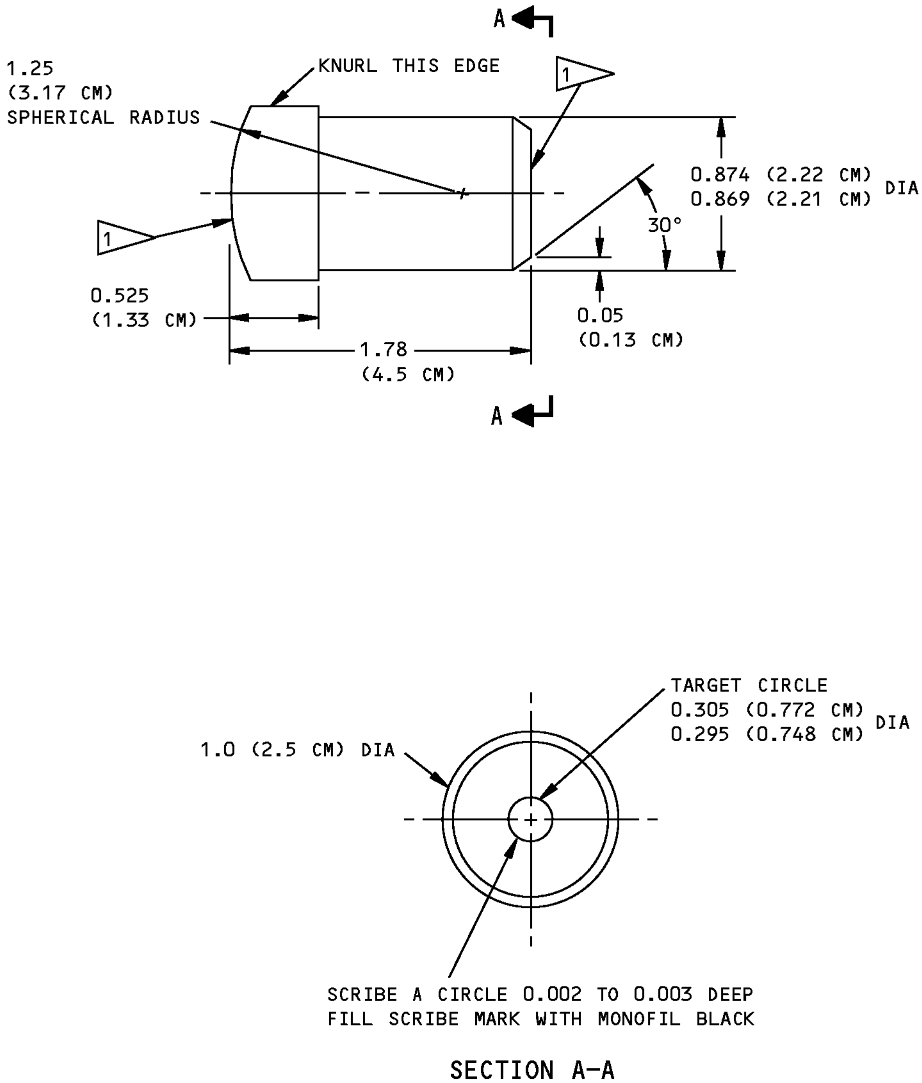


NOTES

- ALL DIMENSIONS ARE IN INCHES
- MATERIAL: PLEXIGLASS OR EQUIVALENT
- SEE PART I, 51-01-00, FOR MANUFACTURING AND ORDERING INFORMATION

[1] ETCH WITH 497G

Probe Holder Guide
Figure 3

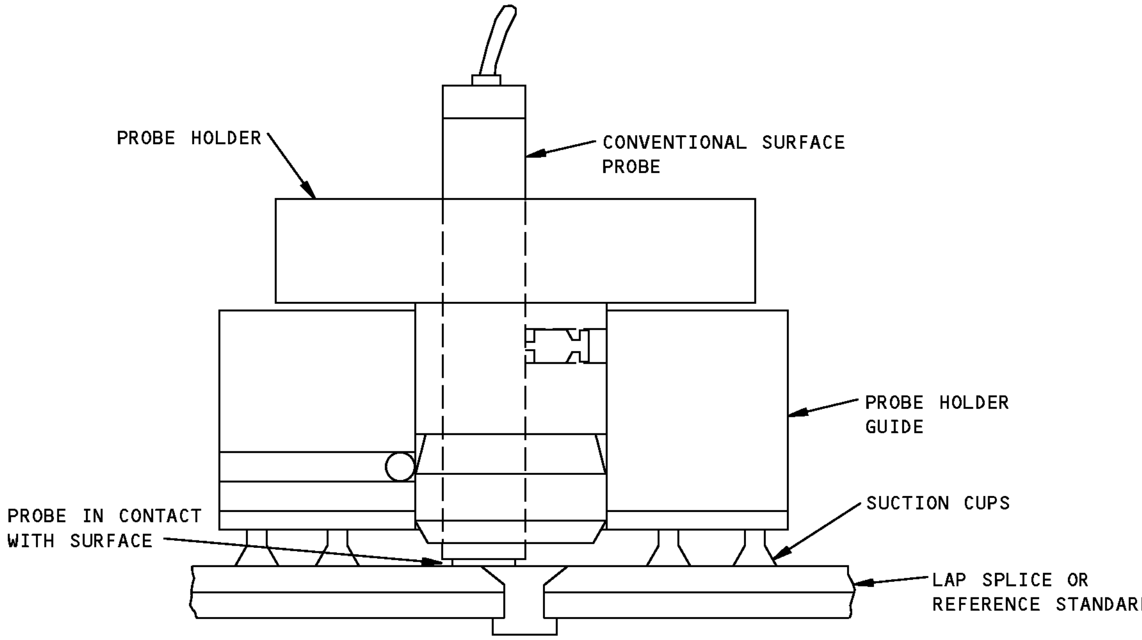


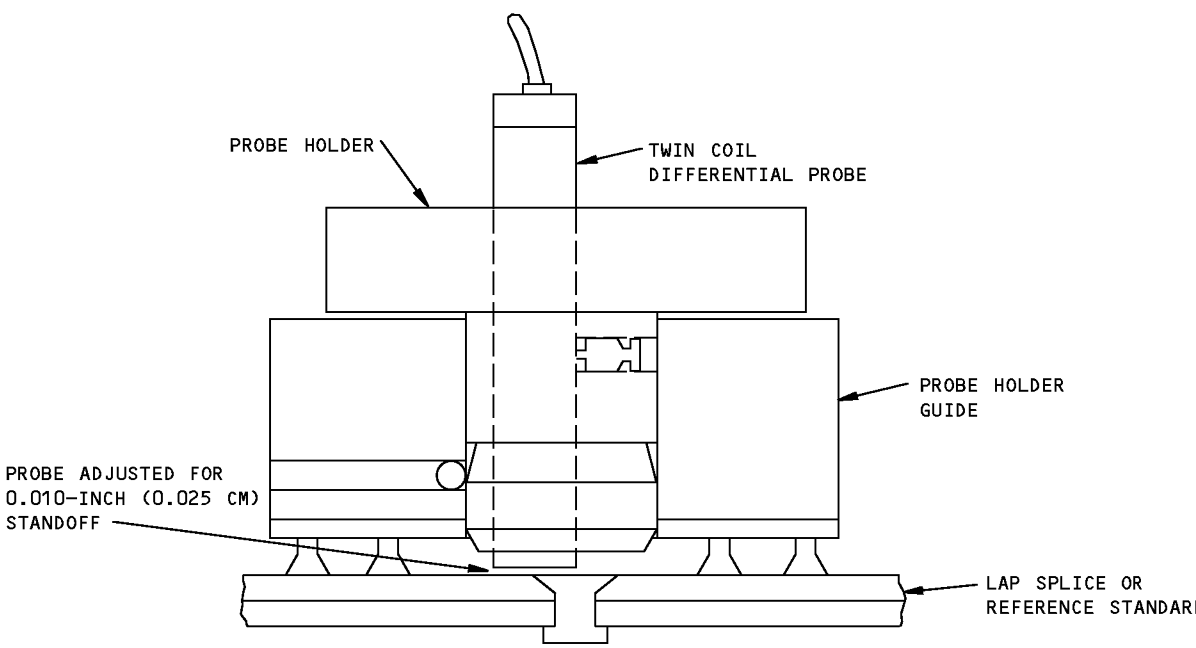
NOTES

- MATERIAL: PLEXIGLASS OR EQUIVALENT
- ALL DIMENSIONS ARE IN INCHES EXCEPT AS NOTED
- BOEING PART NUMBER 497C
- SEE PART I, 51-01-00, FOR MANUFACTURING AND ORDERING INFORMATION

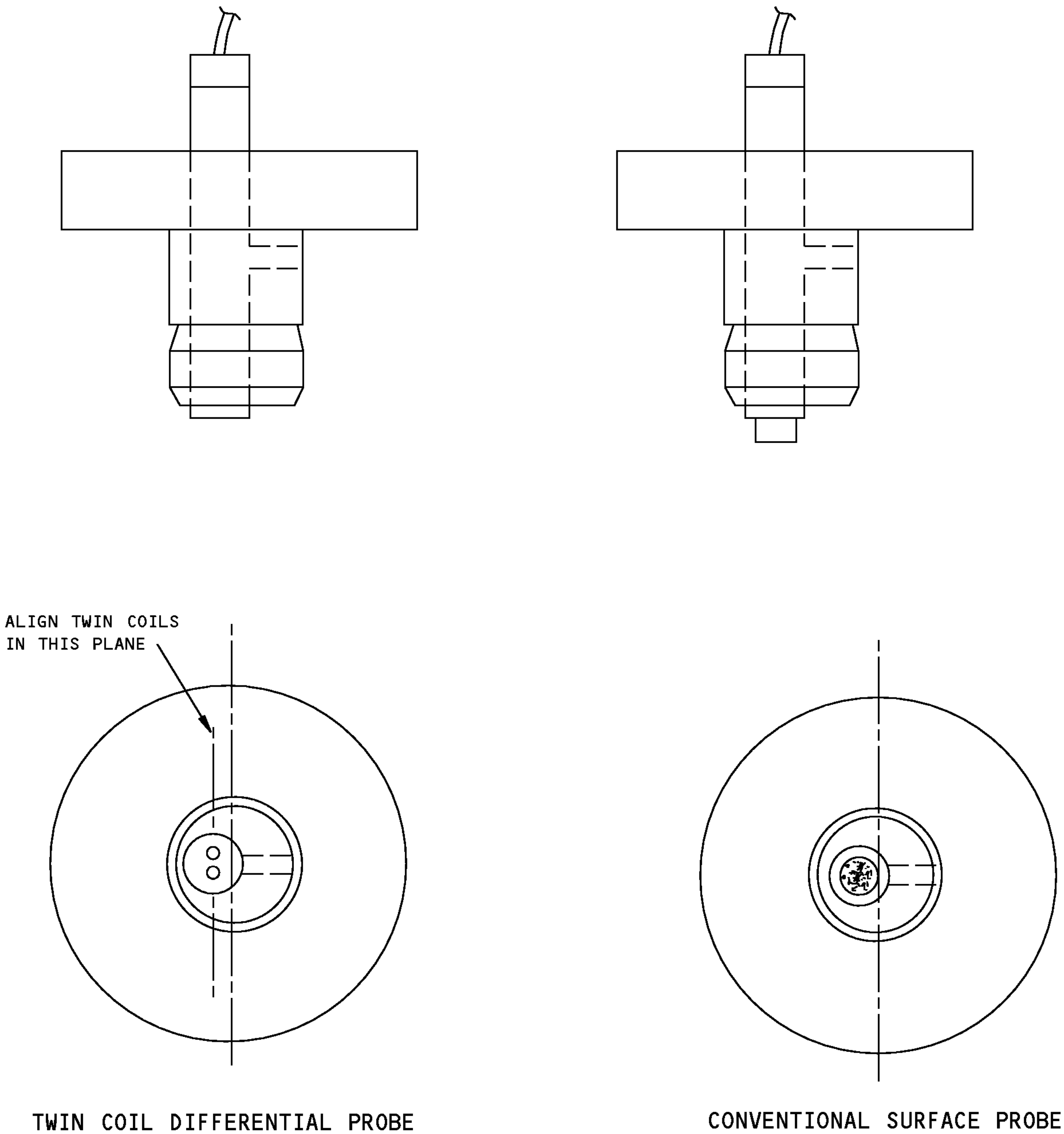
1 POLISH THIS SURFACE TO OPTICAL FINISH

Optical Center
Figure 4

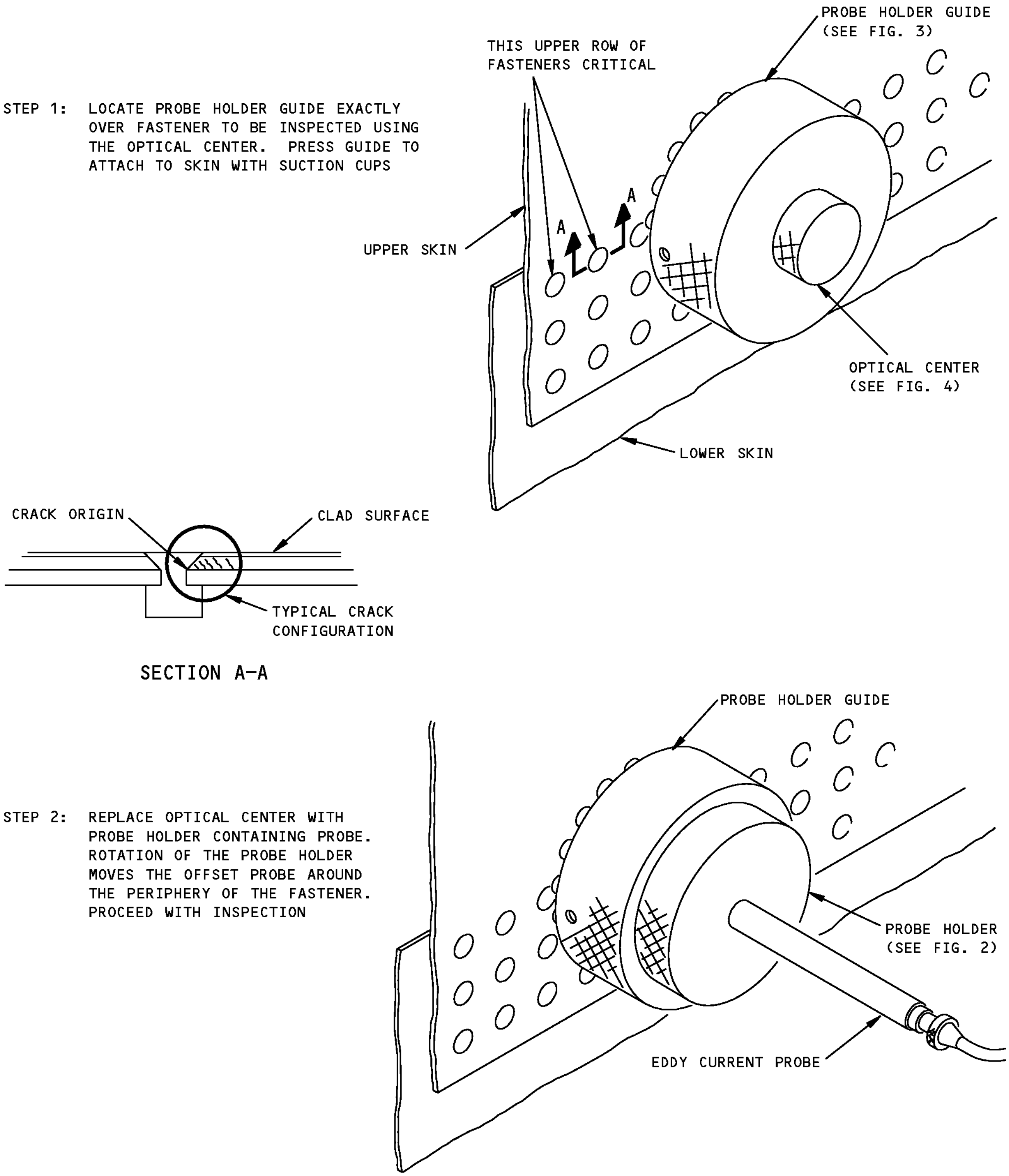




Probe, Holder, and Guide Assembled for Calibration and Inspection
Figure 5



Alternative Probes
Figure 6



Typical Crack Detection
Figure 7

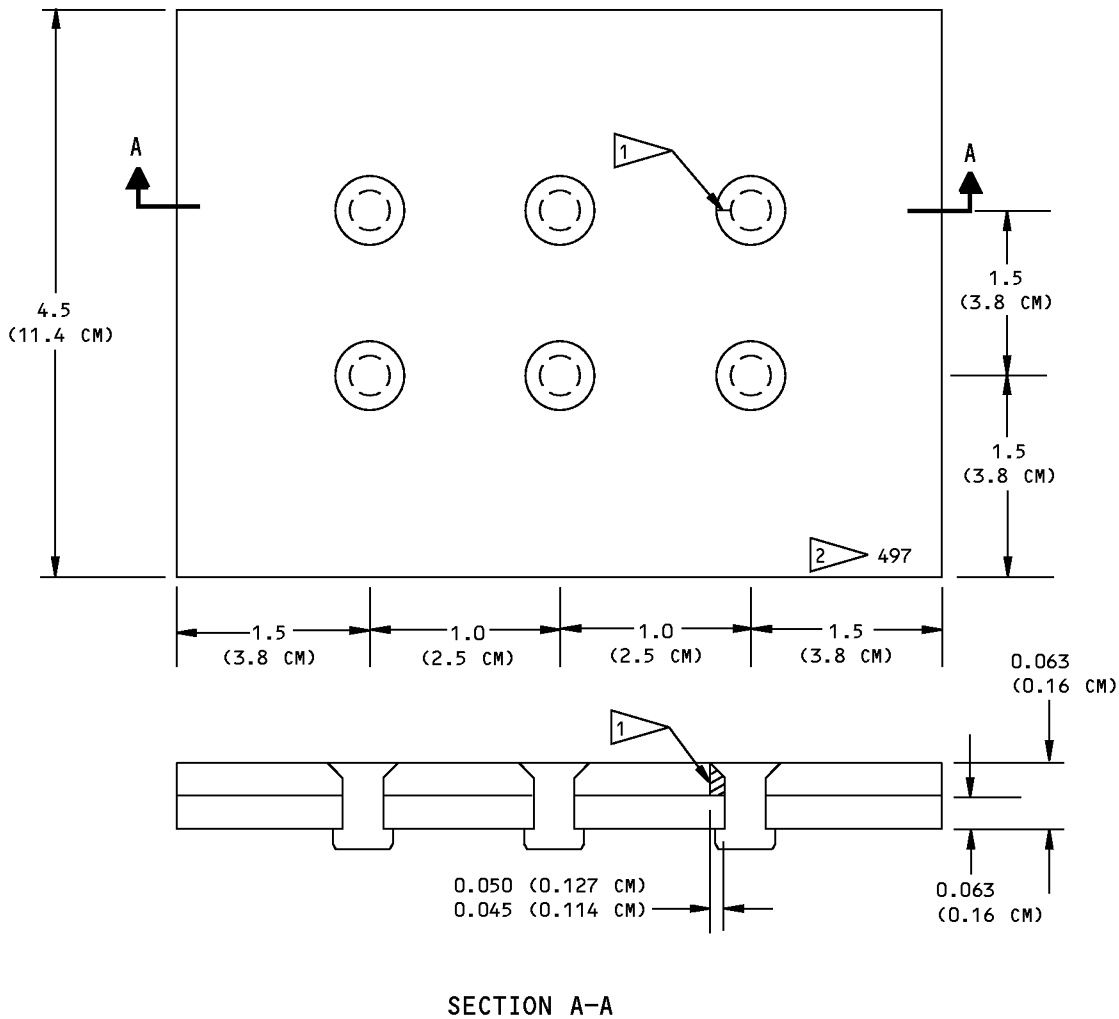
PART 6 - EDDY CURRENT

LONGITUDINAL LAP JOINT INSPECTION WITHOUT FASTENER REMOVAL

1. **Purpose**
   A. To detect cracks in the critical row of fasteners (the upper row) of longitudinal skin lap joints using high frequency eddy current, without removal of fasteners.
   B. The cracks characteristically originate on the inner surface of the outer skin at the edge of the countersink and propagate outward along the faying surface. Refer to Figure 5 for an illustration of a typical crack. This inspection is capable of detecting cracks 0.050 inch (0.127 cm) or longer beneath the countersunk fastener heads in skin materials of 0.063 inch (0.160 cm) thick or less.
2. **Equipment**
   A. Instrument -- A rotating eddy current instrument with oscilloscope display. This procedure was developed using a Nortec Company RECHII instrument.
   B. Probe -- RECHII surface probe No. SPO 2906, Nortec Company.

      NOTE: Other probes should only be used if they satisfy all the requirements of this procedure.
   C. Reference Standard -- Reference Standard No. 497. Refer to Figure 1.
   D. Probe Guide -- Probe Guide No. 497-1. Refer to Figure 2. Probe guide No. SPO-2906-861392 is supplied with probe No. SPO 2906, Nortec Company.
3. **Preparation for Inspection**
   A. Make sure the inspection area is clean.
4. **Instrument Calibration**
   A. Do the manufacturers' start-up procedures.
   B. Set signal mode to full wave presentation.
   C. Connect probe to the probe drive and start the probe drive.
   D. Carefully align probe guide over reference standard at Position 1 (Figure 3).
   E. Put probe and drive into guide as shown in Figure 3 to get a signal as shown in Figure 4, Presentation 3.
   F. Put probe with guide and drive in Position 2 (Figure 3) to get a signal as shown in Figure 4, Presentation 1.

      NOTE: The position of the defect signal will depend on the orientation of the probe drive.
   G. Adjust shape and size of signal with probe trim control. Adjust instrument gain to get approximately an 80 percent of full scale signal (Figure 4, Presentation 1).
5. **Inspection Procedure**
   A. Put probe guide over fastener. Make sure probe guide is accurately aligned using sight lines.
   B. Activate probe drive and make sure oscilloscope baseline is present.
   C. Put probe into probe guide and make contact with fastener head.
   D. Note oscilloscope display using Figure 4 as a guide.
6. **Inspection Results**
   A. Any signals similar to Figure 4, Presentation 1, should be investigated further.
   B. Changing the position of the probe drive through 90˜ should reflect a similar signal shift on the oscilloscope.
   C. Check fastener alignment when indications similar to Figure 4, Presentation 2, are shown.



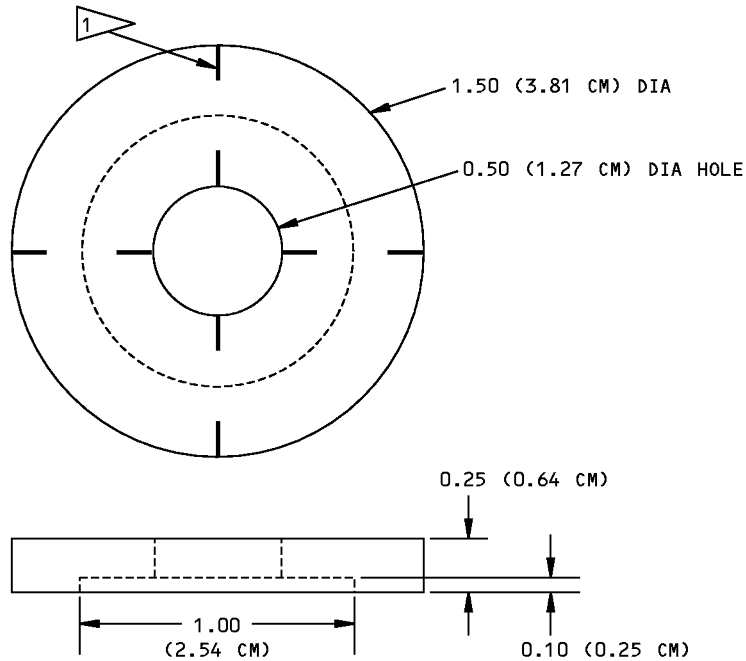
NOTES

- ALL DIMENSIONS ARE IN INCHES (CENTIMETERS IN PARENTHESIS)
- TOLERANCE: X.X ± 0.05 (0.13 CM), X.XXX ± 0.005 (0.013 CM)
- MATERIAL: 2024-T3 OR T4 ALUMINUM
- FASTENERS: BACR15CE6D() RIVETS (6 PLACES)

[1] JEWELER'S SAWCUT 0.030 (0.080 CM) MAX WIDTH

[2] ETCH OR STEEL STAMP WITH 497

Reference Standard 497
Figure 1

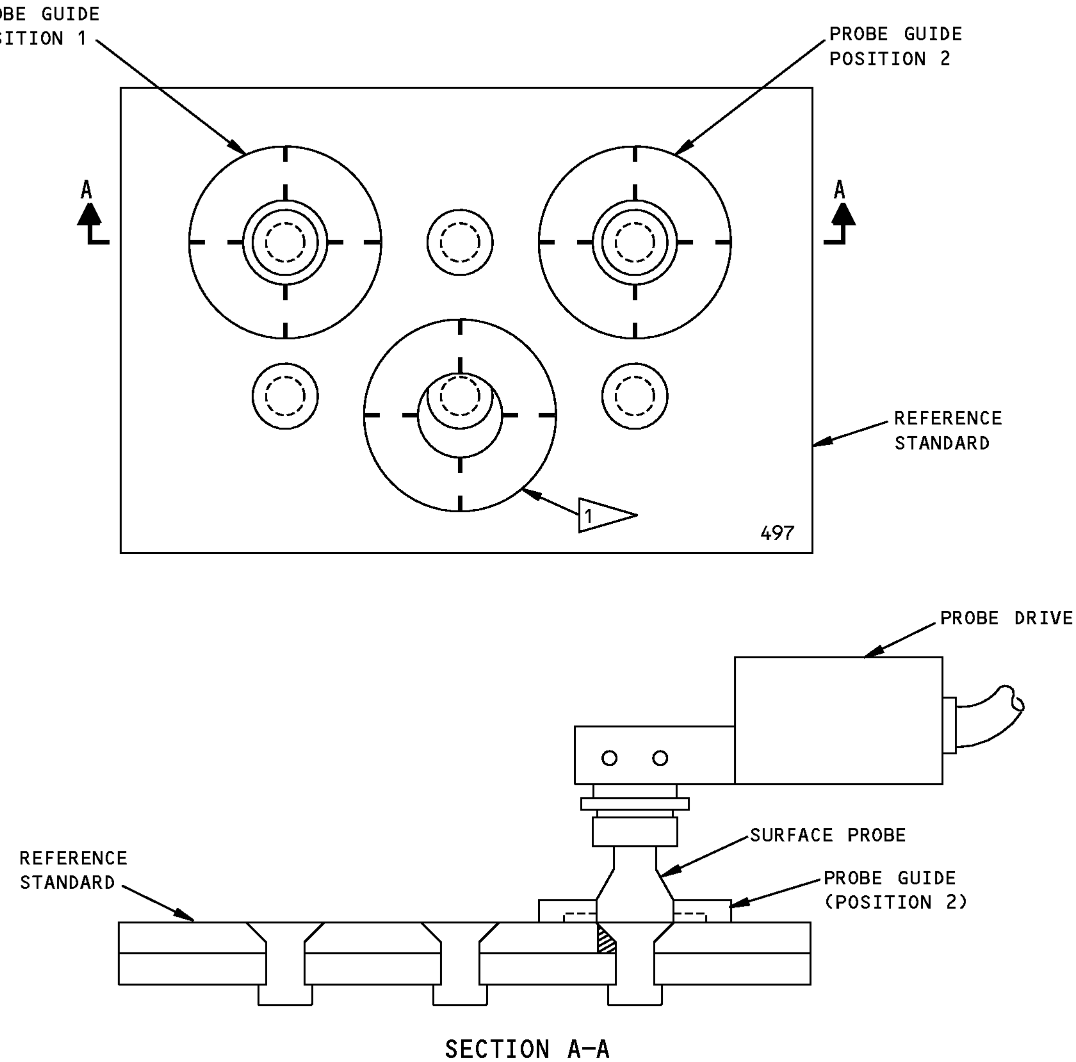


NOTES

- ALL DIMENSIONS ARE IN INCHES (CENTIMETERS IN PARENTHESES)
- TOLERANCE: ±0.02 (0.05 CM)
- MATERIAL: LUCITE OR PLEXIGLASS
- THIS GUIDE IS SUPPLIED WITH PROBE SPO 2906 FROM NORTEC COMPANY

1 SIGHT LINES - SCRIBE AND FILL WITH MARKER INK

Probe Guide 497-1
Figure 2

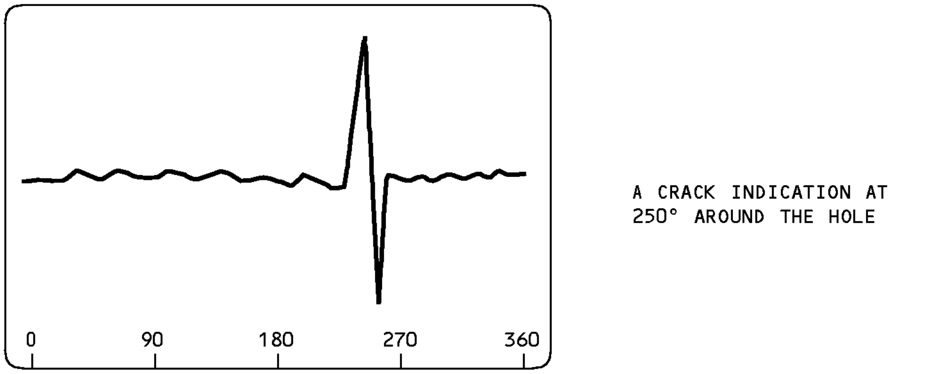


NOTES

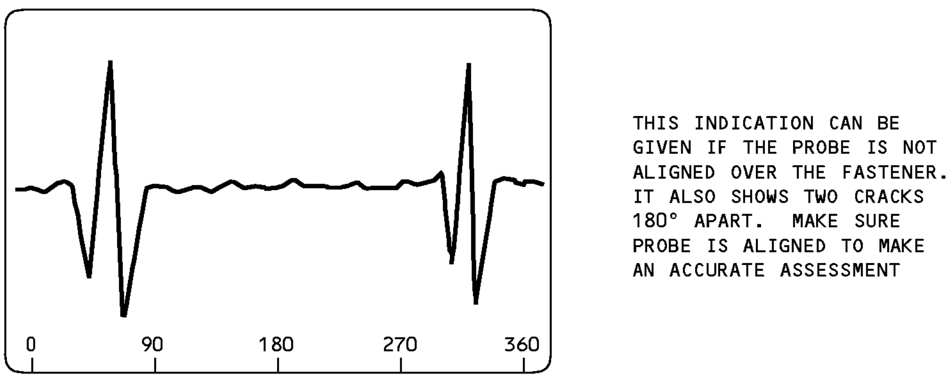
- CENTER PROBE GUIDE OVER FASTENER USING SCRIBE LINES AS A GUIDE

[1] A PROBE GUIDE THAT IS NOT ALIGNED MAY GIVE AN INCORRECT SCREEN DISPLAY (FIG. 4 PRESENTATION 2)

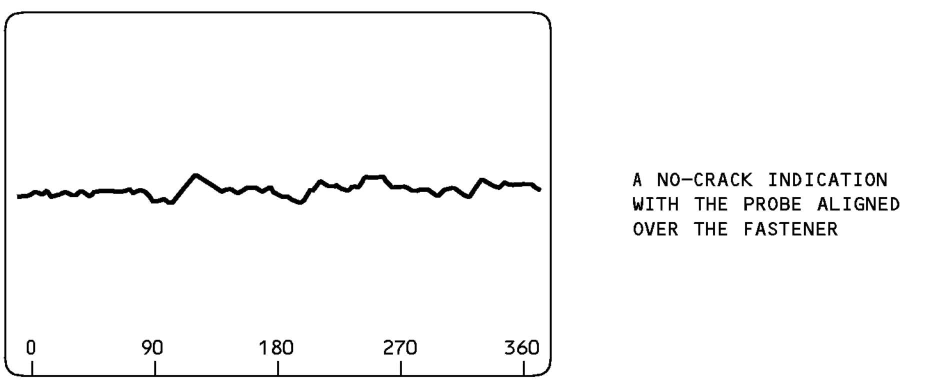
Calibration Positions
Figure 3



PRESENTATION 1

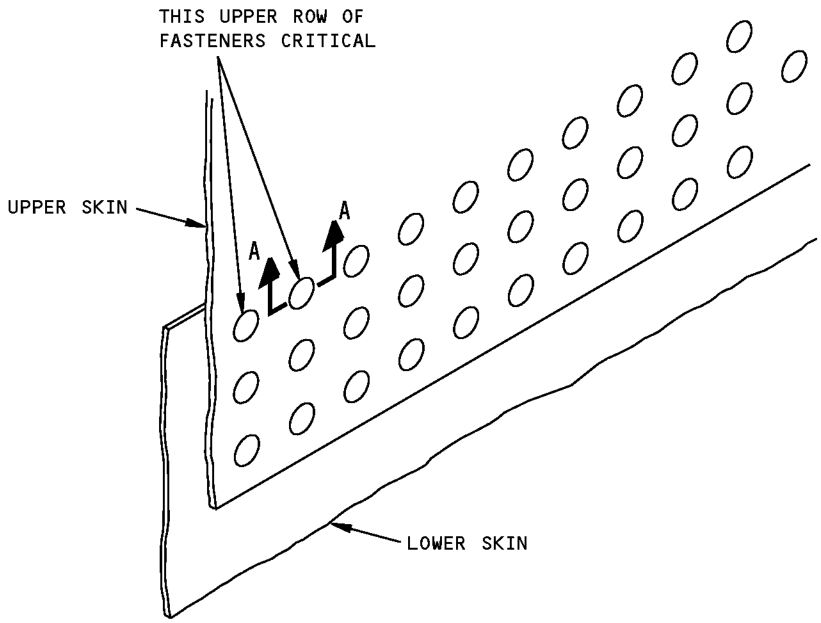


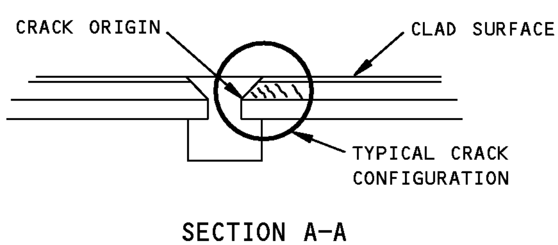
PRESENTATION 2



PRESENTATION 3

Oscilloscope Presentations
Figure 4





Typical Crack Location
Figure 5

PART 6 - EDDY CURRENT

INSPECTION OF EXTERNAL FUSELAGE REPAIRS

1. **Purpose**

   A. To find cracks in fuselage skins or the skins of a lap splice which are covered by external aluminum repairs. The thickness of the repair must be in one of the thickness ranges specified in Figure 1, Sheet 2.

2. **Equipment**

   A. Instruments -- It is necessary to use an impedance plane instrument to do this procedure. The instruments that follow were used to help prepare this procedure:

      (1) Nortec, NDT 19

      (2) Nortec, NDT 19e

      (3) Zetec, MIZ-20A

      (4) Hocking, Phasec 1.1SD

   B. Probes -- Use flat, shielded surface probes to do this procedure. Probes with small diameters are recommended for use on thin repair materials (See Figure 1, Sheet 2). The probes that follow were used to help prepare this procedure.

PROBE NUMBER	DIAMETER (inches)	PROBE TYPE	FREQUENCY RANGE	MANUFACTURER
P905-40-5K	0.25	DIFFERENTIAL	3 kHz TO 9 kHz	NDT ENGINEERING
SPO-5327	0.31	REFLECTION	700 Hz TO 80 kHz	STAVELEY/NORTEC
SPO-5328	0.44	REFLECTION	500 Hz TO 60 kHz	STAVELEY/NORTEC
RS1005-2/TF	0.50	REFLECTION	1 kHz TO 40 kHz	NDT ENGINEERING
SPO-5330	0.62	REFLECTION	100 Hz TO 20 kHz	STAVELEY/NORTEC

   Use a probe that can operate at the necessary inspection frequency. The necessary inspection frequency is specified in Figure 1, Sheet 2 and changes when the thickness of the material above the skin to be examined changes.

   CAUTION: IN SOME INSPECTION AREAS, DIFFERENT MATERIAL THICKNESSES CAN OCCUR ABOVE THE SKIN TO BE EXAMINED (AS A RESULT OF THE REPAIR). IT IS IMPORTANT THAT YOU USE THE CORRECT FREQUENCY AND REFERENCE STANDARD FOR THE THICKNESS OF MATERIAL THAT IS ABOVE THE SKIN TO BE EXAMINED. FAILURE TO USE THE CORRECT FREQUENCY AND REFERENCE STANDARD WILL DECREASE THE SENSITIVITY OF THE INSPECTION AND CRACKS WILL NOT ALWAYS BE FOUND.

   C. Reference Standard - Make the applicable reference standards as specified in Figure 1.

      NOTE: Reference standards ANDT1049 thru ANDT1057 replace NDT1006 thru NDT1014. If you have reference standards NDT1006 thru NDT1009, it is not necessary to replace them with ANDT1049 thru ANDT1052 if they have Alodined rivets. See Flagnote 2 in the Table in Figure 1, Sheet 2.

3. **Preparation for Inspection**

   A. Clean the inspection area. Remove paint from the inspection area if the fastener heads cannot be seen or if the probe cannot be easily moved around the fastener.

4. **Instrument Calibration**

A. Do a check in the repair area to find:

(1) the thickness of the material above the skin to be examined and

(2) the type of fasteners that are used.

B. Refer to Figure 1 with the data of Paragraph 4.A. to identify the necessary reference standard to use during the inspection.

NOTE: Two reference standards are necessary to do the inspection of some repairs, for example lap splices, because of changes to the thickness of the repair. The thickness of the material examined must be in the thickness range that is specified in Figure 1, Sheet 2 for the reference standard.

C. Get a flat surface probe that can operate at the frequency identified in Figure 1, Sheet 2.

NOTE: Use the smallest diameter probe possible that will give a smooth scan inspection around the fastener and the best separation of notch signal from the edge effect signal.

D. Set the instrument frequency in the range specified in Figure 1, Sheet 2 for the applicable inspection conditions.

E. If the inspection area is painted, put a shim that is not conductive on top of the reference standard. Use a shim that is within approximately 0.003 inch (0.08 mm) of the thickness of the paint.

F. Put the probe on the reference standard at probe position 1 adjacent to the same type of fastener as in the repair. See Figure 2.

G. Balance the instrument.

H. Set the balance point in the lower center of the screen display as shown in Figure 3.

I. Adjust the phase control so that the lift-off signal moves horizontally to the left as shown in Figure 3.

J. Move the probe to probe position 2 on the reference standard as shown in Figure 2.

K. Adjust the position of the probe to get a maximum signal from the notch in the reference standard.

L. If necessary, adjust the frequency to get approximately a 90-degree separation between the lift-off line and the notch signal. See Figure 3 for an example of a calibration screen display.

NOTE: If you adjust the frequency, do Paragraph 4.F. thru Paragraph 4.K. again.

M. Adjust the gain to get a signal that is 40 percent of full screen height as shown in Figure 3. Use a vertical to horizontal ratio of 1 to 1.

N. Put the probe at probe position 3 on the reference standard as shown in Figure 2 and balance the instrument.

O. Move the probe around each side of the fastener to the edge of the reference standard until you see the edge effect signal. Monitor the location of the probe above the notch (probe position that gives the maximum signal) and when you first see the edge effect signal, to identify the limits of the inspection around the fastener.

NOTE: Separation of the notch signal from the edge effect signal will decrease as the thickness of the repair material increases. See Figure 4 for examples of screen displays of reference standards ANDT1055 and ANDT1057.

NOTE: It can be possible to increase the separation of the notch signal from the edge effect signal. A change to a smaller diameter probe can help increase the separation. Use a probe that will operate in the frequency range identified in Figure 1, Sheet 2, if one is available, and do Paragraph 4.K. thru Paragraph 4.O. again. See Figure 5 for examples of screen displays of reference standard ANDT1057.

P. If the repair has an edge that is square (not beveled), move the probe from the fastener location to the square edge of the reference standard. Compare this signal to the signals from a beveled edge and the notch.

Q. If flush-head fasteners (aluminum or steel) are used, move the probe so it is on the fastener and compare the edge effect signal to the notch signal.

R. If the screen display dot is not stable when a high instrument gain is necessary for the calibration, change the vertical to horizontal gain ratio. Decrease the horizontal gain to help keep the dot more stable. If a change of the vertical to horizontal gain ratio is made, do Paragraph 4.F. thru Paragraph 4.Q. again.

NOTE: If you decrease the horizontal gain, make sure there is sufficient separation of the notch signal from the edge effect signal. Try not to use more than a 2 to 1 vertical to horizontal gain ratio.

5. Inspection Procedure

A. Put the probe on the repair surface adjacent to and above the fastener head for the fastener type to be examined.

B. Balance the instrument.

C. Do a scan slowly around the fastener and monitor the instrument screen display at the same time. During the scan:

(1) For protruding-head fasteners, keep the probe adjacent to the fastener head during the scan.

(2) For flush-head fasteners, use a circle template to keep the probe an equal distance from the flush-head fastener during the scan.

(3) For fasteners close to the edge, move the probe around to the edge of the skin panel until the edge effect signal goes off the screen display.

(4) Make a mark at the locations where you get a signal that is 20 percent or more of full screen height and looks almost the same as the notch signal from the reference standard.

D. Frequently do a calibration test of the instrument as follows:

NOTE: Do not adjust the gain.

(1) Put the probe on the reference standard to get the maximum signal from the notch. Make sure to put the probe adjacent to the fastener on the reference standard that is the same type as the inspection.

(2) Compare the signal you got from the notch during calibration with the signal you get now.

(3) If the signal from the notch in the reference standard has changed 10 percent or more from the signal you got during calibration, do the calibration and inspection again for all of the fasteners examined since the last calibration test.

6. Inspection Results

A. Signals that are 20 percent or more of full screen height and look almost the same as the notch signal from the reference standard are signs of a possible crack.

B. Compare the signals to the signals you got from the reference standard.

C. The types of conditions that can occur during the inspection are as follows:

(1) A crack on the lower edge of the fastener hole near the edge of the repair.

(a) If a crack occurs on the lower edge of the fastener hole near the edge of the repair, the signal will go up as the probe is moved above the crack but will not go down to the baseline because of the edge effect condition from the repair. See Figure 6 for an example of a crack signal that is near an edge.

NOTE: The separation of the crack signal from the edge effect signal will be more with the inspection on thin repair materials. As the thickness of the repair material increases, the separation of the crack signal from the edge effect signal will decrease. Be careful when you examine near the edge of the repair.

(2) A subsurface edge effect signal from a repair cutout in the skin (below the repair material).

(a) If an inspection is necessary for fasteners near a repair cutout, it is possible to get a subsurface edge effect signal from the edge of the cutout in the skin. This condition can occur if there is not a sufficient amount of edge margin.

(b) Be careful when you examine fasteners that are near the edge of a cutout because a crack can occur near the edge. Monitor the location of the probe around each fastener because an edge effect condition will usually occur at the same location.

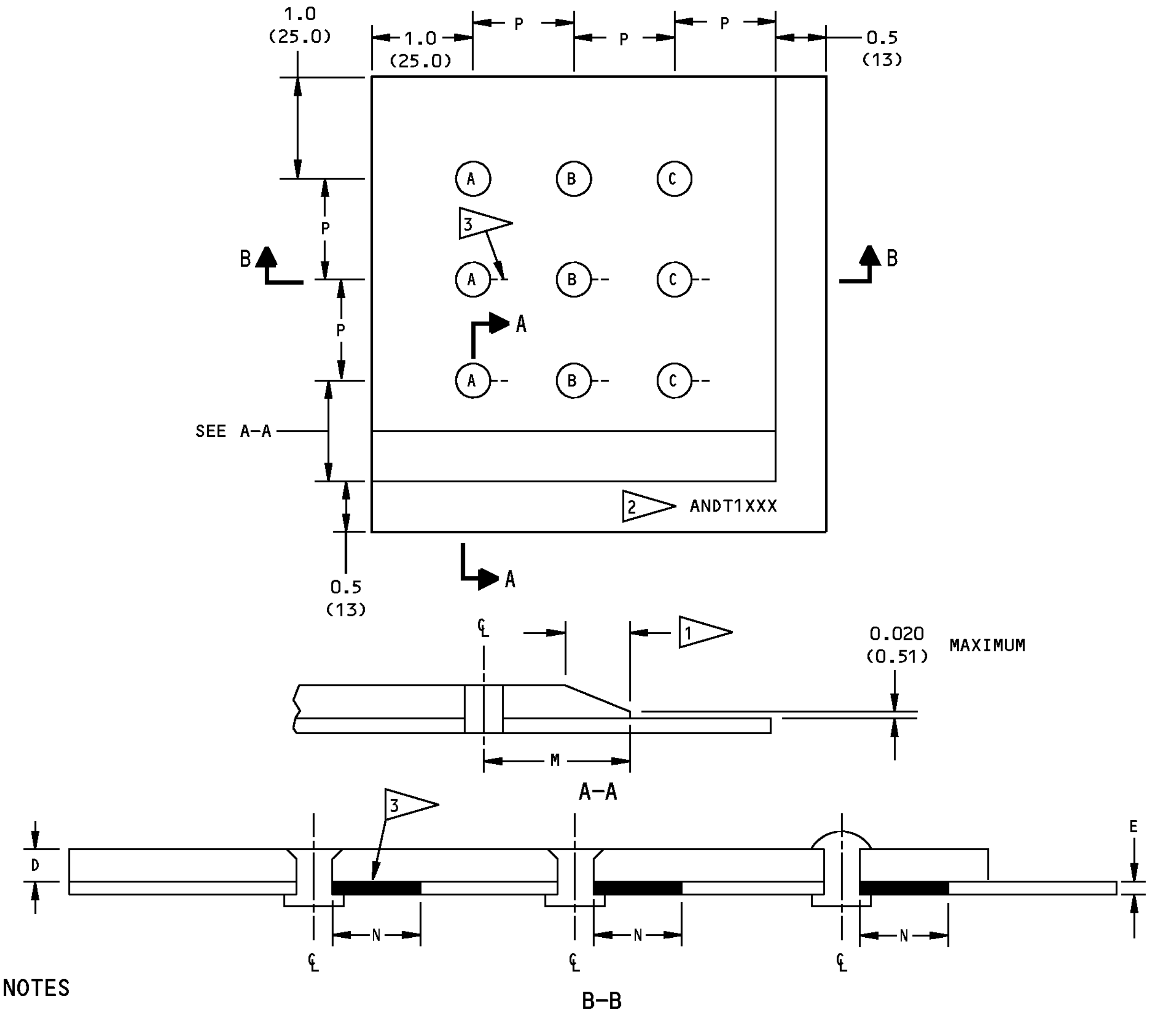
(3) Space (gap) between skins.

(a) This condition can cause the balance point to go up. The balance point signal will go up slowly during the scan as the space between the skins increases.

(4) A thickness change of the material below the inspection skin.

(a) If the thickness of the material below the inspection skin changes, it can cause the balance point to change. Do a check of the balance point signal regularly and balance the instrument as necessary.

D. If you want to make sure of the results, do the fastener hole inspection procedure specified in Part 6, 51-00-16. If you can get access to the inside surface of the skin, do the surface inspection procedure specified in Part 6, 53-30-05.



NOTES

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

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

- SEE FIGURE 1, SHEET 2, FOR THE REFERENCE STANDARD SPECIFICATIONS AND THE DIMENSIONS IDENTIFIED AS LETTERS A THRU E, M, N AND P.
- MATERIAL: USE BARE OR CLAD 2024-T3 OR T4 OR 7075-T6
- BE CAREFUL WHEN YOU INSTALL THE RIVETS. THE BOTTOM PIECE CAN BECOME DAMAGED IF INSTALLED TOO TIGHT.

[1] THE CHAMFER WIDTH IS 0.16 INCH FOR ANDT1049 THRU ANDT1052, ANDT1056 AND ANDT1077; 0.10 INCH FOR ANDT1053; 0.13 INCH FOR ANDT1054; 0.14 INCH FOR ANDT1055; 0.20 INCH FOR ANDT1057 AND ANDT1015.

[2] ETCH OR STAMP THE PART NUMBER ANDT1XXX AS SPECIFIED IN FIGURE 1, SHEET 2. PUT A LETTER "A" IN FRONT OF THE REFERENCE STANDARD NUMBER TO SHOW THAT IT HAS ALODINED RIVETS. REFER TO FIGURE 1, SHEET 2, FLAGNOTE 2.

[3] REFERENCE NOTCH. SIX LOCATIONS. MAKE THE NOTCH LESS THAN 0.030 (0.76) WIDE LENGTH - SEE FIGURE 1, SHEET 2, DIMENSION N.

Reference Standards ANDT1015, ANDT1049 Thru ANDT1057 and ANDT1077
Figure 1 (Sheet 1 of 2)

THICKNESS RANGE OF MATERIAL ABOVE INSPECTION SKIN	REFERENCE STANDARD NUMBER	MINIMUM AIRPLANE SKIN THICKNESS	INSPECTION FREQUENCY (kHz)	REFERENCE NOTCH LENGTH N	REFERENCE STANDARD REPAIR THICKNESS D	REFERENCE STANDARD SKIN THICKNESS E	EDGE MARGIN M	FASTENER SPACING P	FASTENER TYPE [1] A	FASTENER TYPE [1] [2] B	FASTENER TYPE [1] [2] C
0.040 AND LESS	ANDT1049	0.032	6.0-9.0	0.25	0.040	0.040	0.39	1.0	BACB30FN5	BACR15CE5D	BACR15ET7D
0.041-0.050	ANDT1050	0.036	5.0-7.0	0.25	0.050	0.040	0.39	1.0	BACB30FN5	BACR15CE5D	BACR15ET7D
0.051-0.056	ANDT1077	0.036	4.0-6.0	0.25	0.056	0.040	0.39	1.0	BACB30FN5	BACR15CE5D	BACR15ET7D
0.057-0.075	ANDT1051	0.036	2.0-4.0	0.25	0.071	0.040	0.45	1.3	BACB30FN6	BACR15CE6D	BACR15BB8D
0.076-0.090	ANDT1052	0.036	1.0-3.0	0.25	0.089	0.040	0.45	1.3	BACB30FN8	BACR15CE8D	BACR15BB8D
0.091-0.110	ANDT1053	0.050	0.9-2.0	0.30	0.11	0.050	0.57	1.4	BACB30FN8	BACR15CE8D	BACR15BB8D
0.111-0.125	ANDT1054	0.063	0.9-1.5	0.35	0.125	0.063	0.57	1.4	BACB30FN8	BACR15CE8D	BACR15BB8D
0.126-0.160	ANDT1055	0.071	0.8-1.0	0.45	0.16	0.071	0.63	1.75	BACB30FN8	BACR15CE8D	BACR15BB8D
0.161-0.200	ANDT1056	0.080	0.5-0.7	0.55	0.20	0.080	0.63	1.75	BACB30FN8	BACR15CE8D	BACR15BB8D
0.201-0.220	ANDT1057	0.100	0.4-0.6	0.65	0.22	0.100	0.63	1.75	BACB30FN8	BACR15CE8D	BACR15BB8D
0.221-0.250	ANDT1015	0.100	0.3-0.5	0.8	0.25	0.100	0.65	1.75	BACB30FN8	BACR15CE8D	BACR15BB8D

ALL DIMENSIONS ARE IN INCHES

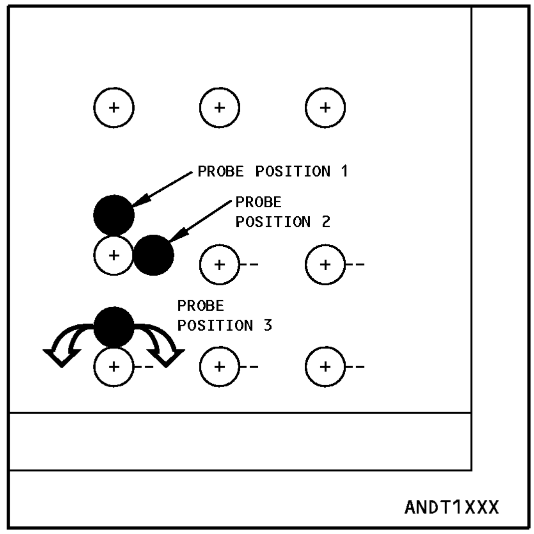
[1] OR EQUIVALENT

[2] THESE RIVETS MUST HAVE A CONVERSION COATED (ALODINE) FINISH. TO MAKE SURE THE FINISH IS ALODINE, REFER TO PART 1, 51-06-01. INSTALL THE RIVETS AS SPECIFIED IN PART 1, 51-01-04. PUT A LETTER 'A' IN FRONT OF THE REFERENCE STANDARD NUMBER TO SHOW THAT IT HAS ALODINE RIVETS.

NOTE: REFERENCE STANDARDS ANDT1049 THRU ANDT1057 REPLACE NDT1006 THRU NDT1014. IF YOU HAVE REFERENCE STANDARDS NDT1006 THRU NDT1009, IT IS NOT NECESSARY TO REPLACE THEM WITH ANDT1049 THRU ANDT1052 IF THEY HAVE ALODINE RIVETS. SEE FLAGNOTE 2.

REFERENCE STANDARD SPECIFICATIONS

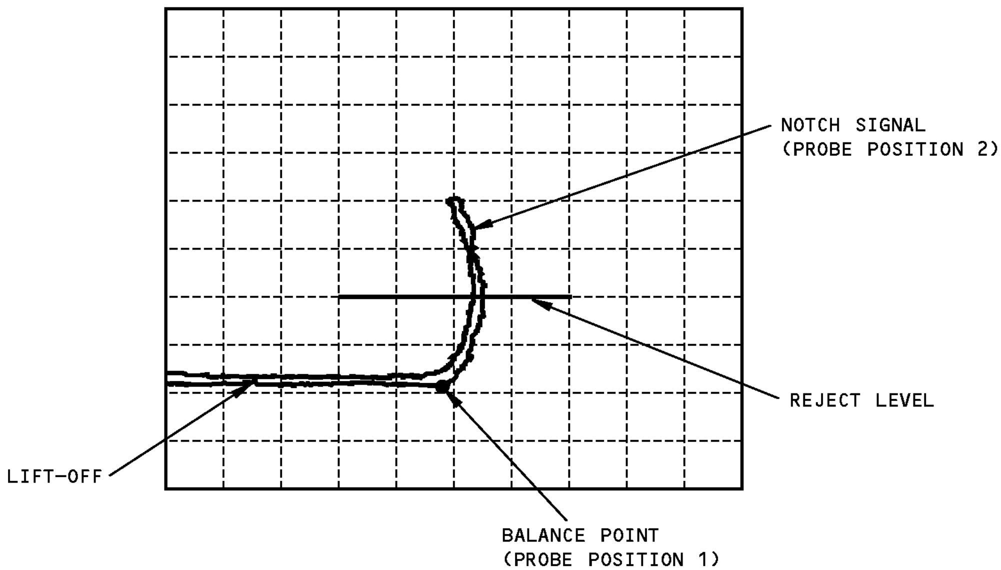
Reference Standards ANDT1015, ANDT1049 Thru ANDT1057 and ANDT1077
Figure 1 (Sheet 2 of 2)



NOTES

- PROBE POSITIONS 1 THRU 3, ARE THE PROBE POSITIONS DURING INSTRUMENT CALIBRATION FOR ALL FASTENER TYPES.
- THE SCREEN DISPLAY IN FIGURE 3 IS AN EXAMPLE OF THE CALIBRATION SIGNALS AT PROBE POSITIONS 1 AND 2. THE NOTCH SIGNAL CAN LOOK DIFFERENT WITH DIFFERENT PROBES AND INSTUMENTS.

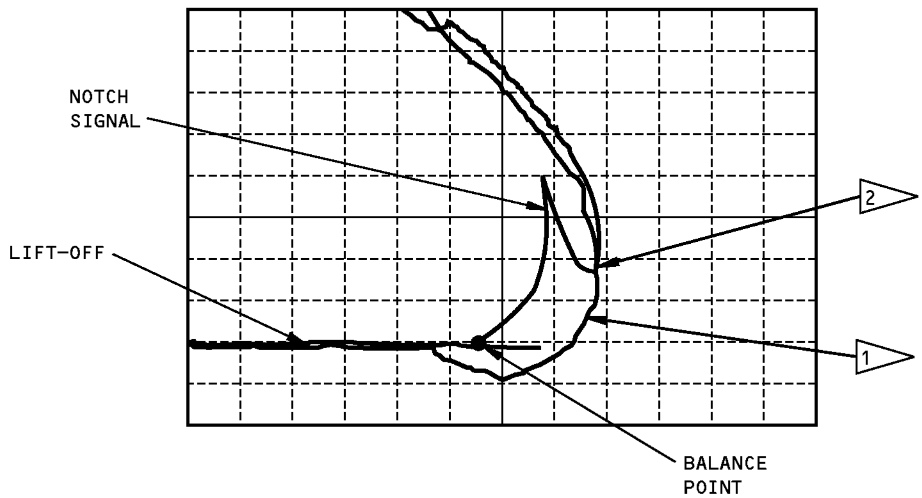
Probe Positions on the Reference Standard During Instrument Calibration
Figure 2



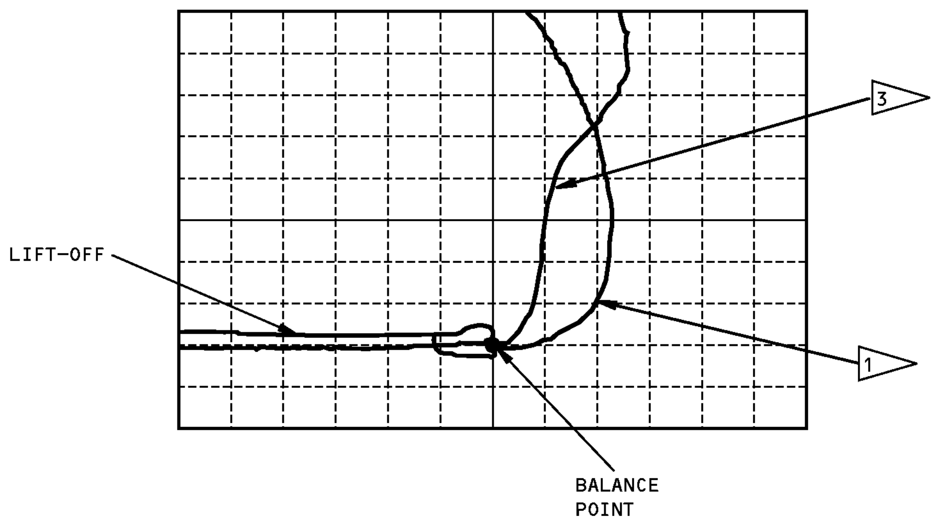
NOTES

- THIS SCREEN DISPLAY IS AN EXAMPLE OF THE CALIBRATION SIGNALS WHEN THE PROBE IS AT PROBE POSITIONS 1 AND 2 (AS SHOWN IN FIG. 2). THE NOTCH SIGNAL CAN LOOK DIFFERENT WITH DIFFERENT PROBES AND INSTRUMENTS.

Calibration Screen Display
Figure 3



REFERENCE STANDARD ANDT1055 WITH PROBE
NUMBER SPO-5330



REFERENCE STANDARD ANDT1057 WITH PROBE
NUMBER SPO-5330

NOTES

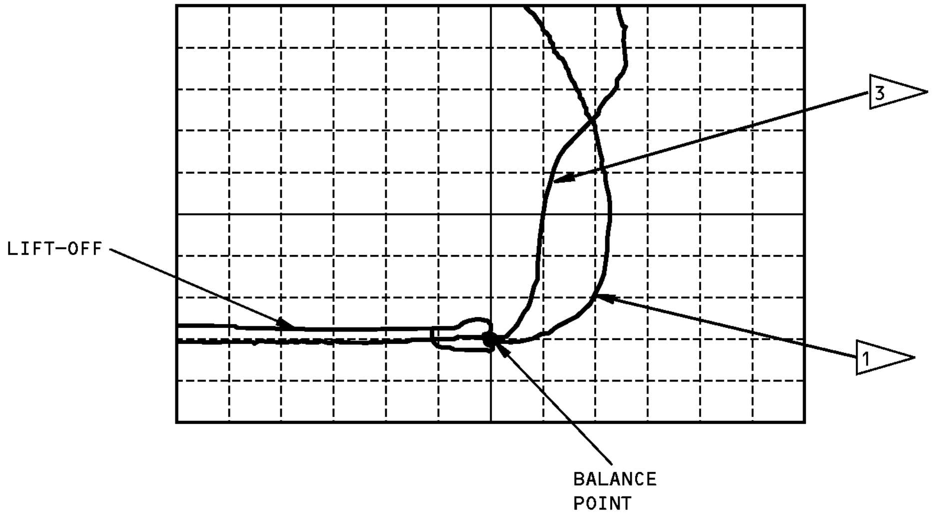
- THE SCREEN DISPLAYS ABOVE ARE SIGNALS WITH THE PROBE ADJACENT TO THE TYPE "C" FASTENER (SEE FIGURE 1, SHEET 2).

[1] EDGE EFFECT SIGNAL FROM THE SIDE OF THE FASTENER WITH NO NOTCH.

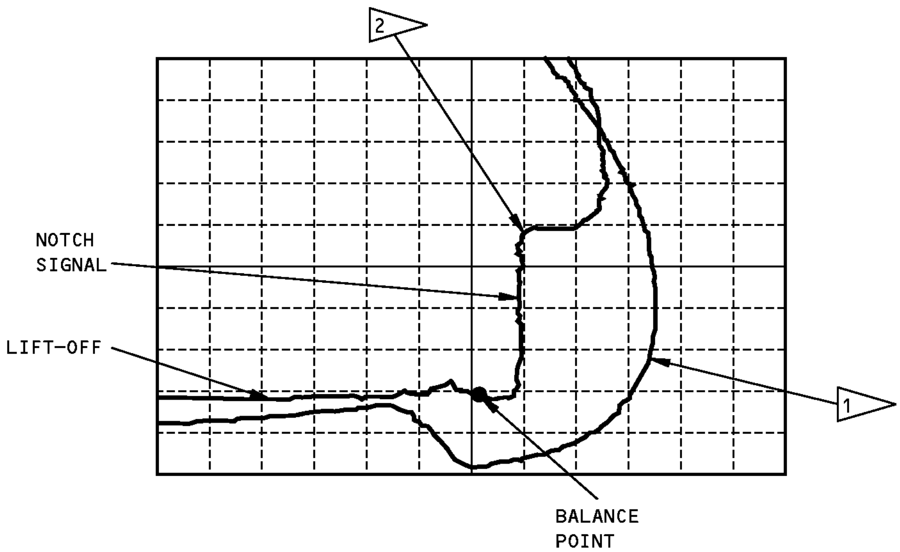
[2] START OF THE EDGE EFFECT SIGNAL FROM THE SIDE OF THE FASTENER WITH THE NOTCH.

[3] NOTCH SIGNAL WITH THE EDGE EFFECT SIGNAL.

Screen Display Examples to Show the Separation Between the Notch Signal and the Edge Effect Signal with an Increase of Repair Material
Figure 4



REFERENCE STANDARD ANDT1057 WITH
PROBE NUMBER SPO-5330



REFERENCE STANDARD ANDT1057 WITH
PROBE NUMBER RS1005-2/TF

NOTES

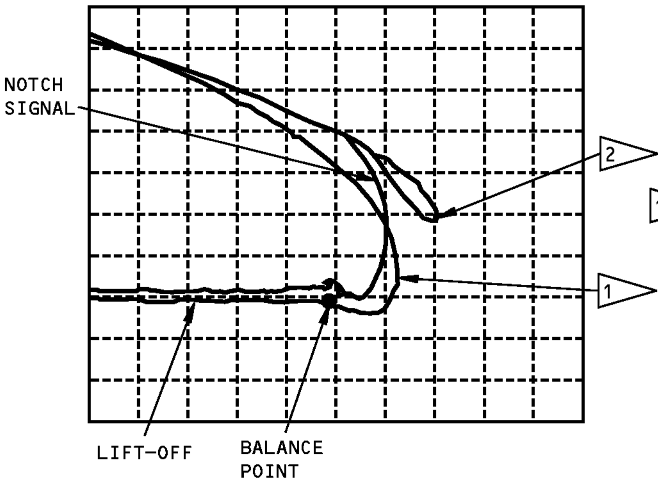
- THE SCREEN DISPLAYS ABOVE ARE SIGNALS WITH THE PROBE ADJACENT TO THE TYPE "C" FASTENER (SEE FIGURE 1, SHEET 2).

1 EDGE EFFECT SIGNAL FROM THE SIDE OF THE FASTENER WITH NO NOTCH.

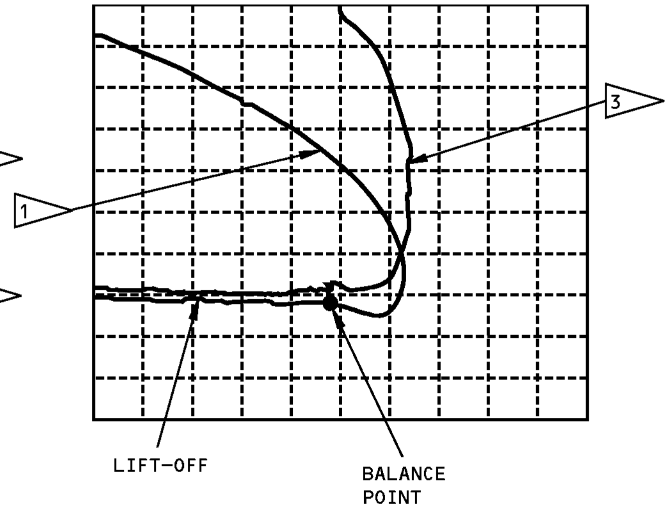
2 START OF THE EDGE EFFECT SIGNAL FROM THE SIDE OF THE FASTENER WITH THE NOTCH.

3 NOTCH SIGNAL WITH THE EDGE EFFECT SIGNAL.

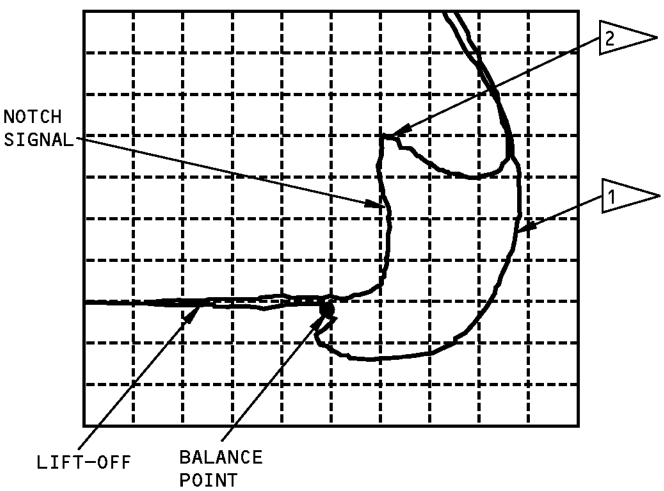
Screen Display Examples to Show the Separation Between the Notch Signal and the Edge Effect Signal with a Change to a Smaller Diameter Probe
Figure 5



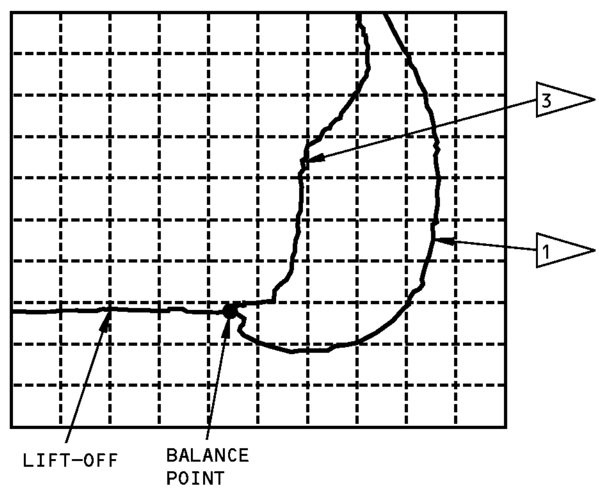
SIGNALS AT PROBE POSITION 3 ON REFERENCE STANDARD ANDT1052



TEST PIECE THAT IS THE SAME AS REFERENCE STANDARD ANDT1052 WITH A 0.025 (6) LONG NOTCH AT THE LOWER EDGE OF THE FASTENER HOLE



SIGNALS AT PROBE POSITION 3 ON REFERENCE STANDARD ANDT1056



TEST PIECE THAT IS THE SAME AS REFERENCE STANDARD ANDT1056 WITH A 0.55 (14) LONG NOTCH

NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- THE SCREEN DISPLAYS ABOVE ARE SIGNALS WITH THE PROBE ADJACENT TO THE TYPE "C" FASTENER (SEE FIGURE 1, SHEET 2).

1 EDGE EFFECT SIGNAL FROM THE SIDE OF THE FASTENER WITH NO NOTCH.

2 START OF THE EDGE EFFECT SIGNAL FROM THE SIDE OF THE FASTENER WITH THE NOTCH

3 NOTCH SIGNAL WITH THE EDGE EFFECT SIGNAL

Screen Display Examples to Compare the Notch Signal at Probe Position 3 to a Notch at the Lower Edge of the Fastener Hole Near the Edge of the Repair
Figure 6

PART 6 - EDDY CURRENT

SUBSURFACE CRACKS THAT START AT THE FAYING SURFACES OF THE AIRPLANE SKINS AND BULKHEAD WEBS

1. **Purpose**

A. Use this procedure to find subsurface cracks in the inspection areas that follow:

(1) The fuselage skin, at fastener rows of the lap splice and fuselage repairs. Figure 1 shows the inspection as it is done on the lower fastener row with the probe on the internal skin surface adjacent to the driven button end of the fastener.

(2) The bulkhead webs at fastener locations. With the probe adjacent to the fastener manufactured head or the driven button end of the fastener as specified by the service bulletin, repair instructions, etc.

B. This is a medium frequency eddy current procedure. It examines a skin thickness range from 0.032 to 0.120 inch (0.81 to 3.05 mm).

C. This procedure uses a spot probe that is not fully shielded to look for cracks that:

(1) Are as much as 3 times longer than they are deep.

(2) Start at the faying surface of the skin or web that the probe touches.

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 or a meter display.

(b) Operates at a frequency between 10 and 30 kHz.

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

(a) MIZ, 10A/B (Meter display); Zetec, Inc.

(b) Phasec 2200 (Impedance display); Hocking/Krautkramer

(c) Nortec 1000/2000 (Impedance display); Staveley, Inc.

(d) NDT 19e (Impedance display); Staveley, Inc.

(e) MIZ-21R (Impedance display); Zetec, Inc.

(f) US 454 (Impedance display); UniWest

C. Probes

(1) Use a spot probe with these properties:

NOTE: A reflection type probe is recommended.

(a) Use a probe with an end diameter of no larger than 0.190 inch (4.83 mm) and a probe height of no more than 0.50 inch (12.7 mm).

(b) Operates at a frequency between 10 and 30 kHz.

(c) Is at a right angle.

(d) During a probe scan around a reference standard fastener without a notch, the balance point signal must not change more than 5% of full screen height (FSH). Calibration Paragraph 4.H. will test the probe for this property.

(2) The probes specified below were used to help prepare this procedure.

NOTE: Probes different from those identified below can be used if they have the properties identified in Paragraph 2.C.(1) above.

(a) NEC-1084 or NEC-1095; NDT Engineering

(b) VM120FX-03-5-.375; VM Products

(c) SPC-4TF-105-1R; EC/NDT Company.

D. Reference Standards

(1) To examine a skin thickness range between 0.032 to 0.120 inch (0.81 to 3.05 mm), four reference standards are necessary.

(2) Use the reference standards that follow for the applicable thickness range to examine:

(a) ANDT1079 to examine the thickness range of 0.032 inch (0.81 mm) to 0.045 inch (1.14 mm)

(b) ANDT1080 to examine the thickness range of 0.046 inch (1.17 mm) to 0.055 inch (1.40 mm)

(c) ANDT1081 to examine the thickness range of 0.056 inch (1.42 mm) to 0.067 inch (1.70 mm)

(d) ANDT1082 to examine the thickness range of 0.068 inch (1.73 mm) to 0.120 inch (3.05 mm)

(3) See Figure 2 for the data about the reference standards.

(4) Reference standards NDT10XX can be used to make reference standards ANDT10XX if you remove the anodized rivets from NDT10XX and install Alodine rivets as specified in Figure 2.

3. Preparation for Inspection

A. Remove all the necessary interior panels and insulation blankets to get access to the inspection area.

B. Remove loose material and sealant from the inspection surface. It is not necessary to remove the corrosion inhibiting compound if it is evenly coated and at a thickness of 0.010 inch (0.25 mm) or less.

C. If tape is used on the probe, make sure that it is on the tip of the coil, not on the outside edges. It is critical that the probe be as near as possible to the fastener. Tape on the outside edge of the probe can cause the distance to change between the probe and the fastener, if the tape is not applied correctly.

4. Instrument Calibration

A. Determine the part thickness from the Structural Repair Manual (SRM), Service Bulletin, or other source for calibration. See Table 1 that follows for the calibration specifications that identify:

(1) The part thickness range.

(2) The reference standard to use for the part thickness range.

(3) The instrument frequency to use.

Table 1 Instrument Calibration Table

Part thickness range to be examined	0.032 to 0.045 inch (0.81 to 1.14 mm)	0.046 to 0.055 inch (1.17 to 1.40 mm)	0.056 to 0.067 inch (1.42 to 1.70 mm)	0.068 to 0.120 inch (1.73 to 3.05 mm)
Reference standard to use	ANDT1079	ANDT1080	ANDT1081	ANDT1082
Instrument frequency to use	25 kHz	20 kHz	15 kHz	10 kHz

B. Put the probe at probe position 1 (adjacent to the machined fastener head) of the applicable reference standard and fastener. See Figure 3.

C. Balance the instrument.

D. If an impedance plane display instrument is used, adjust the vertical gain 14 to 20 dB higher than the horizontal gain or between 5:1 and 10:1 vertical to horizontal gain ratio.

NOTE: The gain ratios in Paragraph 4.D. are necessary to keep the balance point on the screen during the scan. Changes in the thickness of the finish can cause the balance point to move off of the screen display.

E. Set the lift-off as follows:

(1) If a meter display instrument is used: adjust the phase control so that the meter needle moves no more than 5 percent of full scale for probe-to-part distances of up to 0.006 inch (0.15 mm). This is the thickness of two sheets of paper (approximately).

(2) If an impedance plane display instrument is used: adjust the phase control so that the lift-off signal moves horizontally to the left as shown in Figure 3, View C.

F. Adjust the balance point to the position shown in Figure 3. See View B for the meter display and View C for the impedance plane display.

G. Adjust the instrument sensitivity as follows:

(1) Put the probe at probe position 2 (adjacent to the same diameter fastener used for probe position 1) on the reference standard, above the notch to get a maximum signal. See Figure 3, View A.

(2) If a meter display instrument is used:

(a) Adjust the instrument sensitivity to get a notch signal that is 60 percent of full scale (40 percent of full scale higher than the balance point). See Figure 3, View B.

(3) If an impedance plane display instrument is used:

(a) Adjust the instrument sensitivity to put the notch signal at 60 percent of full screen height (40 percent higher than the balance point). See Figure 3, View C.

H. Make a complete scan around the fastener at probe position 1 on Figure 3 and monitor the display for movement of the balance point. If the balance point moves more than 5% of the signal display, use a different probe.

NOTE: Some probes do not have the coil accurately positioned in the center of the probe body, which can cause the balance point to move during the scan around the fastener.

NOTE: Keep the probe at a right angle to the inspection surface when you move the probe around the fastener.

I. Set the instrument alarm to 50% of the notch signal set in Paragraph 4.G..

5. **Inspection Procedure**

A. Examine the inspection area as follows:

(1) Calibrate the instrument as specified in Paragraph 4.

(2) Put the probe on the part surface and adjacent to the fastener to be examined.

(3) Balance the instrument.

(4) Do a complete scan around all of the fasteners to be examined. During the scan:

(a) Keep the probe adjacent to the fastener at all times.

(b) Keep the probe as vertical as possible to the part surface to decrease the balance point movement.

(c) Make a mark at the fastener locations that cause signals to occur that are 20% (or more) above the balance point and are almost the same as the signal you got from the reference standard notch.

(d) Frequently do a check of the instrument calibration during the inspection as follows:

1) Put the probe on the reference standard at probe position 2 (see Figure 3) to get the signal from the notch.

2) If the signal has changed 10% or more, do the calibration and inspection again on all the areas examined since the last calibration check.

6. **Inspection Results**

A. Inspection results for meter display instruments:

(1) An upscale needle movement that is 40% (or more) of full scale (20% higher than the balance position) is a possible crack signal. A crack signal occurs during a short scan.

B. Inspection results for impedance plane display instruments:

(1) Vertical signals that are 40% (or more) of full screen height (20% higher than the balance point) are possible crack signals. A crack signal occurs during a short scan.

C. Signals can occur at different locations as a scan is made around the driven button end of a fastener. This can be caused by an edge effect signal from the fastener hole caused by an out-of-round condition of the driven button end during installation of the fastener. If the signal is more than that referred to in Paragraph 6.A.(1) or Paragraph 6.B.(1) do more analysis as follows:

NOTE: Refer to the flow chart in Figure 4 for the sequence of steps identified below.

(1) Get local engineering approval and remove the fastener.

(2) Do a detailed visual inspection of the hole to look for surface conditions such as burrs, galling, corrosion and out-of-round holes. If one or more of the conditions above are found, get local engineering approval and do a clean-up ream to remove the condition.

(3) Do the fastener hole inspection as specified in Part 6, 51-00-16.

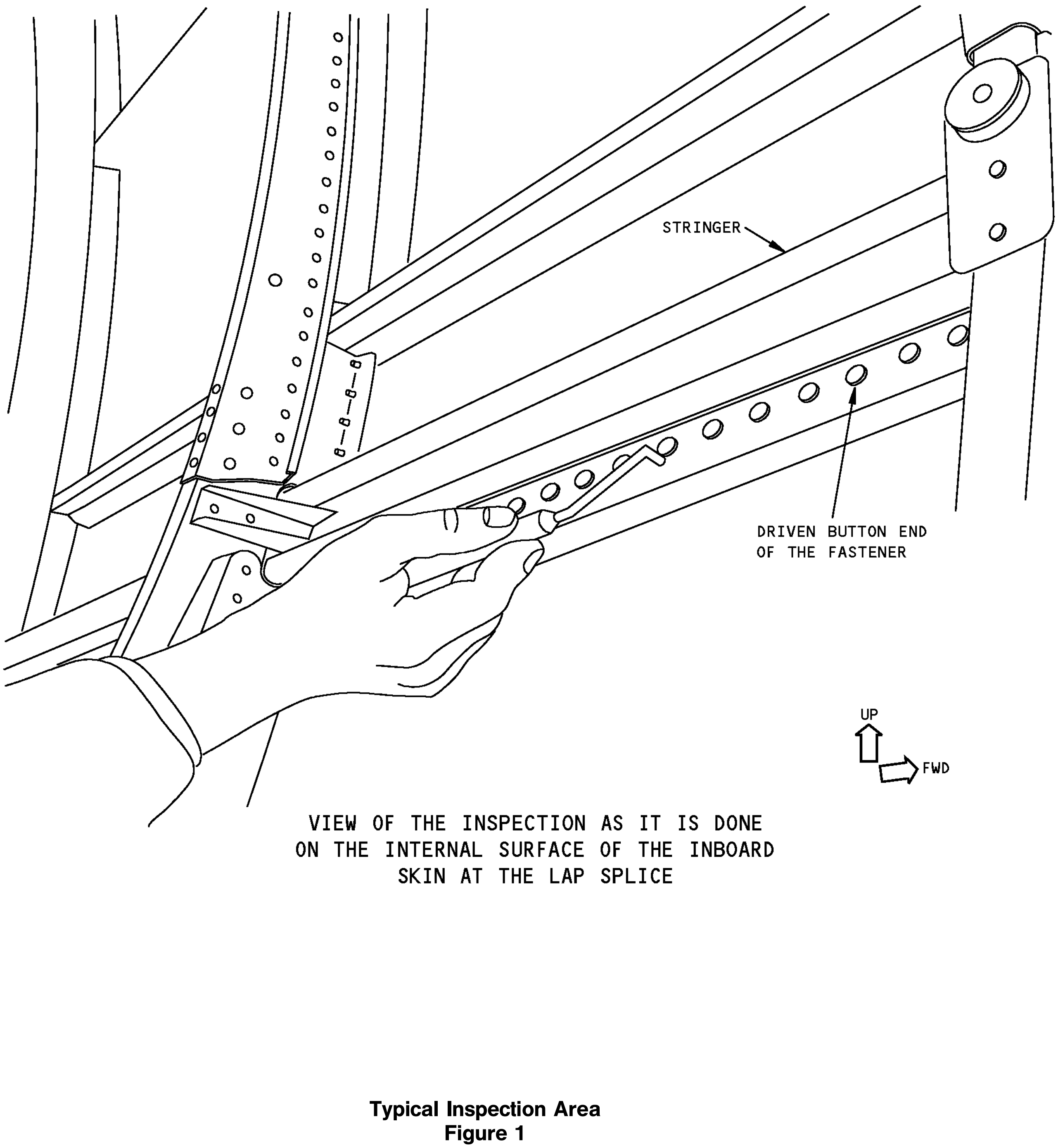
CAUTION: IT IS POSSIBLE TO GET A CRACK SIGNAL WHEN YOU DO THIS PROCEDURE, BUT NOT WHEN YOU DO THE PART 6, 51-00-16 FASTENER HOLE INSPECTION. THIS CAN OCCUR IF THERE ARE CRACKS THAT DO NOT GO INTO THE HOLE. THE PART 6, 51-00-16 FASTENER HOLE INSPECTION WILL ONLY IDENTIFY CRACKS THAT GO INTO THE HOLE.

(4) If a crack signal does not occur when the fastener hole inspection procedure (specified in Paragraph 6.C.(3)) is done, do as follows:

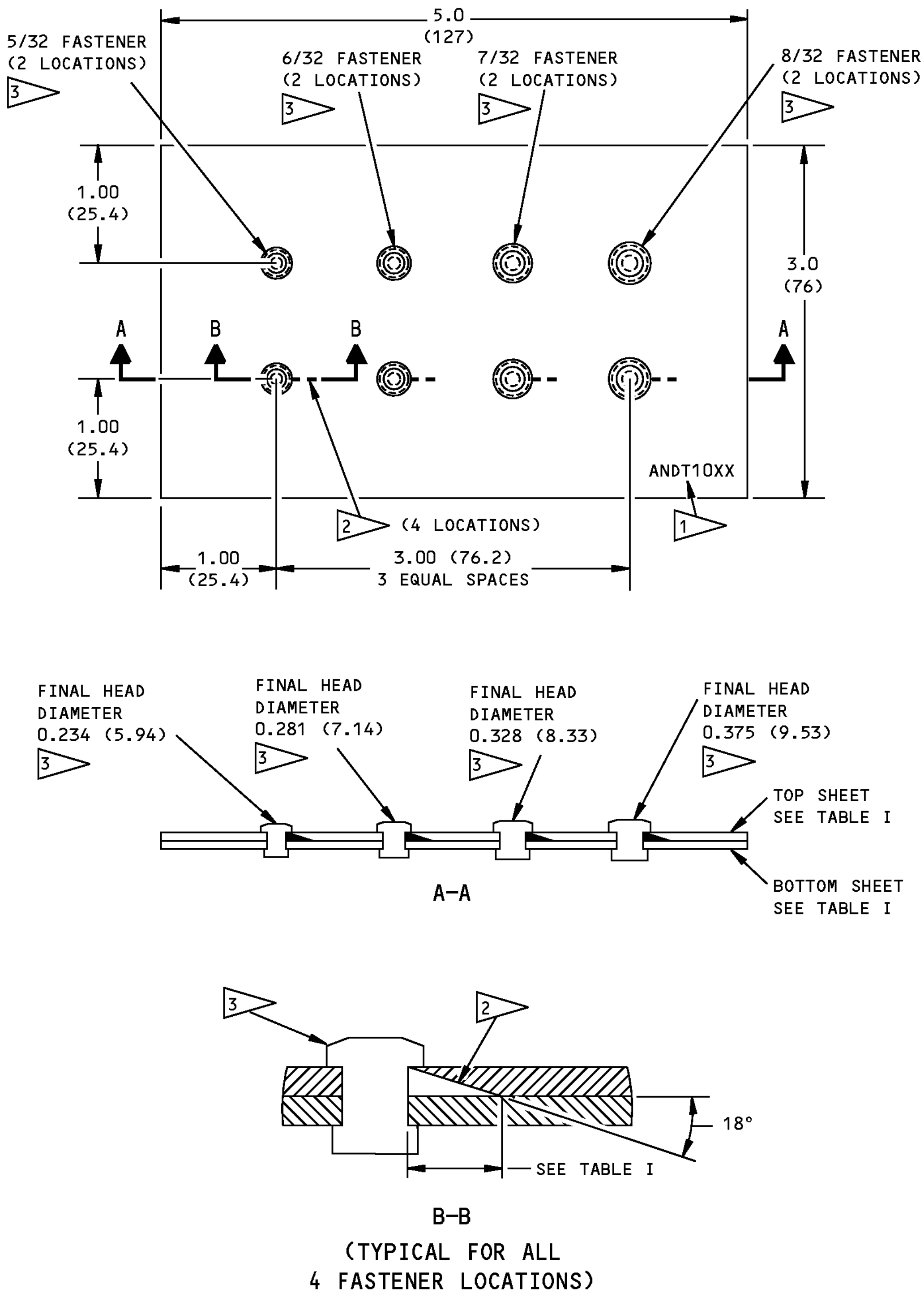
(a) Put an aluminum rivet back into the hole. Make sure the rivet fits tight in the hole and has a sufficient shank length to be used as a probe guide.

(b) Make a scan around the shank of the rivet as specified in Paragraph 5.A.(4).

(c) If the crack signal occurs again, reject the hole.



Typical Inspection Area
Figure 1



Reference Standards ANDT1079 Thru ANDT1082
Figure 2 (Sheet 1 of 3)

REFERENCE STANDARD NUMBER		ANDT1079	ANDT1080	ANDT1081	ANDT1082
MATERIAL THICKNESS	TOP SHEET	0.040 (1.02)	0.050 (1.27)	0.063 (1.60)	0.070 (1.78)
	BOTTOM SHEET	0.040 (1.02)	0.050 (1.27)	0.063 (1.60)	0.070 (1.78)
NOTCH LENGTH AT THE FASTENER LOCATION	5/32 FASTENER	0.142 (3.61)	0.172 (4.37)	0.211 (5.36)	0.232 (5.89)
	6/32 FASTENER	0.150 (3.81)	0.180 (4.57)	0.219 (5.56)	0.240 (6.10)
	7/32 FASTENER	0.158 (4.01)	0.188 (4.78)	0.227 (5.77)	0.248 (6.30)
	8/32 FASTENER	0.166 (4.22)	0.196 (4.98)	0.235 (5.97)	0.256 (6.50)

TABLE I

NOTES:

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

- ANGULAR TOLERANCE: ±1.0 DEGREE
- NOTCH LOCATION TOLERANCES:

  THE NOTCH LOCATION MUST BE WITHIN ±0.005 (±0.10) OF THE CENTERLINE OF THE HOLE AS SHOWN.
- MATERIAL: 2024-T3 OR T4 CLAD ALUMINUM
- FASTENERS: USE ONLY ALODINED RIVETS

  QUANTITY (2) BACR15BB5AD---C
  (2) BACR15BB6AD---C
  (2) BACR15BB7AD---C
  (2) BACR15BB8AD---C
- SURFACE ROUGHNESS: 63 Ra OR BETTER

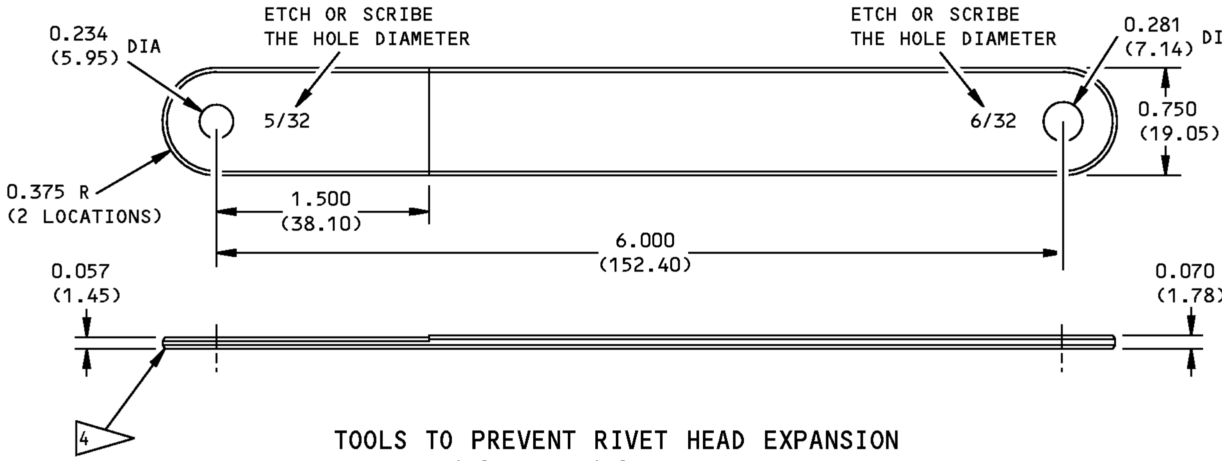
[1] ETCH OR SCRIBE THE REFERENCE STANDARD NUMBER TO THE APPLICABLE REFERENCE STANDARD AS SPECIFIED IN TABLE I.

[2] TAPERED EDM NOTCH:
MAXIMUM WIDTH: 0.010 (0.25)
LENGTH: SEE TABLE I

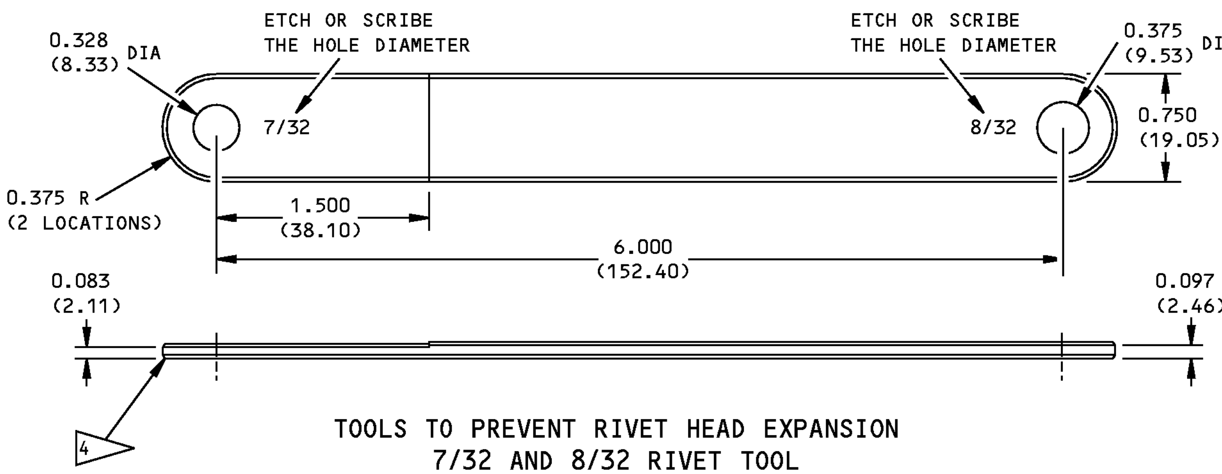
[3] INSTALL THE RIVETS AS FOLLOWS:

- MAKE SURE THE TAIL END OF THE RIVETS HAVE A "C" STAMP THAT IDENTIFIES THAT THE RIVETS ARE ALODINED.
- MACHINE THE FASTENER HEADS TO SIMULATE THE DRIVEN BUTTON DIAMETER.
  5/32 0.231 ±0.002 (5.87 ±0.05)
  6/32 0.278 ±0.002 (7.06 ±0.05)
  7/32 0.325 ±0.002 (8.26 ±0.05)
  8/32 0.372 ±0.002 (9.45 ±0.05)
- CLEAN THE RIVETS, HOLES, COUNTERSINKS AND ALL SURFACES OF THE REFERENCE STANDARDS WITH SOLVENT.
- PUT THE APPLICABLE DIAMETER HOLE OF THE RIVET TOOL AROUND THE RIVET HEAD SO THAT THE SURFACE OF THE TOOL TOUCHES THE TOP SHEET OF THE REFERENCE STANDARD.
- COMPRESS THE RIVET TO GET A BUTTON DIAMETER ON THE TAIL END THAT IS 1.3 TO 1.5 TIMES THE SHANK DIAMETER.

Reference Standards ANDT1079 Thru ANDT1082
Figure 2 (Sheet 2 of 3)



TOOLS TO PREVENT RIVET HEAD EXPANSION
5/32 AND 6/32 RIVET TOOL



TOOLS TO PREVENT RIVET HEAD EXPANSION
7/32 AND 8/32 RIVET TOOL

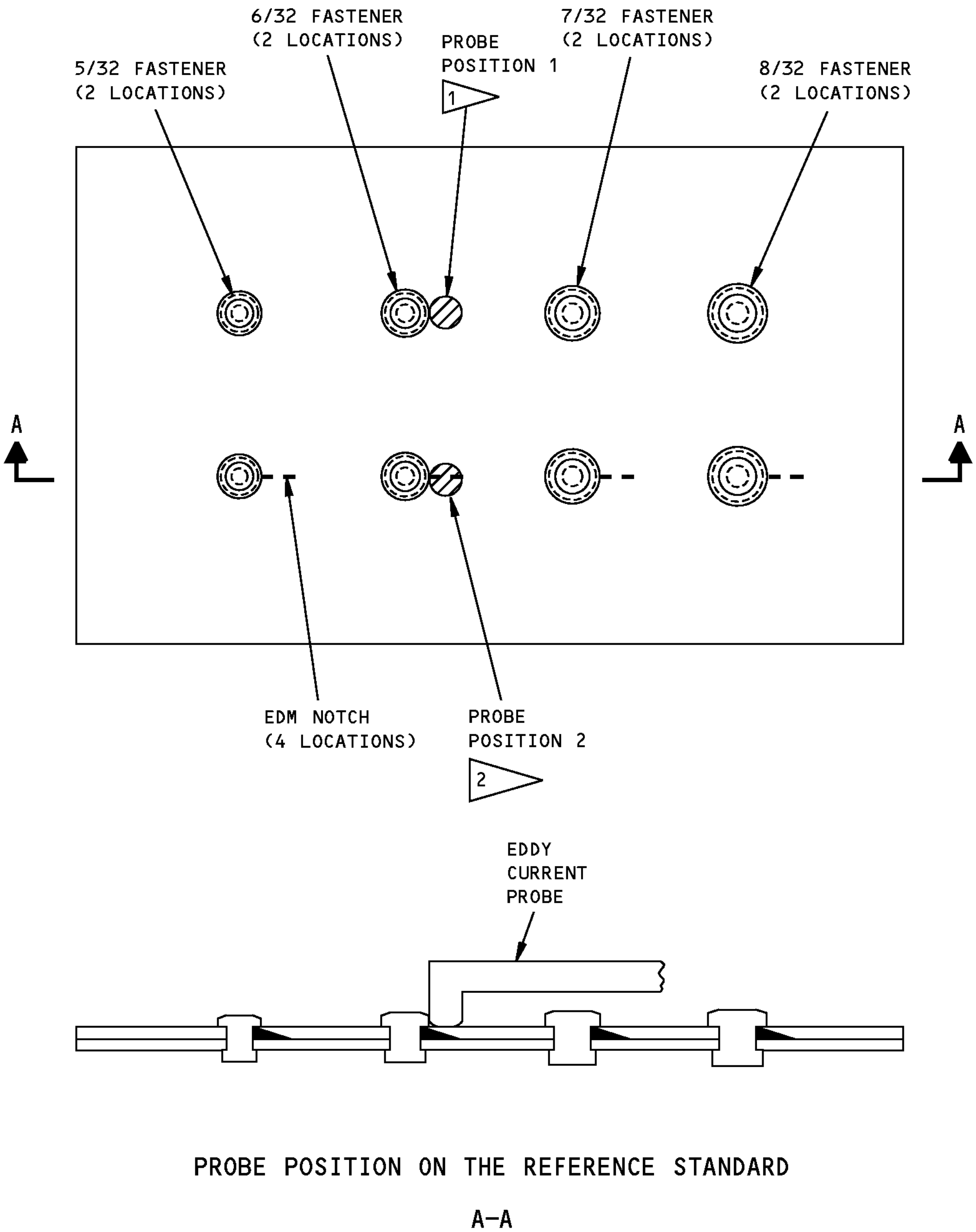
NOTES

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- MATERIAL: STEEL OR STAINLESS STEEL; 40 KSI (OR MORE) YIELD STRENGTH
- USE: THIS TOOL IS PUT AROUND THE RIVET HEAD TO PREVENT EXPANSION OF THE RIVET HEAD AS THE RIVETS ARE COMPRESSED TO FORM THE BUTTON ON THE TAIL END.

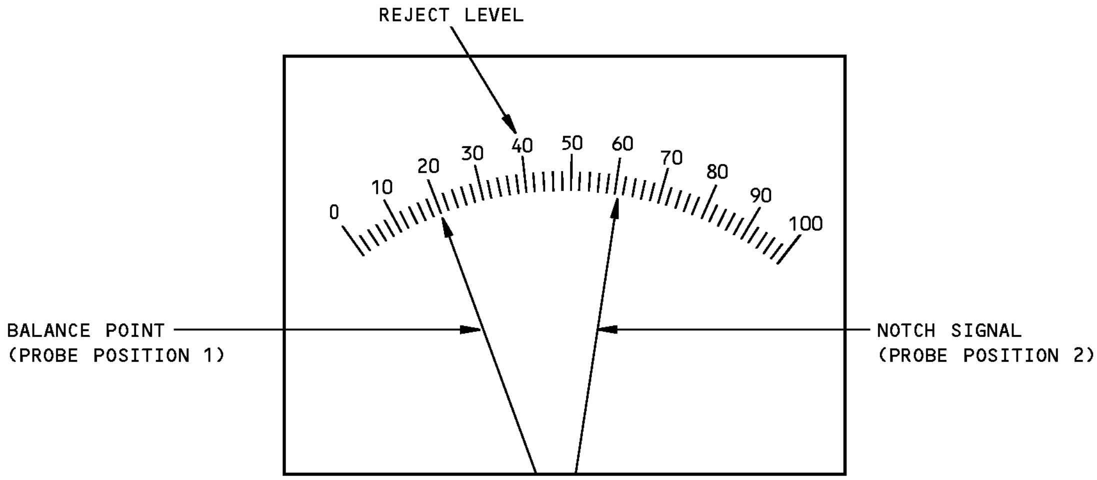
  THE RIVET TOOLS CAN BE USED AS LONG AS THE FINAL RIVET HEAD DIAMETERS ARE AS SPECIFIED ON SHEET 1.

[4] BREAK ALL EXTERNAL EDGES TO A 0.020 RADIUS. DO NOT BREAK HOLE EDGES.

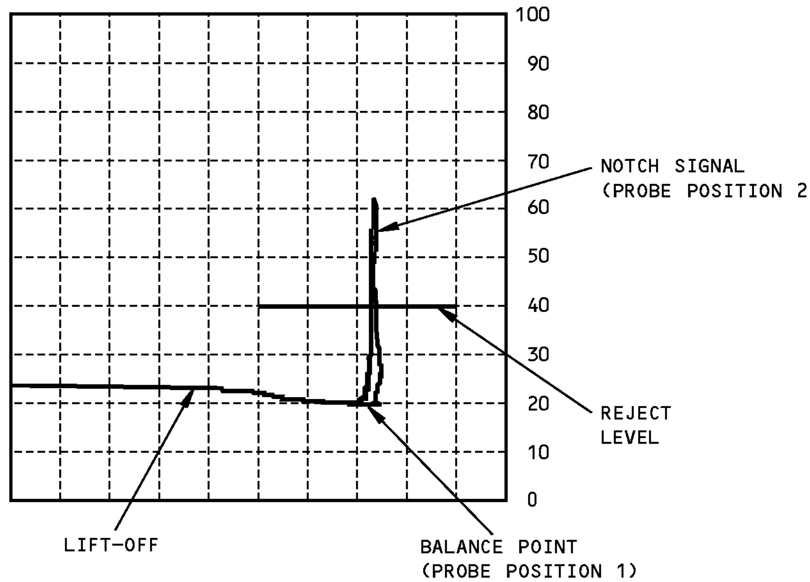
Reference Standards ANDT1079 Thru ANDT1082
Figure 2 (Sheet 3 of 3)



Calibration and Probe Positions
Figure 3 (Sheet 1 of 2)



METER DISPLAY
VIEW B



IMPEDENCE PLANE DISPLAY
VIEW C

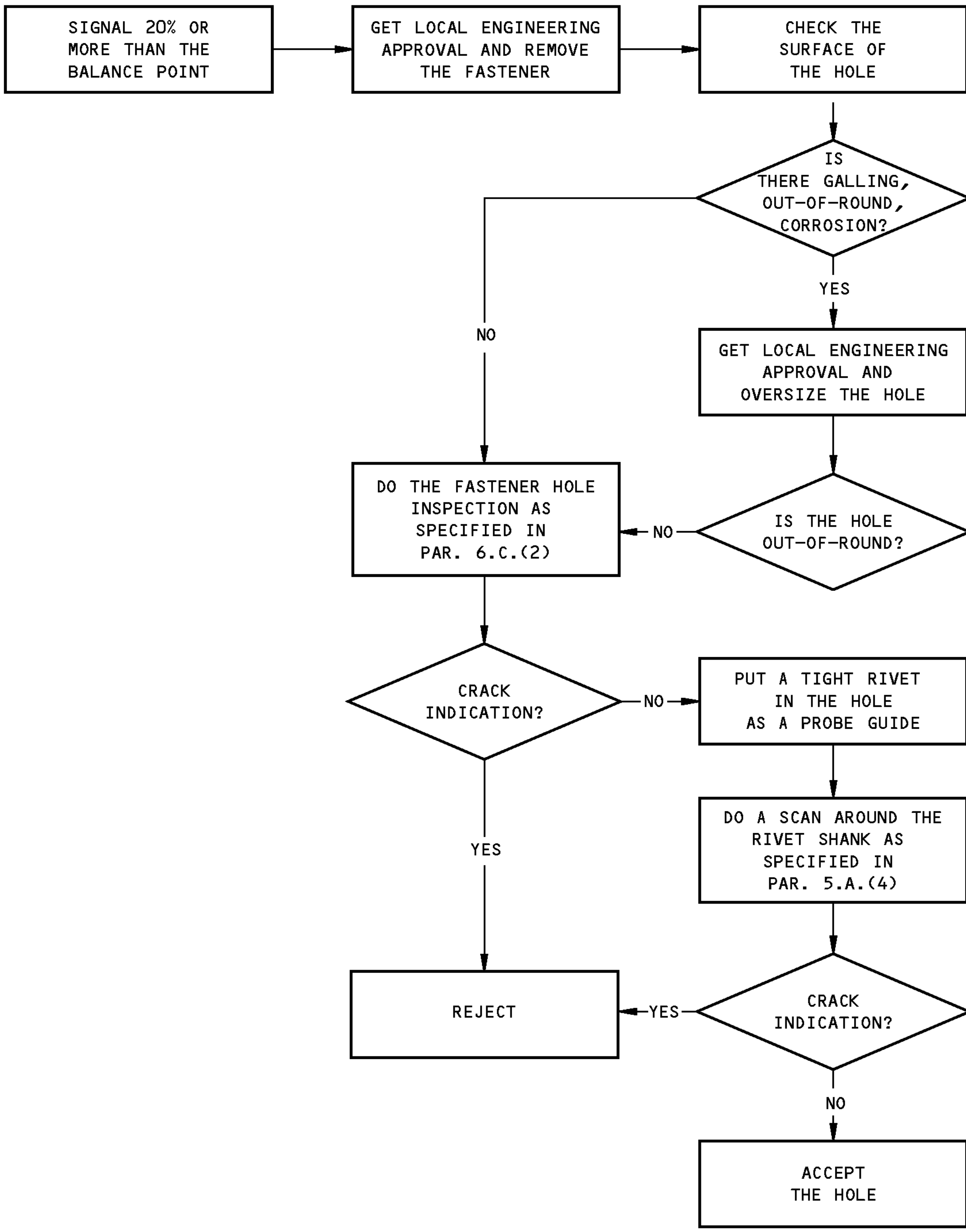
NOTES:

- THE CALIBRATION IS DONE WITH THE PROBE ADJACENT TO THE MACHINED FASTENER HEADS AS SHOWN IN VIEW A. THE INSPECTION ON THE AIRPLANE IS DONE WITH THE PROBE ADJACENT TO THE DRIVEN BUTTON END (TAIL SIDE) OF THE FASTENER.

1 TYPICAL PROBE POSITION 1 FOR ALL (4) FASTENER LOCATIONS WITHOUT A NOTCH

2 TYPICAL PROBE POSITION 2 FOR ALL (4) FASTENER LOCATIONS WITH A NOTCH

Calibration and Probe Positions
Figure 3 (Sheet 2 of 2)



Signal Analysis Flowchart
Figure 4

PART 6 - EDDY CURRENT

SLIDING PROBE INSPECTION PROCEDURE FOR FASTENER LOCATIONS WITH DECALS

1. **Purpose**

   A. Use this eddy current procedure to help find cracks that extend from a fastener location in fuselage skins where the fastener head can not be seen because of decals.

   B. This procedure specifies a scan procedure only. Refer to the sliding probe procedure that references this procedure for the equipment data, calibration data, and to do the inspection result analysis.

2. **Equipment**

   A. Refer to the procedure that references this procedure for the equipment data.

3. **Preparation for Inspection**

   A. Identify the distance between the fastener row to be examined and the skin edge as follows:

      (1) Identify a visible fastener at each end of the decal.

      (2) Measure the distance from the fastener centerline to the skin edge.

      (3) Make marks along the decal that are the distance that was measured in Paragraph 3.A.(2) from the skin edge. Make these marks at intervals that are almost the length of the straightedge. (see Detail I in Figure 1)

      (4) Use a straightedge to connect the marks from Paragraph 3.A.(3) and make a line on the skin from the centerline marks or the visible fastener across the decal. This line will identify the approximate position of the hidden inspection fasteners. (see Detail I in Figure 1)

4. **Instrument Calibration**

   A. Put a shim or tape that is not transparent on the fasteners of the reference standard to simulate the decal. The shim or tape thickness must be the same (±0.005 inch (0.13 mm)) as the decal to be simulated. If the thickness is unknown, use an eddy current instrument that can identify the thickness of the decal.

   B. Continue instrument calibration as specified in the procedure that referenced this procedure.

5. **Inspection Procedure**

   A. Put the probe at one end of the decal so that it is centered on the line you marked on the skin.

   B. Move the probe along the line to find the first hidden fastener. Use a "scrubbing" procedure to help find these fasteners (See Detail I in Figure 1). The "scrubbing procedure" is as follows:

      (1) Slide the probe forward and backward in short strokes in the fastener area while you monitor the signal.

      (2) The maximum signal will occur when the probe is moved across the fastener centerline. (See Detail II in Figure 1)

         NOTE: It is important to fully scrub the fastener area to identify the maximum signal. Fasteners not fully scrubbed can cause reject condition and/or rivet location errors to occur.

         NOTE: When you make a scan, keep the permanent screen adjustment "ON" so that the signals can be compared on the screen. Do a manual erase after each fastener location has been examined.

   C. Monitor the instrument signal pattern. Compare the signals with the signal patterns shown in the procedure that referenced this procedure. Make a mark at all fastener locations that cause signals to occur that are above the reject level of the procedure that referenced this procedure.

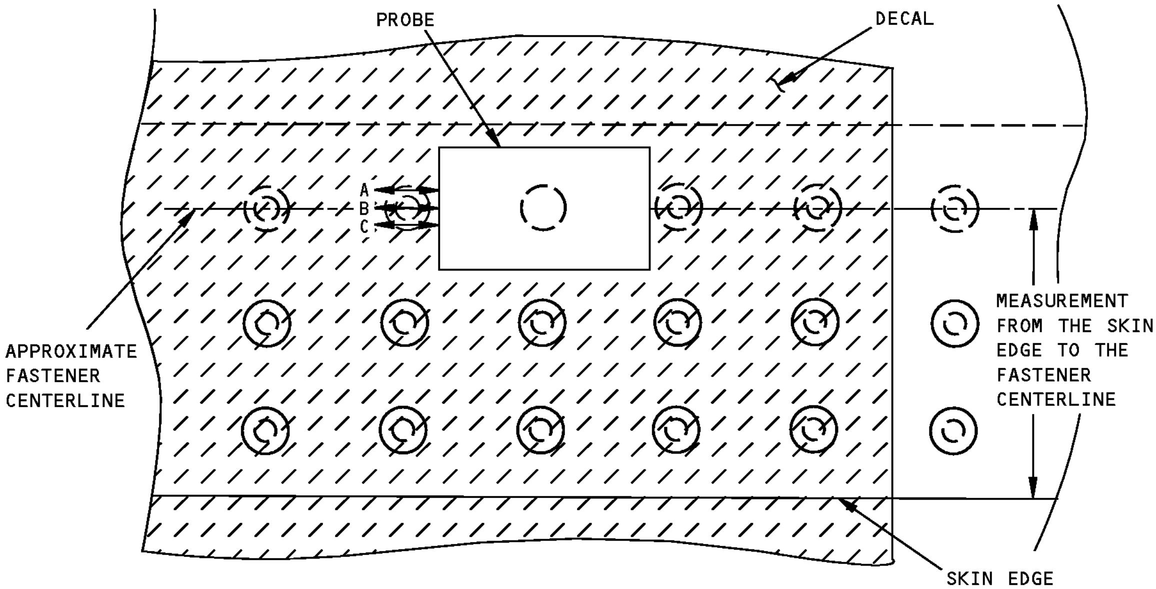
   D. Erase the screen and move the probe to the adjacent fastener location.

   E. Do Paragraph 5.B. again.

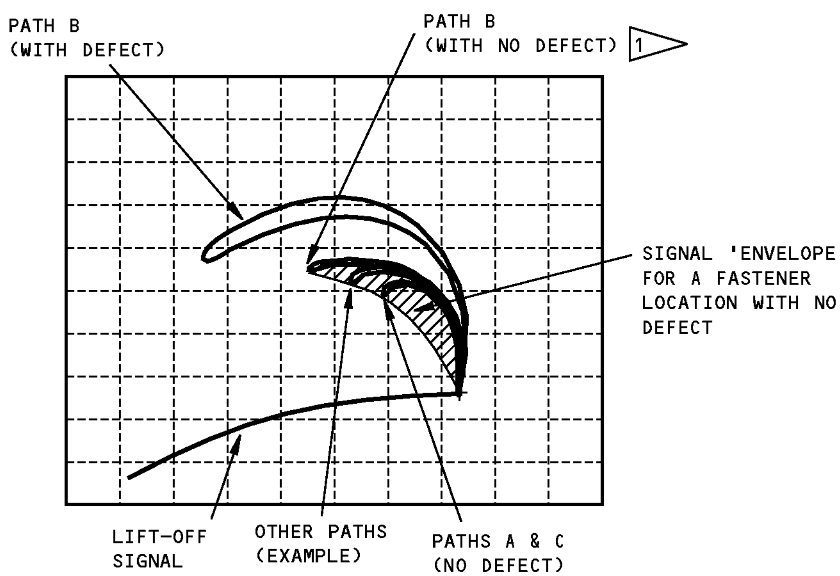
F. Continue to move the probe along the line and do Paragraph 5.B. thru Paragraph 5.E. until each hidden fastener location in the decal has been examined.

6. **Inspection Results**

A. Refer to the procedure that referenced this procedure to help make an analysis of the inspection results.



EXAMPLE SCRUBBING PROCEDURE
DETAIL I



EXAMPLE SCRUBBING SIGNALS
DETAIL II

NOTES:

1 MAXIMUM SIGNAL AT THE FASTENER CENTERLINE

Scrubbing Examples
Figure 1

PART 6 - EDDY CURRENT

FUSELAGE SKIN SCRIBE MARK CRACK INSPECTION - LOWER SKIN AT THE LAP JOINTS AND EXTERNAL DOUBLER EDGES

1. **Purpose**

   A. Use this surface inspection procedure to find cracks in the lower skin panels of the fuselage at the lap joints. This procedure looks for cracks that can occur from scribe marks on the outside surface of the skin. This procedure looks for cracks in the lower skin panels that are:

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

      (2) Are in the forward and aft direction.

   B. This is a high frequency eddy current (HFEC) inspection.

   C. The inspection area to examine is an area that begins at the lower edge of the upper skin of the lap joint and extends to 0.063 inch (1.60 mm) below the lower edge of the upper skin. See Figure 1 for the inspection area.

   D. This inspection uses a specially designed pencil probe on the outside surface of the lower 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 Reference Not Currently Available for data about the equipment manufacturers.

   B. Instrument

      (1) Use an eddy current instrument that:

         (a) Operates at a frequency of 70 kHz.

         (b) Has an impedance plane display.

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

         (a) Phasec 2200, Phasec 2; Hocking

         (b) Elotest B1; Rohmann GmbH

         (c) Nortec 1000/2000; Staveley Instruments.

   C. Probe

      (1) This procedure uses a specially designed, right angle, shielded, pencil probe.

         (a) Use NEC 1006 which is made by NDT Engineering Corp.

   D. Reference Standard

      (1) Use reference standard NDT3065. See Figure 2.

3. **Preparation for Inspection**

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

   A. Remove sealant from the inspection surface at the lower skin of the lap joint and doubler edges before inspection.

   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. Get sufficient access to the inspection area. The inspector must keep the probe 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. Set the instrument frequency to 70 kHz.

B. Set the vertical gain 12 to 16 dB higher than the horizontal gain.

C. If the inspection area is painted, put a nonconductive shim on the reference standard. The thickness of the shim must be equivalent ($\pm$0.003 inch (0.08 mm)) to the paint thickness on the inspection area.

D. Put the probe tip on the inspection surface (lower piece) of reference standard NDT3065 between notch locations identified as "A" and "B". See Figure 3, Detail I. It is recommended to use a piece of thin tape on the tip of the probe to prevent scratches to the surface.

E. Make sure the probe is against the edge of the upper piece and is perpendicular to the inspection surface at all times during the calibration.

F. Balance the instrument.

G. Set the instrument balance point to the lower center area of the screen display as shown in Figure 3, Detail II.

H. Lift the probe off the surface and adjust the instrument phase control to get the lift-off signal to move horizontally from right to left. Make sure the probe is against the top piece during the lift-off adjustment.

I. Move the probe across the notch identified as "B" in the reference standard.

J. Find the probe position on the notch that gives the maximum signal height and adjust the instrument gain to get the signal to 40% of full screen height (FSH) higher than the balance point. See Figure 3, Detail II.

K. Turn the probe 180 degrees and do Paragraph 4.I. and Paragraph 4.J. again. If the signal is less than 40% of FSH, do the calibration again. If there is a difference in the signal heights when the probe is turned, make sure you position the probe for calibration that gives the lowest signal. Use the same probe position to do the scan inspection on the airplane that you used during the calibration.

L. Set the audible alarm to 50% of the signal height (20% FSH higher than the balance point) as shown in Figure 3, Detail II.

M. Move the probe across the notch in the reference standard to find the maximum scan speed. The speed is too fast if the signal decreases more than 10% of the signal height or the alarm does not operate.

N. Move the probe across the notch identified as "A" and monitor the signal. The signal must be equal to or more than the signal from notch "B".

O. The EDM notches identified as "C" and "D" are not used for this inspection procedure.

5. **Inspection Procedure**

A. Calibrate as specified in Paragraph 4.

B. Put the probe against the edge of the upper skin of the lap splice or external doubler at a location where there is no visible scribe line and balance the instrument. See Figure 1 for a typical probe position. If there is no location on the skin panel to be examined where there is no visible scribe line, do the steps that follow:

(1) Put the probe approximately 0.50 inch (13 mm) away from the edge of the upper skin or doubler.

(2) Balance the instrument.

(3) Move the probe to the edge of the upper skin or doubler and monitor the signal on the screen display.

(a) If the signal does not move in the upward direction, balance the instrument again and go to Paragraph 5.C. Use this location to balance the instrument when you examine the skin panel.

(b) If the signal moves in the upward direction as the probe is moved to the edge of the upper skin or doubler, do Paragraph 5.B.(1) thru Paragraph 5.B.(3) again at a different location. Continue to do Paragraph 5.B.(1) thru Paragraph 5.B.(3) until the signal does not move in the upward direction. If there is no location where the signal does not move in the upward direction as the probe is moved toward the edge of the skin or doubler, use a balance point that is away from the skin edge when you examine the skin panel.

C. Keep the probe against the edge of the upper skin of the lap splice and perpendicular to the surface at all times during the inspection scan.

D. Make a scan of the lap joints specified by the local engineering authority within the inspection zone identified in Figure 1.

E. Examine all visual scribe mark indications that are just outside of the inspection zone.

6. **Inspection Results**

A. Signals that are 20% of FSH or higher than the balance point, are possible crack indications. Make a mark on the skin surface of all possible crack indications with a grease pencil, felt pen or wax pencil.

B. Compare the signal that occurs during the inspection to the signal you got from the notch in the reference standard.

C. Do more analysis of signals that are possible cracks as follows:

(1) Put the probe on the lower skin, away from the area of the possible crack and approximately 0.50 inch (13 mm) away from the edge of the upper skin.

(2) Balance the instrument.

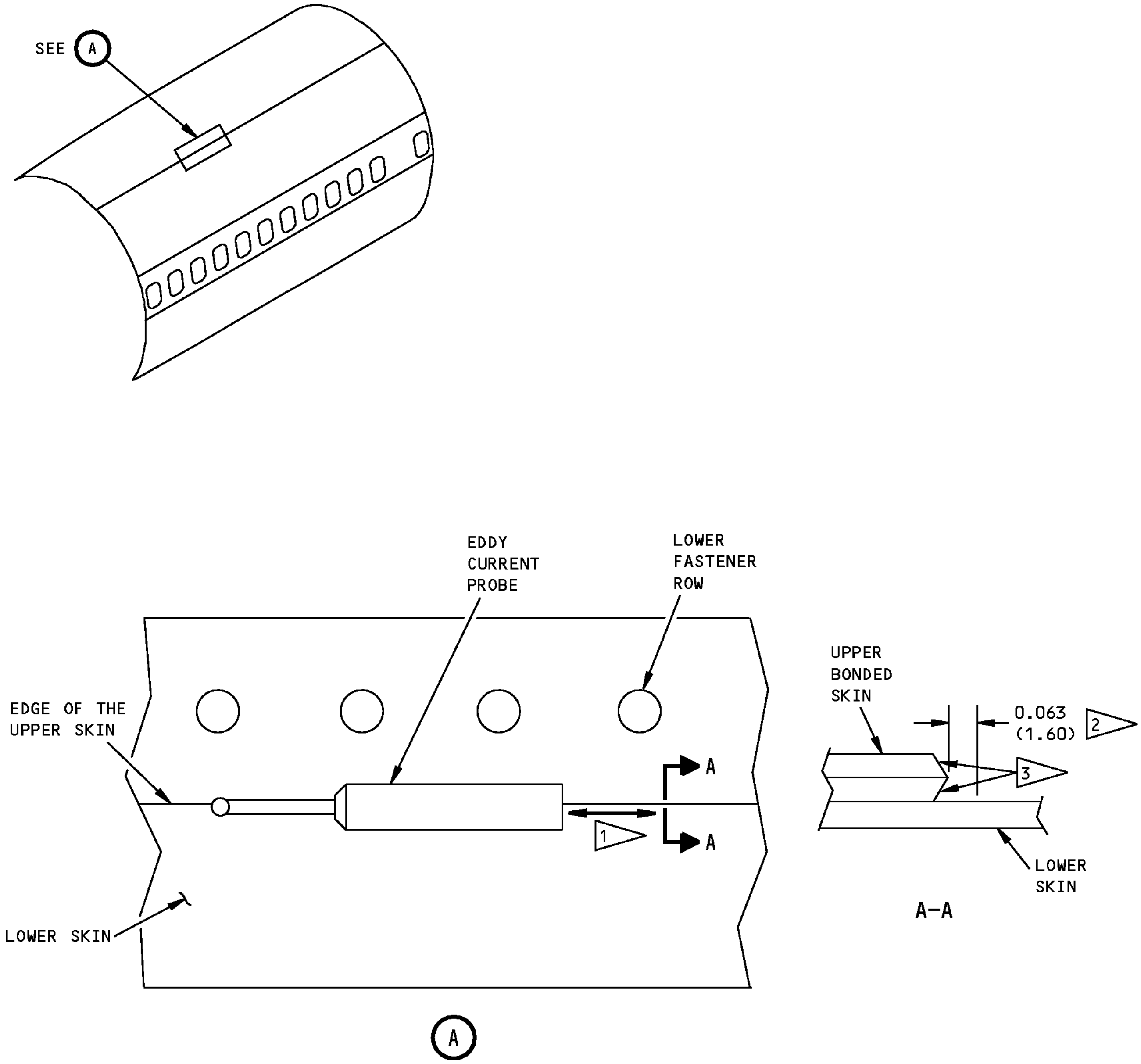
(3) Move the probe to the edge of the upper skin in an area away from the possible crack location and monitor the signal on the screen display. The edge of the upper skin will cause the signal (edge effect) to go in the downward direction from the balance point.

(4) Move the probe to and from the edge of the upper skin as you move the probe into the area of the possible crack signal and monitor the signal on the screen display. A possible crack will cause the signal to go in the upward direction.

D. If the crack indication is at a scribe line that is 0.063 inch (1.60 mm) or less below the edge of the upper skin, do an ultrasonic phased array inspection to make sure there is a crack. Refer to Part 4, 53-00-02.

(1) If a crack indication occurs during the phased array inspection, refer to the applicable Service Bulletin for instructions. If a crack indication does not occur during the phased array inspection, accept the eddy current crack indication as false.

NOTE: False eddy current indications can be caused by a decrease in the conductive clad material.



NOTES:

- DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)

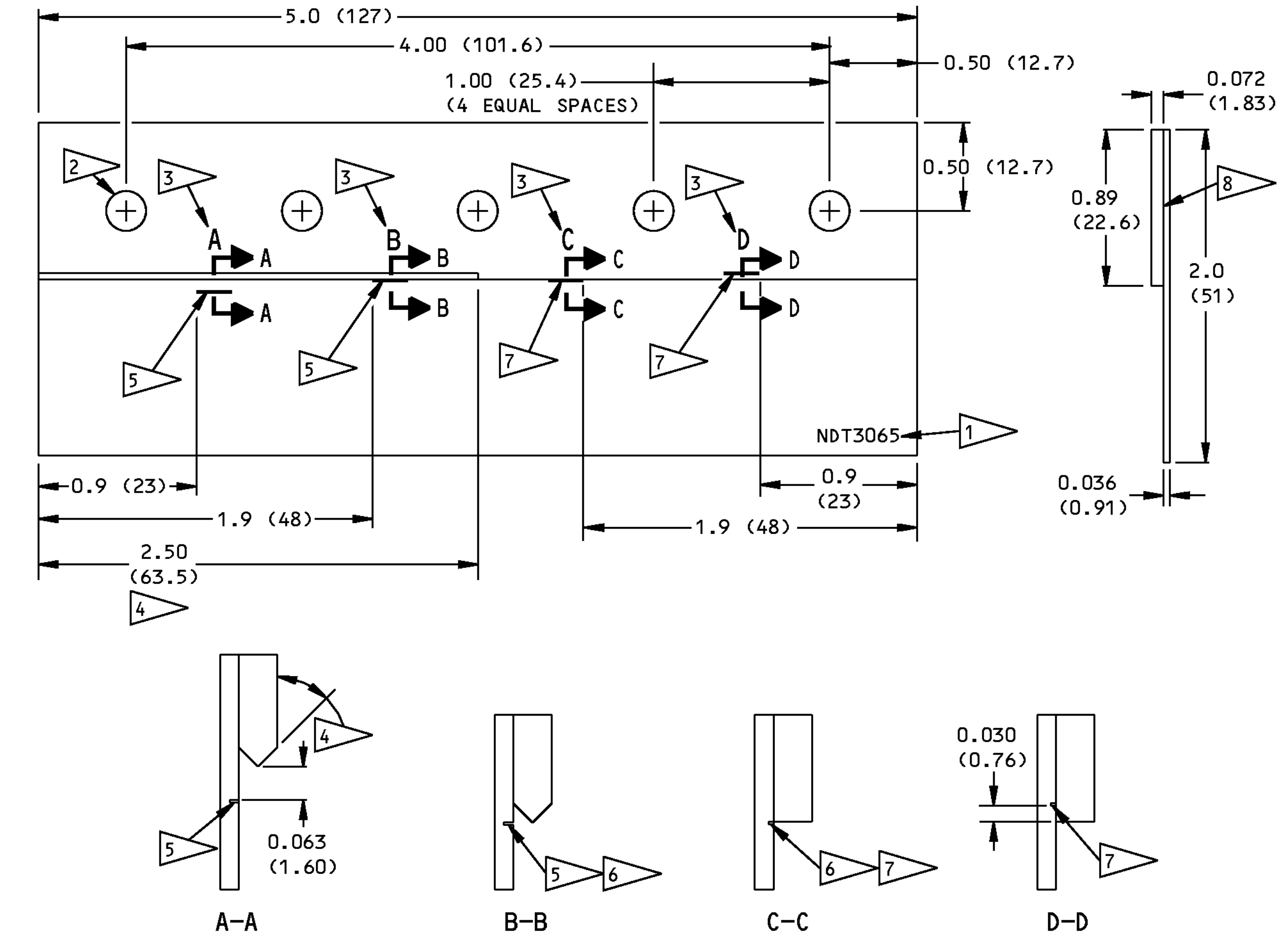
1 POSSIBLE CRACK DIRECTION IN THE LOWER SKIN.

2 APPROXIMATE INSPECTION ZONE

3 CHAMFER LOCATION, SIZE AND SHAPE CAN BE DIFFERENT

PROBE ON THE LOWER SKIN OF THE LAP SPLICE

Inspection Areas
Figure 1



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 ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT3065

2 BACR15CE5D4 OR BACR15GF5D4 (5 LOCATIONS).

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

4 45 DEGREE DOUBLE BEVEL WITH THE END OF THE BEVEL AT THE CENTER OF THE THICKNESS OF THE PIECE.

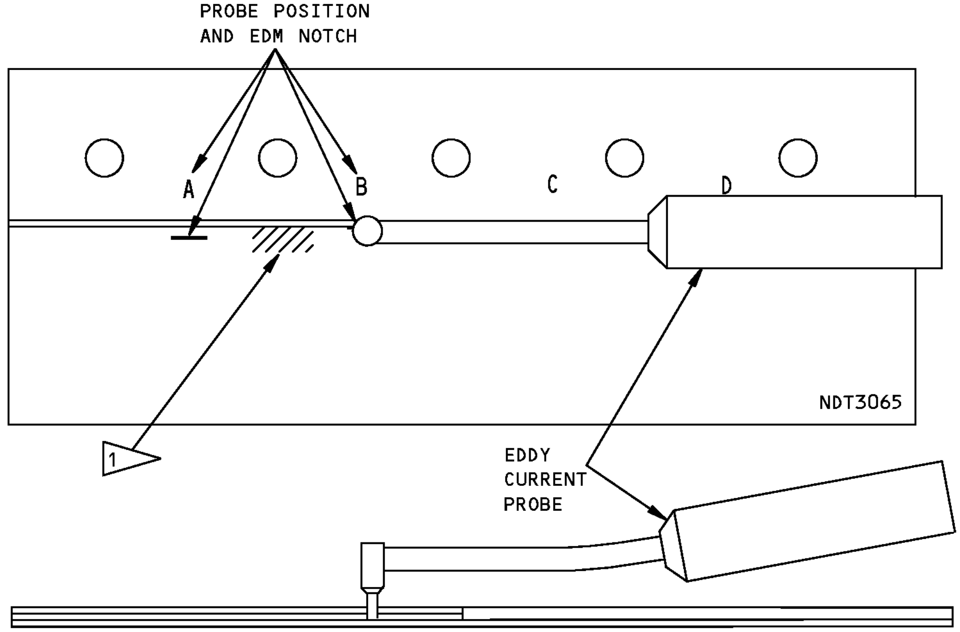
5 EDM NOTCH:
LENGTH: 0.200 (5.08) ±0.010 (0.25)
DEPTH: 0.018 (0.46) ±0.002 (0.05)
WIDTH: 0.005 (0.13) ±0.002 (0.05)

6 PUT THE EDM NOTCH FLUSH (±0.005 (0.13)) WITH THE END OF THE BEVEL AS SHOWN IN SECTION B-B AND FLUSH (±0.005 (0.13)) WITH THE END OF THE SQUARE EDGE AS SHOWN IN SECTION C-C.

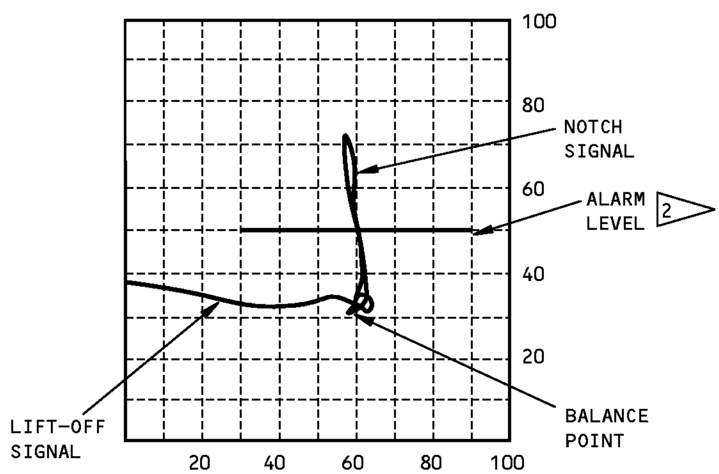
7 EDM NOTCH:
LENGTH: 0.200 (5.08) ±0.010 (0.25)
DEPTH: 0.010 (0.25) ±0.002 (0.05)
WIDTH: 0.005 (0.13) ±0.002 (0.05)

8 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 THE FAYING SURFACE.

Reference Standard NDT3065
Figure 2



PROBE POSITION ON THE
REFERENCE STANDARD
DETAIL I



SCREEN DISPLAY
DETAIL II

NOTES:

- THE SCREEN DISPLAY SHOWN IN DETAIL II IS AN EXAMPLE. DIFFERENT INSTRUMENTS AND TRANSDUCERS CAN CAUSE DIFFERENT DISPLAYS.

1 PROBE POSITION TO SET LIFT-OFF AND BALANCE THE INSTRUMENT

2 THE ALARM LEVEL SHOWN IN DETAIL II IS SET TO 50% OF FULL SCREEN HEIGHT (FSH) (20% OF FSH HIGHER THAN THE BALANCE POINT).

Instrument Calibration
Figure 3

PART 6 - EDDY CURRENT

INSPECTION FOR CRACKS THAT ARE ON THE BACK SIDE AND NOT FULLY THROUGH THE THICKNESS OF AN ALUMINUM PART

1. **Purpose**

   A. This subsurface eddy current inspection can be used to examine aluminum parts for cracks that occur on the back side and do not go through the full thickness. The part can be a skin, doubler, web or equivalent type of part.

   B. This inspection is done with a subsurface eddy current probe and an impedance plane display instrument. Scans must be done perpendicular to a subsurface edge to find cracks that are along the subsurface edge.

   C. The thickness of the part to be examined must be known before this inspection can be done.

2. **Equipment**

   A. Instruments

      (1) All eddy current instruments that have a impedance plane display are permitted for use if they:

         (a) Can operate between 2 and 40 kHz. The frequency must be adjustable in 1 kHz increments

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

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

         (a) NDT 19e; Nortec/Staveley

         (b) Phasec 2200; Hocking/Krautkramer

   B. Probes

      (1) It is necessary to use a spot probe to do this inspection. The spot probe must operate between 2 and 40 kHz. The spot probe diameter must not be more than 0.50 inch (12.7 mm). When this procedure is used internally at lap joint locations, use a 90 degree angle probe.

      (2) The spot probes that follow operated satisfactorily when this procedure was made. Other probes can be used if they can find the notch in the reference standard as specified in the calibration instructions of this procedure.

         (a) SPO-5328; Nortec/Staveley (Reflection probe)

         (b) SPO-5328; Nortec/Staveley (Reflection probe)

         (c) SNG 0.375/31/25K; NDT Engineering (this probe has a spring loaded collar)

         (d) NEC1005; NDT Engineering (Reflection probe, 90 degree angle)

         (e) SPO-5329; Nortec/Staveley (Reflection probe, 90 degree angle)

         (f) NEC1084; NDT Engineering (Reflection probe, 90 degree angle)

         (g) NEC1095; NDT Engineering (Reflection probe, 90 degree angle)

         (h) SPC-4TF-105-2R; EC/NDT (Reflection probe, 90 degree angle)

         (i) NEC1089; NDT Engineering (Reflection probe, 90 degree angle)

         NOTE: For smaller diameter probes, a collar attached around the probe will make the probe scan more stable. If a collar is used, it must be adjusted so that the probe satisfactorily touches the part.

   C. Reference Standard

(1) Make reference standard(s) NDT1085-XXX. The reference standard drawing shown in Figure 2 shows 10 reference standards with different upper layer thicknesses. Make the reference standard(s) that will be nearest the thickness of the part to be examined (within ±0.007 inch (0.18 mm)).

NOTE: If you have reference standard NDT396, then you do not have to make reference standard NDT1085-036. Reference standard NDT396 can be used to examine parts that are 0.033 to 0.040 inch (0.84 to 1.0 mm) thick.

3. Prepare for the Inspection

A. Make sure that the instrument, probe, reference standard and the inspection area are at the same temperature.

B. Get access to the inspection area on the side of the part where the scans will be done.

C. Make sure the part is clean and has no rough paint in the inspection area.

D. Teflon tape on the end of the probe that is not more than 0.004 inch (0.10 mm) thick will make it easier to do the scans, but it is not necessary. The probe can possibly scratch the part if the scans are done without Teflon tape on the probe. If you make a decision to use the Teflon tape on the probe, make sure it is put on the probe before calibration.

NOTE: Some airplanes have sound dampening aluminum foil installed in some areas on the internal side of the airplane. Do not do this inspection through the aluminum foil. Move the aluminum foil from the inspection area before you do the inspection from the internal side of the skin. Do not scratch, scribe or damage the airplane when you move the aluminum foil. Also, remove the adhesive from the skin. Make sure you install the aluminum foil after the inspection.

4. Calibration

NOTE: Refer to the equipment instruction manual as necessary for equipment operation instructions.

NOTE: If the part to be examined is painted, put approximately 0.006 inch (0.15 mm) of transparent, nonconductive tape on the reference standard before calibration.

NOTE: If the part has a nonconductive finish that is 0.003 inch (0.076 mm) thick or less, such as primer, it is not necessary to put nonconductive tape on the reference standard before calibration.

A. Identify the thickness of the part that will be examined.

B. Go to Table 1 in Figure 3 to identify the correct reference standard to use and the instrument frequency for the calibration and inspection. Use the reference standard that is in the range of thicknesses specified in Table 1.

(1) Set the instrument to the applicable frequency specified in Table 1.

NOTE: During calibration, the calibration frequency can be adjusted higher or lower than the frequency specified in Table 1 (see Figure 3).

(2) Set the high pass (HP) filter to off (0 Hz).

(3) Set the low pass (LP) filter to the minimum value that does not decrease the amplitude of the signals at normal scan speeds. If the low pass filter is too low, and the scan speed is increased during the inspection, it is possible to not see a crack indication.

C. Put the probe at position 1 (double layer) on the reference standard that you identified in Paragraph 4.B. See Figure 3, Detail A.

D. Balance the instrument.

E. Adjust the balance point signal so that it is 30 percent of full screen height.

NOTE: The vertical gain must be approximately 14 to 20 db higher than the horizontal gain.

F. Set lift-off so that the signal moves in a horizontal direction to the left. See Figure 3, Detail B.

G. Do a probe scan away from the reference notch so that the probe goes across the edge of the second layer. Monitor the signals on the screen display and stop the probe when it is on the single layer. See Figure 3, Detail A, probe position 1 and 2 and Detail B.

(1) If the end point of the single layer signal is higher than the balance point of the double layer signal, (as shown in Figure 3, Detail E) increase the frequency and adjust the phase to get the signals to look equivalent to Figure 3, Detail B.

(2) If the end point of the single layer signal is lower than the balance point of the double layer signal (as shown in Figure 3, Detail D), decrease the frequency and adjust the lift-off to get the signals to look equivalent to Figure 3, Detail B.

H. Do a probe scan as specified in Paragraph 4.G. and monitor the signal on the display. Make sure there is less than a 5 percent of full screen height difference between the balance point of the double layer signal and the end point of the single layer signal.

I. If necessary, continue to adjust the frequency and lift-off angle so that the balance point of the double layer signal and the end point of the single layer signal are almost equivalent to the signals shown in Figure 3, Detail B.

J. Put the probe at position 3 and do a minimum of three probe scans across the reference notch (probe position 3 to 4 and back) and monitor the notch signal. See Figure 3, Details A and C.

K. Adjust the gain so that the signal from the reference standard notch is 30 percent of full screen height above the balance point as shown in Figure 3, Detail C.

L. Make sure the lift-off is horizontal and to the left.

M. Do a scan across the notch and make small increases in the scan speed to see if the notch signal decreases. If the notch signal decreases, increase the value for the low pass filter a small quantity.

5. Inspection Procedure

A. Calibrate the instrument as specified in Paragraph 4.

B. Put the probe on the part in the inspection area.

C. Balance the instrument and make sure the lift-off goes horizontally to the left as shown in Figure 3, Detail B.

D. Do the probe scans in the inspection area so that the probe scans are at 90 degrees to the direction of possible cracks. During the probe scans:

NOTE: It is important to know the direction that the subsurface cracks can occur before you do the probe scans.

(1) If necessary, make small adjustments to the frequency and lift-off to get the single layer signal and the double layer signal at the same screen heights, or almost the same screen heights, as the signal shown in Figure 3, Detail B. Do not adjust the gain.

(2) It is not necessary to calibrate on the reference standard again after you adjust the frequency for the airplane if the skin thickness is within the range of Table 1 specified in Figure 3.

(3) Monitor the instrument for crack signals. Make sure you can identify subsurface edge signals as compared to crack signals. See Figure 3 for these different signals.

NOTE: It is possible that the inspection area that you examine does not have a second layer edge to scan across. This would prevent the adjustments in Paragraph 5.D.(1). This will be permitted, however, it is important to make sure the lift-off goes horizontally to the left while you do the scans.

CAUTION: DO NOT CHANGE THE GAIN ADJUSTMENT THAT WAS SET DURING THE CALIBRATION. IF THE GAIN IS CHANGED DURING THE INSPECTION, THE INSPECTION WILL BE UNSATISFACTORY.

(4) Make sure the probe scans are one probe diameter or less from each other during the inspection.

NOTE: If a collar is used on a probe, make sure each probe scan is the diameter of the probe and not the diameter of the collar.

6. Inspection Results

A. All signals that are almost the same as the notch signal from the reference standard are crack indications. Also, signals that are 15 percent of full screen height (or more) above the balance point are crack indications. See Figure 3, Detail C for the reject level.

B. Some signals can go up on the screen display and stay there during the scan. These types of signals can occur if material has been removed from the back of the part because of corrosion or grinding.

C. If signals equivalent to those specified in Paragraph 6.A. are found, do the steps that follow:

(1) Get access to the back side of the part where the indication was found. It can be necessary to remove structure to get access to the back side of the part.

(2) Do a surface eddy current scan on the back side of the part that caused the crack indication to occur. Refer to Part 6, 51-00-19 for the surface inspection.

(a) Make sure the probe scans are done in the same direction that caused the indication to occur with the subsurface probe.

D. If signals equivalent to those specified in Paragraph 6.B. are found, do the steps that follow:

(1) Get access to the far side of the part where the indication was found. It can be necessary to remove structure to get access to the back side of the part.

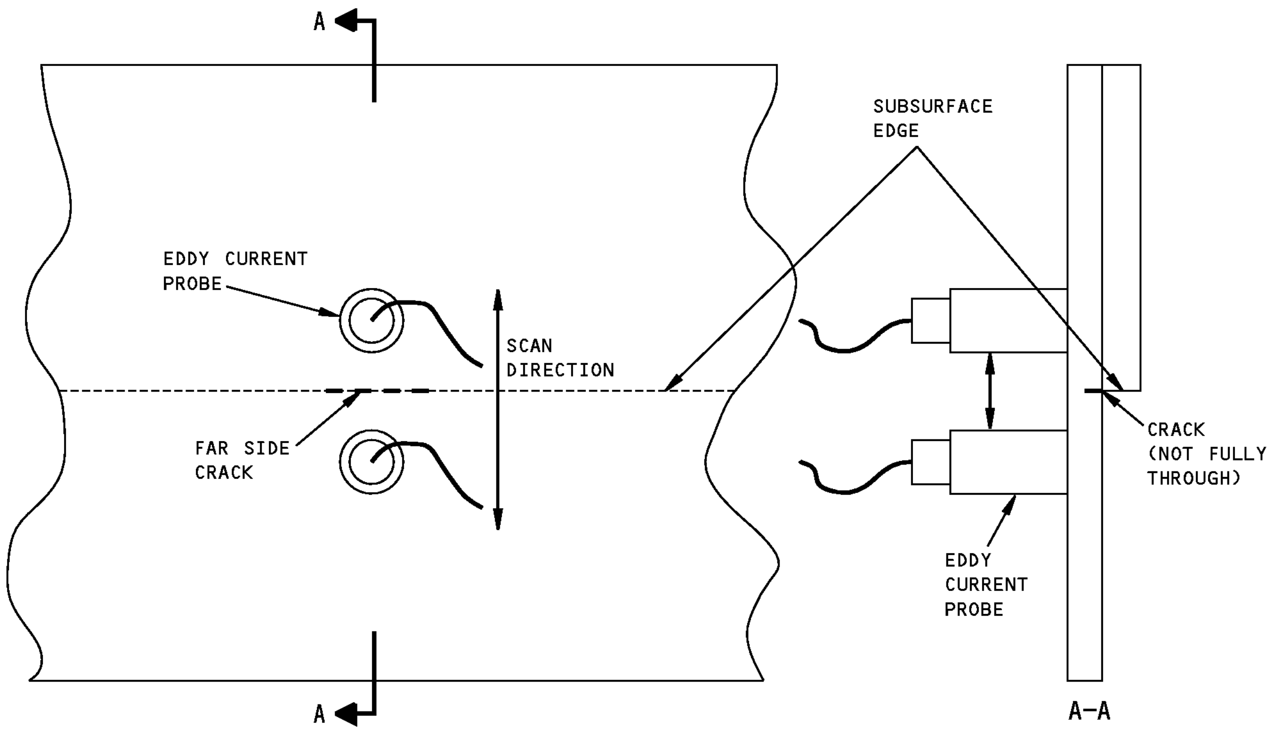
(2) Use one or more of the instruments that follow to find the thickness of the part that caused the crack indication to occur:

(a) a micrometer (if possible)

(b) a Magna-Mike made by Panametrics

(c) an Ultrasonic Thickness gauge

(3) Tell engineering if a thickness is found to be less than the drawing thickness.

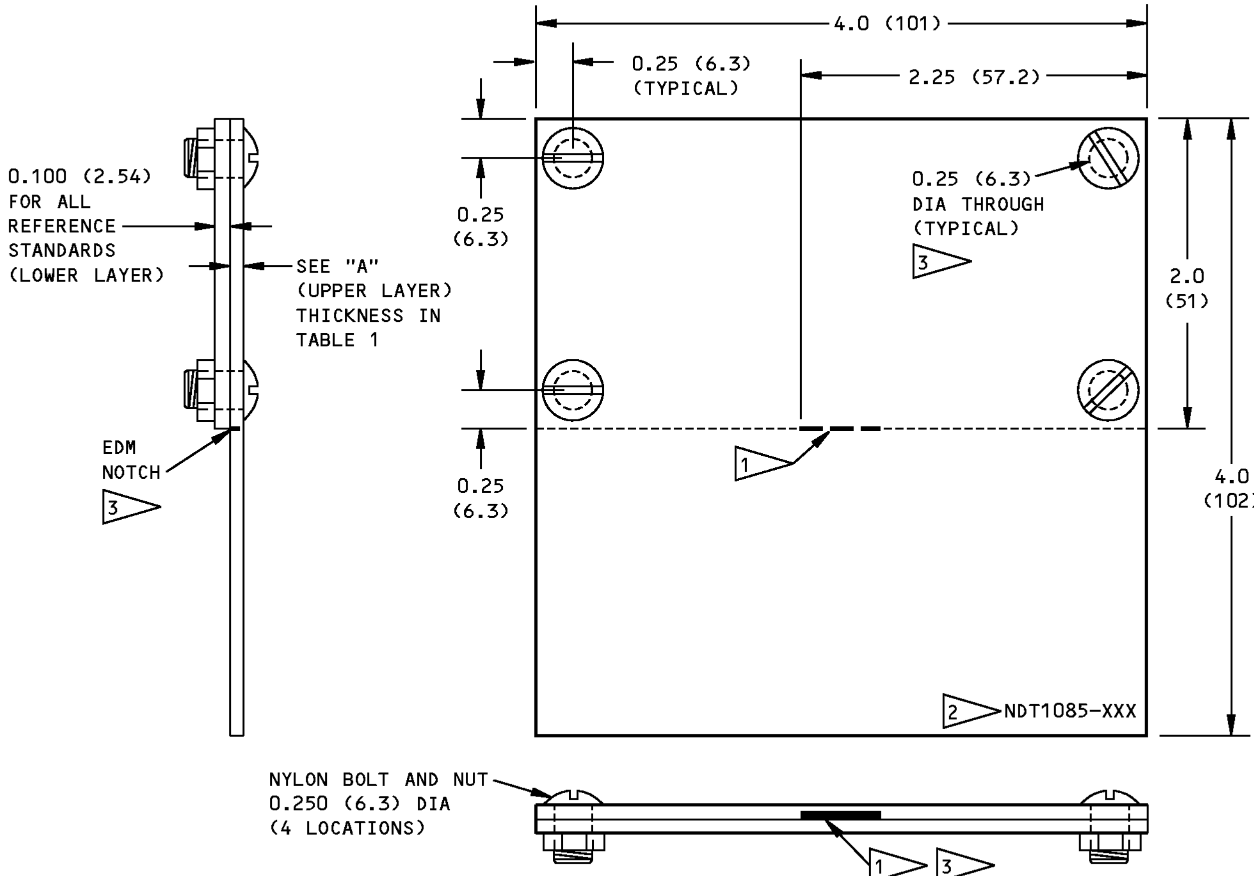


EXAMPLES OF A PART WITH A SUBSURFACE EDGE THAT IS EXAMINED WITH A SUBSURFACE EDDY CURRENT PROBE. THE PART THAT YOU EXAMINE COULD BE DIFFERENT.

NOTES:

- DO THE PROBE SCANS AT 90 DEGREES ACROSS THE SUBSURFACE EDGE OF THE PART WHERE THE CRACKS CAN OCCUR.

Typical Probe Scans on an Aluminum Part
Figure 1



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

- MATERIAL: 2024-T3 CLAD (TWO SKINS)

[1] EDM NOTCH DIMENSIONS IN ALL REFERENCE STANDARDS:
LENGTH: 0.50 (12.7)
DEPTH: 50% THROUGH THE "A" THICKNESS
WIDTH: 0.007 (0.18) MAXIMUM WIDTH

[2] STAMP OR ETCH THE APPLICABLE REFERENCE STANDARD NUMBER. REPLACE XXX WITH THE APPLICABLE "A" THICKNESS AS SPECIFIED IN TABLE 1.

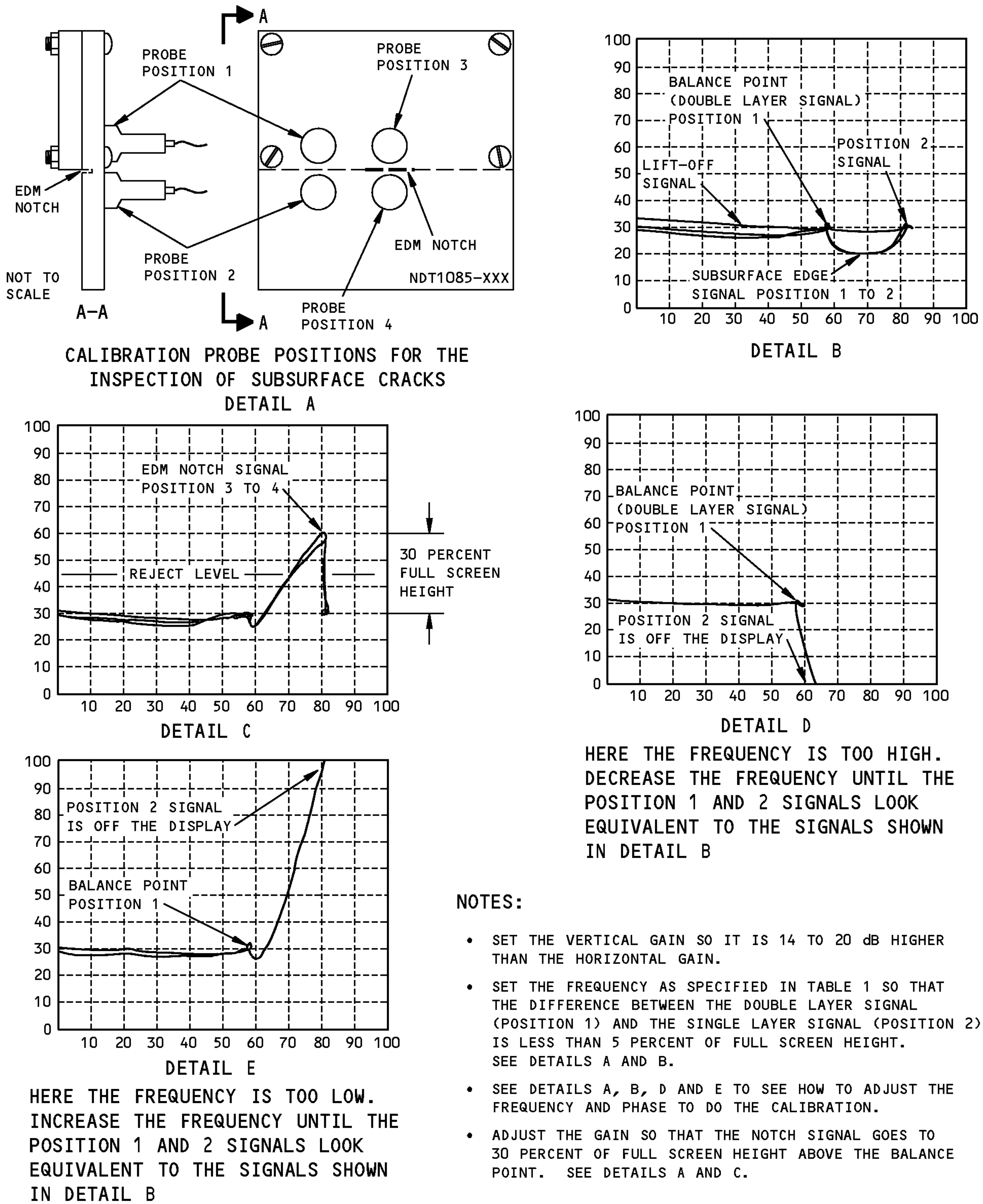
[3] MAKE SURE THE 2ND LAYER EDGE IS IMMEDIATELY ABOVE THE EDM NOTCH BEFORE THE 4 BOLT HOLES ARE DRILLED. THE EDGE OF THE SKIN TO THE NOTCH CENTERLINE TOLERANCE IS 0.010 (0.25).

REFERENCE STANDARD NUMBER	"A" (UPPER LAYER) THICKNESS
NDT1085-032	0.032 (0.81)
NDT1085-036 [4]	0.036 (0.91)
NDT1085-050	0.050 (1.3)
NDT1085-063	0.063 (1.6)
NDT1085-071	0.071 (1.8)
NDT1085-080	0.080 (2.0)
NDT1085-090	0.090 (2.3)
NDT1085-100	0.100 (2.5)
NDT1085-112	0.112 (2.8)
NDT1085-125	0.125 (3.2)

TABLE 1

[4] IF YOU HAVE REFERENCE STANDARD NDT396, THEN YOU DO NOT HAVE TO MAKE REFERENCE STANDARD NDT1085-036.

Reference Standard NDT1085-XXX
Figure 2



Calibration Positions with Impedance Plane Signals
Figure 3 (Sheet 1 of 2)

UPPER LAYER THICKNESS INCH (mm)	REFERENCE STANDARD NUMBER	FREQUENCY AT THE START OF THE CALIBRATION
0.025 TO 0.032 (0.64 TO 0.81)	NDT1085-032	40 KHz
0.033 TO 0.040 (0.84 TO 1.00)	NDT1085-036	34 KHz
0.041 TO 0.050 (1.04 TO 1.27)	NDT1085-050	18 KHz
0.051 TO 0.063 (1.29 TO 1.60)	NDT1085-063	12 KHz
0.064 TO 0.071 (1.62 TO 1.80)	NDT1085-071	10 KHz
0.072 TO 0.080 (1.82 TO 2.03)	NDT1085-080	7 KHz
0.081 TO 0.090 (2.05 TO 2.28)	NDT1085-090	6 KHz
0.091 TO 0.100 (2.31 TO 2.54)	NDT1085-100	4 KHz
0.101 TO 0.112 (2.56 TO 2.84)	NDT1085-112	3 KHz
0.113 TO 0.125 (2.87 TO 3.17)	NDT1085-125	2 KHz

INSTRUMENT FREQUENCIES FOR THE REFERENCE STANDARDS
TABLE 1

NOTE: The instrument frequencies shown above are used at the start of the calibration. It can be necessary to adjust the frequency higher or lower during the calibration to get the signals shown in Details B and C. The best frequency for each reference standard can be different with different probes.

Calibration Positions with Impedance Plane Signals
Figure 3 (Sheet 2 of 2)

PART 6 - EDDY CURRENT

SLIDING PROBE INSPECTION OF THE INBOARD SKIN OF THE LAP SPLICE

1. **Purpose**

   A. Use this procedure to do an inspection for cracks in the inboard skin along the lower row of fasteners in the lap splice.

   B. This inspection procedure can be used on fuselage skins with Alodine or anodized 100 degree and 120 degree countersunk fasteners.

   C. This procedure is done from the external side of the airplane at the lap splices. See Figure 1 for the typical inspection areas along the lower row of fasteners. This procedure will find cracks at tear strap locations and between tear straps.

   D. This procedure uses a sliding probe and an impedance plane instrument that can operate in a dual frequency mode.

   E. You can not do this procedure at a location where the fastener is magnetic (steel) or if a fastener has a protruding head. At locations where the fastener is magnetic or protruding, you must do one of the procedures that follow:

      (1) For an external inspection, refer to Part 6, 53-00-06.

      (2) Do an open hole inspection as shown in Part 6, 51-00-10.

   F. The probe must be accurately aligned with the fastener centerline to do this procedure correctly. For accurate 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.

   G. The upper skin thickness on the airplane must be between 0.036 inch (0.91 mm) and 0.100 inch (2.54 mm) to use this procedure.

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) Can operate in a dual frequency mode.

         (b) Has an impedance plane display.

         (c) Operates at a frequency range of 1 kHz to 20 kHz.

         (d) 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, D-60 and D-62; Hocking Krautkramer

         (b) Nortec 19e; Staveley Instruments

         (c) Nortec 2000D and Nortec 2000D+; Staveley Instruments

         (d) Nortec Workstation; Staveley Instruments

         (e) Phasec 2200 (dual frequency model); Hocking Krautkramer

         (f) US-454; Uniwest

         (g) Elotest B300; Rohmann GmbH

(h) Elotest M2V3; Rohmann GmbH

C. Probes

(1) Use a reflection sliding probe that operates at a frequency range from 1 kHz to 20 kHz.

(2) Some probes give unusual signals on the airplane because of the distance between fasteners and other structure conditions. To get the correct results from this procedure, it is necessary to use one of the probes that follow.

(a) NEC-4039; NDT Engineering Corp

(b) TEK-1504; TECHNA NDT

D. Reference Standard

(1) See Figure 2 for data about the probe guides and reference standards that are applicable to your lap splice inspection.

NOTE: Reference standard NDT1087-X uses 100 degree countersunk aluminum rivets. Some airplanes use 120 degree countersunk rivets at the lap splices. The signals that occur from a 120 degree rivet are almost the same as the signal from a 100 degree rivet.

E. Special Tools

(1) Use a nonconductive probe guide to align the centerline of the probe with the centerline of the fasteners. See Figure 3 for data about the probe guide.

NOTE: Monitor the probe guide position on the centerline of the fasteners during the scans and adjust it if necessary. It is possible that adjacent fasteners on the airplane are not aligned with each other.

(2) Use a magnet to identify magnetic steel fasteners.

(3) Use Teflon (or equivalent) tape on the reference standard before calibration if there is paint on the airplane. The thickness of the tape applied to the reference standard must be almost equivalent to the estimated paint thickness on the airplane. Paragraph 3.D. specifies how to measure the paint thickness with an eddy current instrument.

3. Preparation for Inspection

A. Identify all the inspection areas. Refer to the applicable service bulletin or the specific NDT procedure.

B. Remove loose paint, dirt, and sealant from the surface of the inspection area.

C. If you cannot see the fasteners because the paint is too thick, remove a sufficient amount of paint so that you can see the fasteners.

D. For airplanes that are painted: Make an estimate of the paint thickness on the skin. You can use calibrated nonconductive shims with an eddy current procedure (lift-off measurement) that uses a direct reading or an indirect reading. Apply Teflon tape or clear tape layers to the reference standard, before calibration, so the thickness of the tape layer is approximately equivalent to the thickest paint on the airplane.

NOTE: You can also refer to the paint thickness instructions in the McDonnell Douglas Nondestructive Testing Standard Practice Manual, Part 6, 06-10-01.002, to measure paint thickness on the airplane.

4. Instrument Calibration

A. Refer to the specific NDT procedure to identify the applicable reference standard(s) necessary for calibration. Table 1 shows the allowable skin thickness ranges permitted for use with each reference standard.

B. Refer to Table 1 to identify the applicable frequencies necessary to calibrate the equipment on the reference standard(s) identified in Paragraph 4.A.

C. Make initial adjustments to your instrument as follows:

(1) Set the operation mode to "dual frequency".

(2) Set the probe drive to its highest level.

(3) Set the low pass filter to 50 Hz.

(4) Set the high pass filter to 0 or "off".

(5) Set the screen persistence to "permanent" or "manual erase".

(6) Set Frequency 1 (F1) to the value identified in Table 1 for the applicable reference standard.

(7) Set Frequency 2 (F2) to the value identified in Table 1 for the applicable reference standard.

NOTE: Frequency 2 must be one quarter of Frequency 1. It is permitted to set Frequency 2 to a value that is within 100 Hz of the value specified in Table 1. Some instruments will not allow Frequency 2 settings that are exactly four times less than Frequency 1.

(8) Refer to Figure 14 for the remainder of the initial adjustments for your instrument.

D. Adjust the nonconductive probe guides (NDT1087-P1 positioners) on the reference standard so that the probe is centered when you make a scan on each fastener row.

E. Calibrate your dual frequency eddy current instrument as specified in Figure 5 thru Figure 12. Refer to Figure 4 for a flowchart that shows the calibration procedure.

NOTE: All of the steps must be done carefully to do the calibration for dual frequency eddy current. This procedure shows typical screen displays for each step. We recommend that you use an instrument that can keep your adjustments in memory, and save them at the middle and end of the calibration procedure.

5. Inspection Procedure

A. Put the probe on the outer skin of the lap splice between two fasteners in the upper fastener row, away from a tear strap location.

NOTE: Always balance the probe on fasteners in the upper fastener row before you examine the fasteners in the lower row, to make sure you do not balance on a crack location.

B. Use the nonconductive probe guide to align the probe on the fasteners in the upper row of the lap splice so that the centerline of the probe will move across the center of the fasteners.

C. Move the probe left and right between two fasteners while you monitor the signal. The signal will be at its highest vertical screen position when the probe is centered between two fasteners.

D. Balance the instrument at the location where the probe is centered between two fasteners. Do not balance the probe on the signal "dip" that can occur as the probe gets near each fastener. See Figure 6, View C.

E. Move the probe to the lower row of the lap splice. Use the nonconductive probe guide to align the probe with the centerline of the fasteners. Move the probe slowly along the centerline of the fasteners in the lower row. See Figure 1. As you move the probe, do the steps that follow:

(1) Monitor the instrument display for signals that are higher than the alarm level set in Paragraph 4. (Figure 11, View B). Make a record of signals that are higher than the alarm level.

(2) Keep the permanent screen adjustment "on" so that the signals can be compared on the screen. Do a manual erase after 5 to 10 fastener signals have been compared on the screen.

(3) Monitor the instrument display for large downscale signals. These signals are indications of tear straps or doublers. On tear straps or doublers the signal can move off of the bottom of the screen. Visually identify the location of the tear straps. To examine signals at tear strap locations, do the steps that follow:

(a) While you continue to make a scan across the tear strap, monitor the instrument baseline (the same vertical screen height as the balance point). A signal that goes across the baseline while you are above a tear strap must be examined some more. See Figure 13.

(b) To examine signals that go across the baseline when you are on a tear strap, balance the probe between the two fasteners on the upper row of the lap splice that go through the tear strap. Then make a scan of the fasteners in the lower row that go through the tear strap. Make a record of signals that are higher than the alarm level set in Paragraph 4. (Figure 11, View B).

F. Magnetic fasteners will cause unusual signals. Use a magnet to identify magnetic fasteners. Refer to Part 6, 53-00-06 to examine areas around magnetic fasteners.

6. Inspection Results

A. Signals at fastener locations between tear straps or doublers, if they are higher than the alarm level, are crack indications.

B. Signals at fastener locations above tear straps or doublers, if they are higher than the balance point, or higher than the alarm level when the instrument is balanced at the tear strap, are crack indications.

C. Use the procedures that follow to examine crack indications.

(1) Use the high frequency eddy current inspection, Part 6, 51-00-19, from the internal surface of the airplane.

(2) Use the low frequency inspection, Part 6, 53-00-06, from the internal surface of the airplane at tear strap or doubler locations.

(3) Use the high frequency open hole inspection, Part 6, 51-00-16, after removal of fasteners.

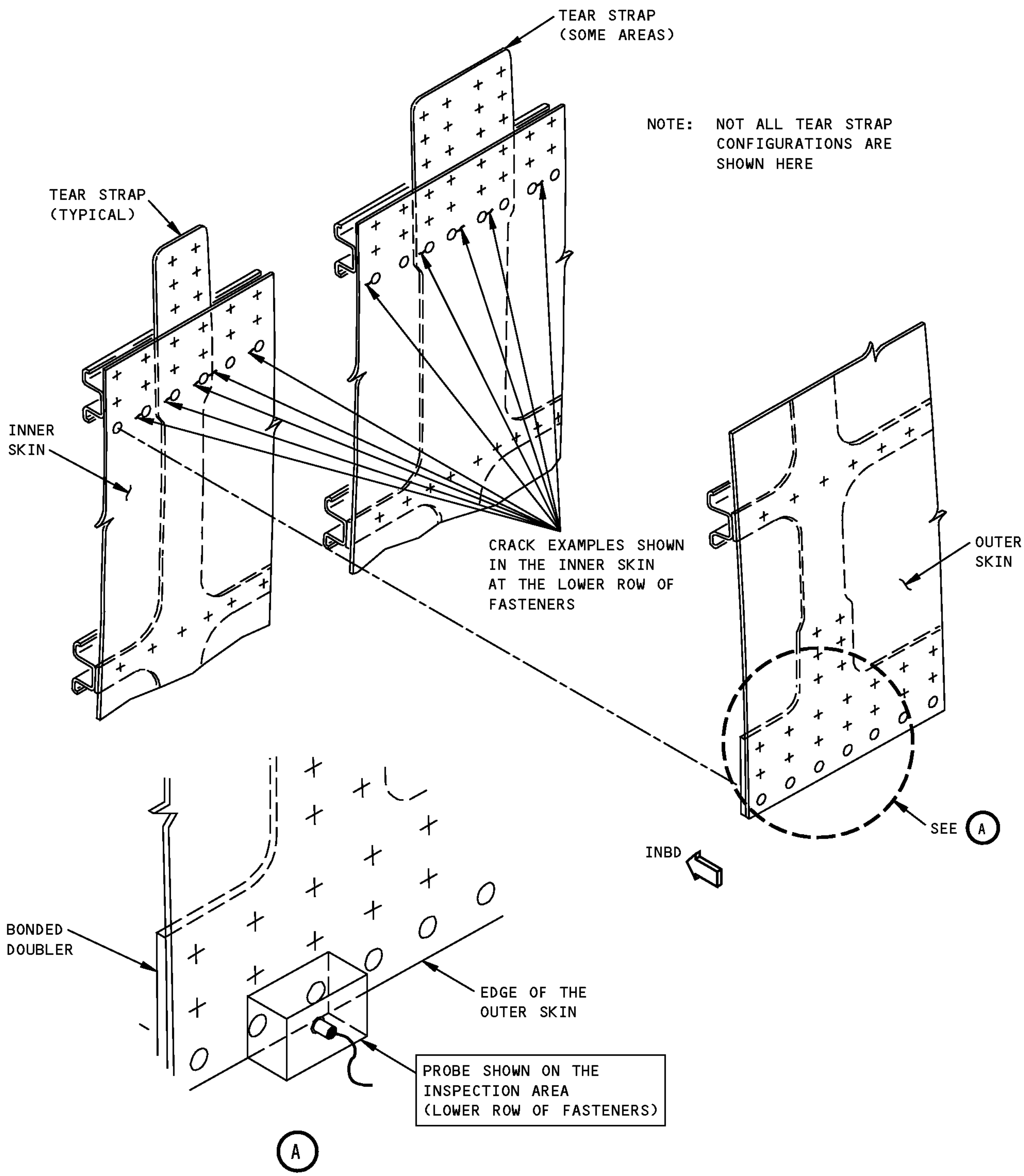
Table 1 Reference Standard and Frequency Selection for Applicable Skin Thicknesses

UPPER "SKIN" THICKNESS RANGE *[1]	MINIMUM LOWER SKIN THICKNESS	EDM NOTCH LENGTH	REFERENCE STANDARD NUMBER	FREQ 1 [kHz]	FREQ 2 [kHz]
0.040 - 0.062 (1.00 - 1.58)	0.036 (1.00)	0.200	NDT1087-1	14	3.4
0.063 - 0.070 (1.60 - 1.78)	0.036 (1.00)	0.200	NDT1087-2	12	3
0.071 - 0.080 (1.80 - 2.03)	0.036 (1.00)	0.180	NDT1087-3	11	2.7
0.081 - 0.089 (2.06 - 2.26)	0.036 (1.00)	0.200	NDT1087-4	9	2.25
0.090 - 0.100 (2.29 - 2.54)	0.05 (1.27)	0.200	NDT1087-5	8	2
0.063 - 0.079 (1.60 - 2.00)	0.05 (1.27)	0.250	NDT1087-6	12	3

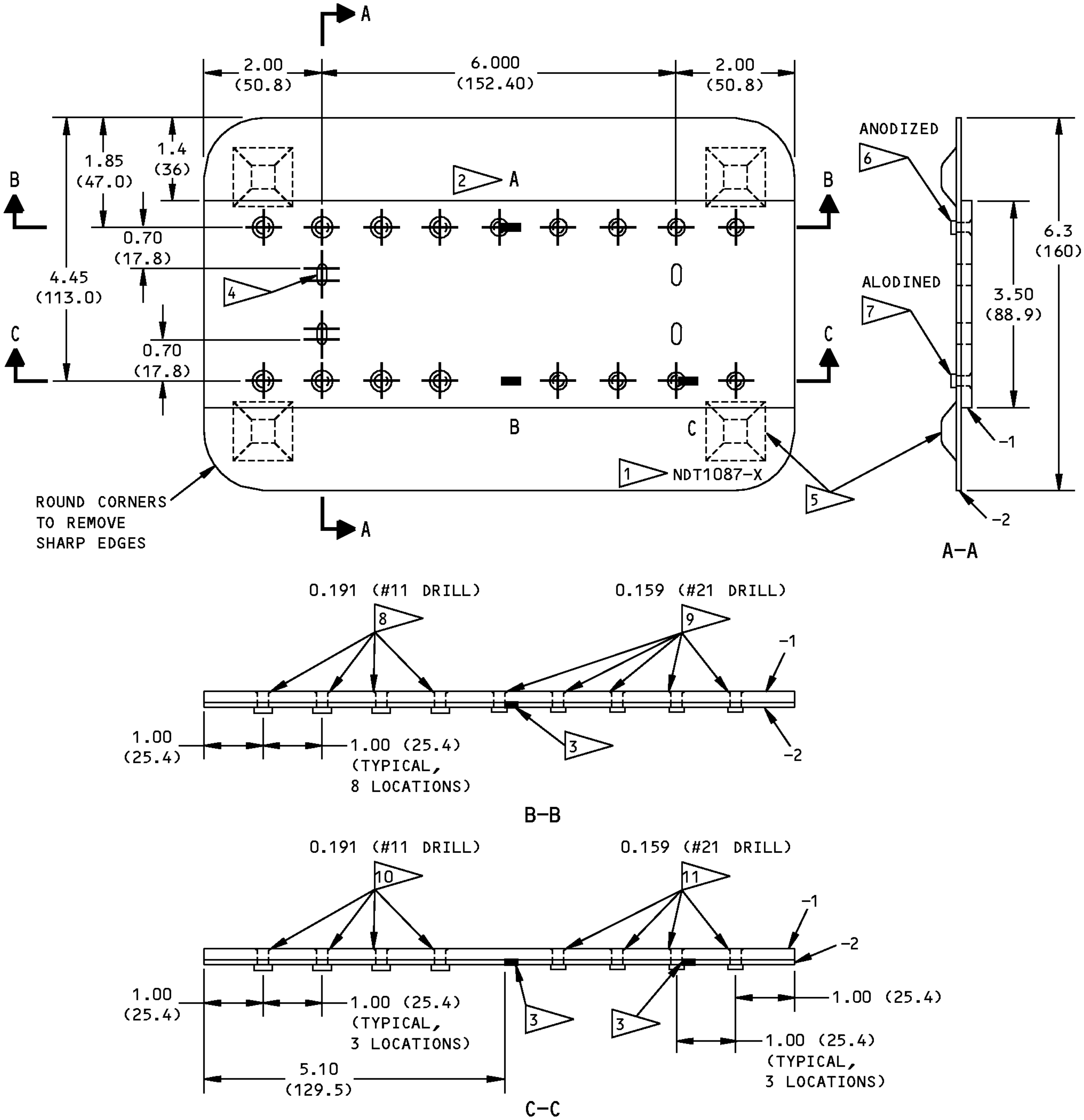
(Continued)

UPPER "SKIN" THICKNESS RANGE *[1]	MINIMUM LOWER SKIN THICKNESS	EDM NOTCH LENGTH	REFERENCE STANDARD NUMBER	FREQ 1 [kHz]	FREQ 2 [kHz]
0.080 - 0.089 (2.03 - 2.26)	0.05 (1.27)	0.250	NDT1087-7	9	2.25
0.090 - 0.100 (2.29 - 2.54)	0.06 (1.52)	0.250	NDT1087-8	8	2

*[1] "Skin" thickness refers to the total thickness of all layers above the lower skin.



Typical Inspection Areas - External Inspection
Figure 1



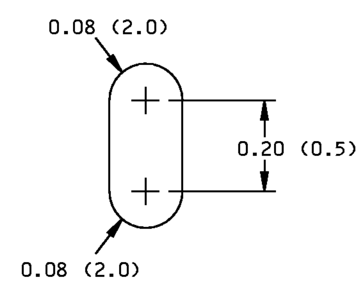
Reference Standard NDT1087-X
Figure 2 (Sheet 1 of 3)

REFERENCE STANDARD NUMBER	UPPER-1 SHEET THICKNESS	LOWER-2 SHEET THICKNESS	EDM NOTCH LENGTH	UPPER (ANODIZED) RIVET ROW 6		LOWER (ALODINED) RIVET ROW 7	
				LEFT SIDE 8	RIGHT SIDE 9	LEFT SIDE 10	RIGHT SIDE 11
NDT1087-1	0.050 (1.27)	0.040 (1.00)	0.200 (5.00)	***6D5 (SEE TABLE 2)	***5D4 (SEE TABLE 2)	BACR15GF6D5	BACR15GF5D4
NDT1087-2	0.071 (1.80)	0.040 (1.00)	0.200 (5.00)	***6D5 (SEE TABLE 2)	***5D5 (SEE TABLE 2)	BACR15GF6D5	BACR15GF5D5
NDT1087-3	0.080 (2.00)	0.040 (1.00)	0.180 (4.57)	***6D5 (SEE TABLE 2)	***5D5 (SEE TABLE 2)	BACR15GF6D5	BACR15GF5D5
NDT1087-4	0.090 (2.29)	0.040 (1.00)	0.200 (5.00)	***6D5 (SEE TABLE 2)	***5D5 (SEE TABLE 2)	BACR15GF6D5	BACR15GF5D5
NDT1087-5	0.100 (2.54)	0.050 (1.27)	0.200 (5.00)	***6D6 (SEE TABLE 2)	***5D5 (SEE TABLE 2)	BACR15GF6D6	BACR15GF5D5
NDT1087-6	0.071 (1.80)	0.063 (1.60)	0.250 (6.35)	***6D6 (SEE TABLE 2)	***5D6 (SEE TABLE 2)	BACR15GF6D6	BACR15GF5D6
NDT1087-7	0.090 (2.29)	0.080 (2.00)	0.250 (6.35)	***6D6 (SEE TABLE 2)	***5D6 (SEE TABLE 2)	BACR15GF6D6	BACR15GF5D6
NDT1087-8	0.100 (2.54)	0.090 (2.29)	0.250 (6.35)	***6D6 (SEE TABLE 2)	***5D6 (SEE TABLE 2)	BACR15GF6D7	BACR15GF5D6

REFERENCE STANDARD DATA
TABLE 1

RIVET CODE	ALLFAST FASTENING SYSTEMS INC. PART NUMBER	SIERRA PACIFIC SUPPLY CO. PART NUMBER
***5D4	AF1049U1D5C4	NAS1097D5-4D
***5D5	AF1049U1D5C5	NAS1097D5-5D
***5D6	AF1049U1D5C6	NAS1097D5-6D
***6D5	AF1049U1D6C5	NAS1097D6-5D
***6D6	AF1049U1D6C6	NAS1097D6-6D
***6D7	AF1049U1D6C7	NAS1097D6-7D

ANODIZED FASTENER DATA
TABLE 2



VIEW A

Reference Standard NDT1087-X
Figure 2 (Sheet 2 of 3)

NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- 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 = 125 Ra OR BETTER
- MATERIAL: 2024-T3 ALUMINUM; CLAD OR BARE (SEE TABLE 1 FOR THE THICKNESS)

1 ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT1087-X.

2 ETCH OR STEEL STAMP THE NOTCH LOCATIONS AS SHOWN.

3 EDM NOTCH ALONG FASTENER CENTERLINE (3 LOCATIONS)
MAXIMUM WIDTH: 0.007 (0.17)
DEPTH: THROUGH-THICKNESS
NOTCH LENGTH: SEE TABLE 1

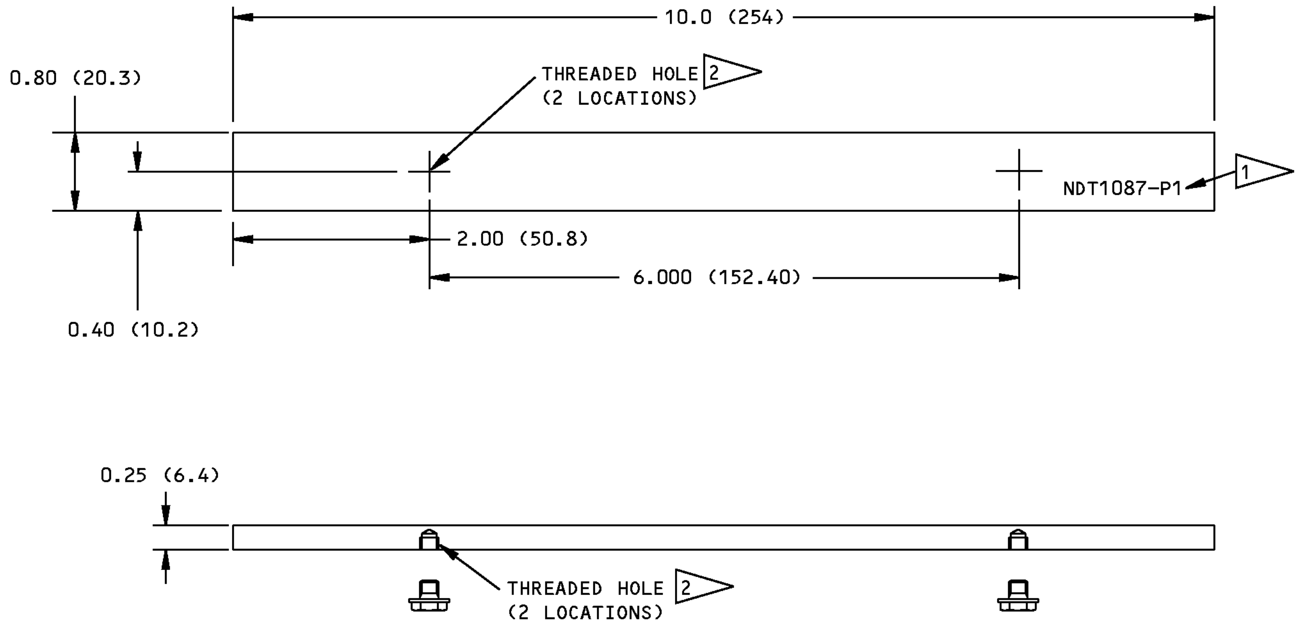
4 SLOT FOR THE PROBE GUIDES (TYPICAL, 4 LOCATIONS) SEE VIEW A.

5 BOND 4 RUBBER FEET TO THE PART IN THE APPROXIMATE LOCATIONS SHOWN.

6 INSTALL ANODIZED RIVETS AS SPECIFIED IN PART 1, 51-01-04.

7 INSTALL ALODINED RIVETS AS FOLLOWS:
- SOLVENT CLEAN EACH RIVET AND RIVET HOLE BEFORE INSTALLATION
- COUNTERSINK DEPTH:
  0.033 (0.84) FOR 5/32 RIVETS
  +0.000/-0.002 (+0.00/-0.05).
  0.041 (1.04) FOR 6/32 RIVETS
  +0.000/-0.002 (+0.00/-0.05)
- MINIMUM BUTTON DIAMETER:
  0.230 (5.8) FOR 5/32 RIVETS
  0.276 (7.0) FOR 6/32 RIVETS
  0.368 (9.3) FOR 8/32 RIVETS
- ALL OTHER INSTALLATION DATA AS SPECIFIED IN PART 1, 51-01-04

Reference Standard NDT1087-X
Figure 2 (Sheet 3 of 3)



NOTES:

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

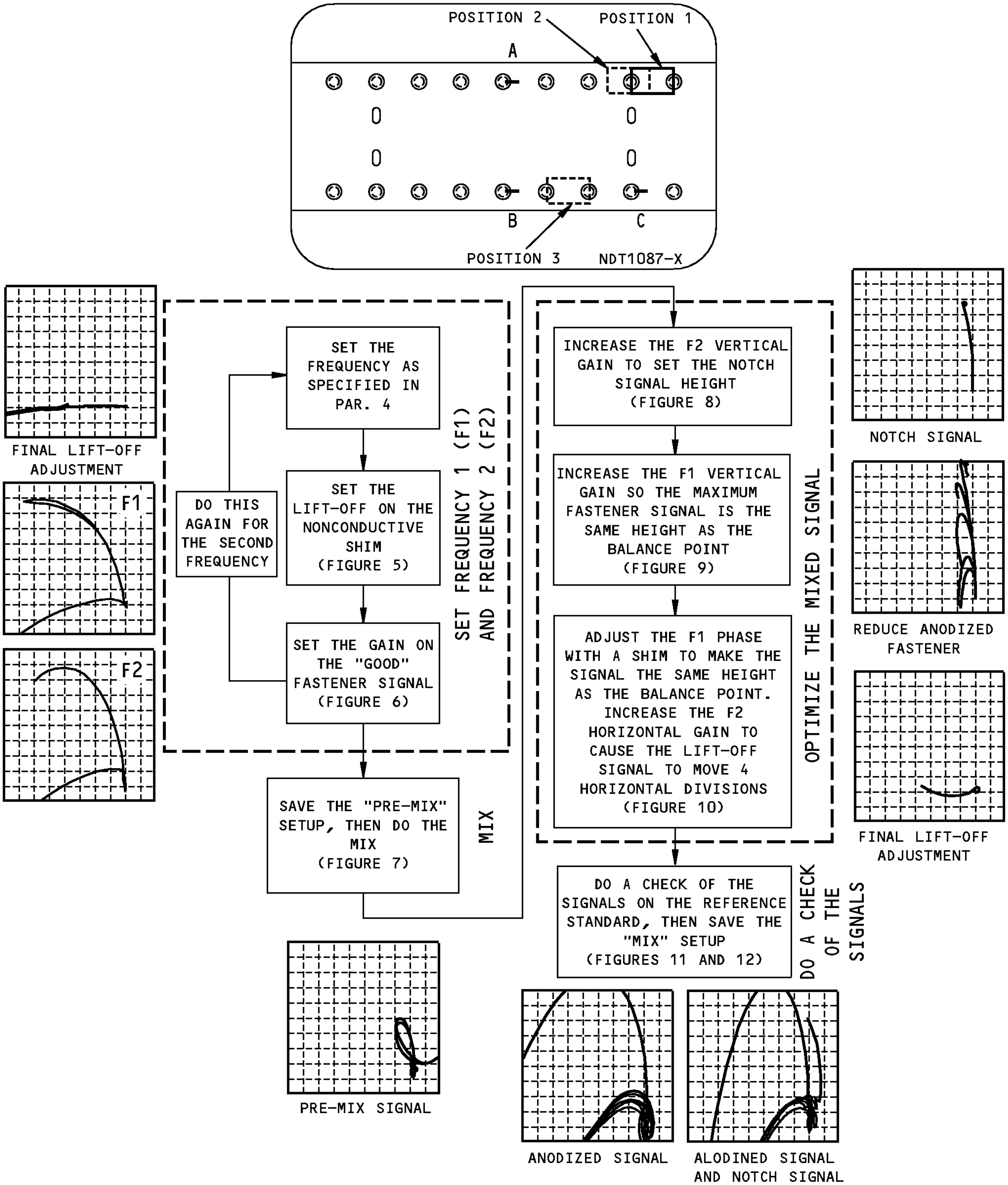
INCHES	MILLIMETERS
X.XXX = ±0.005	X.XX = ±0.10
X.XX = ±0.025	X.X = ±0.5
X.X = ±0.050	X = ±1

- SURFACE ROUGHNESS = 125 Ra OR BETTER
- MATERIAL: PLEXIGLASS OR PLASTIC MATERIAL THAT IS ALMOST THE SAME AS PLEXIGLASS
- MAKE TWO PROBE GUIDES FOR EACH REFERENCE STANDARD

1 ETCH THE PROBE GUIDE NUMBER NDT1087-P1 IN THE LOCATION SHOWN

2 DRILL AND TAP A HOLE FOR 8-32 THUMBSCREWS (OR METRIC EQUIVALENT)
- HOLE DEPTH: 0.18 (4.7)
- THE SCREW GRIP LENGTH MUST MATCH THE REFERENCE STANDARD THICKNESS
- THE SCREW SHANK DIAMETER MUST MATCH THE REFERENCE STANDARD SLOT WIDTH

Probe Guide NDT1087-P1
Figure 3

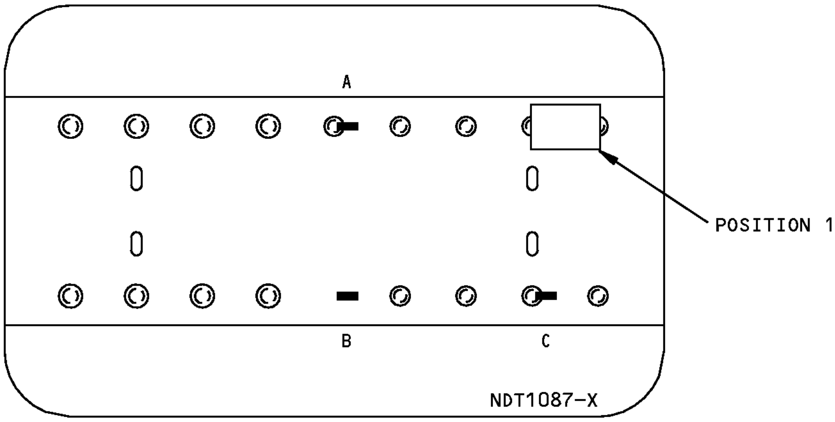


Calibration Flow Chart
Figure 4

DO THE LIFT-OFF CALIBRATION FOR FREQUENCY 1 AND FREQUENCY 2:

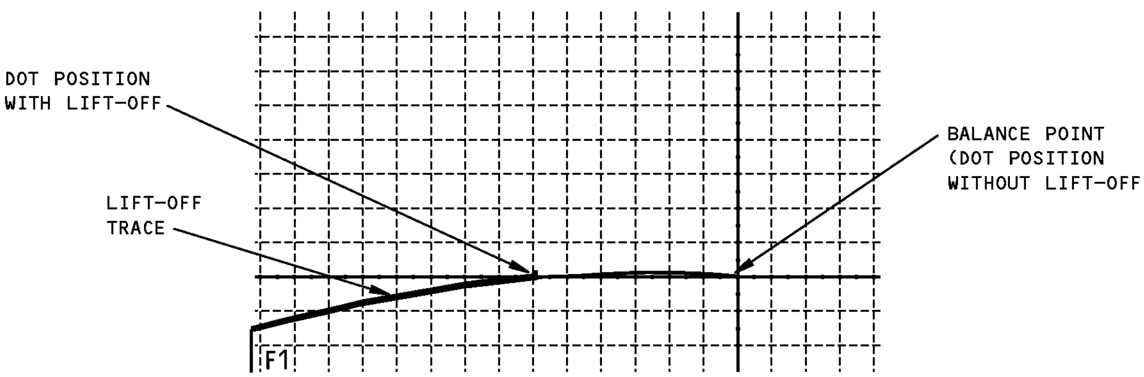
1. SET YOUR INSTRUMENT TO VIEW THE DISPLAY FOR FREQUENCY 1 OR FREQUENCY 2. MAKE SURE THE HORIZONTAL AND VERTICAL GAINS ARE EQUAL OR THE X:Y RATIOS ARE AT 0.0 dB.
2. PUT THE PROBE AT POSITION 1 ON THE APPLICABLE REFERENCE STANDARD AND BALANCE THE INSTRUMENT. SEE VIEW A.

   NOTE: ALWAYS BALANCE THE INSTRUMENT WHEN THE PROBE IS CENTERED BETWEEN FASTENERS. DO NOT BALANCE THE INSTRUMENT ON THE DOWNSCALE "DIP" THAT OCCURS NEAR EACH FASTENER AT SOME FREQUENCIES. SEE FIGURE 6, VIEW C. IT IS RECOMMENDED TO MARK THE LOCATION WHERE THE PROBE IS CENTERED AT THE CORRECT POSITION ON THE REFERENCE STANDARD.



PROBE POSITION TO BALANCE THE INSTRUMENT AND DO THE LIFT-OFF ADJUSTMENT
VIEW A

3. SET THE BALANCE POINT. USE THE POSITION CONTROLS TO SET THE GRATICULE LOCATION APPROXIMATELY 30% OF FULL SCREEN HEIGHT AND 80% OF FULL SCREEN WIDTH. SEE VIEW B.



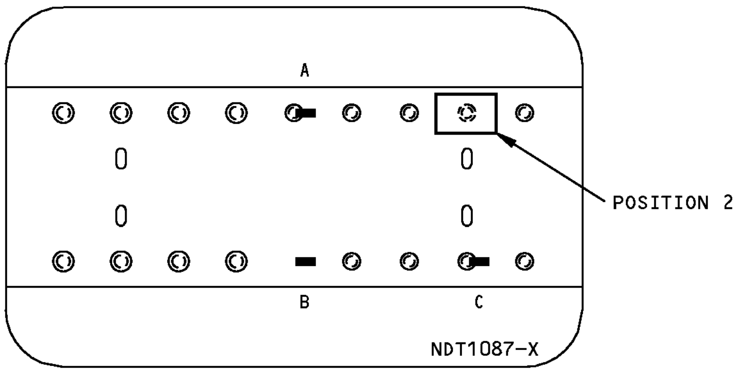
F1 LIFT-OFF SET POINT (F2 SET POINT IS ALMOST THE SAME)
VIEW B

4. PUT A 0.024 TO 0.032 INCH (0.61 TO 0.81 MM) NONCONDUCTIVE SHIM UNDER THE PROBE AT POSITION 1. TWO BUSINESS CARDS CAN BE USED AS SHIMS.
5. ADJUST THE PHASE AND GAIN CONTROLS UNTIL THE SIGNALS WITH AND WITHOUT THE SHIMS ARE THE SAME SCREEN HEIGHT. SEE VIEW B.

Lift-off Calibration for Frequency 1 and 2
Figure 5

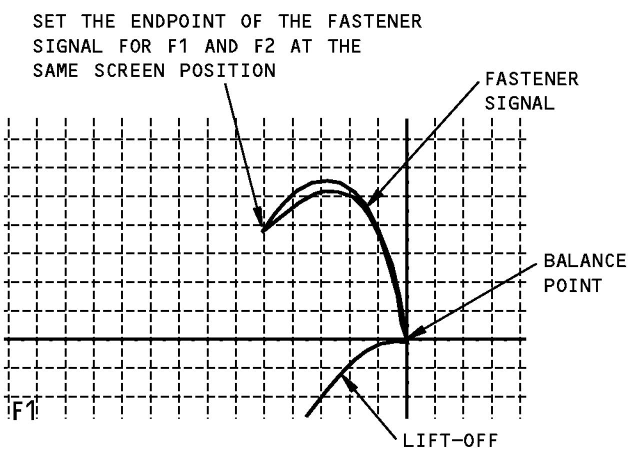
DO THE GAIN ADJUSTMENT FOR FREQUENCY 1 (F1) AND FREQUENCY 2 (F2):

1. SET THE INSTRUMENT TO FREQUENCY 1
2. MOVE THE PROBE ABOVE A "GOOD" FASTENER AT POSITION 2. SEE VIEW A. ADJUST THE PROBE POSITION UNTIL THE SIGNAL IS AT ITS MAXIMUM LENGTH.

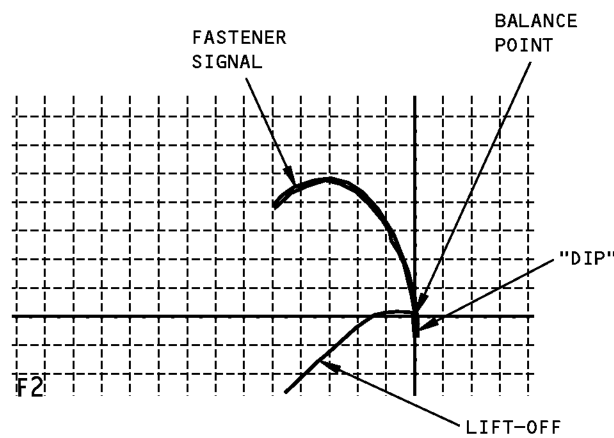


PROBE POSITION FOR FREQUENCY 1 AND FREQUENCY 2 GAIN ADJUSTMENT
VIEW A

3. ADJUST THE GAIN CONTROLS (AND THE X:Y RATIOS, IF APPLICABLE) TO SET THE END POINT OF THE SIGNAL AT 4 VERTICAL DIVISIONS AND 5 HORIZONTAL DIVISIONS FROM THE BALANCE POINT. SEE VIEW B FOR FREQUENCY 1 AND VIEW C FOR FREQUENCY 2.



F1 CALIBRATION SCREEN DISPLAY
VIEW B



F2 CALIBRATION SCREEN DISPLAY
VIEW C

4. SET THE INSTRUMENT TO FREQUENCY 2 AND DO STEPS 1 THRU 3.
5. SAVE THE PRE-MIX SET-UP IN THE INSTRUMENT MEMORY WHEN YOU HAVE SET THE CALIBRATION GAINS FOR FREQUENCY 1 AND FREQUENCY 2. WE RECOMMEND YOU DO THIS SO THAT YOU WILL NOT HAVE TO DO THIS PROCEDURE AGAIN IF YOUR SIGNALS ARE NOT SUFFICIENT AFTER YOU HAVE DONE THE OPTIMIZATION PROCEDURE OF FIGURES 8 THRU 12.

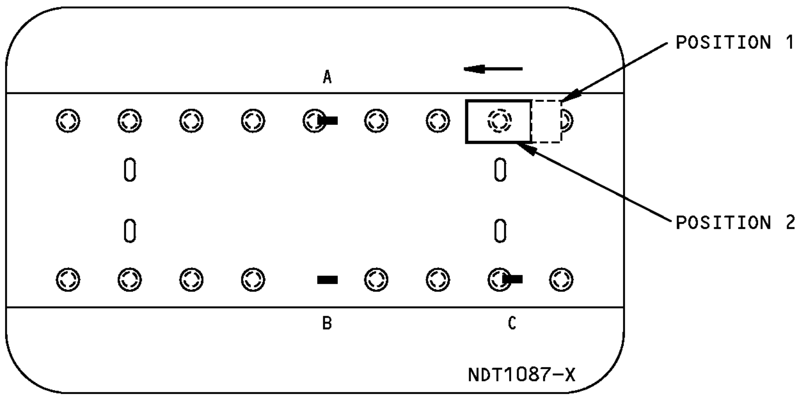
Gain Adjustment for Frequency 1 and Frequency 2
Figure 6

DO A CHECK OF THE MIXED SIGNAL FROM FREQUENCY 1 AND FREQUENCY 2:

1. CHANGE THE INSTRUMENT DISPLAY TO VIEW THE "MIX" SIGNAL ("F1-F2" OR "SUM" ON SOME INSTRUMENTS).

2. PUT THE PROBE AT POSITION 1 (VIEW A) AND BALANCE THE INSTRUMENT.

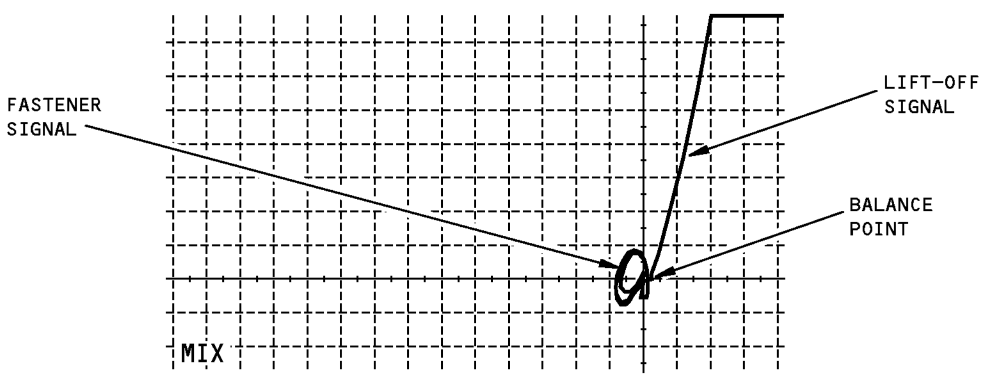
3. GET THE LIFT-OFF SIGNAL TO SHOW ON THE SCREEN DISPLAY AND MOVE THE PROBE ACROSS THE "GOOD" FASTENER AT POSITION 2 (SEE VIEW A). THE SIGNALS MUST LOOK ALMOST THE SAME AS THE SIGNAL SHOWN IN VIEW B. THE PHASE ANGLE OF THE LIFT-OFF SIGNAL IS NOT CRITICAL, BUT IT MUST MOVE TO THE RIGHT.



PROBE POSITION TO DO A CHECK OF THE MIXED SIGNAL
VIEW A

NOTE: THE CORRECT FREQUENCY MIX FOR THIS PROCEDURE IS F2-F1.
SOME INSTRUMENTS, LIKE THE NDT 19E OR NORTEC 2000D USE F1-F2 FOR THE MIX. YOU MUST ADD 180 DEGREES TO THE PHASE VALUES OF FREQUENCY 1 AND FREQUENCY 2 TO GET THE CORRECT MIX SIGNAL.

4. KEEP THE INSTRUMENT DISPLAY IN THE "MIX" MODE WHEN YOU CALIBRATE THE INSTRUMENT IN THE FIGURES THAT FOLLOW.



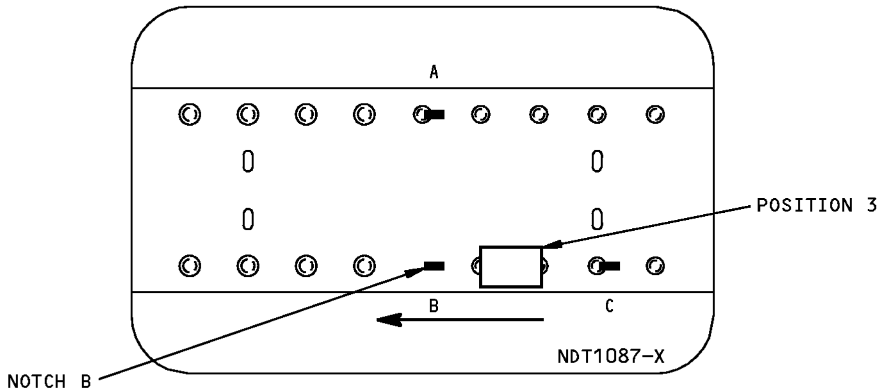
MIX DISPLAY SIGNAL
VIEW B

NOTE: THE FASTENER SIGNAL CAN BE LARGER WITH SOME INSTRUMENTS AND THE LIFT-OFF SIGNAL ANGLE CAN BE DIFFERENT, BUT THE INSTRUMENT CAN STILL BE CALIBRATED WITH THIS PROCEDURE

Mix Display Signal
Figure 7

ADJUST THE MIXED SIGNAL AMPLITUDE FOR THE EDM NOTCH B SIGNAL

1. PUT THE PROBE AT POSITION 3 ON THE APPLICABLE REFERENCE STANDARD AND BALANCE THE INSTRUMENT. SEE VIEW A.

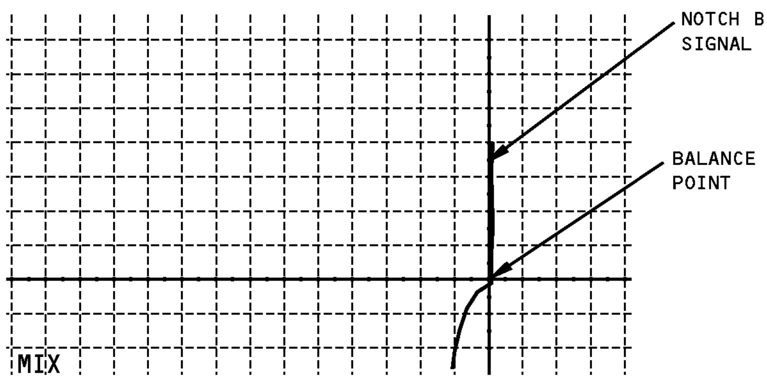


PROBE POSITION FOR INITIAL NOTCH B SIGNAL HEIGHT ADJUSTMENT
VIEW A

2. PUT THE PROBE AT NOTCH B AND MAXIMIZE THE SIGNAL.
3. HOLD THE PROBE AT THE LOCATION WHERE THE SIGNAL FROM NOTCH B IS AT ITS MAXIMUM SCREEN HEIGHT.
4. ADJUST THE FREQUENCY 2 VERTICAL GAIN WHILE YOU MONITOR THE "MIX" SIGNAL UNTIL THE NOTCH SIGNAL IS 4 SCREEN DIVISIONS ABOVE THE BALANCE POINT ON THE SCREEN. SEE VIEW B.

   NOTE: FOR INSTRUMENTS WITHOUT SEPARATE HORIZONTAL AND VERTICAL GAIN CONTROLS (LIKE THE HOCKING 2200) INCREASE THE FREQUENCY 2 GAIN.

5. TURN THE PROBE 180 DEGREES AND DO A CHECK OF THE NOTCH SIGNAL. IF IT IS LOWER THAN BEFORE, ADJUST THE GAIN AGAIN TO GET THE SIGNAL UP TO 4 SCREEN DIVISIONS.

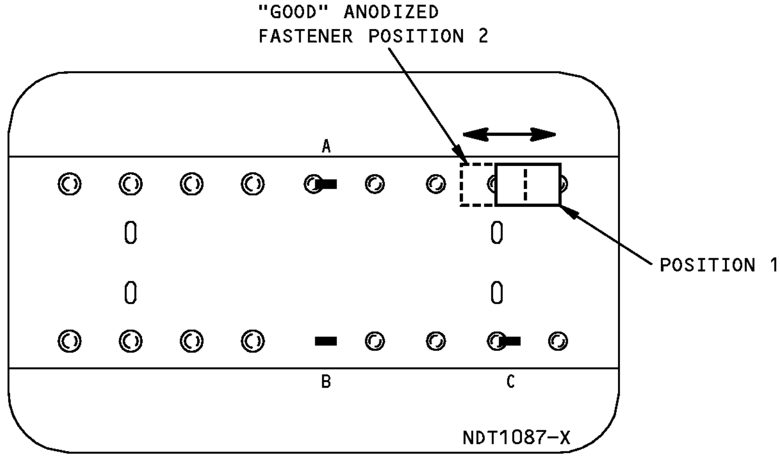


SIGNAL FROM NOTCH B
VIEW B

Mixed Signal Optimization - Adjustment of Notch B Signal Height
Figure 8

ADJUST THE MIXED SIGNAL TO DECREASE THE FASTENER SIGNAL:

1. PUT THE PROBE AT POSITION 1 ON THE APPLICABLE REFERENCE STANDARD AND BALANCE THE INSTRUMENT. SEE VIEW A.



PROBE POSITION FOR FASTENER SIGNAL SUPPRESSION
VIEW A

2. MOVE THE PROBE ACROSS A "GOOD" ANODIZED FASTENER AND MONITOR THE SIGNAL.

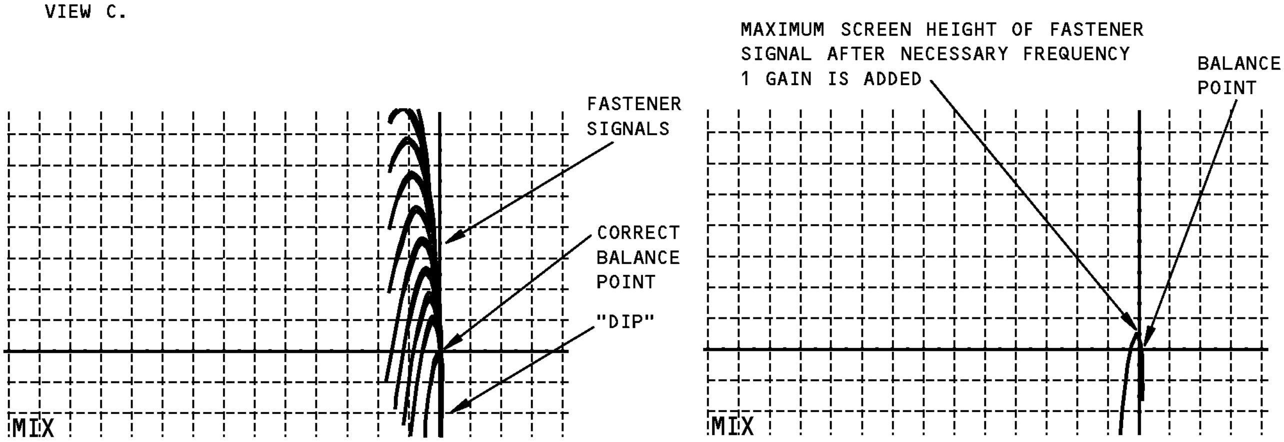
   NOTE: THE SIGNAL CAN MOVE ABOVE THE TOP OF THE SCREEN

3. HOLD THE PROBE AT THE LOCATION WHERE THE FASTENER SIGNAL IS AT THE MAXIMUM SCREEN HEIGHT (OR OFF THE SCREEN).

4. INCREASE THE FREQUENCY 1 VERTICAL GAIN IN 1 DB INCREMENTS WHILE YOU MONITOR THE "MIX" DISPLAY UNTIL THE MAXIMUM ANODIZED FASTENER SIGNAL BEGINS TO DECREASE TOWARD THE BALANCE POINT. SEE VIEW B.

5. MOVE THE PROBE BACK AND THEN ACROSS THE "GOOD" FASTENER AGAIN.

6. CONTINUE TO DO STEP 5 AND INCREASE THE FREQUENCY 1 VERTICAL GAIN OR CH. 1 GAIN UNTIL THE MAXIMUM SIGNAL FROM A "GOOD" ANODIZED FASTENER IS WITHIN 1 VERTICAL DIVISION FROM THE BALANCE POINT. SEE VIEW C.



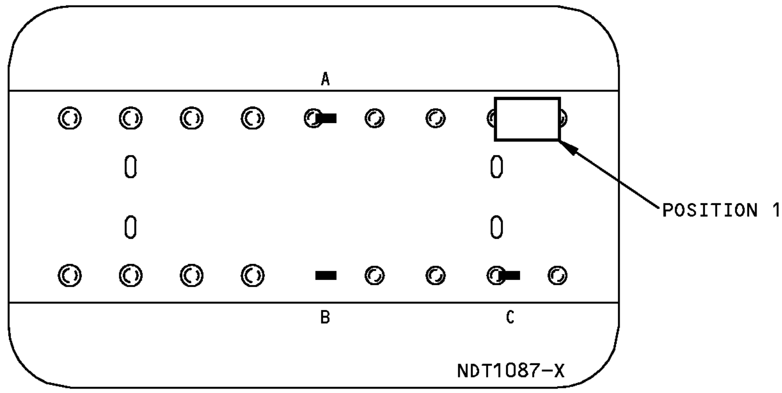
FASTENER SIGNAL DISPLAY AS THE GAIN IS INCREASED
VIEW B

FINAL FASTENER SIGNAL
VIEW C

Mixed Signal Optimization - Suppression of the Fastener Signal
Figure 9

ADJUST THE LIFT-OFF SIGNAL:

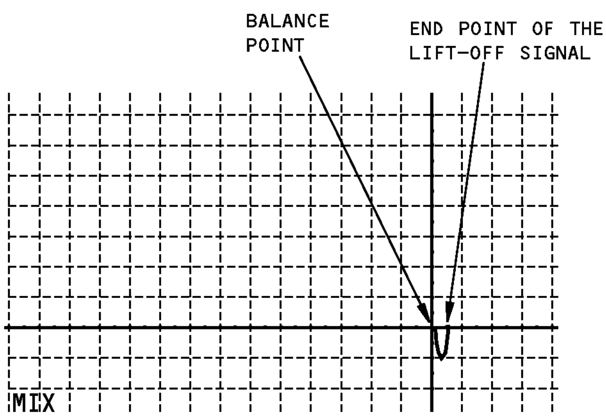
1. PUT THE PROBE AT POSITION 1 ON THE APPLICABLE REFERENCE STANDARD AND BALANCE THE INSTRUMENT. SEE VIEW A.



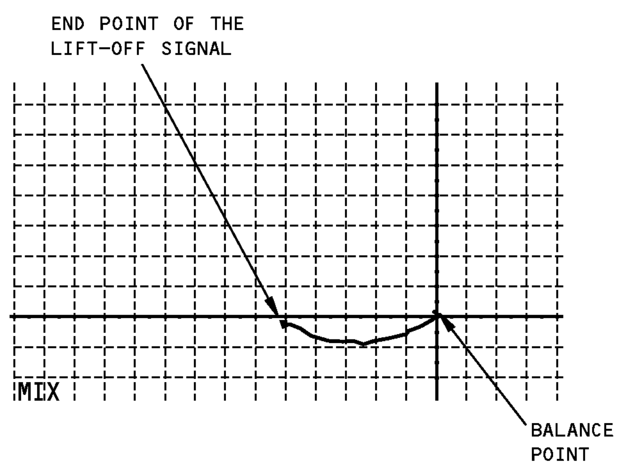
PROBE POSITION FOR THE FINAL LIFT-OFF ADJUSTMENT
VIEW A

2. PUT A 0.012 TO 0.016 INCH (0.30 TO 0.41 MM) NONCONDUCTIVE SHIM UNDER THE PROBE AT POSITION 1. A BUSINESS CARD CAN BE USED AS A SHIM. KEEP THE BUSINESS CARD UNDER THE PROBE TO CAUSE THE LIFT-OFF SIGNAL. DO NOT BALANCE AGAIN WHEN YOU DO STEP 3 AND 4 BELOW.

3. ADJUST THE FREQUENCY 1 PHASE CONTROL WHILE YOU MONITOR THE "MIX" DISPLAY UNTIL THE END POINT OF THE LIFT-OFF SIGNAL IS AT THE SAME VERTICAL SCREEN HEIGHT AS THE BALANCE POINT. SEE VIEW B.



INITIAL LIFT-OFF SIGNAL SET POINT
VIEW B



FINAL LIFT-OFF SIGNAL SET POINT
VIEW C

NOTE: LIFT-OFF IS LEFT FOR ALL INSTRUMENTS BUT HOCKING 2200, FOR WHICH LEFT-OFF IS TO THE RIGHT

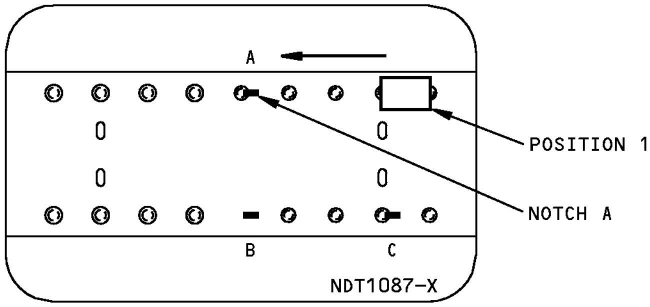
4. INCREASE THE FREQUENCY 2 HORIZONTAL GAIN WHILE YOU MONITOR THE "MIX" DISPLAY UNTIL THE END POINT OF THE LIFT-OFF SIGNAL MOVES ABOUT ONE QUARTER OF THE SCREEN WIDTH TO THE LEFT OF THE BALANCE POINT. SEE VIEW C.

Mixed Signal Optimization - Final Lift-Off Adjustment
Figure 10

FINAL SIGNAL CHECK ON THE REFERENCE STANDARD FOR ANODIZED FASTENERS:

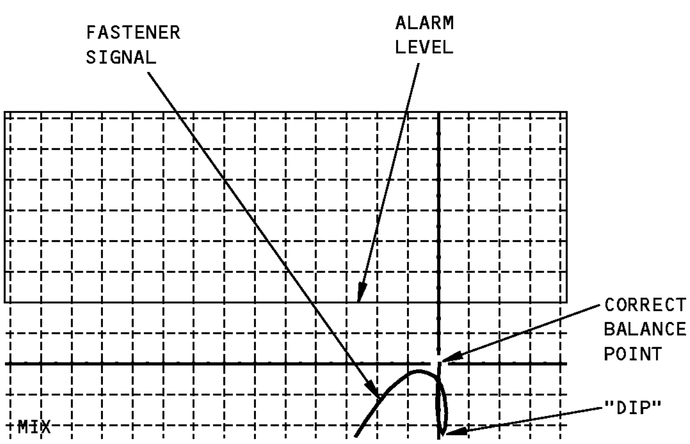
1. PUT THE PROBE AT POSITION 1 ON THE APPLICABLE REFERENCE STANDARD AND BALANCE THE INSTRUMENT. SEE VIEW A.

   NOTE: ALWAYS BALANCE THE INSTRUMENT WHEN THE PROBE IS CENTERED BETWEEN THE FASTENERS. DO NOT BALANCE THE INSTRUMENT ON THE DOWNSCALE "DIP" THAT OCCURS NEAR EACH FASTENER. SEE VIEW B.

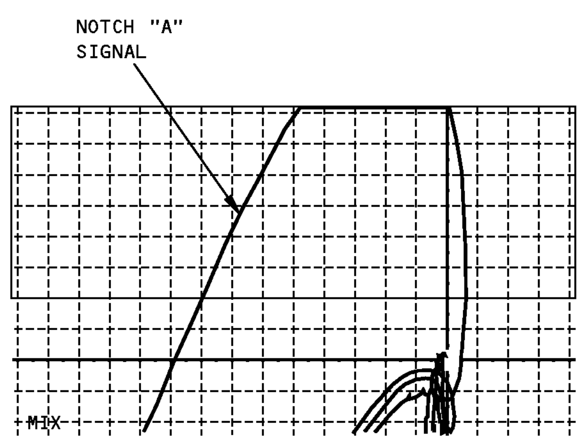


PROBE POSITION FOR AN ANODIZED FASTENER NOTCH SIGNAL
VIEW A

2. SET THE ALARM TO ALARM WHEN THE SIGNAL IS 2 SCREEN DIVISIONS ABOVE THE BALANCE POINT.
3. MOVE THE PROBE ALONG THE UPPER ROW OF FASTENERS IN THE REFERENCE STANDARD, ACROSS NOTCH A, AND MONITOR THE SIGNAL FROM THE NOTCH. IT IS POSSIBLE THAT THE NOTCH "A" SIGNAL WILL NOT GO OFF THE SCREEN DISPLAY, AS SHOWN IN VIEW C, FOR SOME INSTRUMENTS.



CORRECT BALANCE POINT AND "DIP"
VIEW B

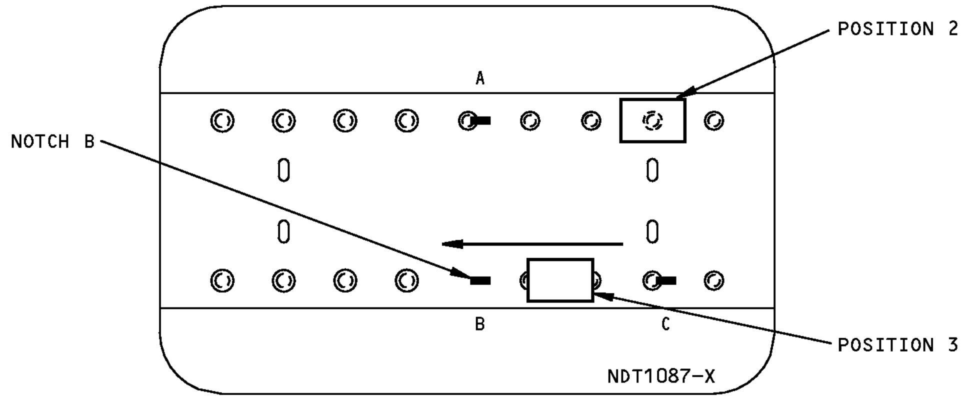


NOTCH "A" SIGNAL AT THE
ANODIZED FASTENER
VIEW C

Signal Check on the Reference Standard - Anodized Fasteners
Figure 11

FINAL SIGNAL CHECK ON THE REFERENCE STANDARD FOR ALODINED FASTENERS:

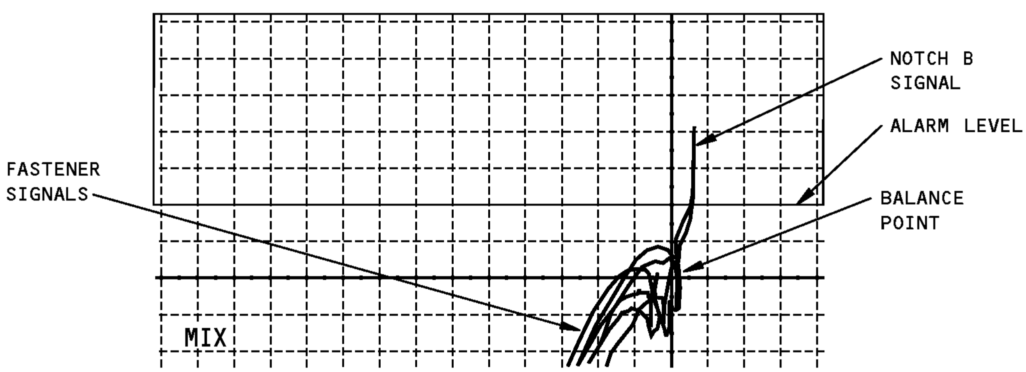
1. PUT THE PROBE AT POSITION 3 ON THE APPLICABLE REFERENCE STANDARD AND BALANCE THE INSTRUMENT. SEE VIEW A



PROBE POSITION FOR AN ALODINED FASTENER NOTCH SIGNAL
VIEW A

2. MOVE THE PROBE ALONG THE LOWER ROW OF FASTENERS IN THE REFERENCE STANDARD, ACROSS NOTCH B, AND MONITOR THE SIGNAL FROM THE NOTCH. THE SIGNAL FROM NOTCH B MUST BE ALMOST THE SAME AS THE SIGNAL SHOWN IN VIEW B.

3. IF THE NOTCH "B" SIGNAL IS NOT 4 DIVISIONS ABOVE THE BALANCE POINT, THEN:
   (a) PUT THE PROBE AT POSITION 3 AND BALANCE THE INSTRUMENT. MOVE THE PROBE ABOVE NOTCH "B" AND MAXIMIZE THE NOTCH SIGNAL. ADJUST THE FREQUENCY 2 VERTICAL GAIN UNTIL THE SIGNAL NOTCH B SIGNAL IS 4 VERTICAL DIVISIONS ABOVE THE BALANCE POINT.
   (b) PUT THE PROBE AT POSITION 2 AND INCREASE THE FREQUENCY 1 VERTICAL GAIN UNTIL THE MAXIMUM ANODIZED FASTENER SIGNAL IS WITHIN 1 VERTICAL DIVISION FROM THE BALANCE POINT.



ALODINED FASTENER NOTCH B SIGNALS
VIEW B

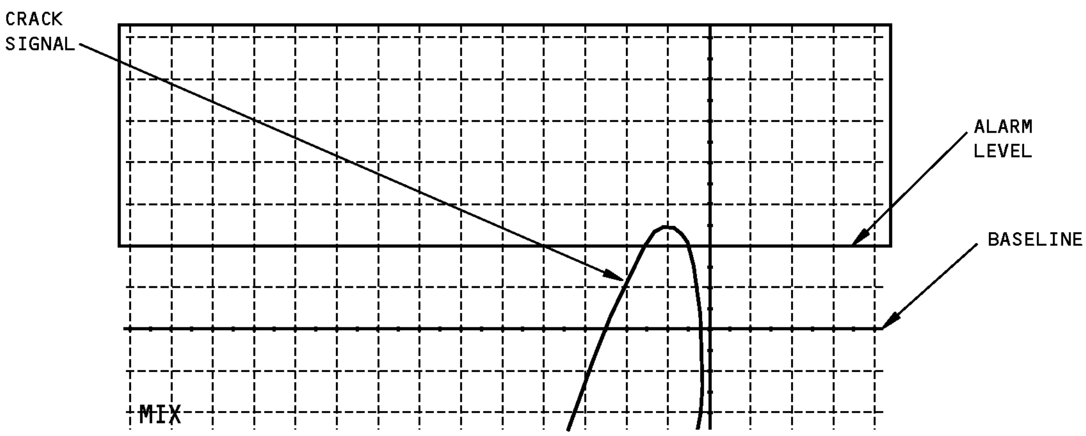
4. AS A FINAL CHECK, MONITOR THE SIGNAL FROM NOTCH C. THIS NOTCH CAN GIVE DIFFERENT SIGNALS THAT ARE RELATED TO THE INSTALLATION FIT OF THE FASTENER IN YOUR REFERENCE STANDARD. THIS NOTCH SIGNAL IS FOR REFERENCE ONLY. DO NOT USE THIS NOTCH SIGNAL FOR CALIBRATION.

5. SAVE YOUR FINAL CALIBRATION IN THE INSTRUMENT MEMORY.

Signal Check on the Reference Standard - Alodined Fasteners
Figure 12

SIGNALS AT TEAR STRAP LOCATIONS THAT ARE HIGHER THAN THE BASELINE (AS SHOWN IN VIEW A) ARE POSSIBLE CRACKS. TO EXAMINE THESE SIGNALS, DO THE STEPS THAT FOLLOW:

1. BALANCE YOUR INSTRUMENT ON THE UPPER FASTENER ROW AS SPECIFIED IN PAR. 5
2. EXAMINE THE LOWER ROW OF FASTENERS THAT GO THROUGH THE TEAR STRAP.
3. MAKE A RECORD OF A SIGNAL THAT IS HIGHER THAN THE ALARM LEVEL SET IN PAR. 4. THESE SIGNALS ARE CRACK INDICATIONS.



SCREEN DISPLAY OF A CRACK SIGNAL AT A TEAR STRAP LOCATION
VIEW A

NOTE: THE BALANCE POINT IS OFF THE BOTTON OF THE SCREEN DISPLAY.

Crack Signal at a Tear Strap Location
Figure 13

PHASEC 2D

1. Press "Menu" button.
2. Set mode to Normal Dual.
3. Set Drive dB to +8
4. Set probe inductance to 82
5. Set probe1 and probe2 to "reflection".
6. Set Filter1 and Filter2 to "BP LOCK"
7. Set HP/LP1 and HP/LP2 to DC/50.0.
8. Set input gains for frequency 1 and frequency 2 to "high"
9. Set GAINMIX to "0.0/0.0"
10. Set PHASEMIX to "0.0"
11. Set DISPLAY to "Spot"
12. Set Graticule to Grid 2 (fine graticules)
13. Set View to "Frequency 1"
14. Set SPOT XY to 138/-19
15. Set View to "Frequency 2"
16. Set SPOT XY to 138/-19
17. Set View to "mix"
18. Set SPOT XY to 138/-19
19. Set Active to Mix
20. Set Shape to Box 1
21. Set Top/Btm to 69/-19
22. Set Lft/Rght to -138/39
23. Set persistence to permanent

PHASE 2D INITIAL INSTRUMENT ADJUSTMENT

Equipment Initial Adjustments
Figure 14 (Sheet 1 of 8)

PHASEC 2000

1. Press Menu button
2. Set probe to "Standard"
3. Set probe drive to "+10dB"
4. Set graticule to "Rect. C" (8 divisions vertically, 16 horizontally)
5. Press Menu again to enter operating mode
6. Select Mode at bottom of display.
7. Set <mode> to "Refl 2 Ch"
8. Set Display to "XY"
9. Set persistence to "Permn't"
10. Set View to "Ch1"
11. Select Input function
12. Set Hi-Pass to "DC"
13. Set Lo-Pass to "50 Hz"
14. Set Inp. Gain to "0dB"
15. Select "PosXY" function
16. Set X-pos 1 at "+60"
17. Set Y-pos 1 at "-38". Balanced dot should now lie on a graticule point two vertical divisions from the bottom of the screen and four horizontal divisions from the right edge.
18. Set the Mode to "Sum View" and select sum to set the values in step 19 and 20 below.
19. View "SUM"
20. Set SUM GAIN to 0.0dB.
21. Set SUM PHASE to 180 degrees

<u>NOTE</u>: The Phasec 2200 does not have independent vertical and horizontal gains. When the procedure specifies a horizontal or vertical gain adjustment, use the gain control for the applicable channel and the x:y ratio

<u>NOTE</u>: When you make the final lift-off adjustment as specified in Figure 10 with the Phasec 2200, the lift off signal goes to the right. Decrease the frequency 2 "X" value in the X:Y mode (example -10 to -4 dB) until the lift-off signal moves to the right a similar but opposite distance from the balance point as shown in Figure 10, View C.

PHASE 2000 INITIAL INSTRUMENT ADJUSTMENT

Equipment Initial Adjustments
Figure 14 (Sheet 2 of 8)

NORTEC 2000D, 2000D+ AND WORKSTATION

1) Push the Set-up button

2) Set the frequency mode to Dual Freq and the probe drive to high. Use the up-arrows and the smart knob to adjust the correct values.

3) Push the Display/Alarm button.

4) Highlight the dual function with the soft key. (Use the right up-arrow.)

5) Make sure that A/G tracking is set to off. Adjust it with the smart knob.

6) Make sure the auto mix function is set to off. Adjust with the smart knob.

7) Push the Display/Alarm button, then the dual soft key on the right side of the screen. Set the value to display F1 (frequency 1) with the smart knob.

8) Push the Main/filter button until the LP filter function shows on the top, right of the display. Use the smart knob to set 50 Hz. Set the high pass filter to "off"

9) Push the Main/filter button until the "FREQ" appears in the lower left of the display (this causes frequency 1 to be displayed). Make the necessary adjustments to frequency 1 as specified in the procedure.

10) Push the Main/filter button again to select FREQ 2 (frequency 2)

NOTE: You must push Display, then Dual (right up arrow) and use the smart knob to set the display to F2 (frequency 2) or you will not be able to see the adjustments you make on the screen.

11) To see the mix mode, push Display/alarm, then dual soft key and use the smart knob to set the display to F1-F2. The display does not show a label that tells what signal is displayed on the screen. You must push Display, then dual, and monitor the upper right side of the screen to make sure that the correct display is shown on the screen.

12) You must add 180 degrees to the phase of channel 1 and channel 2 to cause the correct upscale signal.

NORTEC 2000D, 2000D+, AND WORKSTATION INITIAL INSTRUMENT ADJUSTMENT

Equipment Initial Adjustments
Figure 14 (Sheet 3 of 8)

NOTE: The correct frequency mix for this procedure is F2 - F1

The mixed notch signal will move downscale for the Nortec (Staveley) instruments because the instruments use F1 - F2 to do the mix. To change the display to F2 - F1 you must add 180 degrees to the phase values for each frequency so that the notch signal moves upscale. If you add 180 degrees to a phase value and the result is more than 360, then subtract 360 degrees to get the correct phase value.

Examples: (1) Initial phase value is 280 degrees, 280 + 180 = 460, 460 - 360 = 100 degrees. Correct phase is 100 degrees

(2) Initial phase value is 30 degrees, 30 + 180 = 210, less than 360 degrees. Correct phase is 210 degrees

NORTEC 2000D, 2000D+, AND WORKSTATION INITIAL INSTRUMENT ADJUSTMENT (CONTINUED)

Equipment Initial Adjustments
Figure 14 (Sheet 4 of 8)

ELOTEST M2V3

1) Adjust the parameters for channel 1 in the signal display mode as follows:
   a) With the F-key you can set the active channel.
   b) With the cursor Up and Down keys, you can set the parameter.
   c) With the + and - keys you can adjust all parameters to the necessary values:
      (1) Frequency: (11 kHz)
      (2) Preamplifier: 16 dB (Do not use the Auto-Preamp)
      (3) Total gain: 30,0 dB (This is the sum of Preamp+Mainamp+Y-Spread)
      (4) Spread Y: 0 dB
      (5) Phase: 355
      (6) Display: y/x low. rt.
      (7) Lowpass: 50 Hz
      (8) Amplitude: 100%
      (9) Attenuation: off
      (10) Additional Preamp: off
2) Adjust the parameters for channel 2 in the signal display mode as follows:
   a) With the F-key you can set the active channel.
   b) With the cursor Up and Down keys, you can set the parameter.
   c) With the + and - keys you can adjust all parameters to the necessary values:
      (1) Frequency: (2.7 kHz)
      (2) Total gain: 30,0 dB (This is the sum of Preamp+Mainamp+Y-Spread)
      (3) Spread Y: 0 dB
      (4) Phase: 58.5

      NOTE: The missing parameters Preamplifier, Display, Lowpass, Amplitude, Attenuation and Additional Preamp are already correctly set-up from channel 1.

ELOTEST M2V3 INITIAL INSTRUMENT ADJUSTMENT

Equipment Initial Adjustments
Figure 14 (Sheet 5 of 8)

ELOTEST B 300

(1) Adjust the parameters for channel 1 in the Parameter Setup display mode as follows:

a) With the cursor Up and Down keys, you can set the parameter.

b) With the Smart knob or the cursor right (inc) and left (dec) keys you can adjust all parameters to the necessary values

(1) Frequency: 11 kHz

(2) Amplitude: 50%

(3) Preamplifier: 16 dB

(4) Mainamplifier: 18,5 dB

(5) Spread Y: 0 dB

(6) Phase: 358°

(7) Lowpass: 50 HZ

(8) Highpass: off

(9) Dot Position Y: -59,4 %

(10) Dot Position X: 59,4 %

NOTE: When the Dot-Position X or Y is highlighted, you can call up pre-programmed Dot-Positions with the F1 key.

(2) Adjust the parameters for channel 2 in the Parameter Setup display mode as follows:

a) With the cursor Up and Down keys, you can set the parameter.

b) With the Smart knob or the cursor right (inc) and left (dec) keys you can adjust all parameters to the necessary values

(1) Frequency: 2.6 kHz

(2) Mainamplifier: 16,5 dB

(3) Phase: 358°

NOTE: The missing parameters Amplitude, Preamplifier, Spread Y, Lowpass, Highpass, and Dot Positions X and Y, are already correctly set-up from channel 1.

ELOTEST B 300 INITIAL INSTRUMENT ADJUSTMENT

Equipment Initial Adjustments
Figure 14 (Sheet 6 of 8)

TROUBLESHOOTING:

If you do not get the correct results, do the calibration again but refer to the items that follow that identify possible solutions.

1. The instrument in use does not have independent horizontal and vertical gain adjustments:

   - Calibration on the anodized fasteners must be done so that the endpoints of the frequency 1 and frequency 2 signals move to the same vertical and horizontal position on the screen. For this adjustment, it is necessary to use independent horizontal and vertical gain controls or gain and X:Y ratio adjustments.
   - If your instrument has a single gain control and an X:Y ratio adjustment, then:
     - o To adjust the signal so the endpoint moves to the left, the "x" value must be changed from a larger to a smaller x value. For example, if you change the value from -10 dB to -4 dB, you will move the endpoint to the left. This is equivalent to an increase in the horizontal gain.

2. Mix Signal Does not look the same as Figure 7, View C

   - Make sure the vertical and horizontal gains for each channel are equal (V:H ratio is 1:1) when you adjust the phase in Figure 5. If the lift-off signal moves upscale from the balance point, the mixed lift-off signal can move down and left. If you use a Nortec instrument, it is normal to get a downscale lift-off signal when the steps before the mix are done correctly. You must add 180 degrees of phase to each channel to move the lift-off signal to the right
   - Monitor the F1 and F2 signals separately while you hold the probe at position 2 where you get the maximum signal from a good anodized fastener. The signals from frequency 1 and 2 must start from the same null point and end at the same screen position. If they do not, then adjust the signals so the endpoints occur at 4 vertical and 5 horizontal divisions from the balance point.
   - Use an 0.012 inch (0.30 mm) shim (the thickness of a business card) when you set the lift-off in Figure 5. Adjust the phase control so that no part of the horizontal lift-off signal rises above the baseline.
   - If the steps above do not correct the lift-off, do par. 4.F thru 4.M again.

TROUBLESHOOTING

Equipment Initial Adjustments
Figure 14 (Sheet 7 of 8)

3. Signal From a Good Fastener Signal Gives a Large Upscale Signal:

- Make sure that the initial mix signal, shown in Figure 7, View B looks almost the same
- Adjust the Good fastener signal again
    - o View the mix signal
    - o Balance the probe at position 1. See Figure 9.
    - o Move the probe above the Good fastener at position 2.
    - o As you move the probe above the Good fastener so the signal amplitude is at its maximum, increase the Frequency 1 gain until the maximum signal (top of the signal arch) is within 1 vertical division of the balance point.
    - o Do a check of the notch B signal. If it is not at least 4 vertical divisions from the balance point, then do the instructions in Figure 8 and 9 again.

4. Final Lift-off Signal Does Not Move to the Left:

- If you use a Phasec 2200:
    - o The lift-off signal will move to the right when you calibrate the instrument with the instructions given in Figure 10.
    - o It is acceptable for the lift-off signal to move to the right. The crack signal will still move upscale.
    - o Adjust the channel 2 gain so that the lift-off signal moves to the right approximately 4 horizontal divisions.
    - o Adjust the phase 1 control if the lift-off signal is not horizontal.
- For all other instruments specified in 1.B.2:
    - o Increase the Frequency 2 horizontal gain.

5. The Notch B signal is too high (much greater than 4 vertical divisions) after the final signal mix:

- Decrease the Frequency 2 vertical gain. Frequency 2 is the lower frequency and is most sensitive to the notch.

TROUBLESHOOTING

Equipment Initial Adjustments
Figure 14 (Sheet 8 of 8)

PART 6 - EDDY CURRENT

INSPECTION OF SPLICE STRAPS AT THE SKIN BUTT-SPLICES (HFEC)

1. **Purpose**

   A. Use this surface inspection procedure to find cracks in the splice straps of the fuselage at the circumferential butt splices. This procedure looks for cracks that can occur from scribe lines on the outside surface of the splice straps. This procedure looks for cracks that are:

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

      (2) Are in the up and down direction.

   B. This is a high frequency eddy current (HFEC) inspection that uses a specially designed probe.

   C. The gap between the forward and aft skins must be 0.08 inch (2.0 mm) or more for the probe to touch the splice strap.

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) Operates at a frequency of 70 kHz.

         (b) Has an impedance plane display.

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

         (a) Phasec 2200, Phasec 2; Hocking

         (b) Elotest B1; Rohmann GmbH

         (c) Nortec 1000/2000; Staveley Instruments

   C. Probe

      (1) This procedure uses a specially designed, right angle, shielded, pencil probe. Other probes can be used if they can be calibrated as specified in Paragraph 4.

         (a) Use NEC 1006 which is made by NDT Engineering Corp.

   D. Reference Standard

      (1) Use reference standard NDT3065. See Figure 2.

3. **Preparation for Inspection**

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

   A. Remove the sealant from the splice straps between the forward and aft skins before inspection. Make sure the whole inspection area is free of sealant.

   B. Get sufficient access to the inspection area. The inspector must keep the probe in touch with the inspection surface at the correct angle.

4. **Instrument Calibration**

   A. Set the instrument frequency to 70 kHz.

B. Set the vertical gain 12 to 16 dB higher than the horizontal gain.

C. Put the probe tip on the inspection surface (lower piece) of reference standard NDT3065 between notch locations identified as ‘‘A’’ and ‘‘B’’. See Figure 3, Detail I. It is recommended to use a piece of thin tape on the tip of the probe to prevent scratches to the surface.

D. Make sure the probe is against the edge of the upper piece and is perpendicular to the inspection surface at all times during the calibration.

E. Balance the instrument.

F. Set the instrument balance point to the lower center area of the screen display as shown in Figure 3, Detail II.

G. Lift the probe off the surface and adjust the instrument phase control to get the lift-off signal to move horizontally from right to left. Make sure the probe is against the top piece during the lift-off adjustment.

H. Move the probe across the notch identified as ‘‘B’’ in the reference standard.

I. Find the probe position on the notch that gives the maximum signal height and adjust the instrument gain to get the signal to 40% of full screen height (FSH) higher than the balance point. See Figure 3, Detail II.

J. Turn the probe 180 degrees and do Paragraph 4.H. and Paragraph 4.I. again. If the signal is less than 40% of FSH, do the calibration again. If there is a difference in the signal heights when the probe is turned, make sure you position the probe for calibration that gives the lowest signal. Use the same probe position to do the scan inspection on the airplane that you used during the calibration.

K. Set the audible alarm to 50% of the signal height (20% of FSH higher than the balance point) as shown in Figure 3, Detail II.

L. Move the probe across the notch in the reference standard to find the maximum scan speed. The speed is too fast if the signal decreases more than 10% of the signal height or the alarm does not operate.

M. Move the probe across the notch identified as ’’A’’ and monitor the signal. The signal must be equal to or more than the signal from notch ‘‘B’’.

N. The EDM notches identified as ‘‘C’’ and ‘‘D’’ are not used for this inspection procedure.

5. <u>Inspection Procedure</u>

A. Calibrate as specified in Paragraph 4.

B. Put the probe on the inspection surface. See Figure 1 for the typical probe position.

C. Balance the instrument.

D. Examine all the butt joints specified in the applicable service bulletin or inspection instructions as follows:

(1) Make a scan with the probe against the edge of the forward skin of the butt joint and perpendicular to the splice strap.

(2) Make a scan with the probe against the edge of the aft skin of the butt joint and perpendicular to the splice strap.

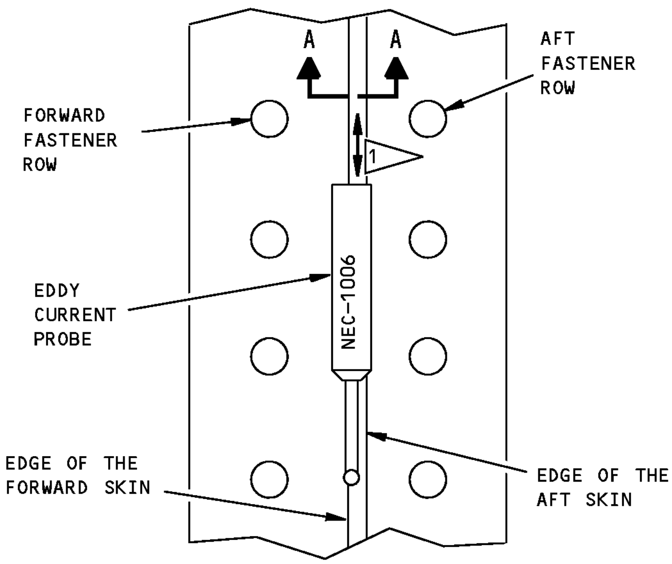
(3) If the gap between the forward and aft skins of the butt joint is more than 0.16 inch (4.1 mm), make a scan with the probe in the middle of the gap.

6. <u>Inspection Results</u>

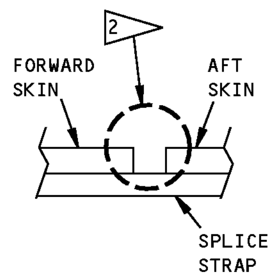
A. Signals that are 20% of FSH or higher than the balance point, are possible crack indications. Make a mark on the skin surface of all possible crack indications with a grease pencil, felt pen or wax pencil.

B. Compare the signal that occurs during the inspection to the signal you got from the notch in the reference standard.

C. Ask Boeing for more analysis help with signals that are from possible cracks.



TYPICAL BUTT-SPLICE



A-A

NOTES:

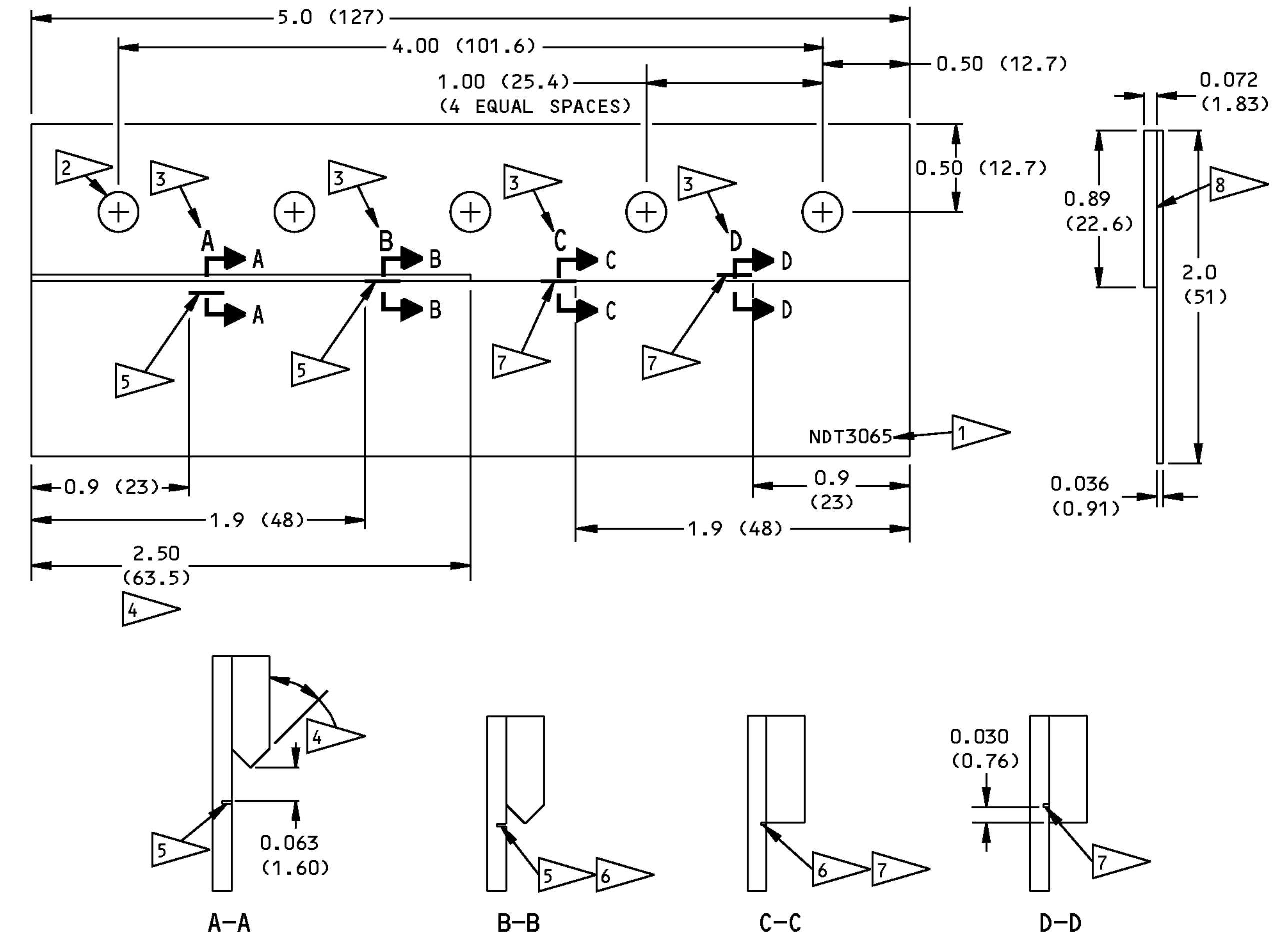
- DIMENSIONS ARE IN INCHES
  (MILLIMETERS ARE IN PARENTHESES)

[1] POSSIBLE CRACK DIRECTION IN THE SPLICE STRAP.

[2] INSPECTION AREA

PROBE ON THE SPLICE STRAP OF THE BUTT-SPLICE

Inspection Areas
Figure 1



NOTES:

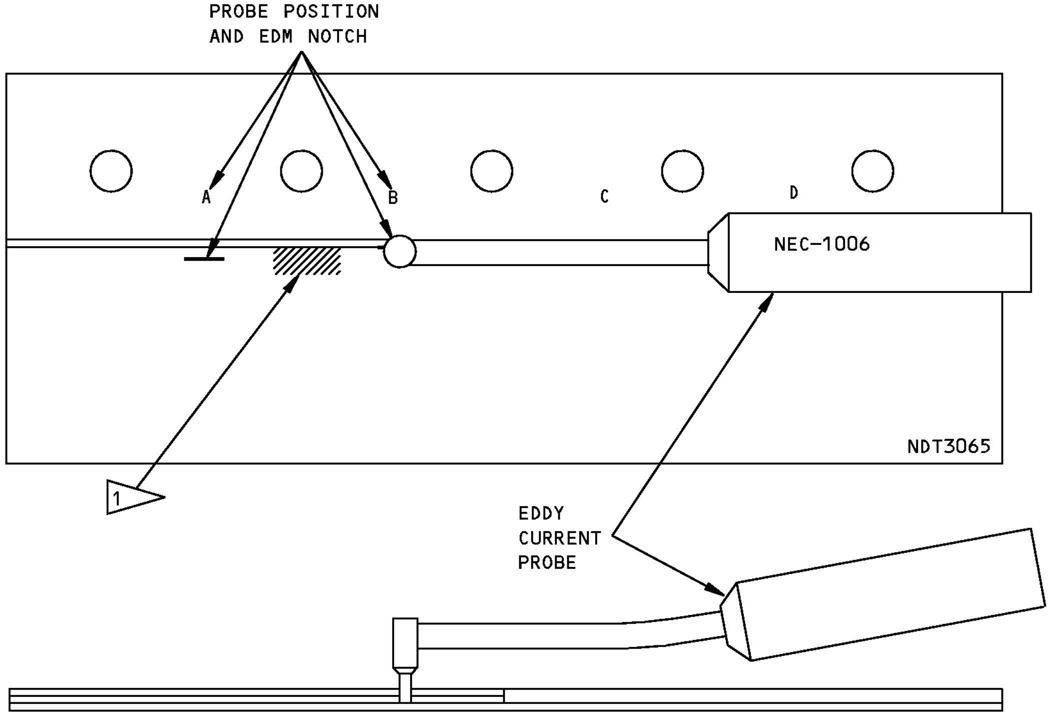
- DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- TOLERANCE (UNLESS SPECIFIED DIFFERENTLY):

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

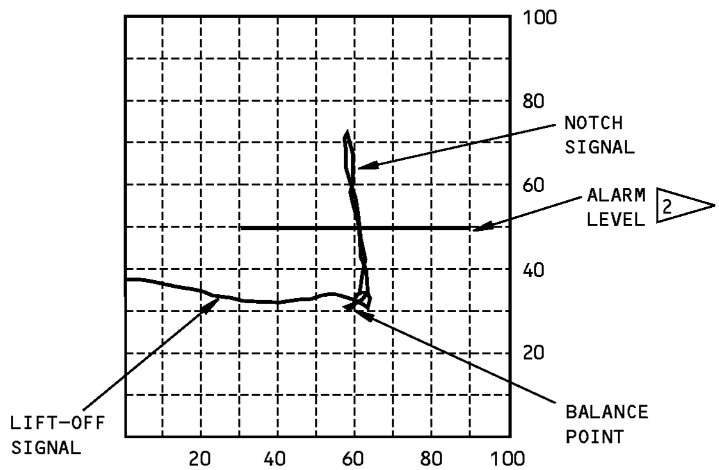
- SURFACE ROUGHNESS: 63 Ra OR BETTER
- MATERIAL: ALUMINUM (CLAD OR BARE)

1. ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT3065
2. BACR15CE5D4 OR BACR15GF5D4 (5 LOCATIONS).
3. ETCH OR SCRIBE THE LETTER ON THE SURFACE OF THE TOP PIECE TO IDENTIFY THE LOCATION OF THE EDM NOTCH AND THE PROBE/TRANSDUCER POSITION FOR THE INSTRUMENT CALIBRATION.
4. 45 DEGREE DOUBLE BEVEL WITH THE END OF THE BEVEL AT THE CENTER OF THE THICKNESS OF THE PIECE.
5. EDM NOTCH:
   LENGTH: 0.200 (5.08) ±0.010 (0.25)
   DEPTH: 0.018 (0.46) ±0.002 (0.05)
   WIDTH: 0.005 (0.13) ±0.002 (0.05)
6. PUT THE EDM NOTCH FLUSH (±0.005 (0.13)) WITH THE END OF THE BEVEL AS SHOWN IN SECTION B-B AND FLUSH (±0.005 (0.13)) WITH THE END OF THE SQUARE EDGE AS SHOWN IN SECTION C-C.
7. EDM NOTCH:
   LENGTH: 0.200 (5.08) ±0.010 (0.25)
   DEPTH: 0.010 (0.25) ±0.002 (0.05)
   WIDTH: 0.005 (0.13) ±0.002 (0.05)
8. 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 THE FAYING SURFACE.

Reference Standard NDT3065
Figure 2



PROBE POSITION ON THE
REFERENCE STANDARD
DETAIL I



SCREEN DISPLAY
DETAIL II

NOTES:

1 PROBE POSITION TO SET LIFT-OFF AND BALANCE THE INSTRUMENT

2 THE ALARM LEVEL SHOWN IN DETAIL II IS SET TO 50% OF FULL SCREEN HEIGHT (FSH) (20% OF FSH HIGHER THAN THE BALANCE POINT).

Instrument Calibration
Figure 3

PART 6 - EDDY CURRENT

INSPECTION OF SPLICE STRAPS AT THE SKIN BUTT-SPLICES (LFEC)

1. **Purpose**

   A. Use this procedure to find cracks in the splice straps at the circumferential-butt-splices of fuselage skin panels. This procedure examines the splice straps for possible 50% through-thickness cracks that are 0.5 inches (13 mm) long (or more) and grow in the circumferential direction. The inspection is done from the outer surface of the airplane.

   B. This procedure examines splice straps that are from 0.050 to 0.100 inch (1.60 to 2.54 mm) thick through fuselage skins that are from 0.050 to 0.156 inch (1.27 to 3.96 mm) thick. This procedure can be used only if the distances between the skins at the butt-splices are more than 0.030 inch (0.76 mm). Tell Boeing about structure that is different from that specified for this procedure.

   NOTE: At the butt-splice and lap-joint intersection locations, the maximum skin thickness (total) that this procedure can be used for is 0.156 inch (3.96 mm).

   C. This procedure uses an impedance plane display instrument and a specially designed sliding probe.

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. Instruments

      (1) Use an eddy current instrument that:

         (a) Has an impedance plane display.

         (b) Operates at a frequency of 1.5 to 3 kHz.

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

         (a) NDT-19e; Nortec/Staveley Instruments

         (b) Hocking 2200; Hocking Krautkramer (GE)

   C. Probe

      (1) The two probes that follow were used to help prepare this procedure. Use one of the two probes to do this inspection.

         (a) NEC-4170; NDT Engineering Corp

         (b) SPC-335-4; EC NDT

   D. Reference Standards

      (1) Make reference standards NDT1088-050/063 as identified in Figure 1.

      (2) Make reference standard NDT1088-062/071 as identified in Figure 2.

      (3) Make reference standard NDT1088-112/100 as identified in Figure 3.

   E. Probe Guide

      (1) A nonconductive straightedge is necessary for this inspection.

      NOTE: The use of a thin nonconductive straightedge is recommended to more easily fit the curved surface of the fuselage.

3. **Preparation for Inspection**

   A. Get access to the inspection areas.

B. Remove loose paint and dirt from the surface of the inspection area.

C. Remove sealant that extends above the outer surface of the fuselage skin that causes the probe to lift off of the fuselage skin surface.

NOTE: Sealant in the space (gap) between the skins at the butt-splices does not have to be removed.

4. **Instrument Calibration**

A. Get the reference standard that is necessary for the location to be examined. Use a reference standard that has a splice strap thickness equal to or less than the airplane splice strap thickness and that has a skin thickness that is equal to or more than the airplane skin thickness. See Table 1 below.

Table 1 Reference Standard and Frequency Data

Skin/Strap Thickness Inch (mm)	Reference Standard Number	Frequency
$\leq$ 0.050/0.063 (1.27/1.60)	NDT1088-050/063	1.5 to 3 kHz
$\leq$ 0.062/0.071 (1.58/1.80)	NDT1088-062/071	1.5 kHz
$\leq$ 0.156/0.100 (3.96/2.54)	NDT1088-112/100	1.5 kHz

B. Set the instrument frequency to the value identified in Table 1 for the reference standard that was selected in Paragraph 4.A.

C. If the inspection area is painted, put a nonconductive shim (paper, tape, etc.) on top of the reference standard. The shim thickness must be within 0.006 inch (0.15 mm) of the thickness of the paint.

D. Set the instrument's gain ratio to 1:1. If the instrument's gain controls can be set independently, adjust the horizontal gain to be 4 dB more than the vertical gain setting.

E. Put the probe on the reference standard at probe position 1 (P1) as shown in Figure 4, Detail I.

(1) Make sure the probe centerline is aligned with the edge of the gap that is opposite the reference notch as shown in Figure 4, Detail I, flagnote 5.

F. Set the nonconductive straightedge lightly against the probe.

(1) Adjust the straightedge as necessary so that it will keep the probe centerline aligned with the edge of the gap that is opposite the reference notch as shown in Figure 4, Detail I.

G. Balance the instrument with the probe at the P1 position.

H. Set the balance point to 30% of full screen height (FSH) and 50% of full screen width (FSW) as shown in Figure 4, Detail II, III, and IV. Balance the instrument again to be sure the dot location is set correctly.

I. Lift the probe off of the reference standard a small distance and adjust the phase control to get a lift-off signal that is almost the same as the lift-off signal shown in Figure 4, Detail II, III, or IV.

J. Make a scan to probe position 2 (P2) and adjust the probe to get a maximum signal from the reference notch as shown in Figure 4, Detail II, III, or IV. Be sure to keep the probe against the straightedge at all times.

K. Adjust the gain control to set the maximum signal from the reference notch at 40% above the balance point.

L. Make two or more scans across the reference notch to make sure the notch signal is set correctly. Adjust the phase and gain as necessary to get a signal that looks almost the same as the reference notch signal shown in Figure 4.

5. **Inspection Procedure**

NOTE: During the instrument calibration the probe was aligned with the edge of the gap that is opposite the reference notch. This was done to set the sensitivity for the worst condition. During the inspection of the failsafe strap at the butt-splices, make sure the centerline of the probe is aligned with the centerline of the gap at all times.

A. The areas to be examined by this procedure are all butt splice locations where scribe marks have been identified in the failsafe strap by a visual inspection. Refer to your records for the areas to examine.

B. Put the probe on the skins in the butt-splice inspection area.

(1) Make sure the probe centerline is aligned with the centerline of the gap as shown in Figure 4, Detail V.

C. Set the nonconductive straightedge lightly against the probe and align it so that the probe will stay correctly aligned during a scan.

D. Balance the instrument. Make sure there are no scribe marks in the splice strap where you balance the instrument. If all of the inspection area has scribe marks, then balance the instrument at a minimum of three locations to get a standard (baseline) signal. Or, if the depth of the scribe marks has been recorded, put the probe across a scribed area where the depth is at a minimum and then balance the instrument.

E. Make a scan along the butt-splice for the full inspection area. During the inspection, do the steps that follow:

(1) Make sure the probe stays aligned during the scan.

(a) If the gap between the two skins is from 0.03 to 0.08 inch (0.76 to 2.0 mm), keep the probe aligned with the gap centerline. If the probe is not kept aligned with the centerline of the gap, the balance point signal will move down-screen as the probe moves nearer to one of the two skins. Adjust the probe guide as necessary to keep the signal near the balance point location.

NOTE: During instrument calibration, when the instrument is balanced with the probe aligned at the edge of the gap, the signal moves in the vertical direction as shown in Figure 4, flagnote 3 of Details II, III, and IV. When the instrument is balanced with the centerline of the probe aligned with the centerline of the gap, the signal will move down-screen. Movement of the signal in the down-screen direction during a scan, is an indication that the straightedge and probe are not aligned with the centerline of the gap.

(b) If the gap between the two skins is from 0.081 to 0.16 inch (2.0 to 4.0 mm), it is necessary to make two scans. Make each scan the same distance from the edge of each skin panel. For example, if the gap is 0.15 inch (3.8 mm), make one scan that is 0.05 inch (1.3 mm) from the forward skin and one scan that is 0.05 inch (1.3 mm) from the aft skin.

(c) If the gap between the two skins is from 0.161 to 0.24 inch (4.0 to 6.0 mm), it is necessary to make three scans. Make a scan along the centerline of the gap and one scan on each side of the centerline with the probe in the middle of the distance from the centerline to the edge of the skin. For example, if the gap is 0.24 inch (6.0 mm), make one scan along the centerline of the gap, one scan that is 0.06 inch (1.5 mm) from the forward skin, and one scan that is 0.06 inch (1.5 mm) from the aft skin.

(2) Make a mark at all the locations where you get a signal that is 20 percent (or more) of full screen height above the balance point.

(3) Frequently do a test of the instrument calibration as follows:

NOTE: Do not adjust the gain during this test.

NOTE: Refer to the manufacturer's instrument manual for recommended time intervals to do this test.

(a) Put the probe at position P1 on the reference standard and balance the instrument. Make sure the probe centerline is aligned with the edge of the gap that is opposite the reference notch.

(b) Move the probe to position P2 and compare the signal you got from the notch during the initial calibration with the signal from the notch that you get now.

(c) If the signal from the notch in the reference standard has changed 10 percent or more from the signal you got during calibration, do the calibration and inspection again for all locations that were examined since the last calibration test.

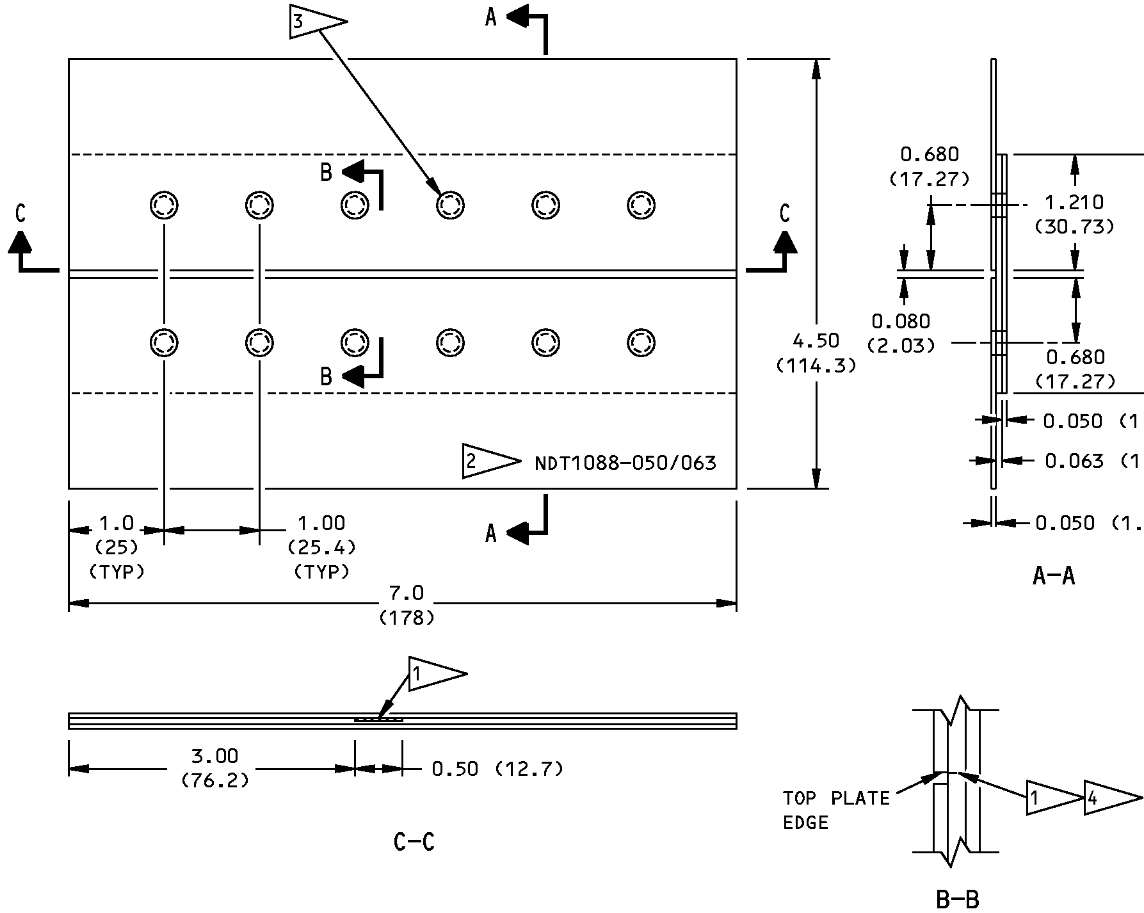
(4) Refer to Paragraph 6. to make an analysis of all locations that cause signals to occur that are 20% (or more) of FSH above the balance point.

6. Inspection Results

A. Locations must be examined more fully if they cause signals to occur that are 20 percent (or more) of FSH above the balance point and look almost the same as the notch signal from the reference standard.

B. Compare the signals that occur during the inspection on the airplane to the signals you get from the reference standard. Also compare to the same location on the opposite side of the airplane to see if the signal occurs at this location too. If the signal occurs at the same location on the two sides and is approximately the same amplitude and phase, the signal is caused by substructure and can be ignored.

C. At all locations where crack type signals occur, and where there is internal access, do an eddy current inspection as specified in Part 6, 53-00-10.



NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- 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: 2024-T3, -T4, OPTIONAL: ALL AIRPLANE QUALITY MATERIAL WITH AN ELECTRICAL CONDUCTIVITY BETWEEN 28.5% IACS AND 32% IACS CAN BE USED

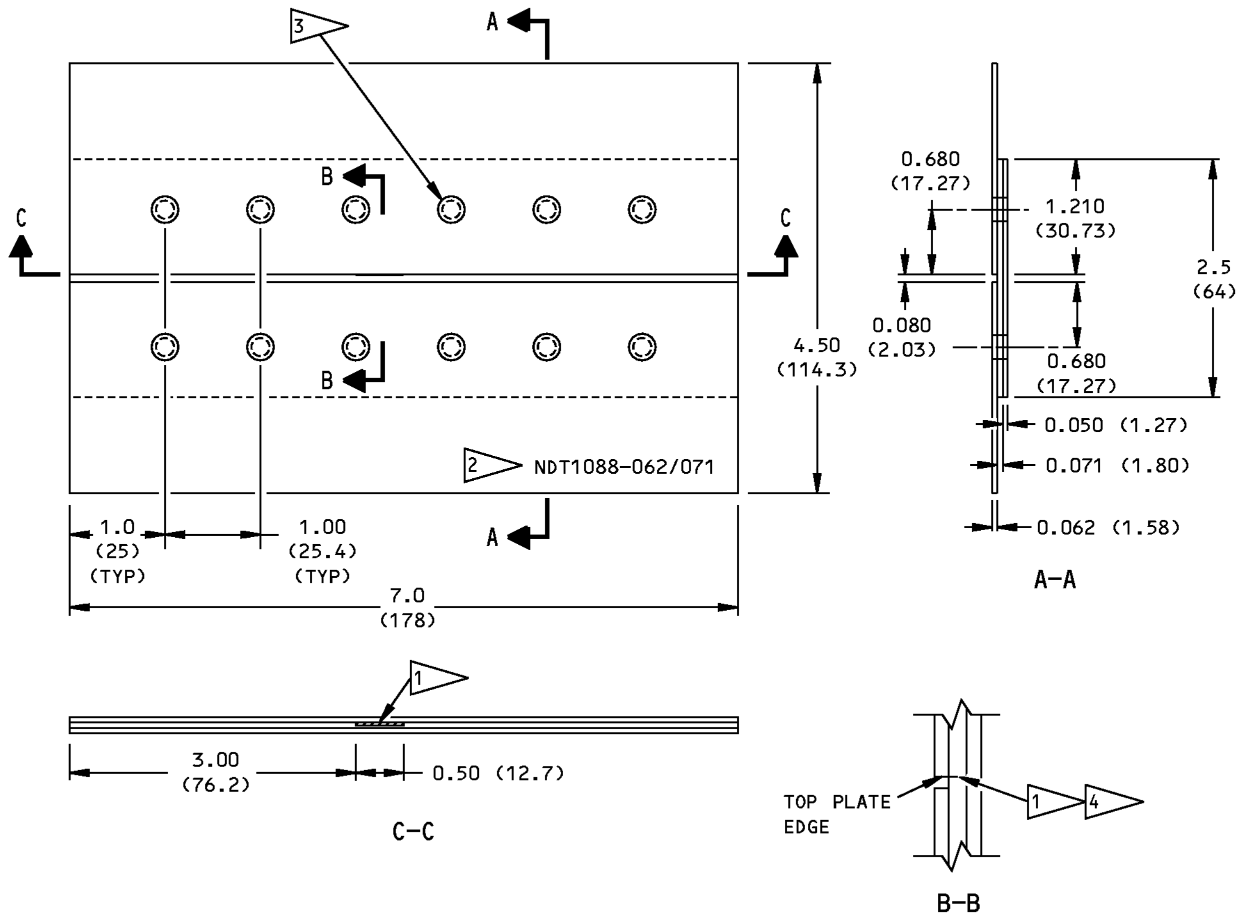
1 EDM NOTCH: 0.50 (12.7) LONG x 0.032 (0.80) DEEP x 0.007 (0.18) MAXIMUM WIDTH

2 ETCH OR STAMP THE REFERENCE STANDARD NUMBER AT APPROXIMATELY THIS LOCATION

3 INSTALL BACR15CE6D4 OR BACR15GF6D4 FASTENERS. OTHER FASTENERS ARE OPTIONAL TO THESE.

4 INSTALL THE EDM NOTCH FLUSH TO -0.005 (0.13) FROM THE EDGE OF THE TOP PLATE. (NOTE: NO PART OF THE EDM NOTCH CAN BE UNDER THE TOP PLATE)

Reference Standard NDT1088-050/063
Figure 1



NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- 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: 2024-T3, -T4, OPTIONAL: ALL AIRPLANE QUALITY MATERIAL WITH AN ELECTRICAL CONDUCTIVITY BETWEEN 28.5% IACS AND 32% IACS CAN BE USED

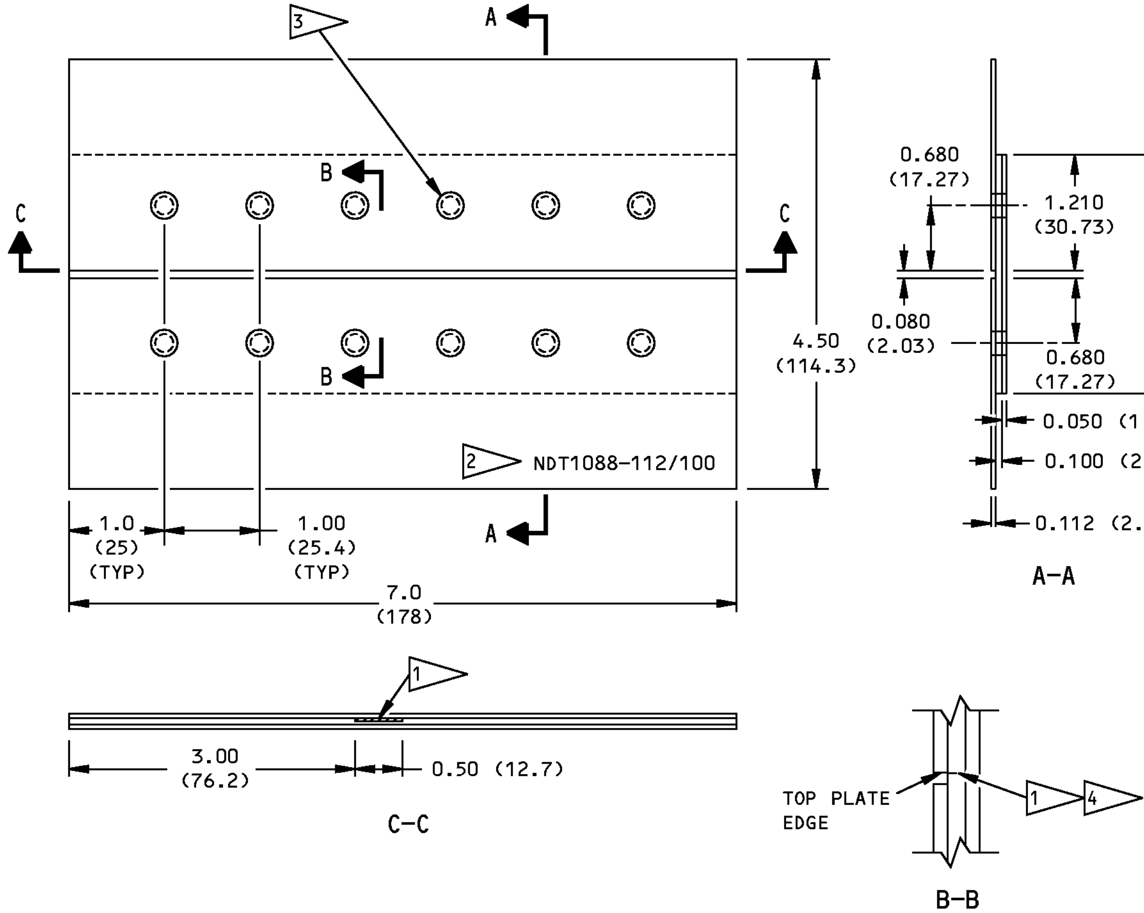
1 EDM NOTCH: 0.50 (12.7) LONG x 0.035 (0.89) DEEP x 0.007 (0.18) MAXIMUM WIDTH

2 ETCH OR STAMP THE REFERENCE STANDARD NUMBER AT APPROXIMATELY THIS LOCATION

3 INSTALL BACR15CE6D4 OR BACR15GF6D4 FASTENERS. OTHER FASTENERS ARE OPTIONAL TO THESE.

4 INSTALL THE EDM NOTCH FLUSH TO -0.005 (0.13) FROM THE EDGE OF THE TOP PLATE. (NOTE: NO PART OF THE EDM NOTCH CAN BE UNDER THE TOP PLATE)

Reference Standard NDT1088-062/071
Figure 2



NOTES:

- ALL DIMENSIONS ARE IN INCHES (MILLIMETERS ARE IN PARENTHESES)
- 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: 2024-T3, -T4, OPTIONAL: ALL AIRPLANE QUALITY MATERIAL WITH AN ELECTRICAL CONDUCTIVITY BETWEEN 28.5% IACS AND 32% IACS CAN BE USED

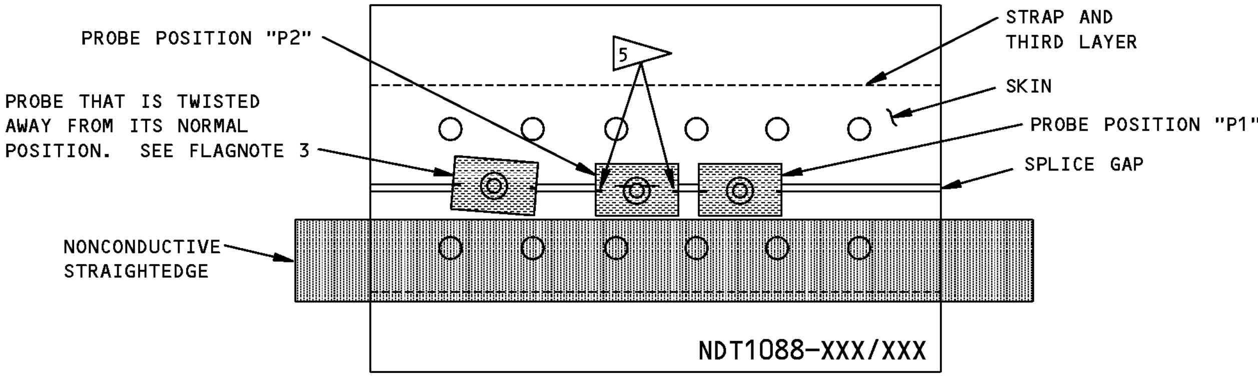
1 EDM NOTCH: 0.50 (12.7) LONG x 0.050 (1.27) DEEP x 0.010 (0.25) MAXIMUM WIDTH

2 ETCH OR STAMP THE REFERENCE STANDARD NUMBER AT APPROXIMATELY THIS LOCATION

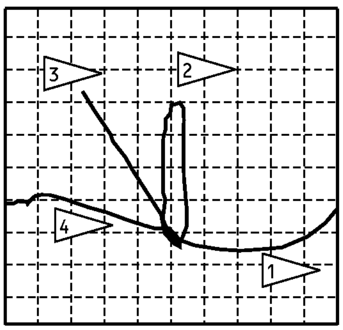
3 INSTALL BACR15CE6D4 OR BACR15GF6D4 FASTENERS. OTHER FASTENERS ARE OPTIONAL TO THESE.

4 INSTALL THE EDM NOTCH FLUSH TO -0.005 (0.13) FROM THE EDGE OF THE TOP PLATE. (NOTE: NO PART OF THE EDM NOTCH CAN BE UNDER THE TOP PLATE)

Reference Standard NDT1088-112-100
Figure 3

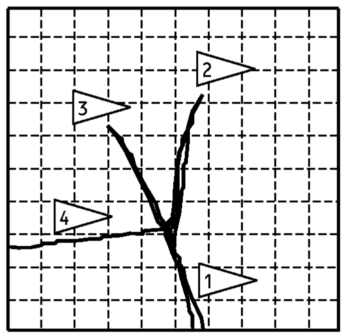


DETAIL I



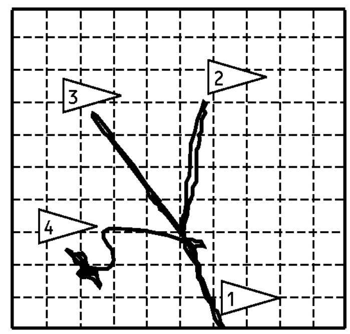
SCREEN CALIBRATION DISPLAY FOR REFERENCE STANDARD NDT1088-050/063

DETAIL II



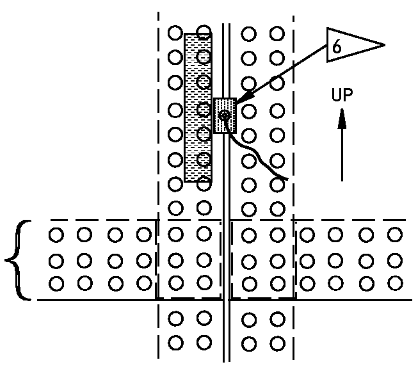
SCREEN CALIBRATION DISPLAY FOR REFERENCE STANDARD NDT1088-062/071

DETAIL III

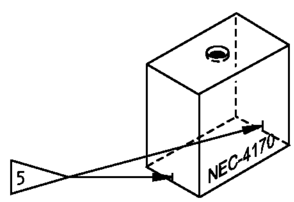


SCREEN CALIBRATION DISPLAY FOR REFERENCE STANDARD NDT1088-112/100

DETAIL IV



DETAIL V



NOTES:

1. LIFT-OFF SIGNAL
2. REFERENCE NOTCH SIGNAL
3. THIS SIGNAL OCCURS WHEN THE PROBE IS TWISTED AWAY FROM THE STRAIGHTEDGE DURING CALIBRATION. THE SIGNAL CAN ALSO MOVE IN THE OPPOSITE DIRECTION AND CAN BE SHORTER IN LENGTH THAN IS SHOWN HERE.
4. SIGNAL FROM A SUBSURFACE EDGE
5. USE THESE MARKS ON THE PROBE TO HELP KEEP THE PROBE ALIGNED WITH THE EDGE OF THE GAP DURING INSTRUMENT CALIBRATION AND ALIGNED WITH THE CENTERLINE OF THE GAP DURING THE INSPECTION.
6. KEEP THE PROBE ALIGNED WITH THE CENTERLINE OF THE GAP DURING ALL INSPECTIONS. THE DIRECTION OF THE SCAN IS OPTIONAL.

Calibration and Inspection Details
Figure 4

PART 6 - EDDY CURRENT

LAP SPLICE C-SCAN INSPECTION FOR SURFACE CRACKS IN THE LOWER SKIN

1. **Purpose**

   A. Use this surface inspection procedure to find cracks in the lower skin panels of the fuselage at the lap joints. This procedure looks for cracks that can occur from scribe lines on the outside surface of the skin. This procedure looks for cracks in the lower skin panels that are:

      (1) 0.20 inch (5.1 mm) (or more) long and 0.018 inch (0.46 mm) (or more) deep.

      (2) In the forward and aft direction.

   B. This procedure examines the lower skin for cracks in an area that is from 0.063 to 1 inch (1.60 to 25.4 mm) from the outer skin edge of the lap joint.

   C. This procedure uses a high frequency eddy current array.

   D. This procedure was written for the OmniScan MX with Eddy Current Array Module, Software Revision MXE-2.0ROT4; made by Olympus.

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 a high frequency, eddy current array instrument that:

         (a) Has at least a 32 channel probe that can scan an area that is at least 1 inch (25 mm) but less than 1.5 inches (37 mm) in width.

         (b) Operates at a frequency range of 200 kHz to 400 kHz.

         (c) Has a C-Scan display mode.

      (2) The instrument that follows was used to help prepare this procedure.

         (a) OmniScan MX with Eddy Current Array Module, Software Revision MXE-2.0ROT4; made by Olympus.

   C. Probes

      (1) Use an array probe that operates from 200 kHz to 400 kHz.

      (2) The OmniScan MX array probes that follow were used to help prepare this procedure.

         (a) SBBR-022-300-032 ECT Array probe.

         (b) SBBR-026-300-032 ECT Array probe.

   D. Reference Standard

      (1) Use reference standard NDT1095. See Figure 1 for the reference standard.

   E. Special Tools

      (1) We recommend that you use a computer mouse with a USB connector when you calibrate the OmniScan MX instrument for this inspection.

      (2) We recommend that you use a compact keyboard with a USB connector to record notes and file names in the OmniScan MX instrument.

      (3) Teflon tape.

3. Preparation for Inspection

A. Identify the inspection area. Refer to the applicable service bulletin.

B. Remove loose paint, dirt, and sealant from the surface of the inspection area.

C. For airplanes that are painted, make an estimate of the paint thickness and record the results. You can use calibrated nonconductive shims with an eddy current procedure (lift-off measurement) that uses a direct reading or an indirect reading instrument.

NOTE: You can also refer to the paint thickness instructions in the McDonnell Douglas Nondestructive Testing Standard Practice Manual, Part 6, 06-10-01.002, to measure paint thickness on the airplane.

4. Instrument Calibration

NOTE: The calibration instructions that follow are for the OmniScan eddy current array instrument. Other eddy current array or C-Scan instruments can be used if they can be calibrated on reference standard NDT1095 and get the same calibration results specified in Paragraph 4. Refer to the manufacturer's operation instructions if you use a different eddy current array instrument.

A. Attach the eddy current module and the eddy current array to the instrument as specified in the manufacturer's instructions.

NOTE: The OmniScan MX instrument has key pad commands that make the set-up easier.

B. Go to the File menu and set up the instrument as follows:

(1) Open the Open (F2) sub-menu.

(2) Open the Open (F8) sub-sub menu.

(3) If the correct calibration file is in storage, open the file and go to Paragraph 5. If the correct calibration file is not in storage, close the menu and continue with the calibration instructions that follow.

C. Go to the Measurement menu and set up the instrument as follows:

NOTE: To make sure that numerical entries are accepted, push the Accept Key after the entry is completed.

(1) Open the Reading (F2) sub-menu:

(a) Make sure the Freeze mode is Off.

NOTE: Push the Freeze Key to toggle the instrument in and out of the freeze mode. The orange LED light will flash when the Freeze mode is On.

1) Open the Acquisition (F7) sub-sub-menu and set Reading 1 to AMax.

2) Open the Acquisition (F7) sub-sub-menu and set Reading 2 to 0AMax.

3) Open the Acquisition (F7) sub-sub-menu and set Reading 3 to SAMax.

4) Open the Acquisition (F7) sub-sub-menu and set Reading 4 to IAMax.

(b) Make sure the Freeze mode is on.

1) Open the Analysis (F8) sub-sub-menu and set Reading 1 to APP.

2) Open the Analysis (F8) sub-sub-menu and set Reading 2 to 0PP.

3) Open the Analysis (F8) sub-sub-menu and set Reading 3 to SPPP.

4) Open the Analysis (F8) sub-sub-menu and set Reading 4 to IPPP.

5) Select the PP Cursor (F9) sub-sub-menu and set to ON.

(2) Open the Subtraction (F4) sub-menu:

(a) Make sure the Freeze mode is on.

1) Open the Type (F7) sub-sub-menu and set to Column.

2) Open the Activate (F8) sub-sub-menu and set to Off.

(3) Open the Signal Reference (F5) sub-menu:

(a) Set the Signal Ref. 1 (F7) sub-sub-menu to ON.

D. Go to the Preferences menu and set up the instrument as follows:

(1) Make sure the Freeze mode is Off.

(2) Open the Instrument (F4) sub-menu.

(a) Open the Category (F7) sub-sub-menu and set to unit.

(b) Open the Units (F8) sub-sub-menu and set to millimeters.

(c) Open the Angle Units (F9) sub-sub-menu and set to ASME.

(d) Open the Ampl Units (F10) sub-sub-menu and set to Voltage.

E. Go to the EC Settings menu and set up the instrument as follows:

(1) Make sure the Freeze mode is Off.

(2) Open the Settings (F3) sub-menu:

(a) Open the Frequency (F7) sub-sub-menu and set to 300 kHz ± 100 kHz.

(b) Open the Probe Drive (F8) sub-sub-menu and set to 2.0 Volts.

(c) Open the Gain (F9) sub-sub-menu and set to 40 dB +/- 5 dB.

(d) Open the Rotation (F10) sub-sub-menu and set to 325° ± 25°.

(e) Open the Vertical Gain (F11) sub-sub-menu and set to 10.0 dB.

(3) Open the Filter (F4) sub-menu:

(a) Open the Select (F7) sub-sub-menu and set to Filter 1.

(b) Open the Type (F8) sub-sub-menu and set to None.

(4) Open the Channel (F5) sub-menu:

(a) Open the Select (F7) sub-sub-menu and set to Channel 1.

(b) Open the Enable (F8) sub-sub-menu and set to ON.

(c) Do Paragraph 4.E.(4)(a) and Paragraph 4.E.(4)(b) again to set Elements 2 thru 32 to ON.

F. Go to the Scan menu and set up the instrument as follows:

(1) Make sure the Freeze mode is Off.

(2) Open the Inspection (F2) sub-menu:

(a) Open the Type (F7) sub-sub-menu and set to One Line Scan.

(b) Open the Scan (F8) sub-sub-menu and set to Time.

(c) Open the Acq. Rate sub-sub menu and set to 200 Hz.

G. Go to the Display menu and make the adjustments that follow:

(1) Open the Set-Up (F2) sub-menu:

(a) Make sure the Freeze mode is Off.

1) Open the Acquisition (F7) sub-sub-menu and set to C.

2) Open the Analysis (F8) sub-sub-menu and set to CSI.

(2) Open the Properties (F3) sub-menu:

(a) Make sure the Freeze mode is Off.

(b) Open the Display (F7) sub-sub-menu and set to C-Scan.

1) Open the Component (F8) sub-sub-menu and set to Y|.

2) Open the Interpolation (F10) sub-sub-menu and set to ON.

3) Open the Display Range (F11) sub-sub-menu and set to 3.

(c) Open the Display (F7) sub-sub-menu and set to Strip.

1) Open the Component (F8) sub-sub-menu and set to Y|.

2) Open the Direction (F10) sub-sub-menu and set to Top-Bottom.

(3) Open the Color (F6) sub-menu:

(a) Make sure the Freeze mode is Off.

1) Open the Start (F7) sub-sub-menu and set to -1.00v.

2) Open the End (F8) sub-sub-menu and set to 1.00v.

3) Open the Load (F9) sub-sub-menu, select and load the Alarm.pal file to set the C-Scan colors as follows:

a) Scroll through the list and select the Alarm.pal file.

b) Push the Accept Key.

H. Go to the Alarm/Output menu and set up the instrument as follows:

(1) Make sure the Freeze mode is Off.

(2) Open the Alarm Output (F2) sub-menu:

(a) Open the Select (F7) sub-sub-menu and set to Alarm 1.

(b) Open the Output (F8) sub-sub-menu and set to None.

I. If you want to keep the settings, save the settings to a file as follows:

(1) Make sure the Freeze mode is Off.

(2) Go to the File menu, then open the File (F3) sub-menu, then open the Save Setup As (F8) sub-sub-menu.

(a) Go to Filename (F9) and change the file name to the name you want to use for this procedure.

(b) Push the Save button (F7).

J. Put a nonconductive layer (Teflon tape), that is within ± 0.003 inch (0.08 mm) of the thickness of the paint on the inspection area, on the surface of the reference standard.

K. Put an additional nonconductive layer (Teflon tape) with a thickness of about 0.003 inch (0.08 mm) at Probe Position B on the reference standard as shown in Figure 2.

L. Put the probe at Position A on reference standard NDT as shown in Figure 2.

M. Push the Balance/Calibration Key to balance the probe.

N. Put the probe on the nonconductive layer at Figure 2, Position B and make a scan along the lap until the probe is fully on the bare metal surface. The scan must be a minimum of 0.5 inches (12.7 mm) long on the Teflon tape area and a minimum of 0.5 inches (12.7 mm) long on the bare area.

O. Push the Freeze Key to put the instrument in freeze mode. The display will change from a C-Scan in a single window to a three window CSI Display and the orange LED light will flash slowly.

P. Make sure that the C-scan display does not contain horizontal black lines. A black line is an indication that an eddy current element is bad. If black lines occur, do the steps that follow:

(1) Do Paragraph 4.E.(4) to make sure that all eddy current elements are energized.

(2) Use a different eddy current array probe.

Q. If the arrow in the impedance plane display is small and not easy to see, go to the Display menu, then to the Autofit sub-menu and push the Best Fit Key.

R. If the arrow in the impedance plane display is large and off screen, go to the Display menu, then to the Autofit sub-menu and push the Full Scale Key.

S. Use the procedure that follows to set the lift-off phase angle:

(1) Go to the EC Settings menu, then open the Settings (F3) sub-menu and make the adjustments that follow:

(a) Put the mouse cursor on the C-Scan display in the area that shows the bare area scan at Figure 2, Position A of the reference standard.

(b) Push the left mouse button two times. A red X must occur on the C-Scan at an area that shows the bare area of the reference standard. See the C-Scan display on Figure 3 for an example.

(c) Put the mouse cursor at the location on the C-Scan display that shows the area scanned at the Teflon tape covered position on the reference standard at Figure 2, Position B.

(d) Push the right mouse button two times. A blue + must occur on the C-Scan at an area that shows the tape covered area of the reference standard. See the C-Scan display on Figure 3 for an example.

(e) If the blue + is on a horizontal line that is different from the horizontal line that the red X is on, put the mouse cursor on the horizontal line that goes through the blue +. A double arrow must be displayed.

(f) Push and hold the left mouse button, and pull the horizontal line until it is on top of the horizontal line that goes through the red X. See the C-Scan display on Figure 3 for an example.

(g) Release the left mouse button when the line goes through the red X.

(h) Press the Rotation Key (F10).

(i) Look at the impedance display at the upper left side of the screen and adjust the rotation parameter (phase) until the pink arrow points horizontally to the left side of the impedance display. See the impedance display on Figure 3 for an example.

NOTE: The Full Size or Best Fit Key can be used to keep the arrow on the impedance plane display.

(j) Push the Accept Key.

(k) The two scans, one on the Teflon tape area and the other on the bare area of the reference standard, for the two areas must be about the same shade of green. See the impedance display on Figure 3 for an example.

T. Set the EDM notch signal as follows:

(1) Push the Freeze Key to put the instrument in scan mode. The orange LED light will go out.

(2) Put the probe at Probe Position A on the reference standard as shown in Figure 2. Make sure the probe is aligned with the edge of the lap and push the Balance/Calibration Key to balance the instrument.

(3) Move the probe from Figure 2, Probe Position A to Probe Position C along the edge of the lap on reference standard NDT1095 as shown in Figure 2 to make an initial scan.

(4) Do a check of the C-scan display to make sure that all three EDM notches show clearly. The typical crack display is a red indication on a green background, as shown in Figure 4, Details A thru C.

(5) Adjust the gain setting, if necessary, so that the EDM notch shows as a red indication as shown in Figure 4, Details A thru C. See Figure 5, Detail II for an example when there is not sufficient gain.

(6) Move the probe from Probe Position C to Probe Position D along the edge of the lap on reference standard NDT1095 as shown in Figure 2 to identify if there is too much gain.

(a) If the notch on the reference standard between Probe Position C and Probe Position D shows as a red indication then there is too much gain. Remove some gain and do Paragraph 4.T.(3) thru Paragraph 4.T.(6) again until the notch between Probe Position C and Probe Position D on the reference standard does not show a red indication.

NOTE: The gain setting must cause the notch locations between Probe Position A and Probe Position C to show as red indications.

U. Save your final calibration set-up in the instrument memory. The file name must identify this procedure number.

5. Inspection Procedure

A. Load the correct calibration file for this inspection into the instrument's memory, and make sure that the selections of Paragraph 4. are correct.

B. Put the array probe on reference standard NDT1095 so that it is on the lower skin inspection area below the lap splice and make a scan from Figure 2, Probe Position B to Probe Position C to do a check of the calibration.

(1) Do Paragraph 4. again, if the calibration is not sufficient to identify the EDM notches.

C. Balance the array probe on the lower skin. Make sure that the array probe touches the edge of the lap splice. See Figure 6 for the correct probe position.

D. Make a scan of the lower skin along the edge of the lap splice, as shown in Figure 6. During the scan:

(1) Make sure that the probe touches the lap joint for the full scan.

(2) Monitor the C-scan display. In areas without cracks a green background will be seen. See Figure 4 for examples of crack indications in the skin.

(3) Mark all locations that cause red crack indications to occur on the eddy current array display. Mark the locations as follows:

(a) Move the probe toward one end of the crack until the red crack signal is shown on the display.

NOTE: When the probe is stopped above a crack, a red horizontal stripe indication will occur on the display.

(b) Make a mark on the airplane with an approved marker. Align the mark with the location of the eddy current coils on the probe.

(c) Move the probe to find the other end of the crack.

(d) Make a mark on the airplane with an approved marker. Align the mark with the location of the eddy current coils on the probe.

6. Inspection Results

A. Red indications on the C-scan display are possible cracks. These areas must be examined some more.

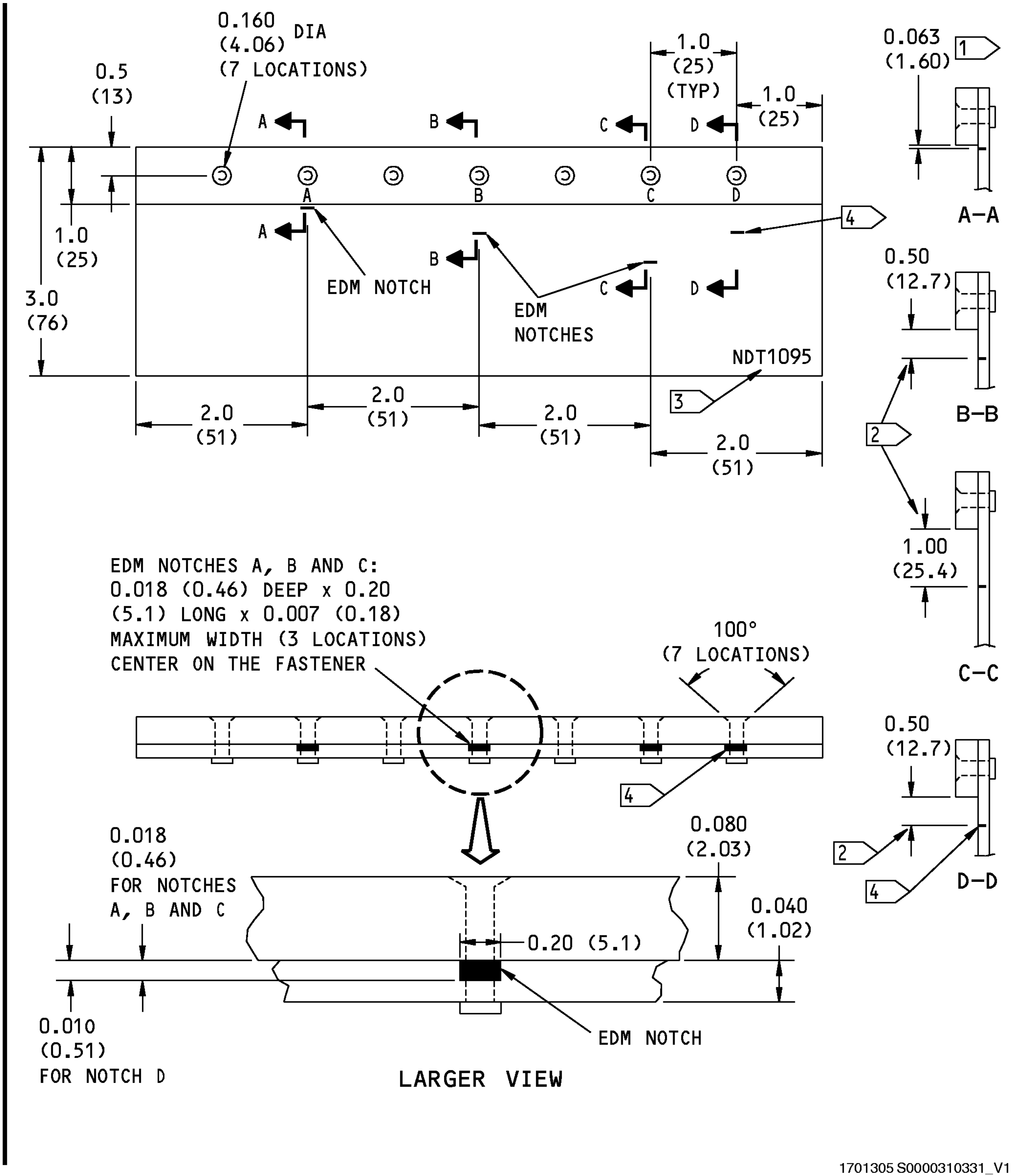
(1) Do a check of the paint thickness on your airplane. If the paint thickness on the airplane is thinner than the nonconductive coating on the reference standard, the inspection can be too sensitive.

(2) Do a check of your gain setting. A gain setting that is too high can cause incorrect crack indications. See Paragraph 4.

B. You can use the applicable procedure that follows to help make sure that the indications are from cracks:

(1) Part 6, 51-00-19 for 757 and 767 airplanes.

(2) Part 6, 51-00-01, procedure 2 for 777 airplanes.



Reference Standard NDT1095
Figure 1 (Sheet 1 of 2)

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

- NOTCH DEPTH TOLERANCE: ±0.002 (0.05). NOTCH LENGTH TOLERANCE: ±0.010 (0.25)
- MATERIAL: 2024-T3 CLAD
  BOTTOM LAYER: 12.0 (304) x 4.0 (102) x 0.040 (1.0)
  TOP LAYER: 12.0 (304) x 1.0 (25) x 0.080 (2.03)
- RIVETS: BACR15GF5D5 OR BACR15CE5D5. QUANTITY 7.

[1] THE NOTCH LOCATION TOLERANCE (FROM THE EDGE) FOR THIS NOTCH IS +0.003 (0.08), -0

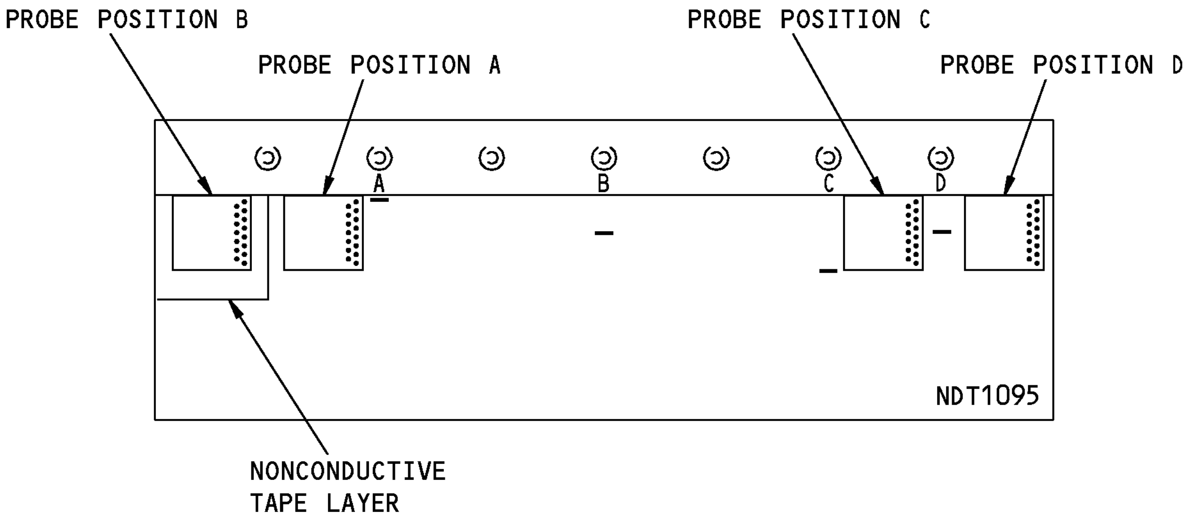
[2] THE NOTCH LOCATION TOLERANCE (FROM THE EDGE) FOR THESE THREE NOTCH LOCATIONS IS ±0.005 (0.13).

[3] ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT1095

[4] EDM NOTCH D: 0.010 (0.51) DEEP X 0.20 (5.1) LONG X 0.007 (0.18) MAXIMUM WIDTH. CENTER ON THE FASTENER

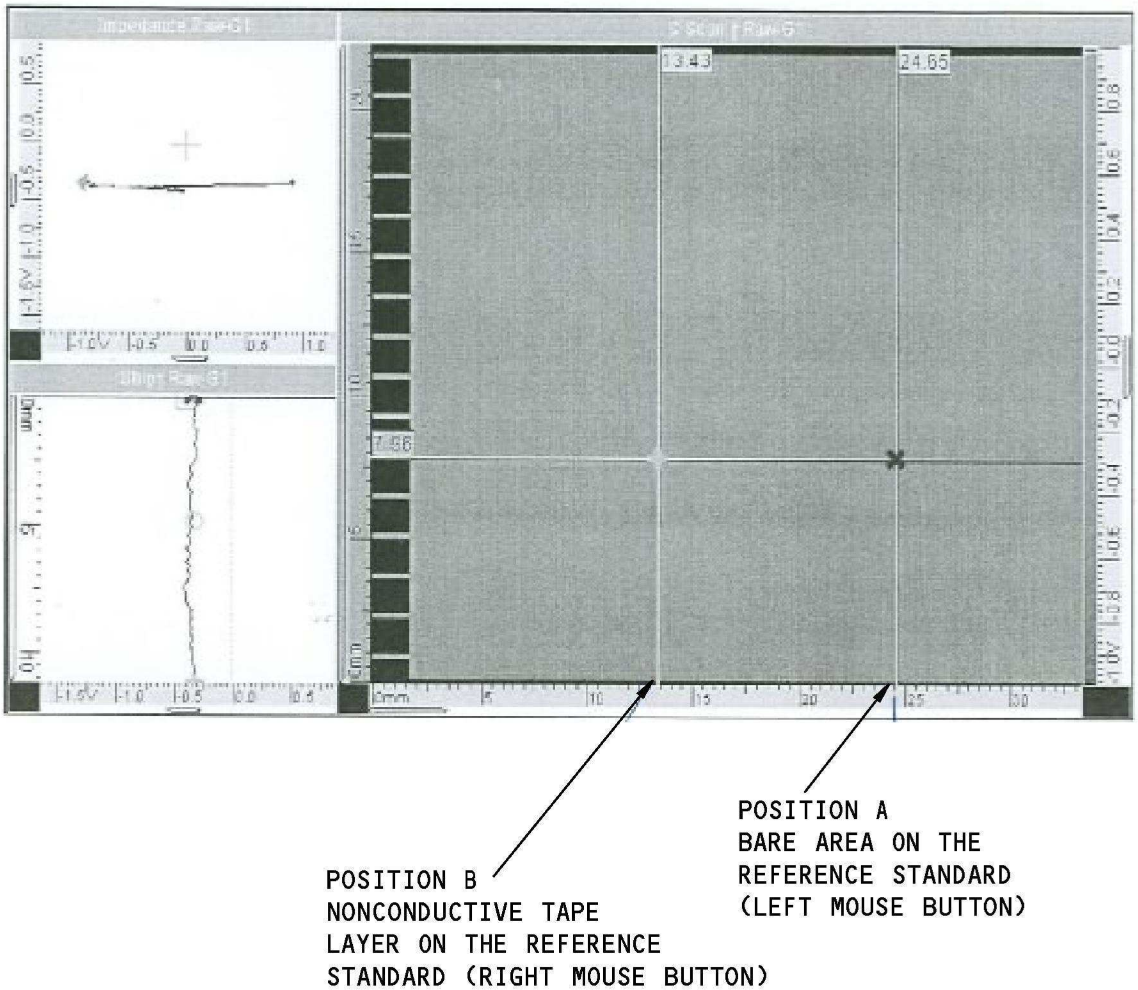
1701176 S0000311326_V1

Reference Standard NDT1095
Figure 1 (Sheet 2 of 2)



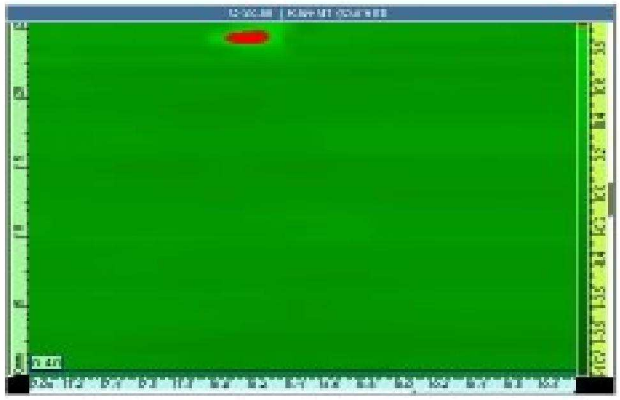
1701935 S0000310332_V1

Calibration Probe Positions
Figure 2

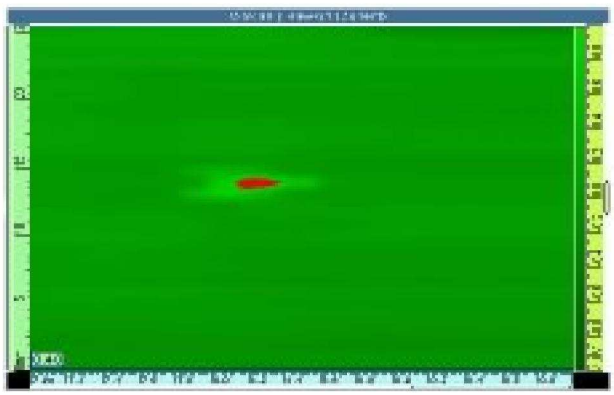


1701948 S0000310333_V1

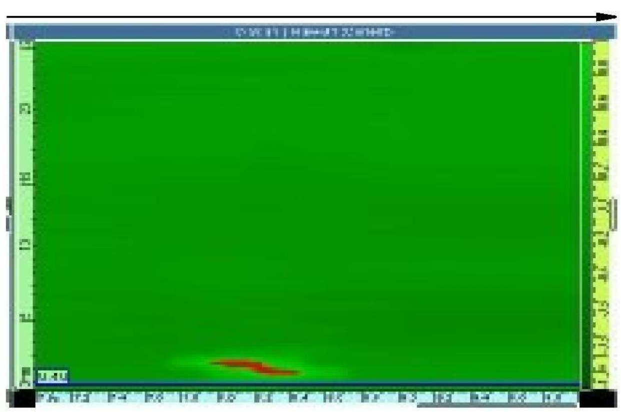
Lift-off Adjustment
Figure 3



NOTCH A SIGNAL
DETAIL A



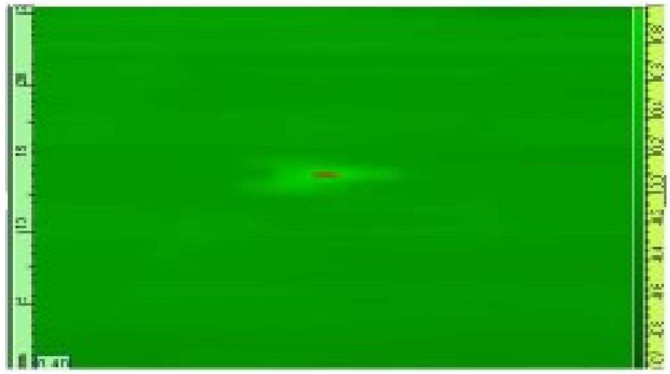
NOTCH B SIGNAL
DETAIL B



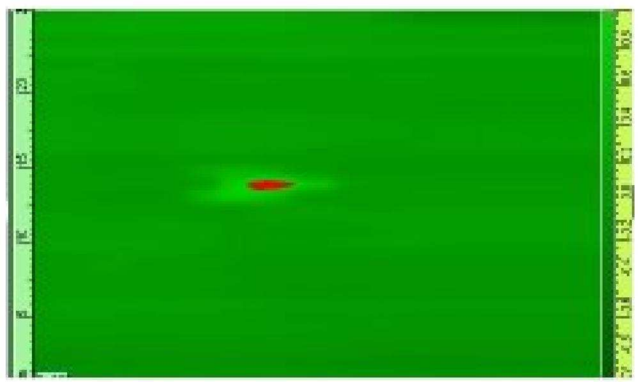
NOTCH C SIGNAL
DETAIL C

1701946 S0000310334_V1

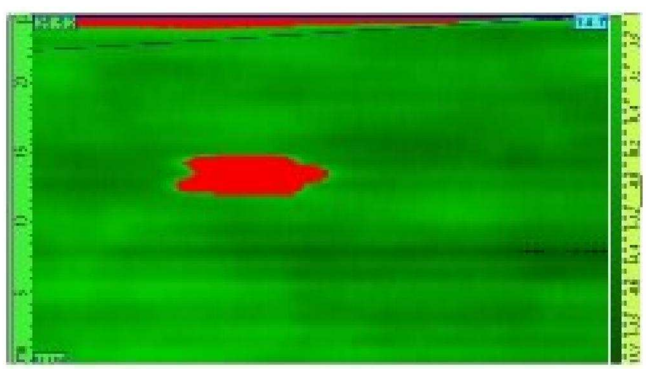
Reference Standard Notch Position
Figure 4



NOT SUFFICIENT GAIN
DETAIL A



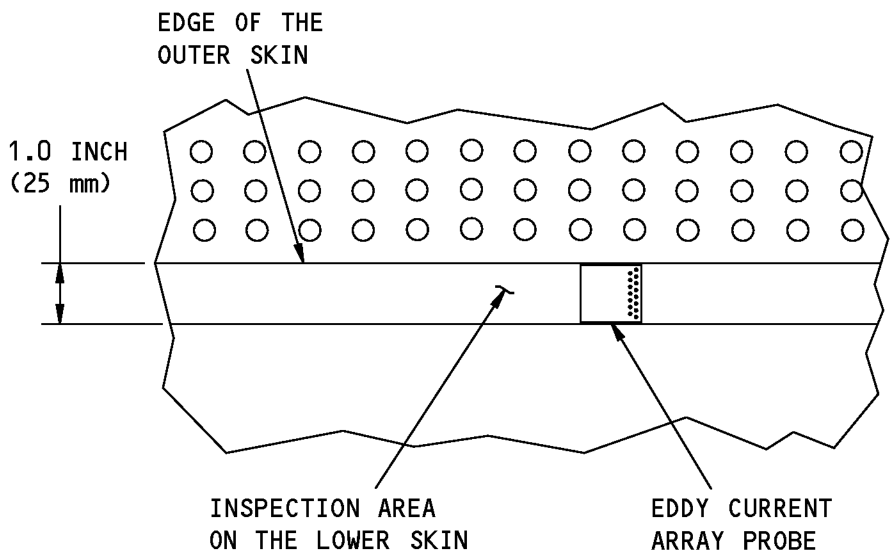
CORRECT GAIN
DETAIL B



TOO MUCH GAIN
DETAIL C

1701210 S0000310335_V1

Gain Settings
Figure 5



1700919 S0000310336_V1

Inspection Areas
Figure 6