



## 737 NON-DESTRUCTIVE TEST MANUAL

### PART 4 - ULTRASONIC

#### FORWARD ENTRY DOOR UPPER HINGE ARM

##### 1. Purpose

- A. To detect cracks, 0.060 x 0.060-inch or greater, at the lower inboard and outboard corner of the splined hole in the forward entry door upper hinge arm, P/N 65-29995-1.
- B. Service Bulletin Reference: 737-52-1044
- C. 737 Maintenance Planning Document (D6-17594) Reference:
  - (1) Item: 6-52-03

##### 2. Special Instruction

- A. It is recommended that this ultrasonic inspection be performed by experienced personnel only.

##### 3. Equipment

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

- A. This inspection has been performed using the following equipment:
  - (1) Ultrasonic instrument. Any pulse echo ultrasonic instrument that will satisfy the performance requirements of this procedure is suitable for this inspection. The following instruments have been used and found suitable:
    - (a) USL-38; Krautkramer Branson
    - (b) NDT-131; Nortec
  - (2) Transducer
    - (a) 5.0 MHz, 0.25-inch (0.63 cm) diameter transducer in a 0.375-inch (0.95 cm) diameter case
  - (3) Transducer Positioning Fixture 123
    - (a) Fabricate or purchase the transducer positioning fixture shown in Detail I in Figure 1.

**NOTE:** As an alternative to the above transducer and transducer positioning fixture, a commercially available 45° shear wave (aluminum) transducer, maximum case size approximately 1.0 inch (2.54 cm) long, 0.35 inch (0.89 cm) wide and 0.65 inch (1.65 cm) high can be used. An Automation Industries model 57A3064, Type SMZ, 5.0 MHZ, 45°A transducer was used in developing this procedure.
  - (4) Reference Standard
    - (a) Fabricate the reference standard from a spare part, P/N 65-29995-1 or -2 as shown in Detail II in Figure 1. The 0.060 x 0.060 inch saw cut shall be on the lower inside surface (door closed).
  - (5) Couplant
    - (a) Light grease or oil

##### 4. Prepare for the Inspection

- A. Open door.
- B. Remove any loose or flaking paint from the lower surface of the hinge arm. Use a medium grade sandpaper to smooth any rough or corroded surfaces.
- C. Coat the part surface with couplant.



## 737 NON-DESTRUCTIVE TEST MANUAL

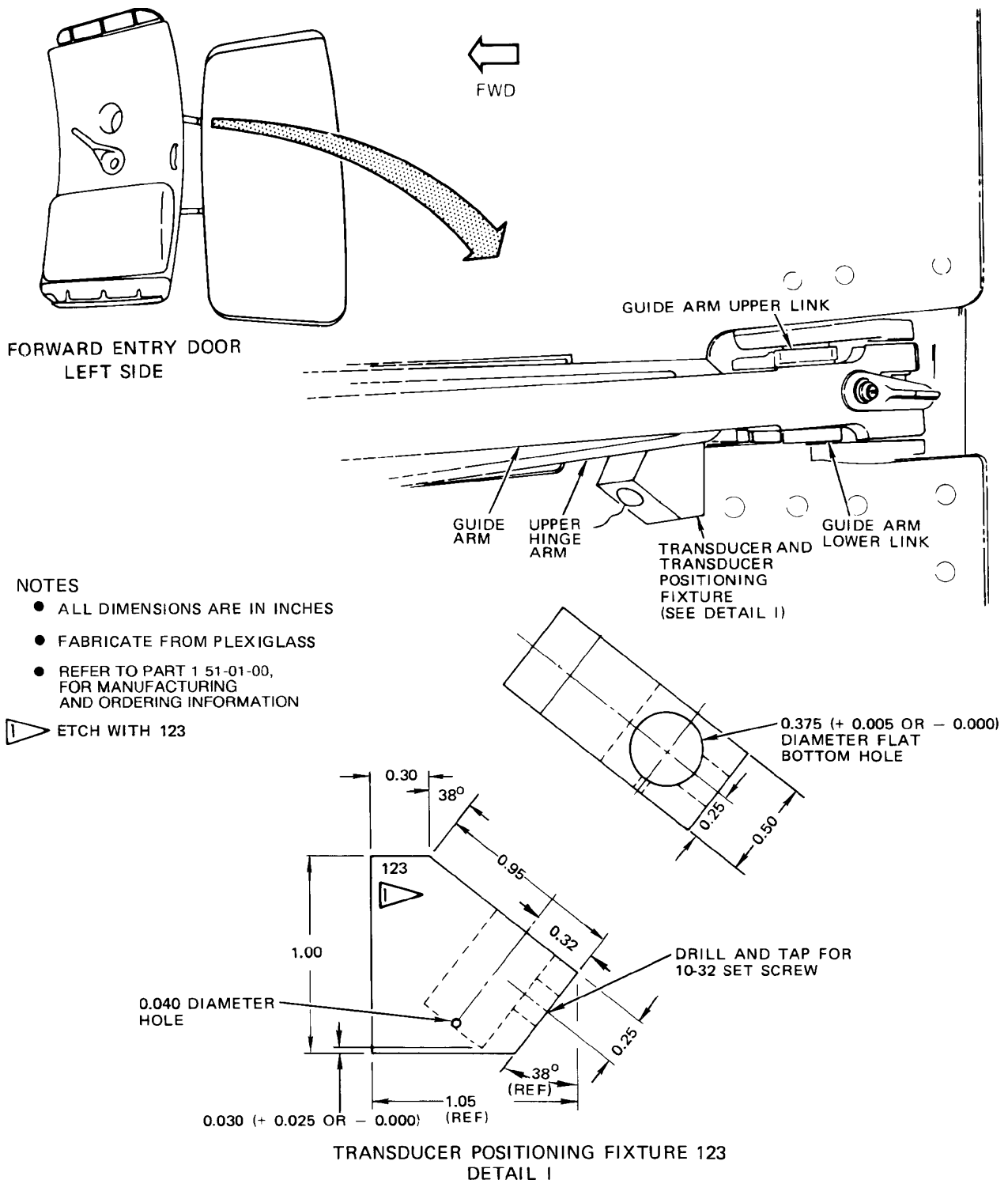
### 5. Instrument Calibration

- A. Seat the transducer firmly in the transducer positioning fixture with couplant.
- B. Coat the reference standard with couplant.
- C. Place the transducer positioning fixture on the reference standard, as shown in Detail III in Figure 1 and position to obtain the maximum response from the simulated crack.
- D. Center the crack response on the instrument and adjust the signal level to approximately 50 percent. Note the signal position and its characteristic movement as the transducer assembly is moved (see Detail I in Figure 2). This instrument setting should be used to evaluate indications located during inspection of the hinge arm.
- E. Scan the opposite side of the hole (which does not contain a saw cut) to determine the amplitude of indications from the splines (see Detail II in Figure 2).

### 6. Inspection Procedure

- A. Place the transducer positioning fixture on the lower surface of the upper hinge arm and scan in the same manner used to locate the simulated crack in the reference standard (see Detail III in Figure 1).
- B. Ultrasonic indications equal to or greater than 50 percent of full screen height are probable cracks and should be investigated further.

**737**  
**NON-DESTRUCTIVE TEST MANUAL**



2157778 S0000471244\_V1

**Forward Entry Door Upper Hinge Arm**  
**Figure 1 (Sheet 1 of 2)**

**EFFECTIVITY**  
**ALL; 737-100 AND -200 AIRPLANE LINE NUMBERS**  
**1 THRU 325**

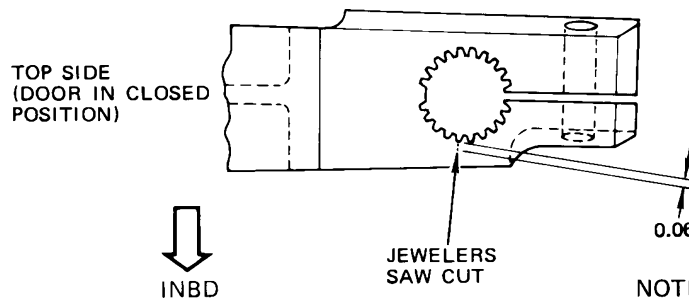
**PART 4 52-10-01**

D6-37239

BOEING PROPRIETARY - Copyright © Unpublished Work - See title page for details

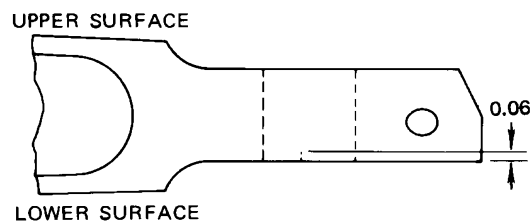
Page 3  
Nov 15/2015

**737**  
**NON-DESTRUCTIVE TEST MANUAL**

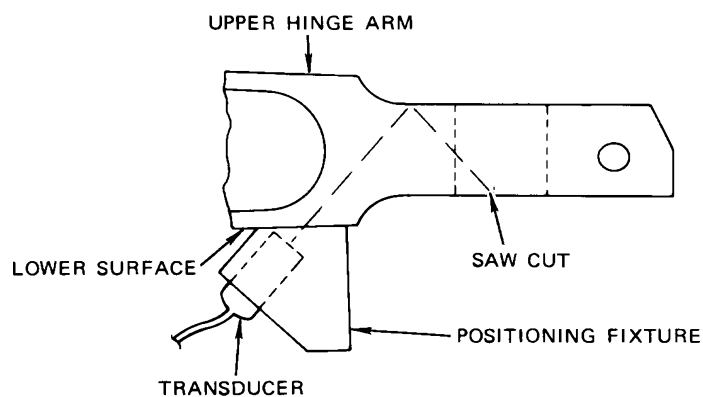


**NOTES**

- ALL DIMENSIONS ARE IN INCHES
- REFERENCE STANDARD  
FABRICATED FROM SPARE  
PART (REFERENCE  
65-29995-1, -2)



**REFERENCE STANDARD  
DETAIL II**



**TRANSDUCER POSITION FOR CALIBRATION AND INSPECTION  
DETAIL III**

2157779 S0000471245\_V1

**Forward Entry Door Upper Hinge Arm  
Figure 1 (Sheet 2 of 2)**

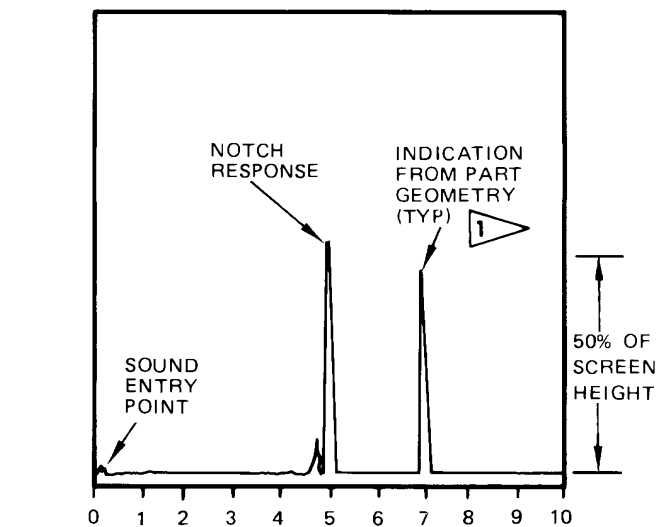
**EFFECTIVITY**  
**ALL; 737-100 AND -200 AIRPLANE LINE NUMBERS**  
**1 THRU 325**

D6-37239

**PART 4 52-10-01**

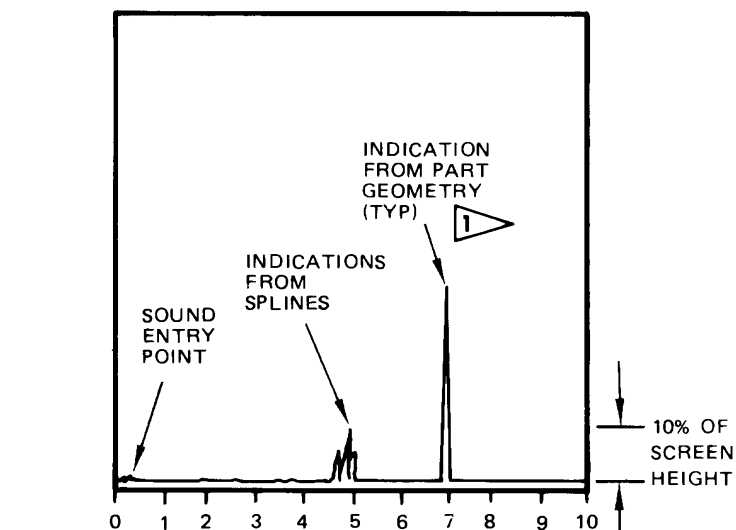
Page 4  
Nov 15/2015

# 737 NON-DESTRUCTIVE TEST MANUAL



RESPONSE PATTERN FROM NOTCHED SIDE OF STANDARD

DETAIL 1



RESPONSE PATTERN FROM UN-NOTCHED SIDE OF STANDARD

DETAIL II

**1** VERIFY REFLECTIONS FROM PART GEOMETRY BY FINGERDAMPING IF POSSIBLE.

2157780 S0000471246\_V1

Ultrasonic Response Patterns from Reference Standard  
Figure 2

EFFECTIVITY  
ALL; 737-100 AND -200 AIRPLANE LINE NUMBERS  
1 THRU 325

D6-37239

BOEING PROPRIETARY - Copyright © Unpublished Work - See title page for details

**PART 4 52-10-01**

Page 5  
Nov 15/2015



## 737 NON-DESTRUCTIVE TEST MANUAL

### PART 4 - ULTRASONIC

#### AFT CARGO DOOR FRAMES

##### 1. Purpose

- A. Use this procedure to examine the cargo door frames for cracks. This ultrasonic shear wave inspection is done with the aft cargo door open. The cargo door seal retainer must be removed to do this inspection. This inspection is done on the aft frame and the forward frame. See Figure 1 for the inspection areas.
- B. This procedure can find cracks in the door frame radius that are not fully through the frame. These cracks start on the internal side of the frame. See Figure 1 for the inspection areas.
- C. Service Bulletin Reference: 737-52A1079, 737-52A1153

##### 2. Equipment

- A. General
  - (1) Use inspection equipment that can be calibrated on the reference standard specified in Paragraph 2.D.
  - (2) Refer to Part 1, 51-01-00 for data about the equipment manufacturers.
- B. Instrument
  - (1) All ultrasonic instruments are permitted for use if they:
    - (a) Can operate at a frequency between 9 MHz and 11 MHz. Broadband instruments can be used if they can do the calibration instructions of this procedure.
    - (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) USN 52; Krautkramer Branson
    - (b) Sonic 136; Staveley Instruments
    - (c) Epoch 2002; Panametrics
- C. Ultrasonic Transducer
  - (1) Use a transducer that:
    - (a) Puts a shear wave in aluminum that is between 65 and 75 degrees.
    - (b) Operates at a frequency between 9 MHz and 11 MHz.
    - (c) Has a maximum outer case length of 0.315 inch (8.0 mm).
    - (d) Can give satisfactory results during calibration as specified in Paragraph 4.
  - (2) The transducers that follow were used to help prepare this procedure.
    - (a) Part Number SUS 1015-10MHz-70A; NDT Engineering Corp.
    - (b) Part Number HS-7520-10-70A; Staveley Sensors

**NOTE:** A different vendor can make this transducer, but the transducer must have the properties specified in Paragraph 2.C.(1). The calibration in Paragraph 4. must also be done satisfactorily with the transducer.
- D. Reference Standard – Make reference standard NDT3068 as specified in Figure 2.

ALL

EFFECTIVITY

**PART 4 52-10-02**

D6-37239

BOEING PROPRIETARY - Copyright © Unpublished Work - See title page for details

Page 1  
Nov 15/2015



## 737 NON-DESTRUCTIVE TEST MANUAL

E. Ultrasonic Couplant – Use oil, grease or an equivalent couplant that will not damage the part.

### 3. Prepare for the Inspection

A. Open the aft cargo door that is between body stations 796 and 844.

**NOTE:** It is optional to remove the cargo door from the airplane to do this inspection.

B. Remove the door seal retainers from the aft and forward frame inspection areas identified in Figure 1.

**CAUTION:** THE TRANSDUCER SCAN AREA MUST BE CLEANED CORRECTLY. IF SEALANT, DIRT, AND PAINT ARE NOT REMOVED, SUFFICIENT ULTRASOUND WILL NOT GO INTO THE FRAME.

C. Remove sealant and paint from the inspection areas shown in Figure 1. See Figure 1, flagnote 1, for the transducer scan area.

### 4. Instrument Calibration

A. Connect the cable to the transducer and the instrument.

B. Set the instrument frequency between 9 MHz and 11 MHz. If a broadband instrument is used, then it is not necessary to adjust the frequency.

C. Make sure the “reject” is set to “off”.

D. Apply couplant to the transducer scan area on reference standard NDT3068. The transducer scan area is adjacent to the straight edge (see Figure 3).

**NOTE:** Too much couplant in front of the transducer can cause a signal to occur on the screen display that is not from the EDM notch. If this occurs, remove the couplant from in front of the transducer. Do not remove couplant that is below the transducer.

E. Put the transducer on reference standard NDT3068 so the front of the transducer is where the flat area starts. Make sure the transducer points to the EDM notch.

F. Slowly move the transducer left and right until the signal from the EDM notch is at a maximum height on the screen.

G. Adjust the gain to put the notch signal at 90 percent of full screen height. See Figure 3 for the calibration signals.

H. Adjust the range and delay so the signal from the notch is at 50 percent of full screen width and the initial pulse is at 0. See Figure 3.

I. Increase the gain by 12 dB.

### 5. Inspection Procedure

A. Do the calibration as specified in Paragraph 4.

B. Put sufficient couplant on the surface of the frame in the transducer scan area. The transducer scan area is the door frame surface where the frame is flat. Make sure no couplant goes on the area outboard of the line shown in Figure 1, flagnote 3. See Figure 1 for the transducer scan area and the possible crack locations in the radius of the door frame.

C. Put the transducer on the frame in the inspection area. Make sure the front of the transducer is on the line as shown in Figure 1, views A-A and B-B, flagnote 3. See Figure 1 for the inspection area on the frames.

ALL

EFFECTIVITY

**PART 4 52-10-02**

D6-37239

Page 2  
Nov 15/2015



737

## NON-DESTRUCTIVE TEST MANUAL

- D. Slowly do a complete scan in the transducer scan area while you keep the front of the transducer on the guide line. As you do the scan on the guide line, slowly turn the transducer 15 degrees left and right. Monitor the screen display for crack indications as you do the scan. See Figure 1 for the inspection areas, scan direction, and guide line in flagnote 3.
- E. Do Paragraph 5.B. thru Paragraph 5.D. on the frame on the opposite side of the aft cargo door.

### 6. Inspection Results

- A. An ultrasonic signal is a crack signal if:
  - (1) The signal is 30 percent or more of full screen height and between 35 and 80 percent of full screen width.
- B. Some signals can be caused by couplant that is in front of the transducer on the frame. Other signals can be caused by grease or sealant on the frame where cracks could occur. If you get a crack-type signal, clean the area in front of the transducer to see if the signal could be caused by couplant on the frame in front of the transducer. Do not remove couplant from below the transducer.
- C. Some signals can be caused by the transducer. To see if the signal is from the transducer, move the transducer away from the guide line and back to the guide line. If the signal does not move left or right on the screen display during the transducer movement, that signal is from the transducer and not from a crack.
- D. Compare the signals that occur during the inspection to the signals that you got from the reference standard notch during calibration.
- E. Make sure the indication is not from a fastener hole where the skin is installed. These fastener holes are on the other side of the frame radius. These holes could give indications on the display between 75 to 85% (approximately) of full screen width. See if the signal occurs when the transducer points at a fastener hole.

ALL

EFFECTIVITY

**PART 4 52-10-02**

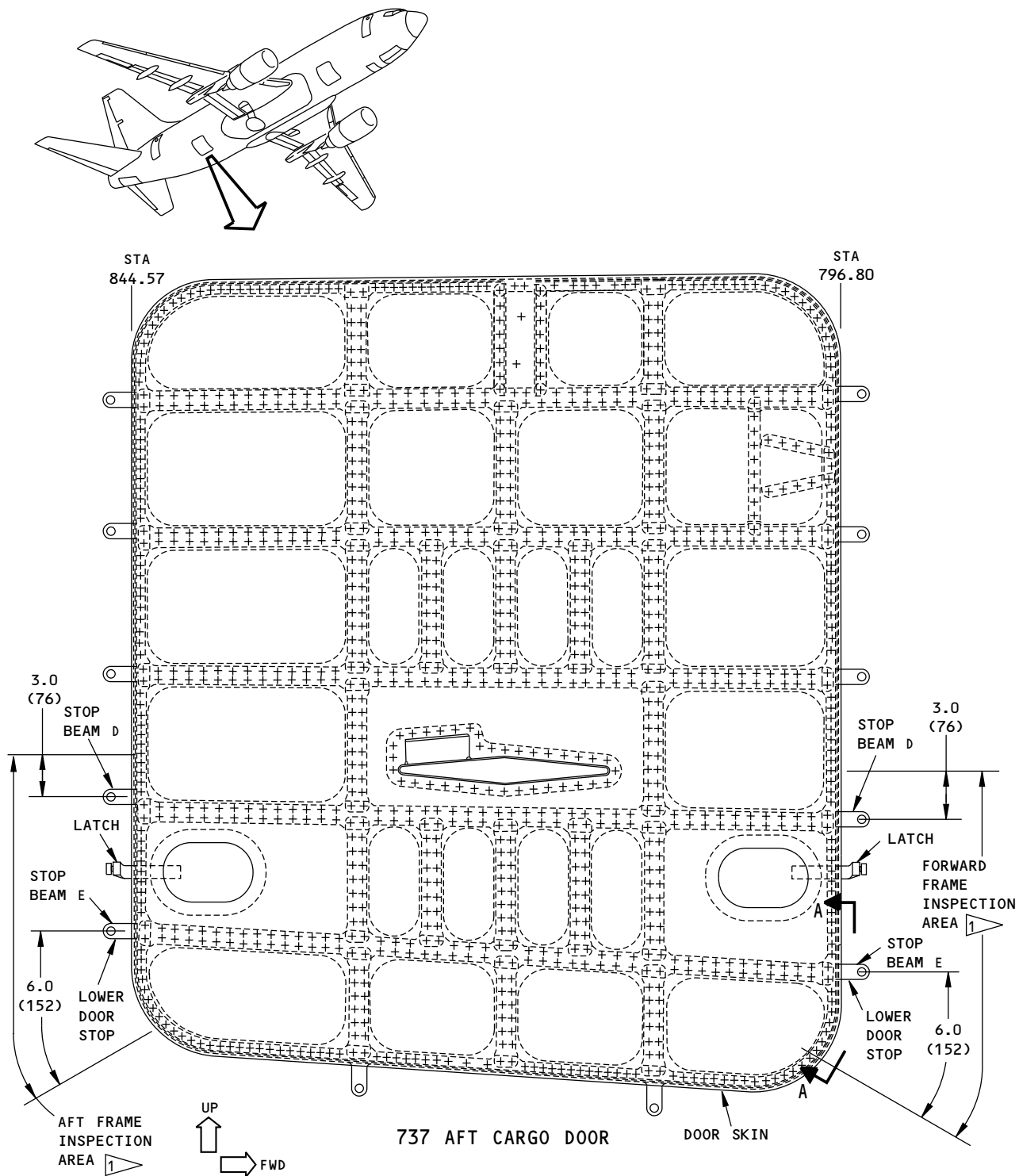
D6-37239

BOEING PROPRIETARY - Copyright © Unpublished Work - See title page for details

Page 3  
Nov 15/2015



# 737 NON-DESTRUCTIVE TEST MANUAL



Inspection Areas on the Aft Cargo Door Frame  
Figure 1 (Sheet 1 of 2)

ALL EFFECTIVITY

PART 4 52-10-02

D6-37239

Page 4  
Nov 15/2015



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

- 1 THE ULTRASONIC INSPECTION AREAS ON THE AFT AND FORWARD FRAMES ARE FROM 3 INCHES (76 MM) ABOVE STOP BEAM D TO 6 INCHES (152 MM) BELOW STOP BEAM E.
- 2 THE FORWARD FRAME IS SHOWN HERE. THE INSPECTION AREA ON THE AFT FRAME IS OPPOSITE AND EQUIVALENT. THE COMPLETE INSPECTION IS NOT SHOWN HERE. SEE FIGURE 1, SHEET 1 FOR THE COMPLETE INSPECTION AREA.
- 3 MAKE A LINE WITH A FELT TIP MARKER ON THE FRAME AS SHOWN ABOVE. THIS LINE IS MADE WHERE THE FLAT AREA ON THE FRAME STARTS. THIS LINE IS USED AS A GUIDE SO THE FRONT OF THE TRANSDUCER GOES ALONG THE LINE DURING THE SCANS. THE TRANSDUCER MUST BE KEPT ON THE FLAT AREA OF THE FRAME DURING THE INSPECTION. IF THE FRONT OF THE TRANSDUCER GOES OUTBOARD OF THE SCAN LINE, THE TRANSDUCER WILL LIFT OFF OF THE FRAME. IF THIS OCCURS, SOUND WILL NOT GO IN THE FRAME.
- 4 THESE TWO FASTENERS CAN POSSIBLY BE BELOW THE TRANSDUCER DURING THE SCANS. OTHER FASTENER HOLES CAN POSSIBLY BE BELOW THE TRANSDUCER DURING THE SCANS. THIS CONDITION IS PERMITTED.
- 5 THIS IS THE TRANSDUCER SCAN AREA ON THE FRAME. REMOVE PAINT AND SEALANT FROM THIS AREA BEFORE YOU DO THE INSPECTION. IF PAINT OR SEALANT IS ON THE TRANSDUCER SCAN AREA, SUFFICIENT SOUND WILL NOT GO INTO THE FRAME.

2157805 S0000471251 V1

### Inspection Areas on the Aft Cargo Door Frame

Figure 1 (Sheet 2 of 2)

ALL EFFECTIVITY

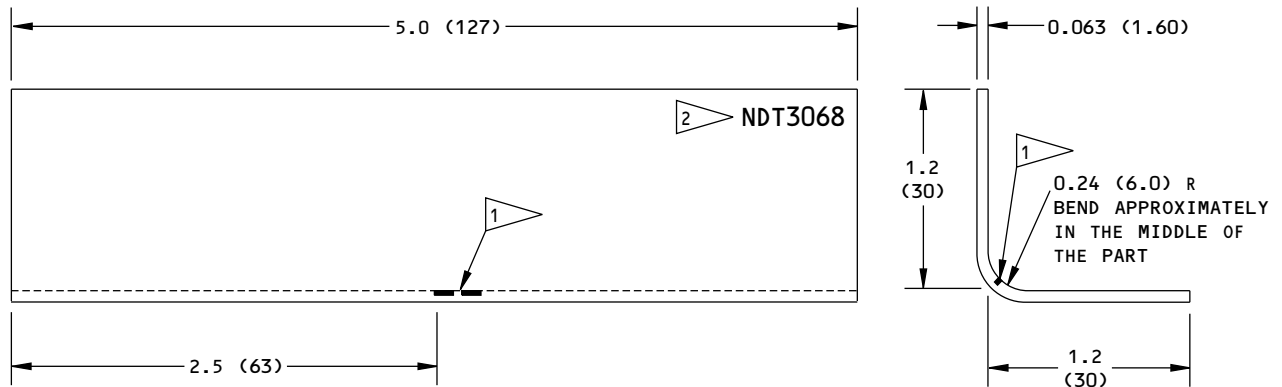
**PART 4 52-10-02**

D6-37239

Page 5  
Nov 15/2015



737  
NON-DESTRUCTIVE TEST MANUAL



- DIMENSIONS ARE IN INCHES  
(MILLIMETERS ARE IN PARENTHESES)

- TOLERANCES (UNLESS SPECIFIED DIFFERENTLY):

<u>INCHES</u>	<u>MILLIMETERS</u>
X.XXX = $\pm 0.004$	X.XX = $\pm 0.10$
X.XX = $\pm 0.007$	X.X = $\pm 0.18$
X.X = $\pm 0.10$	X = $\pm 2.5$

- BEND LOCATION TOLERANCE:  $\pm 0.15$  (3.8)
- BEND THE MATERIAL BEFORE YOU MAKE THE EDM NOTCH.
- SURFACE ROUGHNESS: 63 Ra OR BETTER
- MATERIAL: 2024-T3 CLAD - THIS MATERIAL CAN BE BENT IN THE T3 CONDITION. MORE HEAT TREAT IS NOT NECESSARY. 7075-T6 CLAD (OPTIONAL) - THIS MATERIAL CAN ONLY BE BENT IN THE T $\phi$  CONDITION. THEN HEAT TREAT TO T6.  
DIMENSIONS: 5.0 (127) X 2.4 (61) X 0.063 (1.60).

- 1 PUT THE EDM NOTCH IN THE CENTER OF THE RADIUS  $\pm 0.015$  (0.38) (CONCAVE SIDE): 0.25 (6.3) LONG X 0.045 (1.1) DEEP X 0.007 (0.17) MAXIMUM WIDTH.
- 2 ETCH OR STEEL STAMP THE REFERENCE STANDARD NUMBER NDT3068 AT APPROXIMATELY THIS LOCATION.

2157806 S0000471252\_V1

Reference Standard NDT3068  
Figure 2

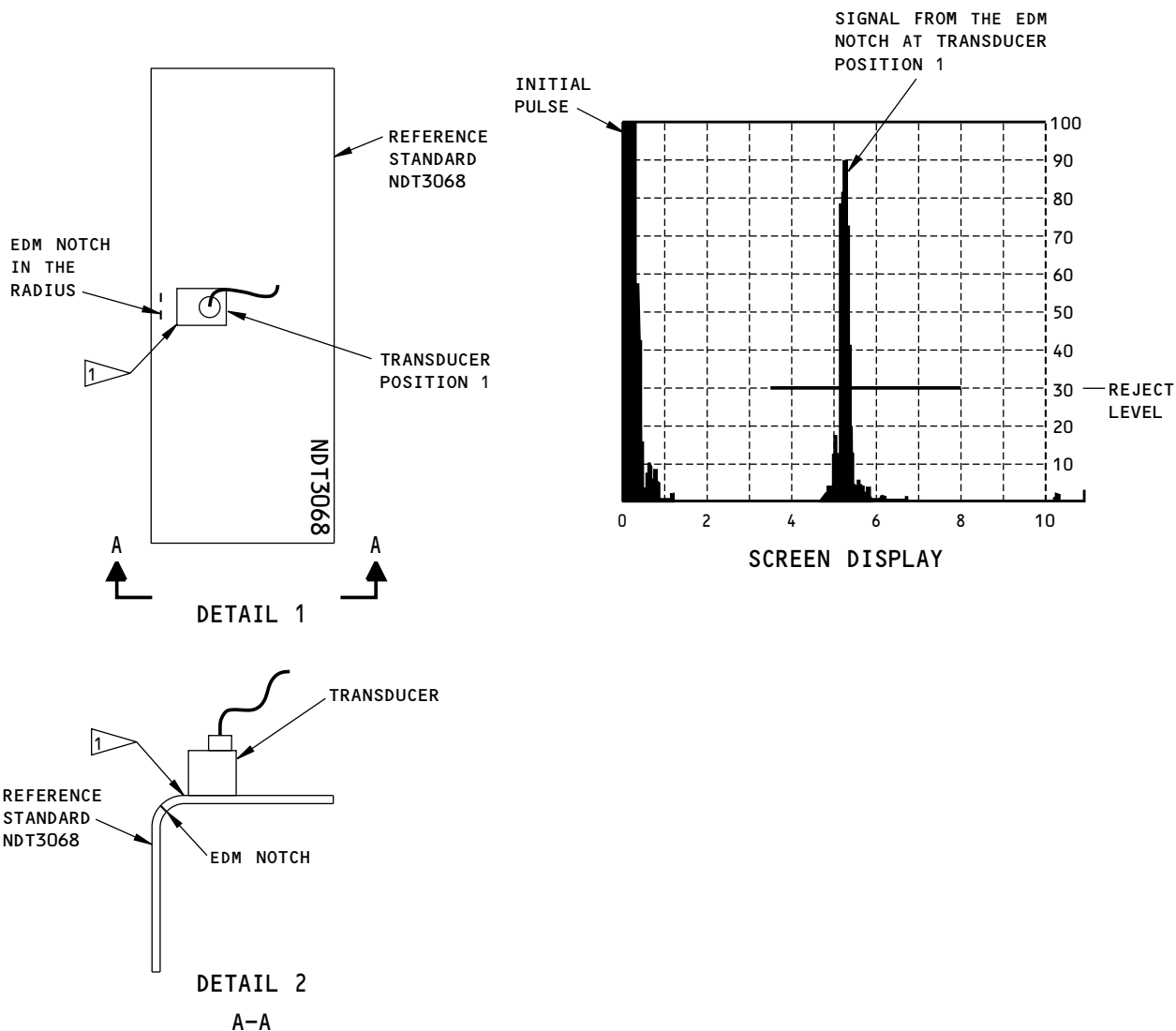
ALL EFFECTIVITY

PART 4 52-10-02

D6-37239

Page 6  
Nov 15/2015

# 737 NON-DESTRUCTIVE TEST MANUAL



## NOTES:

- DO THE CALIBRATION AS SPECIFIED IN PARAGRAPH 4. SET THE INITIAL PULSE AT 0 PERCENT OF FULL SCREEN WIDTH. SET THE EDM NOTCH SIGNAL AT 50 PERCENT OF FULL SCREEN WIDTH. SEE DETAILS 1 AND 2 AND THE SCREEN DISPLAY ABOVE.
- ADJUST THE GAIN SO THE EDM NOTCH SIGNAL IS AT 90 PERCENT OF FULL SCREEN HEIGHT.
- INCREASE THE GAIN BY 12 DB.

1 PUT THE FRONT OF THE TRANSUCER ON THE REFERENCE STANDARD WHERE THE FLAT AREA OF THE REFERENCE STANDARD STARTS. THIS WILL MAKE SURE SUFFICIENT ULTRASOUND GOES INTO THE REFERENCE STANDARD.

2157807 S0000471253\_V1

Calibration  
Figure 3

ALL EFFECTIVITY

PART 4 52-10-02

D6-37239

BOEING PROPRIETARY - Copyright © Unpublished Work - See title page for details

Page 7  
Nov 15/2015