PART 6 - EDDY CURRENT

DIRECTIONAL AUTOPILOT SERVO HOUSING

1. Purpose

A. To find cracks in the Autopilot Servo Housing at the internal thread root of the filter boss (Figure 1). Paragraph 2. contains the original-metered-instrument procedure using the MIZ-10A, MIZ-10B developed for the reference service bulletin. Paragraph 3. contains an alternative inspection giving the procedure and criteria necessary to make sure of a satisfactory inspection using all metered-eddy-current instruments. Paragraph 4. contains an alternative inspection giving the procedure and criteria necessary to make sure of a satisfactory inspection using impedance plane instruments.

B. Service Bulletin reference: 767-22-0027

2. THE METERED EDDY CURRENT INSTRUMENT INSPECTION PROCEDURE

CAUTION: IF OTHER METERED OR CRT IMPEDANCE PLANE EDDY CURRENT INSTRUMENTS ARE USED, REFER TO SECTION 3 OR SECTION 4 FOR THE ALTERNATIVE INSPECTION PROCEDURE AND CRITERIA.

A. Equipment

(1) Instruments - The only eddy current metered instruments that can be used for this inspection are:

(a) MIZ 10A - Zetec, Inc.

(b) MIZ 10B - Zetec, Inc.

(2) Probe - For this procedure, only one specified probe is designed for this inspection.

(a) Threaded hole probe P/N THP 1.56-161500K with an impedance matched coax cable - NDT Engineering Corp.

(3) Reference Standard - Standard 605 is provided by Boeing (Figure 2). Refer to the reference service bulletin for ordering information.

NOTE: This standard has been evaluated by Boeing to make sure of satisfactory performance.

B. Preparation

(1) Refer to the reference Service Bulletin for airplane system shutdown before an inspection.

(2) Remove the covers and the filters from the three-housing-filter bosses (Figure 1).

(3) Carefully clean all of the hydraulic fluid from the filter boss threads.

C. Instrument Calibration

(1) Attach the probe to an instrument with an impedance-matched-coax cable.

(2) Turn the instrument on and allow it to warm up per manufacturer's instructions.

(3) Set the instruments frequency to 500 kHz.

(4) Turn the threaded probe into Reference Standard 605 until the coil is approximately halfway into the standard. Put the probe coil segment opposite to the notch in the reference standard (Figure 3, Probe Position A).

NOTE: Start the probe into standard from lettered/numbered side of standard.

NOTE: The probe coil segment is identified by a white line on the circumference of the probe.

(5) Balance the probe and the instrument per the manufacturer's instructions.

(6) Adjust the lift-off by lightly pressing the probe coil segment away from the reference standard.

(7) Adjust the meter position to 10 percent of the full scale to make a baseline.

(8) Turn the probe in the reference standard to get the maximum notch signal (Figure 3, Position B).

(9) Set the gain to get 80 percent of the full scale notch signal above the 10 percent baseline response.

(10) Turn probe in the reference standard until the meter goes back to the baseline and check the lift-off per Paragraph 2.C.(6).

NOTE: If the lift-off adjustment is necessary, check the gain per Paragraph 2.C.(7), Paragraph 2.C.(8), and Paragraph 2.C.(9).

(11) Turn the probe through the reference standard and make sure that the baseline noise response does not change more than ± 15 percent. The ± 15 percent does not include the response from the edge effect. If the baseline noise is more than ± 15 percent, clean probe and reference standard threads, check for coil damage. If necessary, replace the probe. If the probe is in satisfactory condition and the noise still is more than ± 15 percent, contact Boeing.

D. Inspection Procedure

(1) Get access to the inspection area per Figure 1.

(2) Calibrate the probe/instrument per Paragraph 2.C.

CAUTION: THE PROBE SHOULD BE THREADED FREELY INTO THE FILTER BOSS. DO NOT FORCE THE PROBE AS THIS MAY DAMAGE THE PROBE THREADS OR SENSING COIL.

(3) Select a filter boss and thread the probe into the housing for at least one full turn. Balance the instrument. Check the lift-off and adjust if necessary. Do not change probe/instrument sensitivity.

CAUTION: DO NOT FORCE THE PROBE INTO THE BOTTOM THREADS AS THIS MAY DAMAGE THE SENSING COIL.

(4) Continue to turn the probe into the filter boss. Watch the meter until the probe is stopped by the bottom threads of the filter boss.

(5) A fast upscale meter response with a short movement of the probe is an indication of a crack. Make an analysis of the indication per Paragraph 2.E.

(6) Do the inspection again for the other two filter boss locations. Refer to Paragraph 2.D.(3) and Paragraph 2.D.(4).

E. Inspection Results

(1) A fast up and down meter response with a short movement of the probe is an indication of a short circumferential crack. Compare this response with the 605 reference standard notch response. A long circumferential crack will have a fast upscale signal response as the probe coil goes through the front end of the crack followed subsequently by a fast downscale meter response as the probe coil goes through the opposite end of the crack. The distance the probe is turned between the upscale and downscale meter movement must agree with the length of the crack. Compare the maximum upscale meter response of a long crack with the reference standard response.

(2) For all crack indications, the maximum upscale meter response is the primary procedure to find the crack depth. Crack depth determines the group of the cracks as to Class I, Class II or Class III per the reference service bulletin.

3. Alternate Metered Eddy Current Inspection Procedure

A. Equipment

(1) Instrument - All metered eddy current instruments that can meet the necessities of this procedure.

(2) Probe - A special probe designed for this inspection is necessary and must be matched to the equipment being used. Probes are supplied by Boeing. Refer to referenced service bulletin for ordering information.

(3) Reference Standard - The 605A reference standard is supplied by Boeing (Figure 3). Refer to reference service bulletin for ordering information.

NOTE: An analysis of this standard has been made by Boeing to make sure of satisfactory performance.

B. Preparation

(1) Refer to the reference Service Bulletin for airplane system shutdown before inspection.

(2) Remove the covers and the filters from the three housing filter bosses (Figure 1).

(3) Carefully clean all of the hydraulic fluid from the filter boss threads.

C. Instrument Calibration

(1) This section of the procedure is done using Reference Standard 605A.

(2) Attach the probe to an instrument with an impedance-matched-coax cable.

(3) Turn instrument on and allow it to warm up per the manufacturer's instructions.

(4) Set instruments frequency at 500 kHz if available.

NOTE: If the instrument does not operate at 500 kHz, notify Boeing of the instruments name, model number, and probe frequency to be used. A special probe that matches instrument frequency and impedance will be supplied by Boeing.

(5) Turn the threaded probe into the reference for two turns and place probe coil between notches one (1) and two (2) (Figure 5, Probe Position A).

NOTE: Start the probe into the standard from the lettered/numbered side of standard.

(6) Balance the probe and the instrument per the manufacturer's instructions.

(7) Lightly press the probe coil segment away from the reference standard to adjust the lift-off.

(8) Make a baseline at least 10 percent above minimum meter position.

(9) Turn the probe in the reference standard to get the maximum number-one-notch signal (Figure 5, Position B).

(10) Set the gain to get a 70 percent full scale notch signal above the baseline response.

(11) Turn the probe in the reference standard until meter returns to baseline and check lift-off per Paragraph 3.C.(7).

NOTE: If lift-off adjustment is necessary, check gain per Paragraph 3.C.(8), Paragraph 3.C.(9) and Paragraph 3.C.(10).

(12) Turn the probe in the reference standard until the meter movement from notch number two (2) is at a maximum. The meter must read a minimum decrease of 20 percent from the maximum value of notch number one (1) per Paragraph 3.C.(10). Contact Boeing if the alternate-metered instrument/probe combination does not meet the necessary needs.

(13) Turn the probe through the reference standard and make sure that the baseline noise response does not change more than ± 15 percent. If the baseline noise is more than ± 15 percent, clean probe and reference standard threads and check for coil damage. If necessary, replace the probe. Contact Boeing if the probe is in satisfactory condition and the noise still is more than ± 15 percent.

D. Inspection Procedure

(1) Get access to the inspection area per Figure 1.

(2) Calibrate the probe/instrument per Paragraph 3.C.

CAUTION: THE PROBE SHOULD BE THREADED FREELY INTO THE FILTER BOSS. DO NOT FORCE THE PROBE AS THIS MAY DAMAGE THE PROBE THREADS OR SENSING COIL.

(3) Get a filter boss and turn the probe into the housing for at least one full turn. Balance the instrument. Check the lift-off and adjust if necessary. Do not change probe instrument sensitivity.

CAUTION: DO NOT FORCE THE PROBE INTO THE BOTTOM THREADS AS THIS MAY DAMAGE THE SENSING COIL.

(4) Continue to turn the probe into the filter boss. Watch the meter until the probe is stopped by the bottom threads of the filter boss.

(5) A fast upscale meter response with a very short movement of the probe is an indication of a crack. Make an analysis of the crack per Paragraph 3.E.

(6) Do the inspection again for the other two filter boss locations as specified in Paragraph 3.D.(3), Paragraph 3.D.(4) and Paragraph 3.D.(5).

E. Inspection Results - To determine between Class I, Class II and Class III indications

(1) A fast up and down meter response with a very short movement of the probe is an indication of a short circumferential crack. A long circumferential crack will have a fast upscale signal response as the probe coil passes over the front end of the crack followed later by a downscale meter response as the probe coil goes over the opposite end of the crack. The distance the probe is turned between the upscale and downscale meter movement is the length of the crack. Compare the maximum upscale meter response crack indications with the 605A Reference Standard notch response.

(2) Put into groups and note any crack indications by comparing the response to the notch responses of the 605A standard.

(a) A crack signal that is less than the signal from notch number two (2) is Class I.

(b) A crack signal that is equal to or greater than that from notch two (2) but less than the signal from notch one (1) is Class II.

(c) A crack signal that is equal to or greater than the signal from notch number one (1) is class III.

4. Alternate Impedance Plane Eddy Current Inspection Procedure

A. Equipment

(1) Instrument - All impedance plane eddy current instruments that can meet the necessary condition of this procedure.

(2) Probe - It is necessary for this procedure to use a special probe designed for this inspection that must be matched to the equipment being used. Probes are supplied by Boeing. Refer to reference service bulletin for ordering information.

(3) Reference Standard - The 605A reference standard is supplied by Boeing (Figure 3). Refer to reference service bulletin for ordering information.

NOTE: An analysis of this standard has been made by Boeing to make sure of satisfactory performance.

B. Preparation

(1) Refer to reference Service Bulletin for airplane system shutdown before inspections.

(2) Remove the covers and the filters from the three housing filter bosses (Figure 1).

(3) Carefully clean all of the hydraulic fluid from the filter boss threads.

C. Instrument Calibration

(1) This section of the inspection procedure is done using reference standard 605A.

(2) Attach the probe to the instrument with impedance-matched-coax cable.

(3) Turn the instrument on and allow it to warm up per the manufacturer's instructions.

(4) Set the instrument frequency at 500 kHz if available.

NOTE: If the instrument does not operate at 500 kHz, notify Boeing of the instruments name, model number and probe frequency to be used. A special probe that matches instrument frequency and impedance will be delivered by Boeing.

(5) Set the instruments vertical and horizontal controls for a one-to-one signal display.

(6) Turn the threaded probe into the reference standard for two turns and place probe between notches (1) and two (2) (Figure 5, probe position A).

NOTE: Start probe into standard from the lettered/numbered side of standard.

(7) Balance the probe and instrument per the manufacturer's instructions.

(8) Adjust the lift-off trace for a horizontal deflection to the left by lightly pressing the probe coil segment away from the reference standard to get a lift-off line (Figure 6).

(9) Adjust the instruments display so that the balance point position is one major division up from the bottom and two-to-three major divisions from the right edge of the screen (Figure 6).

(10) Turn the probe in the reference standard to get the maximum signal trace from notch number one (1).

(11) Adjust the vertical, horizontal, and/or gain/sensitivity controls to get a notch signal trace that is 70 percent of the vertical screen height from the balance point and at a 60 to 80 degree phase angle (Figure 6).

(12) Turn the probe in the reference standard until signal trace returns to the lift-off line and recheck the lift-off trace per Paragraph 4.C.(8).

NOTE: If it is necessary to adjust the lift-off trace, check the vertical screen height per Paragraph 4.C.(11).

(13) Turn the probe in the reference standard until the maximum signal trace is gotten from notch number two (2). The screen trace height must show a minimum reduction of 20 percent from the maximum screen trace height of notch number one per Paragraph 4.C.(11). Contact Boeing if the impedance-plane-instrument/probe combination does not meet these requirements.

(14) Turn the probe through the reference standard and examine the noise trace along the lift-off line. The noise trace should not be more than ± 0.75 vertical spaces except for edge effect. If the noise trace is more than ± 0.75 vertical spaces, clean probe and reference standard threads and check sensing coil for damage. If necessary, replace the probe. Contact Boeing if the probe is in satisfactory condition and the noise level still is more than ± 0.75 vertical spaces.

D. Inspection Procedure

(1) Get access to inspection area per Figure 1.

(2) Calibrate the instrument per Paragraph 4.C.

CAUTION: THE PROBE SHOULD BE THREADED FREELY INTO THE FILTER BOSS. DO NOT FORCE THE PROBE AS THIS MAY DAMAGE THE PROBE THREADS OR SENSING COIL.

(3) Select a filter boss and turn the probe into the housing for at least one full turn. Balance the instrument. Check the lift-off for a horizontal deflection trace to the left from the balance point. Adjust lift-off if necessary. Do not change probe/instrument sensitivity.

CAUTION: DO NOT FORCE THE PROBE INTO THE BOTTOM THREADS AS THIS MAY DAMAGE THE SENSING COIL.

(4) While watching the instrument display screen, continue to turn the probe into the filter boss until the probe is stopped by the bottom threads of the filter boss.

(5) A fast upward movement of the screen trace with very short movement of the probe is an indication of a crack (Figure 7, Details I and II). Make an analysis of the indications of a crack per Paragraph 4.E. The phase angle of the crack signal may change as much as ± 20 degrees from that of the reference standard notch.

(6) Do the inspection again for the other two filter boss locations. Refer to Paragraph 4.D.(3), Paragraph 4.D.(4) and Paragraph 4.D.(5).

E. Inspection Results

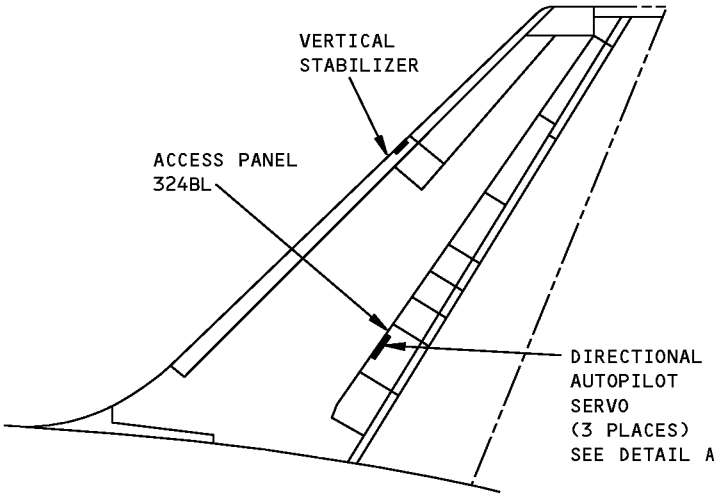
(1) A fast up and down movement of the screen trace in the approximate direction (± 20 degrees) of the reference standard notch trace is an indication of a short circumferential crack (Figure 7, Detail I). A long circumferential crack will have a fast upward screen trace movement in the approximate direction of the reference standard notch, as the probe passes over the front end of the crack. This is followed by a fast downward screen trace movement, as the probe coil passes over the opposite end of the crack. The distance the probe is turned between the up and down signal trace movement is the length of the crack. Compare the maximum vertical signal trace point with the 605A reference standard vertical signal trace response.

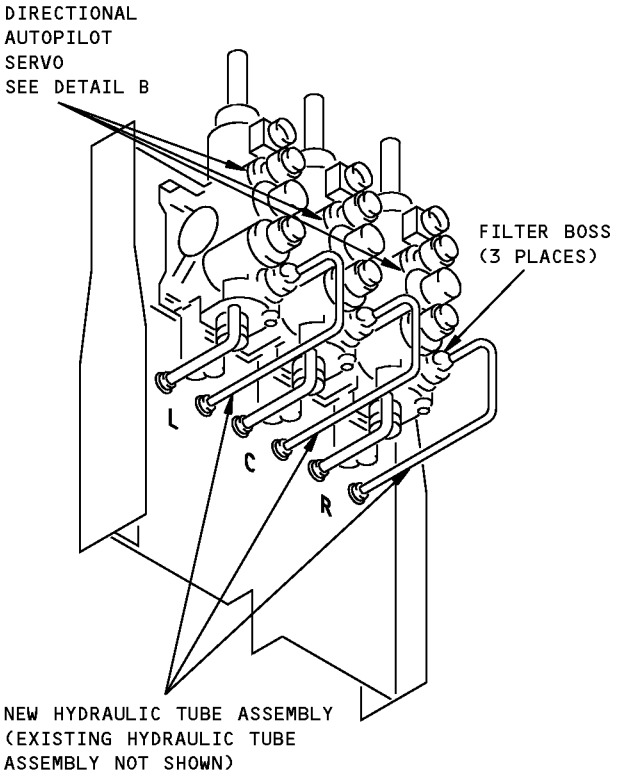
(2) Classify and note any crack indications by comparing the responses of the 605A reference standard.

(a) A crack signal that is less than the signal from notch number two (2) is Class I.

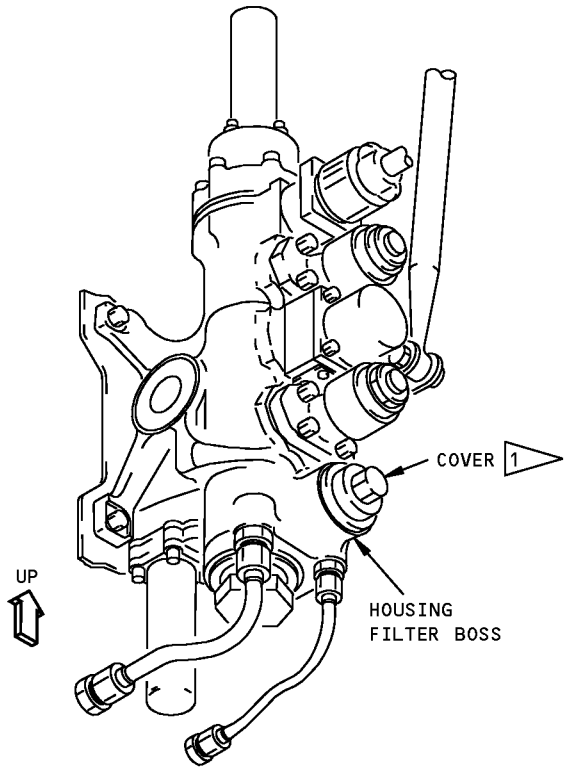
(b) A crack signal that is equal to or greater than the signal from notch (2) but less than the signal from notch one (1) is Class II.

(c) A crack signal that is equal to or greater than the signal from notch number one (1) is Class III.





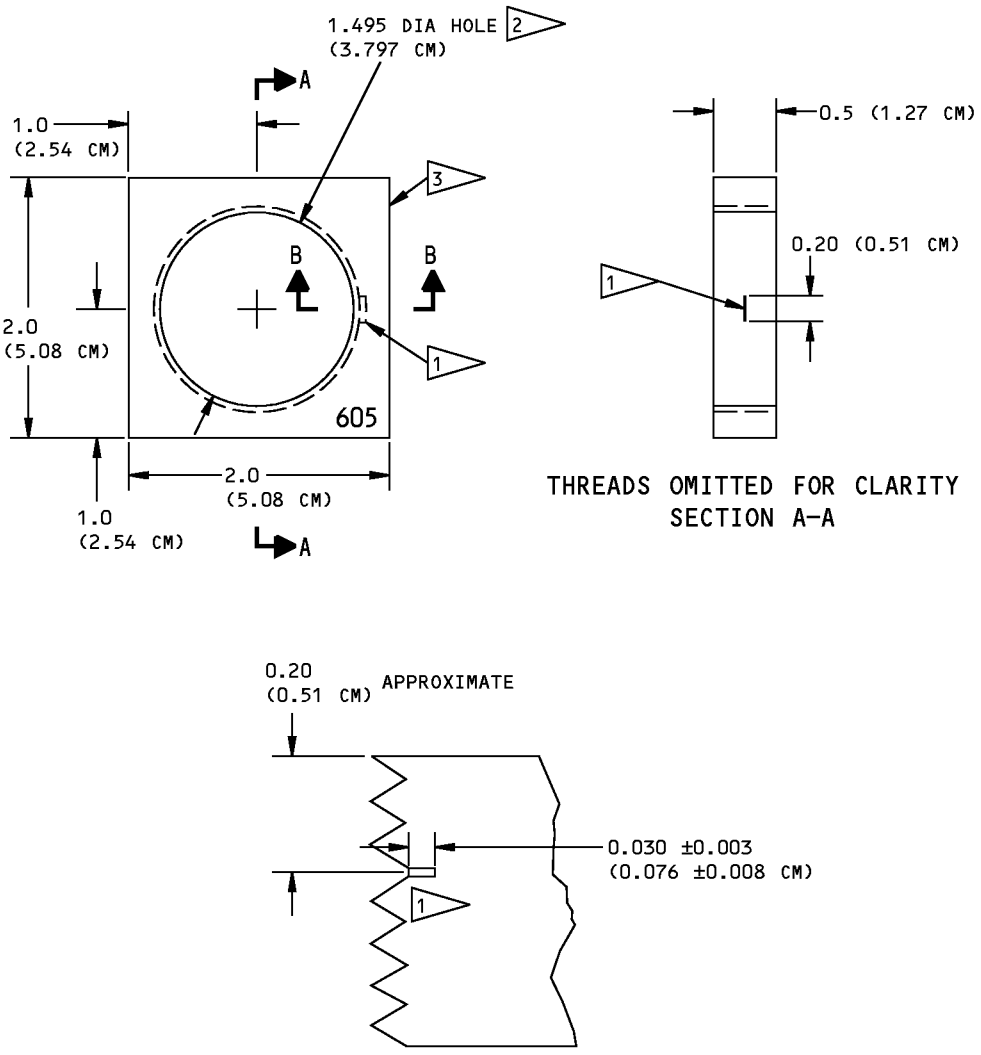
PERFORM AN EDDY CURRENT INSPECTION
ON THE THREE SERVOS
DETAIL A



DIRECTIONAL AUTOPILOT SERVO
DETAIL B

1 REMOVE COVER AND FILTER TO GAIN ACCESS TO INTERNAL THREADS

Directional Autopilot Servo Housing Filter Boss
Figure 1



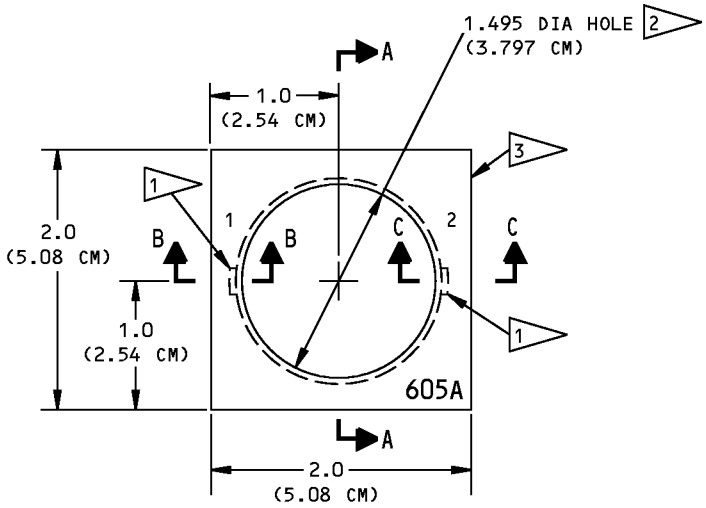
NOTES

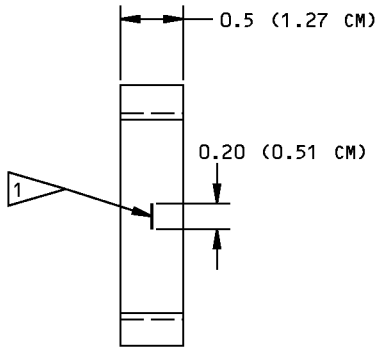
- ALL DIMENSIONS ARE IN INCHES (CENTIMETERS IN PARENTHESES)
- MATERIAL: 2024-T3,-T4 OR 7075-T6 ALUMINUM
- TOLERANCE: X.X ±0.05 (0.13 CM)
  X.XX ±0.01 (0.03 CM)
  X.XXX ±0.005 (0.013 CM)
  EXCEPT AS NOTED
- ETCH OR STEEL STAMP WITH 605
- REFERENCE STANDARDS ARE AVAILABLE FROM BOEING

  NOTE: BOEING STANDARDS ARE CHECKED TO ASSURE SATISFACTORY PERFORMANCE

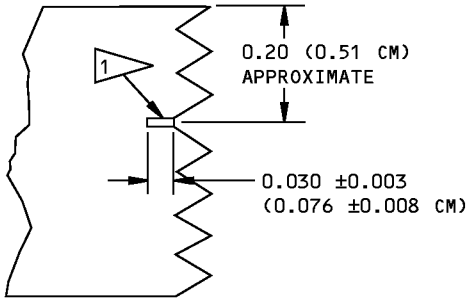
1. EDM NOTCH (IN THREAD ROOT) 0.005 (0.013 CM) WIDE
2. BORE AND THREAD 1.563-16 (CLASS 3A), TAPPING IS OPTIONAL
3. THREADS MUST BE MACHINED OR TAPPED WITHOUT REMOVAL OF STANDARD FROM THE LATHE AFTER THE BORING OPERATION
4. OPTIONAL CONFIGURATION: 2.25-INCH OD CIRCULAR STANDARD OPTIONAL TO 2.0-INCH SQUARE STANDARD

Reference Standard 605
Figure 2

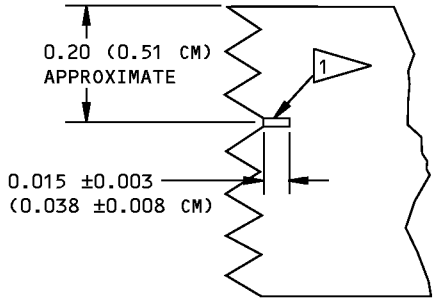




THREADS OMITTED FOR CLARITY
SECTION A-A



REF STD NO. 605A NOTCH NO. 1
SECTION B-B



REF STD NO. 605A NOTCH NO. 2
SECTION C-C

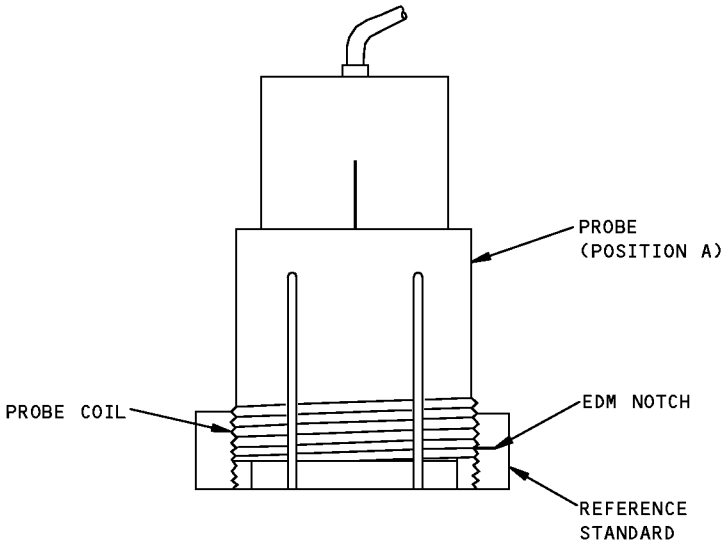
NOTES

- ALL DIMENSIONS ARE IN INCHES (CENTIMETERS IN PARENTHESES)
- MATERIAL: 2024-T3,-T4 OR 7075-T6 ALUMINUM
- TOLERANCE: X.X ±0.05 (0.13 CM)
  X.XX ±0.01 (0.03 CM)
  X.XXX ±0.005 (0.013 CM)
  EXCEPT AS NOTED
- ETCH OR STEEL STAMP WITH 605A
- REFERENCE STANDARDS ARE AVAILABLE FROM BOEING

  NOTE: BOEING STANDARDS ARE CHECKED TO ASSURE SATISFACTORY PERFORMANCE.

1. EDM NOTCH (IN THREAD ROOT) 0.005 (0.013 CM) WIDE
2. BORE AND THREAD 1.563-16 (CLASS 3A), TAPPING IS OPTIONAL
3. THREADS MUST BE MACHINED OR TAPPED WITHOUT REMOVAL OF STANDARD FROM THE LATHE AFTER THE BORING OPERATION
4. OPTIONAL CONFIGURATION: 2.25-INCH OD CIRCULAR STANDARD OPTIONAL TO 2.0-INCH SQUARE STANDARD

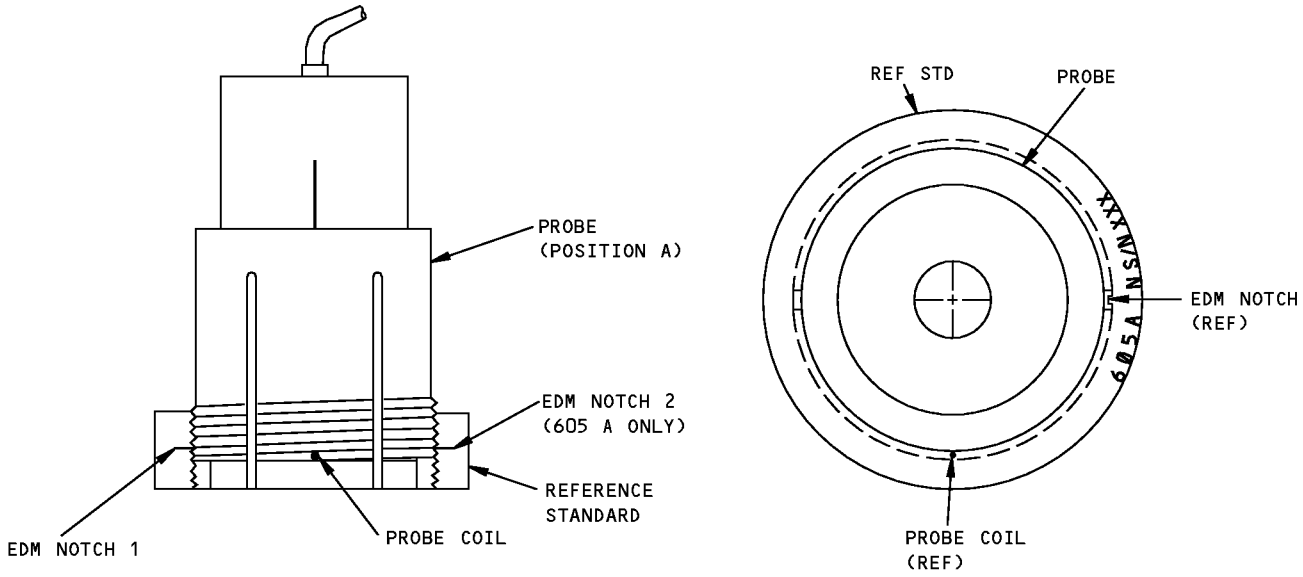
Reference Standard 605A
Figure 3



NOTES

- POSITION A (SHOWN): PROBE COIL LOCATED AWAY FROM EDM NOTCH
- POSITION B: PROBE COIL LOCATED AT EDM NOTCH

Instrument Calibration For Reference Standard 605
Figure 4

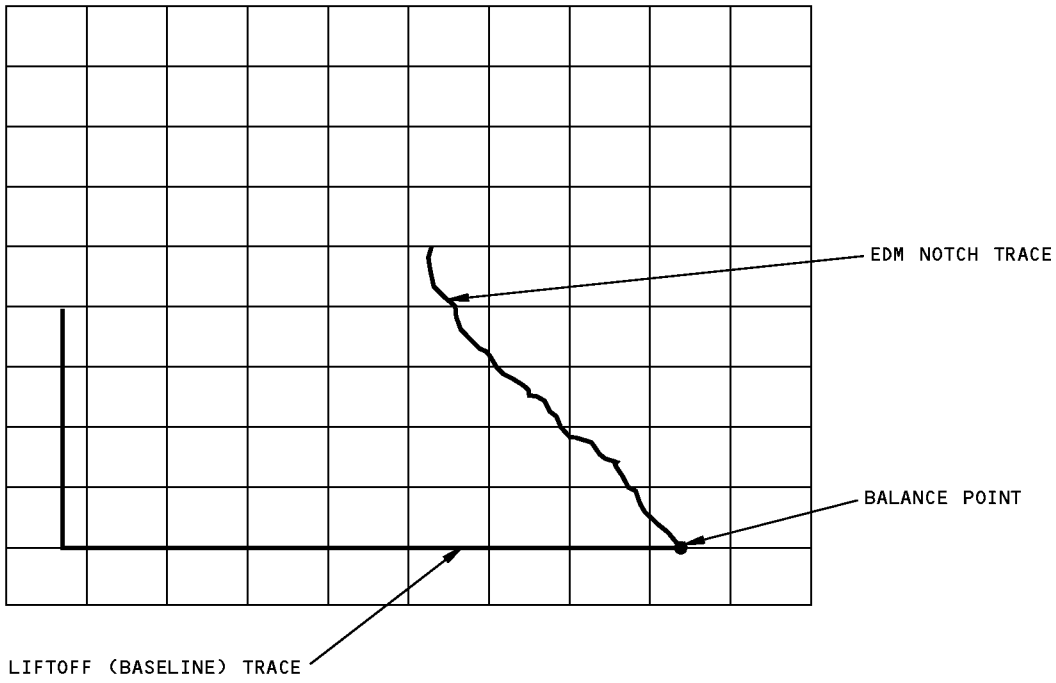


PROBE POSITION "A"

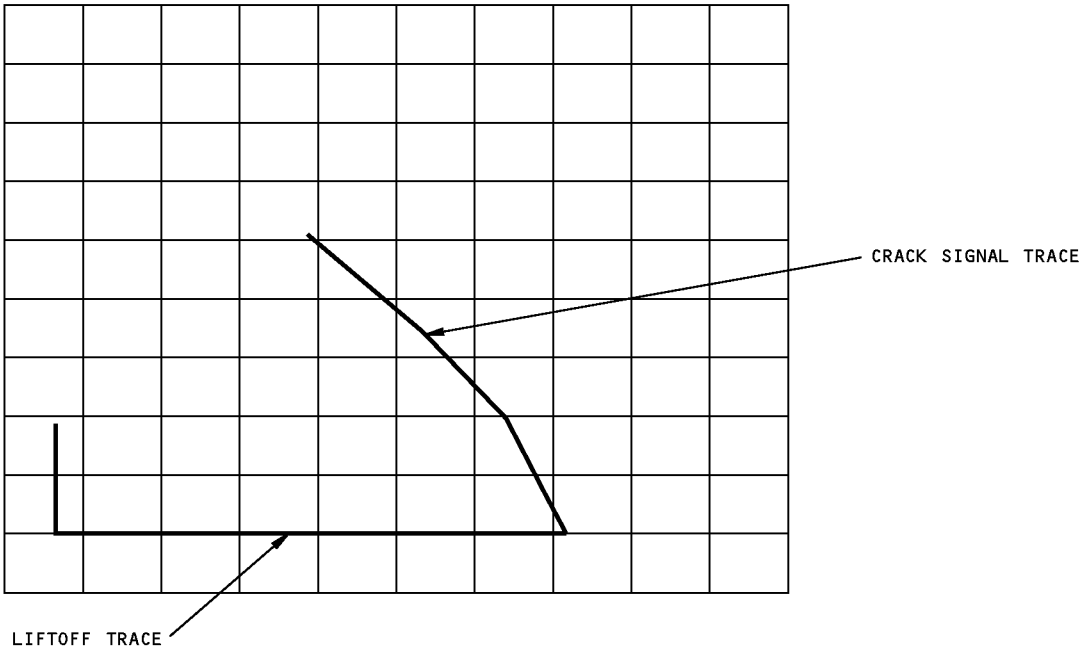
NOTES

- POSITION A (SHOWN): PROBE COIL LOCATED AWAY FROM EDM NOTCH
- POSITION B: PROBE COIL LOCATED AT EDM NOTCH

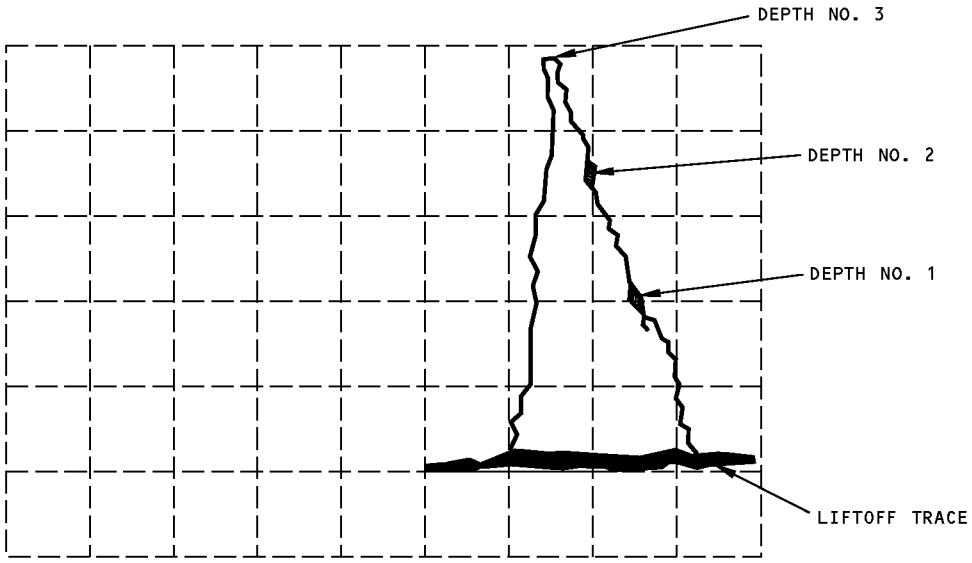
Instrument Calibration For Reference Standard 605A
Figure 5



Maximized EDM Notch Signal Trace at 5 Vertical Spaces
Figure 6



TYPICAL SHORT CRACK SIGNAL TRACE
DETAIL I



TYPICAL LONG CRACK SIGNAL TRACE OCCURRING OVER
APPROXIMATELY 60 DEGREES OF PROBE ROTATION.
SIGNAL INDICATES THREE DISTINCT CRACK DEPTHS
DETAIL II

Typical Crack Signals
Figure 7