

SERVICE BULLETIN**REVISION NOTICE****FLIGHT CONTROLS - NON-DESTRUCTIVE INSPECTION (NDI) OF 374461-5, -7, AND -11 ELEVATOR BOOSTER FOR ACTUATOR CRACKS**

Attached is Revision 2, dated October 3, 2019, to Service Bulletin 382-27-51. Information added or changed in this issue is indicated by a vertical revision bar in the margin of affected pages, or pointing hand for illustrations.

This revision changes the Description and Accomplishment Instructions to clarify that the same inspection procedure may be used to inspect the booster whether the booster is removed or installed on the aircraft, and changes the order of the Accomplishment Instructions procedure steps.

This revision is a complete reissue and replaces Revision 1 of this Service Bulletin dated January 17, 2018. Retain this notice with your copy of this Service Bulletin.

Aircraft previously modified by this Service Bulletin are not affected by this revision.

List of Previous Revisions and/or Reissues

Basic	July 17, 2017
Revision 1	January 17, 2018

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File: I-4496R2

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SERVICE BULLETIN**FLIGHT CONTROLS - NON-DESTRUCTIVE INSPECTION (NDI) OF 374461-5, -7, AND -11 ELEVATOR BOOSTER FOR ACTUATOR CRACKS**

NOTE: This Service Bulletin is incomplete without Appendix A.

1. PLANNING INFORMATION**A. EFFECTIVITY**

- (1) This Service Bulletin is applicable to all FAA Certificated Hercules aircraft (excluding 382J aircraft).
- (2) Spares - This Service Bulletin is applicable to all spare 374461-5, 374461-7, and 374461-11 Elevator Boosters. New spare boosters or overhauled boosters with new actuators which have never been put into service do not require inspection.

B. REASON

- (1) A C-130J operator reported two elevator booster actuators that experienced a significant hydraulic fluid leak. Examination of the components revealed that the fluid leaks were caused by fatigue cracks within the actuator cylinder. In one actuator, the fatigue crack propagated to a sufficient length to rupture the cylinder causing a major leak and loss of hydraulic system pressure in flight. A third actuator was found cracked when performing an ultrasonic inspection similar to the procedure included in this Service Bulletin but had not yet leaked hydraulic fluid. The Part Number 5C5803 Actuator has been produced since the 1970's and is common/interchangeable with all C-130/L382 model aircraft.
- (2) Laboratory analysis of the cracked actuators revealed an internal area within the cylinder body that is prone to fatigue crack initiation. The fatigue crack propagates hidden within the cylinder under normal operational loading until either a minor fluid leak is evident or the cylinder ruptures creating a major leak. A similar fatigue failure occurred in 1990 which resulted in incorporation of a fatigue improvement at actuator Serial Number 1397. The overhaul manual and vendor drawings were revised to build up overhauled and new actuators with only the improved cylinders. The post-1397 actuators have now experienced similar fatigue cracking problems and the fatigue improvements were not sufficient to eliminate the problem.
- (3) There is possibility that both left and right cylinders in the elevator booster actuator could initiate and propagate a fatigue crack that ruptures both cylinders during the same flight. While there is no reported case of a dual failure, it nevertheless can be expected to occur as the actuators continue to experience fatigue loading from normal flight. If this occurs, control column forces are significantly increased and it will become difficult to change aircraft pitch away from the trimmed attitude.
- (4) This Service Bulletin requires an ultrasonic inspection of the booster actuator cylinders on all affected aircraft with the Part Number 5C5803 Actuator installed within the 374461-5, -7 and -11 Elevator Booster Assemblies. Spares of new and overhauled booster assemblies are also affected if Part Number 5C5803 Actuator is installed.

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- (5) Lockheed Martin Aeronautics Company recommends that the initial inspection be accomplished on or before 4,000 Flight Hours accumulated on the actuator and a recurring inspection of 1,400 Flight Hours thereafter. If the actuator flight hours are greater than 4,000, or are unknown, the inspection should be performed at the next convenient maintenance period but not to exceed 180 days from receipt of this Service Bulletin.

C. DESCRIPTION

This Service Bulletin directs the inspection of the elevator booster actuators using an ultrasonic procedure. The inspection may be performed while the booster remains installed on the aircraft or with the booster removed from the aircraft. If a crack is detected, then the elevator booster must be removed and replaced before the next flight.

D. APPROVAL

- (1) The aircraft owner/operator will make an appropriate entry in the aircraft log records upon compliance with this Service Bulletin.
- (2) After the work has been completed on each affected aircraft, please complete and mail or fax (770 494-5682) a Notice of Service Bulletin Compliance; or notify Lockheed Martin Aeronautics Company of compliance with this Service Bulletin at website address: <http://www.lockheedmartin.com/eoc> and log into Data Library.
- (3) FAA approval of the Progressive Inspection Procedures change in this Service Bulletin has not been solicited and customers with FAA Certificated airplanes are urged to follow up with the agency for approval if necessary.

E. MANPOWER

The manpower estimates provided have not been validated and are estimates only. These estimates are provided only as a convenience for customer planning purposes. It is estimated that approximately five man-hours (a crew of one qualified technicians) will be required to accomplish the work described herein on each affected aircraft. This will take approximately five hours elapsed time while the aircraft is out of service.

NOTE: This Service Bulletin is based upon the configuration of the aircraft as it was delivered from Lockheed Martin Aeronautics Company. Previous service bulletins issued by Lockheed Martin Aeronautics Company have been considered in the preparation of this Service Bulletin, but no consideration has been given to peculiar changes made to the aircraft by the owner/operator since its delivery.

F. MATERIAL - COST AND AVAILABILITY

None.

G. TOOLING - PRICE AND AVAILABILITY

None.

H. WEIGHT AND BALANCE

None.

SERVICE BULLETIN**I. REFERENCES**

Hercules Maintenance Manual

J. OTHER PUBLICATIONS AFFECTED

None.

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2. ACCOMPLISHMENT INSTRUCTIONS

WARNING: ENSURE THAT ALL APPLICABLE SAFETY PRECAUTIONS ARE OBSERVED WHILE ACCOMPLISHING THE WORK PRESCRIBED IN THIS PUBLICATION.

NOTE: Some steps in the accomplishment instructions are identified as Required for Compliance (RC). If this Service Bulletin is mandated by an Airworthiness Directive (AD), the steps identified as RC must be done to comply with the AD. Steps not identified with RC are recommended and may be deviated from; done as a part of other actions; or done with accepted methods different from those given in the Service Bulletin if the RC steps can be done and the airplane returned to a serviceable condition.

These work instructions refer to methods, techniques, and practices described in other referenced documents. When the words "refer to" are used and there are other acceptable methods, techniques, and practices (including tools, equipment, and test equipment) those acceptable methods, techniques, and practices (including tools, equipment, and test equipment) may be used to complete the work. When the words "in accordance with" are included in the instruction, the methods, techniques, and practices specified (including tools, equipment, and test equipment) in the referenced document must be used.

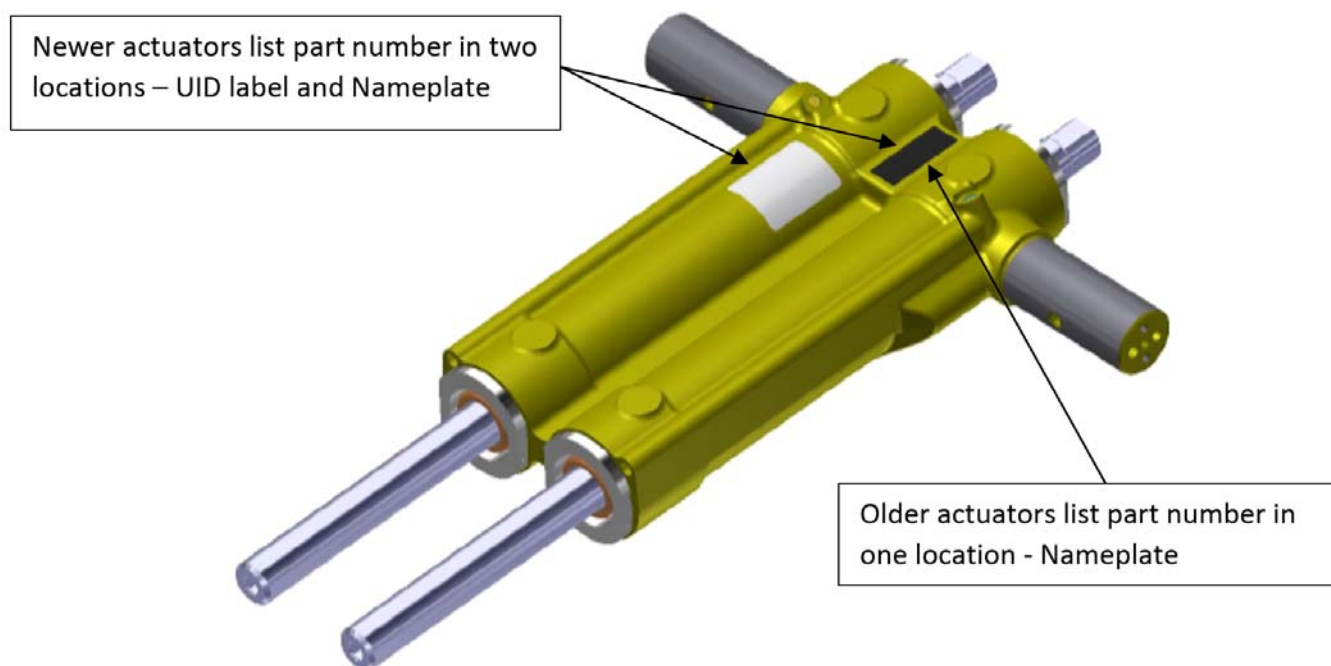
- A. Prepare aircraft for maintenance.
- B. Close Cargo Door. Refer to appropriate Hercules Maintenance Manual.
- C. Deactivate Cargo Door. Refer to appropriate Hercules Maintenance Manual.
- D. Deactivate Booster Hydraulic System. Refer to appropriate Hercules Maintenance Manual.
- E. Deactivate Utility Hydraulic System. Refer to appropriate Hercules Maintenance Manual.
- F. RC - Examine 374461-5, 374461-7 or 374461-11 Elevator Booster to determine part number of actuator. Inspection of data label will show actuator part number. See Figure 1.
 - (1) If part number of actuator is other than 5C5803 or actuator is known to have less than 4,000 flight hours, no further action is required. Proceed to Step 2.I.
 - (2) If actuator part number is 5C5803 and actuator flight hours are undetermined or greater than 4,000, perform NDI procedure in accordance with Appendix A.
- G. RC - If a crack is detected on either actuator cylinder, proceed as follows:
 - (1) Prior to next flight, replace elevator booster. Refer to appropriate Hercules Maintenance Manual.
 - (2) Report actuator serial number and flight hours (if known) to Lockheed Martin Customer Support Center at the address below.
 - (3) All boosters which are removed because of crack detection should be returned to overhaul facility. The overhaul facility shall disassemble the actuator and confirm the crack in accordance with existing overhaul inspection procedures.
- H. If no crack is detected during NDI Inspection procedure, then no further action is required. Proceed to Step 2.I.
- I. Restore Utility Hydraulic System to normal. Refer to appropriate Hercules Maintenance Manual.
- J. Restore Booster Hydraulic System to normal. Refer to appropriate Hercules Maintenance Manual.
- K. Restore Cargo Door to normal. Refer to appropriate Hercules Maintenance Manual.

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L. Restore aircraft to service.

NOTE: If assistance is needed, contact your local Lockheed Martin Aeronautics Company representative, or the Customer Support Center in Marietta, Georgia, USA, as follows:

TELEPHONE:	(770) 494-9131
FAX:	(770) 494-9122
E-MAIL:	hercules.support@lmco.com
MAIL:	Lockheed Martin Aeronautics Company 86 South Cobb Drive Dept. 3E1M, Zone 0591 Marietta, GA 30063, USA

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Identification of Actuator Part Number
Figure 1

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SERVICE BULLETIN**3. MATERIAL INFORMATION**

No material is required to accomplish this inspection.

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SERVICE BULLETIN**NDI OF THE ELEVATOR BOOSTER ASSEMBLY ACTUATOR BETWEEN THE FLUID TRANSFER BORE AND MAIN CYLINDER INTERNAL BORE, LEFT AND RIGHT SIDES**

NOTE: Some steps in the accomplishment instructions are identified as Required for Compliance (RC). If this Service Bulletin is mandated by an Airworthiness Directive (AD), the steps identified as RC must be done to comply with the AD. Steps not identified with RC are recommended and may be deviated from; done as a part of other actions; or done with accepted methods different from those given in the Service Bulletin if the RC steps can be done and the airplane returned to a serviceable condition.

These work instructions refer to methods, techniques, and practices described in other referenced documents. When the words "refer to" are used and there are other acceptable methods, techniques, and practices (including tools, equipment, and test equipment) those acceptable methods, techniques, and practices (including tools, equipment, and test equipment) may be used to complete the work. When the words "in accordance with" are included in the instruction, the methods, techniques, and practices specified (including tools, equipment, and test equipment) in the referenced document must be used.

1. **PURPOSE:** Perform nondestructive inspection of the elevator booster assembly actuator (Part No. 5C5803) at the forward-most end to detect cracking along the fluid transfer bore, left and right cylinders. See Figure 1 for the elevator booster assembly installed on-aircraft and Figure 2 for the inspection areas of interest.
2. **DESCRIPTION:** The elevator booster actuator contains small diameter fluid passageways connected to the main piston bores by small diameter diagonal bores drilled at 45-degree angles to the noted piston bores. These angled passageways are susceptible to fatigue cracking which initiates at the corners of the diagonal bore and propagates through the cylinder wall.
3. **DEFECTS:** Cyclic loading may result in fatigue cracks initiating at the corners of the diagonal bore, located between the fluid transfer bore and main cylinder bore, and propagate in an approximate fore-aft direction along the ligament between the noted bores. See Figure 3 for the expected location and orientation of fatigue cracking in the elevator booster assembly.
4. **PREPARATION OF AIRPLANE:**

NOTE: For general airplane surface preparations and general airplane safety precautions, refer to applicable Nondestructive Inspection Manual.

WARNING: ENSURE POWER IS ISOLATED FROM ALL SYSTEMS IN THE INSPECTION AREA. FAILURE TO ISOLATE POWER MAY CAUSE SERIOUS INJURY TO PERSONNEL AND MAY RESULT IN DAMAGE TO THE AIRPLANE.

- A. Isolate power from all systems in the inspection area. Refer to applicable maintenance manuals.
- B. Deactivate Cargo Door and Booster and Utility Hydraulic Systems. Refer to applicable maintenance manuals.
- C. Review nameplate on actuator to verify part number is 5C5803 before performing the Primary NDI Procedure.

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5. PRIMARY NDI PROCEDURE - ULTRASONIC:

A. NDI Equipment:

NOTE: Refer to applicable Nondestructive Inspection Manual for inspection instrument model numbers, equipment part numbers, and current manufacturers and suppliers.

- (1) Ultrasonic inspection instrument.
- (2) Ultrasonic instrument-to-transducer cable.
- (3) Miniature transducer, shear wave, aluminum, 45-degree, 5 MHz, 0.187 x 0.187-inch (5 x 5 mm) element, top mount connector.
- (4) Ultrasonic couplant.

B. Access: Access to the elevator booster assembly is achieved through the aft cargo compartment, located above the cargo door.

NOTE: The calibration and inspection may be performed on-aircraft with the elevator booster assembly in the installed condition. Figures 2 through 4 should be used for reference in identifying the expected cracking orientation and proper transducer placement.

C. RC - Preparation of Part: Remove any loose dirt, flaking or scaling coatings, oils, and greases from the inspection areas to permit adequate transducer coupling with the part. Clean the inspection areas in accordance with the applicable Nondestructive Inspection Manual.

D. RC - Instrument Settings and Calibration: Set up and calibrate the ultrasonic instrument utilizing the on-aircraft elevator booster assembly and equipment settings as specified in this procedure. Refer to the instrument manufacturer's operating instructions and the applicable Nondestructive Inspection Manual for additional instructions for shear wave ultrasonic scanning.

- (1) Connect the 45-degree transducer and cable to the ultrasonic instrument and adjust the initial instrument settings to the following:

BASIC	GAIN (Initial): 32.0 dB	RANGE: 1.024 in (26.0 mm)	PROBE DELAY: 0.000 μ s	VELOCITY: 0.1232 in/ μ s (3130 m/s)	ZERO DELAY: 2.700 μ s
PULSER RECEIVER	FREQUENCY: 5 MHz	ANGLE: 45 degrees	DAMPING: 50 Ohm	FILTER: 5-15 MHz	RECTIFY: FULLWAVE
	PULSER: SQUARE	PULSER MODE: SINGLE			
GATE	GATE 1 START: 0.630 in (16.0 mm)	GATE1 WIDTH: 0.150 in (3.8 mm)	GATE1 LEVEL: 30% FSH		

- (2) Apply couplant to the elevator booster assembly at Position 1 at the forward-most end of the cylinder. See Figures 3 and 4. Slide the transducer up and down the side of the cylinder and maximize the signal response from the fluid transfer bore.
- (3) Adjust the RANGE and ZERO DELAY, as necessary, to position the maximized signal response from the fluid transfer bore at 30 percent full screen width (FSW) or 3 on the horizontal timebase (TB).

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- (4) Maximize the signal response from the fluid transfer bore and adjust the GAIN, as necessary, to achieve an 80 percent full screen height (FSH) signal response from the bore. See Screen Display 1 in Figure 5, Sheet 1, for the maximized signal response after adjustment.

E. RC - Inspection:

(1) Preliminary Marking and Detection of Diagonal Bore:

- (a) Measuring from the forward-most end of the cylinder, mark two lines at 1.40 and 1.77 inches (35 and 45 mm) on the outside of the cylinder. These markings identify the location for transducer placement when establishing the signal response from the diagonal bore. See Figure 3. The location of the diagonal bore, measured at the interior cylinder bore, is located from approximately 1.20 to 1.53 inches (30.5 to 38.8 mm) from the forward-most end of the cylinder.
- (b) Place the transducer at Position 2 between the two marked lines. See Figure 4. Using the raised forging seam at the cylinder centerline as a backstop, slide the transducer fore/aft while observing the signal response from the diagonal bore at approximately 55 percent FSW (5.5 TB).
- (c) Maximize the signal response from the diagonal bore and adjust the GAIN, as necessary, to achieve an 80 percent FSH signal response from the diagonal bore. See Screen Display 1 in Figure 5, Sheet 1, for the maximized signal response after adjustment.

(2) Inspection for Fatigue Cracking:

NOTE: A lack of back wall echo (BWE) from the bores during scanning is typical and may occur as the transducer angle, position, or coupling changes as it moves along the noted raised seam centerline.

- (a) Couple the transducer at Position 2 and maximize the signal response from the diagonal bore. See Figure 4.
- (b) Using the raised forging seam as a guide, scan forward and aft of the diagonal bore markings on the housing. Measured from the forward-most end of the cylinder, scan a distance from 1.18 to 2.75 inches (30 to 70 mm) along the cylinder. See Figure 3 for the typical scanning zone.
- (c) A simultaneous reduction in the diagonal bore signal response at approximately 55 percent FSW (5.5 TB) and an increase in the fatigue crack response at approximately 65 to 70 percent FSW (6.5 to 7 TB) will indicate a fatigue crack in the cylinder. See Screen Display 2 in Figure 5, Sheet 2 for a typical signal response from fatigue cracking.
- (d) Any fatigue crack response, located at approximately 65 to 70 percent FSH (6.5 to 7 TB) shall be assessed in accordance with the accept/reject criteria in Paragraph 5.F.
- (e) Repeat the inspection procedure on the adjacent cylinder by marking the housing for transducer placement and repeat the calibration, as required.

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F. RC - Accept/Reject Criteria:

- (1) Fatigue crack indications will be observed as a simultaneous reduction in the diagonal bore signal response at approximately 55 percent FSW (5.5 TB) and an increase in the fatigue crack response at approximately 65 to 70 percent FSW (6.5 to 7 TB). See Screen Display 2 in Figure 5, Sheet 2 for the expected signal responses from the diagonal bore and typical fatigue cracking.
- (2) Accept Criteria: Any fatigue crack response, located at approximately 65 to 70 percent FSW (6.5 to 7 TB), and less than 30 percent FSH will be considered an acceptable defect and shall be further reported. See Screen Display 3 in Figure 5, Sheet 3 for the maximum allowable signal response for fatigue cracking. A confirmed acceptable defect will allow for continued use of the elevator booster assembly.
- (3) Reject Criteria: Any fatigue crack response, located at approximately 65 to 70 percent FSW (6.5 to 7 TB), and greater than 30 percent FSH will be considered a rejectable defect and shall be further reported. A confirmed rejectable defect will require replacement of the elevator booster assembly.

6. REPORTING:

- A. Mark and report any confirmed defects that exceed the 30 percent FSH amplitude. Reporting should include the following:

- (1) The elevator booster housing nameplate and stamped upper level assembly serial numbers.
- (2) Identification of the pilot (right) and/or co-pilot (left) side that was rejectable.
- (3) Identification of cracking to the forward and/or aft sides of the diagonal bore.
- (4) The maximum percent FSH of the observed crack response(s).

7. SYSTEM SECURING: Restore any finishes removed to permit inspection and remove any inspection equipment and supplies from the inspection area. Remove any safety and/or maintenance equipment from the area and perform operational checkouts, as required, in accordance with the maintenance manual.

NOTE: If assistance is needed, contact your local Lockheed Martin Aeronautics Company representative, or the Customer Support Center in Marietta, Georgia, USA, as follows:

TELEPHONE:	(770) 494-9131
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Elevator Booster Assembly as Installed on Aircraft (View Looking Aft and Up from the Cargo Ramp)
Figure 1

APPENDIX A

July 17, 2017
Revision 2, October 3, 2019

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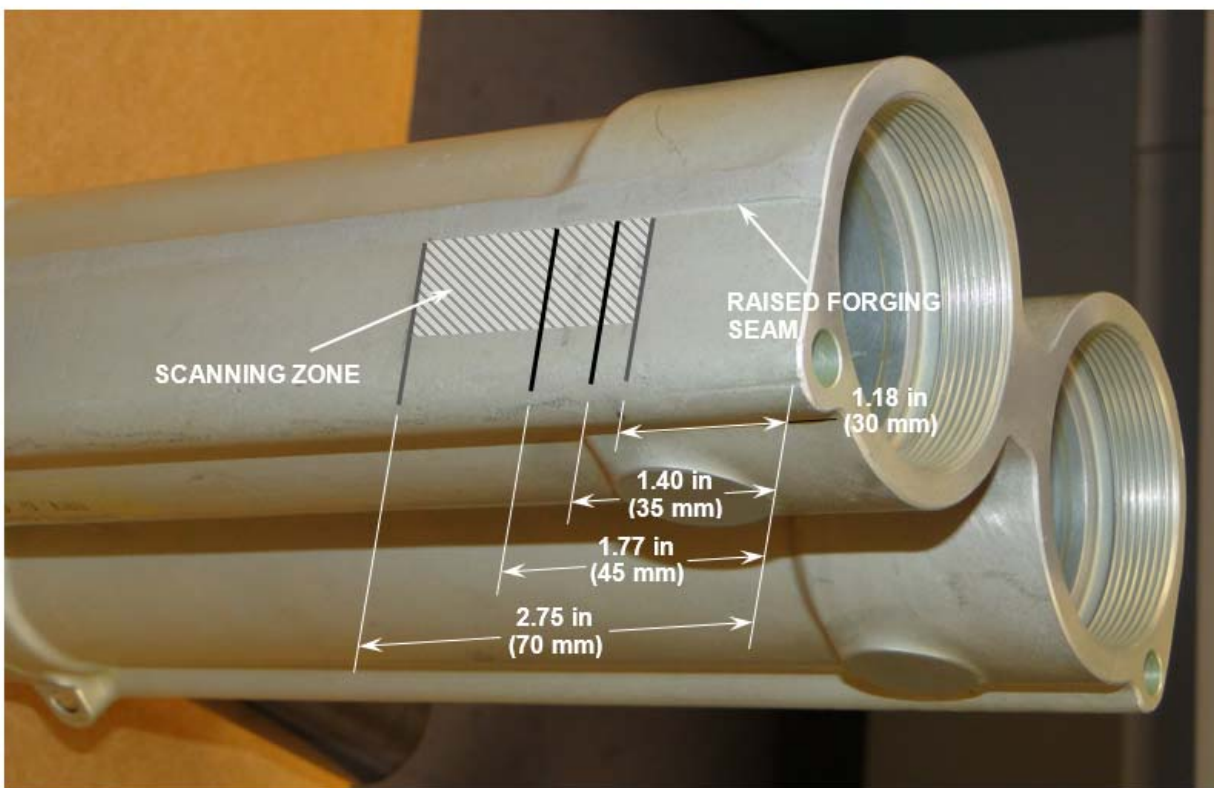
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Disassembled Elevator Booster Assembly with Ligaments of Interest Noted
Figure 2

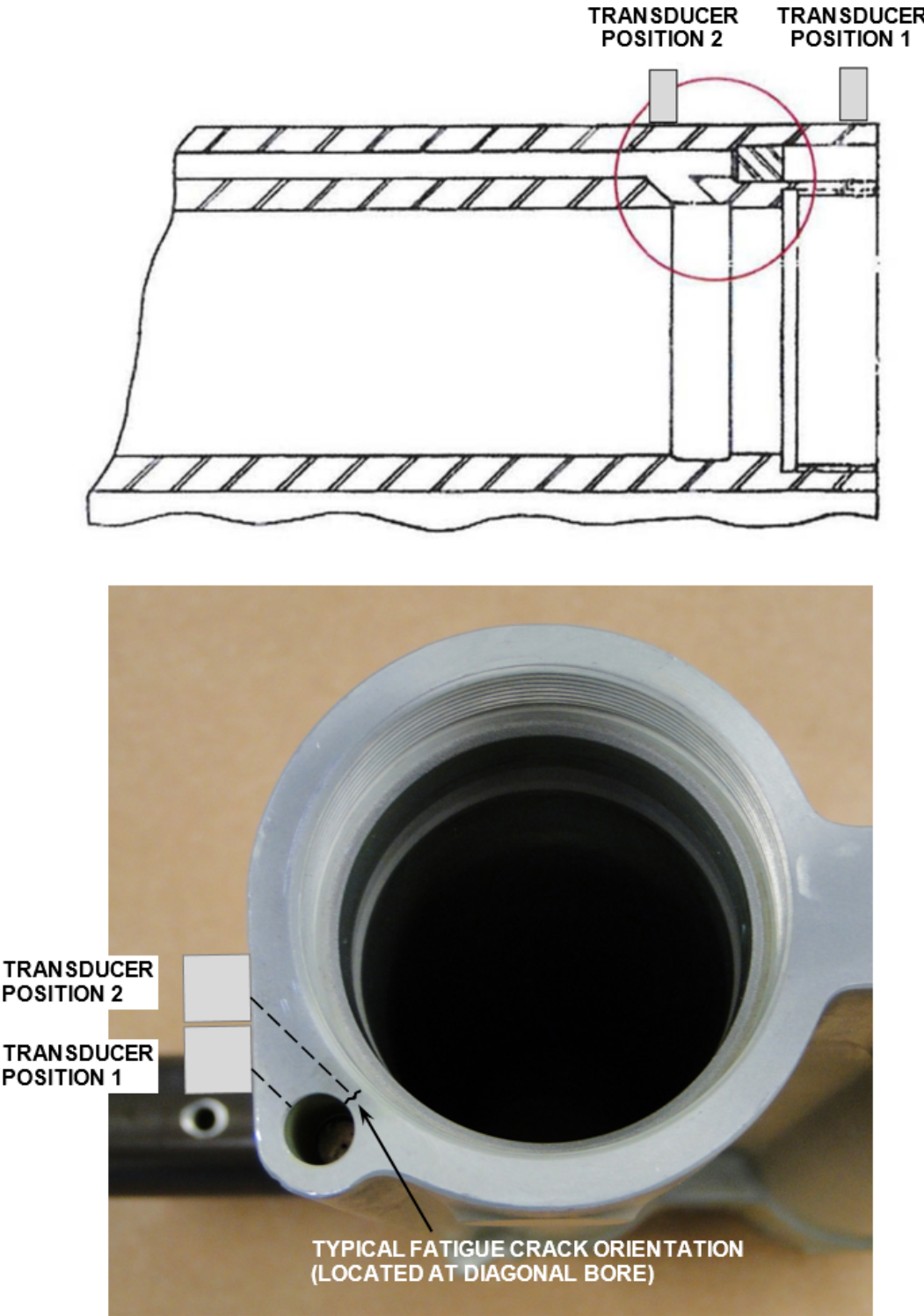
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Expected Crack Location and Orientation, Common to Main Cylinder Bore and Diagonal Bore, and Measurements Identifying Diagonal Bore Location and Scanning Zone
Figure 3

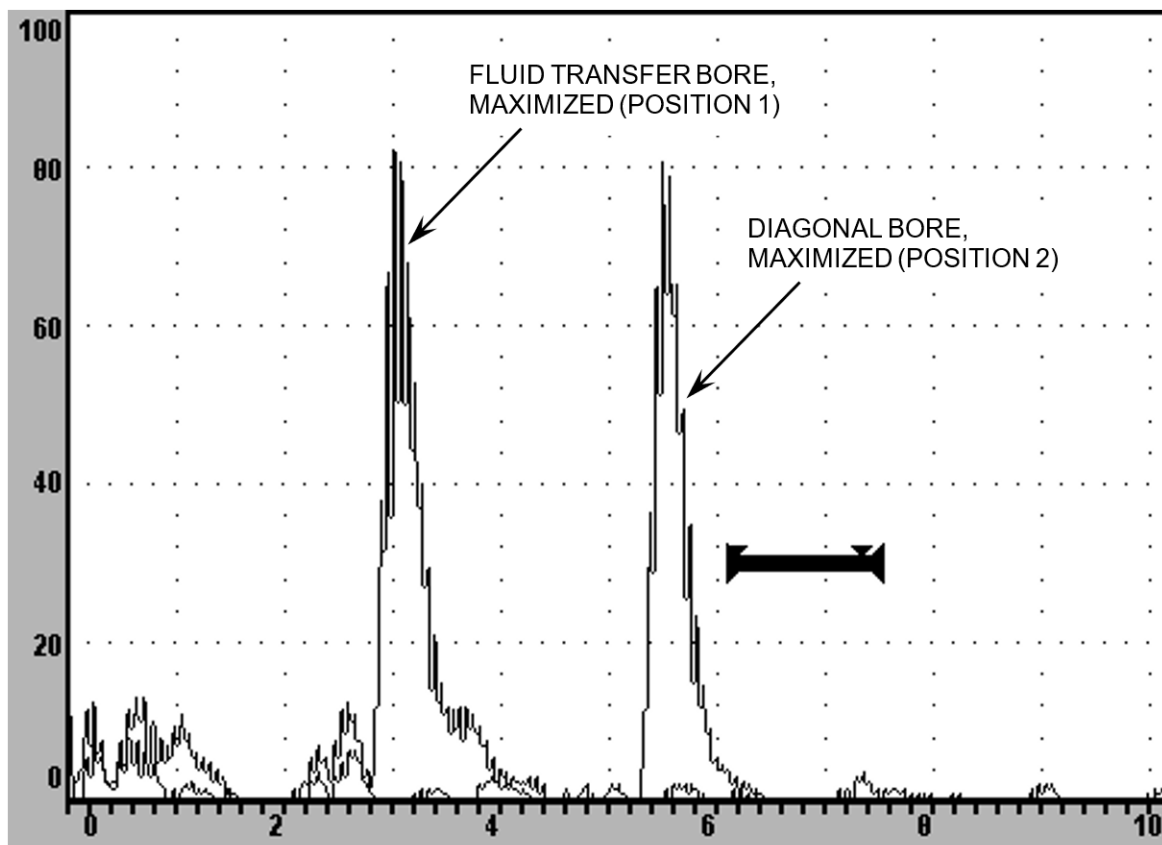
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Transducer Positions for Calibration at Diagonal Bore
Figure 4

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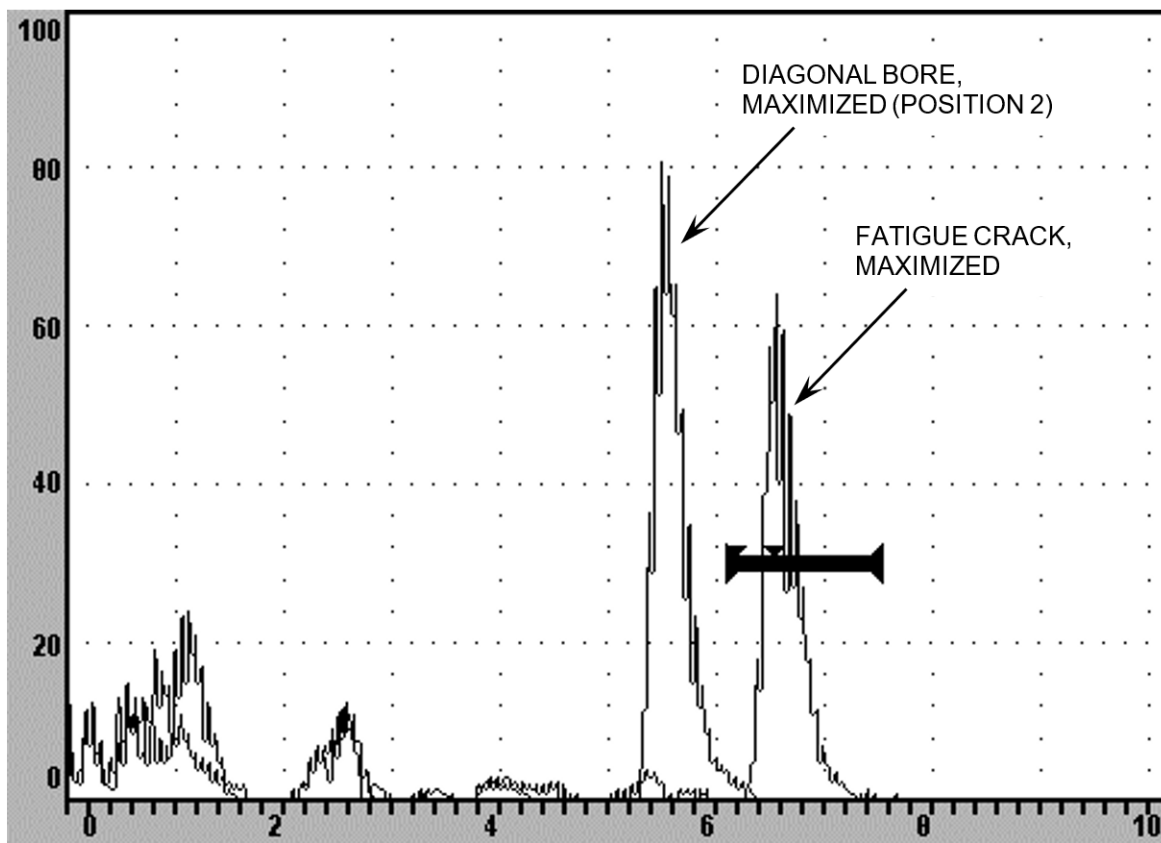


Screen Display 1: Maximized Signal Responses from Fluid Transfer Bore and Diagonal Bore.

Ultrasonic Signal Responses During Calibration and Inspection
Figure 5, Sheet 1 of 3

APPENDIX A

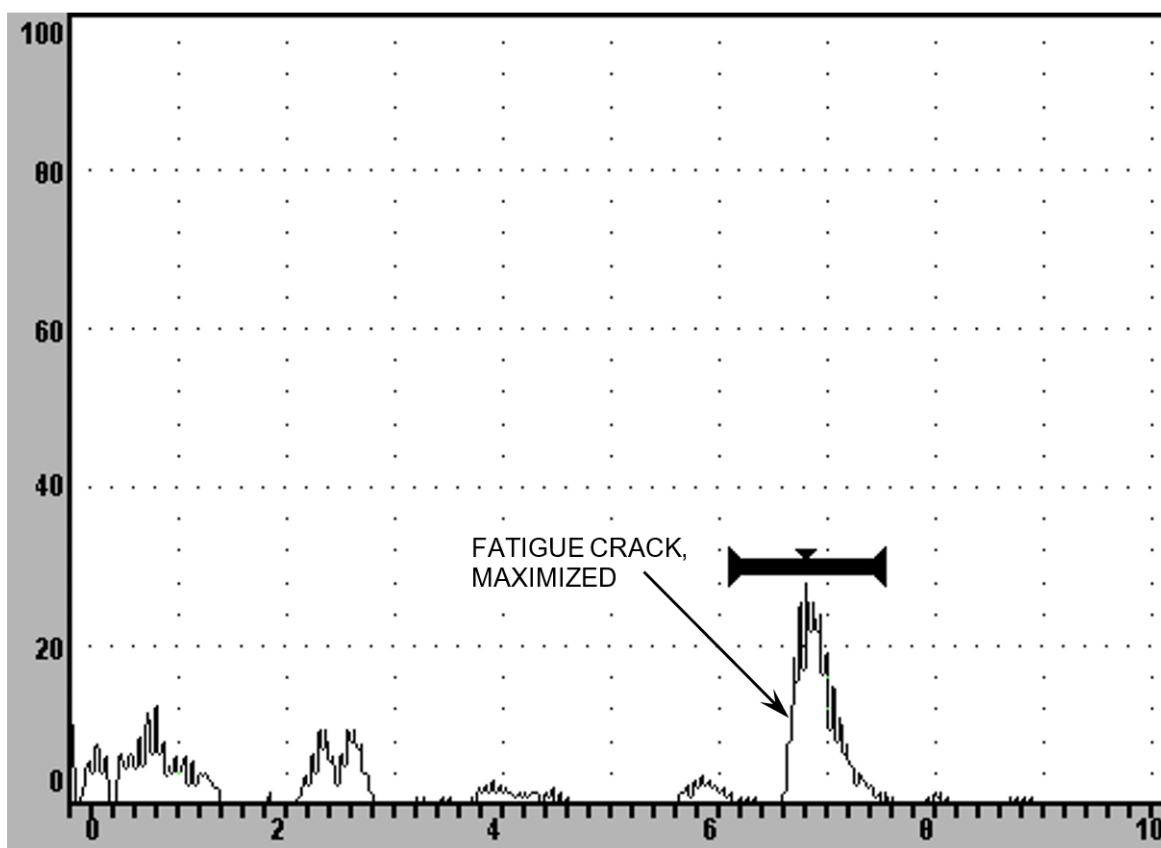
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Screen Display 2: Maximized Signal Response from Diagonal Bore and Typical Maximized Crack Response Exceeding 30 Percent Gate.

Ultrasonic Signal Responses During Calibration and Inspection
Figure 5, Sheet 2

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Screen Display 3: Maximum Allowable Crack Response Below 30 Percent Gate.

Ultrasonic Signal Responses During Calibration and Inspection
Figure 5, Sheet 3

APPENDIX A