INCREMENTAL CHANGE Release Notification Date: 08/18/2023

SPM 70-32-85 ENHANCED IMMERSION ULTRASONIC INSPECTION OF LIFE LIMITED HARDWARE

DISCLAIMER

The Incremental Changes published by GE Aviation are considered Instructions for Continued Airworthiness. These Incremental Changes, along with the current Manual revision and published Temporary Revisions, constitute the latest Instructions for Continued Airworthiness.

GE Designated: -CONFIDENTIAL-

HIGHLIGHTS

HIGHLIGHT REFERENCE	DESCRIPTION OF CHANGE
sk70-32-85-270-001	Technical Change: Changed procedure to add new methods and calibration requirements.

TASK 70-32-85-270-801

1. General.

A. This document describes the equipment, technique, and procedure for conducting component level immersion ultrasonic inspections of engine-run hardware. The inspection areas and specific requirements are detailed in the Engine Shop Manual.

B. The inspection procedure utilizes 0 degree longitudinal, 20 degree longitudinal sound waves, 45 degree, and 65 degree shear waves.

C. For specific cases where the procedure or equipment described in this document cannot be applied in their total content, specific exceptions shall be obtained in writing from GE Aviation to document the deviation.

D. The following documents shall form a part of this procedure to the extent specified herein. Unless a specific issue is specified, the latest revision shall apply.

(1) Appropriate equipment instruction manuals.

(2) National Aerospace Standard (NAS-410) (latest revision).

(3) Appropriate Service Bulletin or Engine/Shop Manual procedure.

E. Personnel requirements.

(1) Personnel performing this inspection must be certified in accordance with National Aerospace Standard (NAS-410), American Society of Nondestructive Testing (ASNT-TC-1A), Air Transport Association Specification No. 105 (ATA 105), COSAC, or any equivalent certification document acknowledged by the local regulatory agencies.

(2) It is strongly recommended that personnel performing this inspection receive practical training in the use of this procedure and must demonstrate proficiency in the calibration and evaluation routines before accept/reject authority is delegated.

(3) Any training which may be provided by GE Aviation for a technique requiring the performance of this inspection method does not imply that the personnel who receive that training have met the requirements for inspector certification in accordance with NAS-410, ASNT-TC-1A, or ATA 105.

2. Equipment.

Subtask 70-32-85-270-001

A. The following list does not include all the equipment necessary to do this inspection but does include all items for which substitution cannot be made without written approval from GE Aviation.

(1) Immersion inspection system

(a) The immersion inspection system used must be comprised of an immersion tank, a motor-driven rotary table, a bridge providing X-axis and Y-axis motion and a Z-axis search tube providing A-axis and B-axis motion, or six-axis articulate arm robot.

(b) The system shall be under computer or numeric control.

(c) Inspection systems capable of semi-automatic operation may be used for the inspection of all rotating hardware with prior agreement from GE Aviation.

(d) The system shall be capable of following the contours of the part being inspected in all inspection modes. The capability of the system to follow the contour of the part shall be demonstrated to GE Aviation before approval to use this procedure is given.

(e) The bridge type X, Y, and Z systems must be checked annually to determine that the accuracies described in Table 1 throughout the work envelope are being maintained. Inspection facilities must supply a quality plan which describes this process.

(f) The positioning repeatability of the robot arm is to be assessed by moving the robot (the movement must be at least 12.00 inches (304.8 mm)) to a given taught position three consecutive times, measuring the position each time with a dial indicator reading off of a stationary object. Three different taught positions are to be utilized for this measurement (one for each of the three Cartesian directions, X, Y, and Z) maximum permitted 0.001 inch (0.02 mm), refer to Table 2. In addition, the positioning repeatability and backlash of the turntable C must be measured. The system mechanical parameters described in Table 3 are to be used for robots on the U/T tanks. Measure and record the maximum indicator measurement or run-out for each data set described below over 12.00 inches (304.8 mm) minimum move between two taught points zeroing the indicator at each end throughout the work envelope. The use of precision square, parallel bars with a dial indicator mounted on the T-axis face of the robot or other suitable location will be required. All equipment used must be within calibration dates. The system must be checked annually to determine that the accuracies described in Table 1 are being maintained. Inspection facilities must generate a quality plan which describes this process. Systems that have a turntable must have a Robot User Frame or offline Virtual User Frame set at the Center of table.

Inspection System Accuracies - Table 1

X Axis	
Straightness/Parallelism to turntable	Within 0.010 in. per foot (0.883 mm/m)
Straightness perpendicular to turntable	Within 0.010 in. per foot (0.883 mm/m)
Positioning accuracy	Within 0.005 in. per foot (0.416 mm/m)
Positioning backlash	Within 0.005 in. (0.127 mm)
Y Axis	
Straightness/Parallelism to turntable	Within 0.010 in. per foot (0.883 mm/m)
Straightness perpendicular to turntable	Within 0.010 in. per foot (0.883 mm/m)
Positioning accuracy	Within 0.005 in. per foot (0.416 mm/m)
Positioning backlash	Within 0.005 in. (0.127 mm)
Z Axis	
Straightness/Perpendicularity to turntable in both X and Y planes	Within 0.010 in. per foot (0.883 mm/m)
Positioning accuracy	Within 0.005 in. per foot (0.416 mm/m)
Positioning backlash	Within 0.005 in. (0.127 mm)
Manipulator	
A Axis positioning accuracy	Within 0.5 degree
A Axis positioning backlash	Within 0.2 degree
A Axis parallelism to Y Axis	Within 0.010 in. (0.254 mm)
B Axis positioning accuracy	Within 0.5 degree
B Axis positioning backlash	Within 0.2 degree
B Axis parallelism to X Axis	Within 0.010 in. (0.254 mm)
Turntable	
Surface runout	Within 0.015 in. (0.38 mm) total indicator runout
Runout part centering	Within 0.010 in. (0.254 mm)
Speed accuracy	Within 3 percent of indicated speed

Positioning Repeatability - Table 2

Measurement	Trial 1	Trial 2	Trial 3	Deleted	Deleted	Max.

X direction	0.000	0.000	0.000	Deleted	Deleted	0.000
Y direction	0.000	0.000	0.000	Deleted	Deleted	0.000
Z direction	0.000	0.000	0.000	Deleted	Deleted	0.000
C direction	0.000	0.000	0.000	Deleted	Deleted	0.000

System Mechanical Parameters for Six-axis Articulate Arm Robot - Table 3

X, Y, and Z directions			
Data Set	Description	Limit	Measured Runout
X_Y	Moving in the +X direction, measuring runout in the Y direction	0.010 in./foot	--
X_Z	Moving in the +X direction, measuring flatness in the Z direction	0.010 in./foot	--
Y_X	Moving in the -Y direction, measuring runout in the X direction	0.010 in./foot	--
Y_Z	Moving in the -Y direction, measuring flatness in the Z direction	0.010 in./foot	--
Z_X	Moving in the +Z direction, measuring runout in the X direction	0.010 in./foot	--
Z_Y	Moving in the +Z direction, measuring runout in the Y direction	0.010 in./foot	--
Turntable Runout			
Surface Runout	Moving C table and measuring flatness in Z direction at 13 inches radial position. Robot must remain stationary	0.010 in.	
Centering	Moving C 360 degrees measuring runout at table edge	0.010 in.	
Speed Accuracy	--	Within 3 percent of indicated speed	

NOTE: The table has no need to be level when using the user frame because automatic compensation is applied, A to Y axis manipulator check does not need to be done on systems with a swivel gimbal manipulator.

(2) Immersion inspection system.

(a) Ultrasonic instrument with distance amplitude curve (DAC) or similar instrument approved by GE Aircraft Engines for this inspection.

(b) The instrument must be checked on an annual basis with ASTM E127 area amplitude blocks to prove that the instrument can maintain linearity as described in Table 4.

Ultrasonic Instrument Linearity Parameters - Table 4

Area Amplitude Checks Flat Bottom Hole (FBH) #	Expected amplitude percent Full Screen Height (FSH)
5	95
4	61±2
3	34±2
2	15±2
1	4±2

NOTE: The area amplitude blocks may have correction factors. The amplitude of each response should be corrected accordingly.

Attenuator Tracking dB Change	Expected amplitude percent FSH
0	95
-2	75±2
-4	60±2

-6	48±2
-8	38±2
-10	30±2
-12	24±2
-14	19±2
-16	15±2
-18	12±2
-20	9±2
-22	8±2
-24	6±2

NOTE: Any front surface or back surface signal may be used for the attenuator tracking in the list above.

(3) Ultrasonic transducers.

(a) Type A: A Harisonic I31006-T, UTX IX-139, TLC IS1010GA transducer with a 3.00 inch (76.2 mm) or equivalent transducer approved by GE Aviation shall be used for this inspection.

(b) Type B: A Harisonic I70512T, UTX IX-141, TLC IX0519GB transducer with a 6.00 inch (152.4 mm) or equivalent transducer approved by GE Aviation shall be used for this inspection.

(c) Type B Alternate: A Harisonic I2G0512T, UTX IX-1303 transducer with a 1.25-inch (31.8 mm) water path may be used if part geometry prohibits the use of a Type B transducer. An equivalent transducer approved by GE Aviation shall be used for this inspection.

(d) For new transducers the following must be checked:

1 Focal length (initial use).

a The following are necessary focal length tolerances for respective transducer types:

Type A	2.900-3.500 inches
Type B	5.700-6.500 inches

2 Center Frequency (initial use).

a The following are necessary center frequency tolerances for respective transducer types:

Type A	8.0-11.0 MHz
Type B	4.5-6.0 MHz

3 Signal to noise.

4 Resolution.

(e) For in service transducers the following must be checked annually:

1 Signal to noise.

2 Resolution.

(f) Set the amplitude for 80 percent FSH for each transducer per FBH, refer to Table 5. Verify the FBH signal separation from the front surface signal. Verify the signal-to-noise ratio (SNR) by moving away from the FBH and taking the noise percent from the same area as the FBH.

NOTE: Table 5 is shown to verify prior to initial use of transducer.

Resolution / SNR - Table 5

Transducer	FBH	Full Baseline Recover	SNR %14 Max.
TYPE A	0.060 in. #1	Yes/No	--
TYPE B	0.125 in. #2	Yes/No	--
TYPE B Alternate	0.125 in. #2	Yes/No	--

(4) DAC test: Type B transducer.

NOTE: SGP-177 block will be required for DAC test, or an approved alternative.

(a) Calibrate in longitudinal mode per Subtask 70-32-85-270-004.

(b) Plot the final gain for the two holes on a chart of gain versus depth. (Use calibration chart from Figure 2 or equivalent). Join the two points from 0.250 inch and 2.0 inches with a straight line and extend on Table 2 to 3.0 inches.

(c) For evaluation purposes, make sure that the DAC is linear, record the amplitude of the points at 0.5 inch (12.7 mm), 1.0 inch (25.4 mm), 1.5 inch (38.1 mm), 2.5 inch (63.5 mm), and 3.0 inch (76.2 mm) side-drilled hole (SDH) and compare to DAC on and DAC off for corrected gains. DAC on versus DAC off must be in the range of plus or minus 3 percent FSH.

(5) Calibration blocks.

(a) SGP044 side drill hole calibration block, and 4013316-417 (0.060 inch to 1.50 inches deep) FBH Blocks or equivalent calibration block approved by GE Aviation shall be used for this inspection.

(6) Data recording instruments/systems. Type B transducer.

(a) An electronic data recording system or equivalent approved by GE Aviation shall be used for this inspection.

(b) The ability of the recorder to record a response from a 0.125 inch (3.18 mm) deep

number 2 flat-bottomed hole at the designated inspection speeds must be demonstrated to GE Aviation. The response must be set to 30 percent FSH when peaked statically in the longitudinal mode and must not be recorded at less than 28 percent FSH.

(c) The ability of the recorder to record a response at the designated inspection speeds shall be checked on an annual basis.

B. A complete ultrasonic inspection tooling kit (P/N GE-FQAP-381 or GE-FQAP-727) can be obtained by contacting the following: Contact ndttooling@ge.com For appropriate Kit needs required.

3. Procedure.

Subtask 70-32-85-270-002

A. Set up and calibrate as follows:

Subtask 70-32-85-270-003

(1) The initial instrument settings are shown in Table 6.

(2) Record the transducer and calibration block serial numbers. Use worksheet from Figure 1 or equivalent.

(3) Align the calibration block parallel to either the X or Y axis. Level the calibration block at a sufficient depth to ensure a 6.0 inch (152 mm) water path can be obtained. The block should be shimmed as required so the change in water path during calibration does not exceed 0.010 inch (0.25 mm) total runout.

(4) Normalize the beam to the calibration block in the A and B axes.

Subtask 70-32-85-270-004

(5) Calibrate the longitudinal mode as follows with Type B Transducer:

(a) Adjust the instrument per Subtask 70-32-85-270-003.

(b) With the beam normal to the calibration block, set the water path to 6.0 inches (152 mm).

(c) Set the peak of the front surface response to the first major division (1.0) on the CRT baseline.

(d) Position the transducer over the 2.0 inch (51 mm) deep side-drilled hole (SDH) and maximize the response using linear axes only, without changing the water path.

(e) Using the range control and delay control calibrate the sweep range to 0.250 inch (6.35 mm) per major division on the CRT baseline such that the peak of the front surface response is at the first major division on the CRT and the peak of the response from the 2.000 inch (50.80 mm) deep SDH is at the ninth major division on the CRT.

(f) Record all instrument settings.

(g) The instrument gain shall be calibrated for the 0.250-inch (6.35 mm) SDH through the 2.0 inch (51 mm) deep SDH.

(h) Maximize the response from each hole using linear translation without changing the water path and adjust the gain to set the amplitude of the response from each hole to a minimum of 80 percent of FSH. Record the gain and amplitude for each hole.

NOTE: The amplitude of the response must be set as close as possible to 80 percent but must not exceed 83 percent.

(i) Adjust the gain recorded for the 0.250-inch (6.35 mm) deep SDH by the appropriate correction factor Table 7. Record the final gain and amplitude. Adjust the gain recorded for the 2.0 inch (51 mm) deep SDH by the appropriate correction factor and record the final gain and amplitude. These gains recorded must be the calibration gains used to set the inspection levels.

(j) Calibrate the DAC of the instrument for longitudinal mode from 0.250 inch (6.35 mm) through 2.0 inches (51 mm).

Initial Instrument Settings - Table 6

Transducer	Type A	Type B Long	Type B Shear
Waterpath	3.0 in.	6.0 in./2.0 in.	6.0 in./2.0 in.
Gain	45dB	45dB	45dB
Pulse Receiver			
Display	FW	FW	FW
Damp	50 ohms	50 ohms	50 ohms
Energy	High	High	High
DAC	Off	Off	Off
Filter	10 MHz	5 MHz	5 MHz
Mode	Single	Single	Single
Voltage	High	High	High
Ascan Interface			
Range	2.5	2.5	2.5
Focus	Surface	Surface	Surface
Delay	3.0 Longitudinal	6.0/2.0 Longitudinal	6.0/2.0 Shear
Threshold	40	40	40
Mode	Interface/Longitudinal	Interface/Longitudinal	Artificial/Shear

Correction Factors for Calibration Block - Table 7

	Titanium 6-4	Inconel 718 and Rene

	0.250 in. (6.35 mm)	1.000 in. (25.40 mm)	2.000 in. (50.80 mm)	0.250 in. (6.35 mm)	1.000 in. (25.40 mm)	2.000 in. (50.80 mm)
LONGITUDINAL	-4 DB	--	-4 DB	-2 DB	--	-2 DB
45° SHEAR	-2 DB	--	+1 DB	0 DB	--	+6 DB
65° SHEAR	-7 DB	--	NA	-6 DB	--	NA
20° LONGITUDINAL	-5 DB	--	-5 DB	0 DB	--	0 DB
20° SUBSURFACE LONGITUDINAL	--	-11 DB	-4 DB	--	-5 DB	0 DB
45° SUBSURFACE SHEAR	--	-8 DB	+6 DB	--	-5 DB	-2 DB

Subtask 70-32-85-270-005

(6) Calibrate in the 45-degree Shear Mode as follows with Type B Transducer:

(a) Adjust rectification to Full Wave. Adjust interface synchronization to Artificial.

(b) Angle the transducer to create a 45-degree refracted shear wave such that the sound is being directed from the shallow hole to the deep hole. Set the water path to 6.0 inches (152 mm).

(c) Set the peak of the front surface response to the first major division (1.0) on the CRT baseline.

NOTE: If a sufficient front surface response cannot be obtained, the edge of the block may be used.

(d) Position the transducer over the 2.000 inch (50.80 mm) deep SDH and maximize the response using linear axes only, without changing the water path.

(e) Using the range control and the delay control, calibrate the sweep range to 0.250 inch (6.35 mm) per major division on the CRT baseline such that the peak of the front surface response is at the first major division on the CRT and the peak of the response from the 2.000 inch (50.80 mm) deep SDH is at the ninth major division on the CRT.

(f) Record all instrument settings.

(g) The instrument gain shall be calibrated for the 0.250 inch (6.35 mm) SDH and the 2.000 inch (50.80 mm) deep SDH.

(h) Maximize the response from each hole using linear translation without changing the water path and adjust the gain to set the amplitude of the response from each hole to a minimum of 80 percent of FSH. Record the gain and amplitude for each hole.

NOTE: The amplitude of the response must be set as close as possible to 80 percent but must not exceed 83 percent.

(i) Adjust the gain recorded for the 0.250 inch (6.35 mm) deep SDH by the appropriate correction factor for the specific material to be inspected (Table 7) and record the final gain and amplitude. Adjust the gain recorded for the 2.000 inch (50.80 mm) deep SDH by the appropriate correction factor and record the final gain and amplitude. These gains recorded shall be the calibration gain used to set the inspection levels.

(j) Calibrate the DAC of the instrument for 45-degree shear mode from 0.250 inch (6.35 mm) through 2.000 inches (50.80 mm).

(7) Calibrate in the 65-degree Shear Mode as follows with Type B Transducer:

(a) Adjust rectification to Full Wave. Adjust interface synchronization to Artificial.

(b) Angle the transducer to create a 65-degree refracted shear wave such that the sound is being directed from the shallow hole to the deep hole. Set the water path to 6.0 inches (152 mm).

(c) Set the peak of the front surface response to the first major division (1.0) on the CRT baseline.

NOTE: If a sufficient front surface response cannot be obtained, the edge of the block may be used.

(d) Position the transducer over the 0.250-inch (6.35 mm) SDH hole and maximize the response using linear axes only, without changing the water path.

(e) Using the fine control and the delay control, calibrate the sweep range to 0.050 inch (1.27 mm) per major division on the CRT baseline such that the peak of the front surface response is at the first major division on the CRT and the peak of the response from the 0.250 inch (6.35 mm) deep SDH is at the sixth major division on the CRT.

(f) Record all instrument settings.

(g) The instrument gain shall be calibrated for the 0.250 inch (6.35 mm) deep SDH.

(h) Maximize the response from the 0.250 inch (6.35 mm) deep hole using linear translation without changing the water path and adjust the gain to set the amplitude of the response from the hole to a minimum of 80 percent of FSH. Record the gain and amplitude of the response.

NOTE: The amplitude of the response must be set as close as possible to 80 percent but must not exceed 83 percent.

(i) Adjust the gain recorded for the 0.250 inch (6.35 mm) deep SDH by the appropriate correction factor for the specific material to be inspected (Table 7) and record the final gain and amplitude. This gain recorded shall be the calibration gain used to set the inspection levels.

(8) Calibrate in the 20-degree longitudinal mode as follows with Type B Transducer:

(a) Adjust rectification to full wave. Adjust interface synchronization to artificial.

(b) Angle the transducer to create a 20-degree refracted longitudinal wave such that the sound is being directed from the shallow hole to the deep hole. Set the water path to

6.0 inches (152 mm).

(c) Set the peak of the front surface response to the first major division (1.0) on the CRT baseline.

NOTE: If a sufficient front surface response cannot be obtained, the edge of the block can be used.

(d) Position the transducer over the 2.000 inch (50.80 mm) deep SDH and maximize the response with a linear axes only, without changing the water path.

(e) Use the range control and the delay control, to calibrate the sweep range to 0.250 inch (6.35 mm) for each major division on the CRT baseline such that the peak of the front surface response is at the first major division on the CRT and the peak of the response from the 2.000 inch (50.80 mm) deep SDH is at the ninth major division on the CRT.

(f) Record all instrument settings.

(g) The instrument gain must be calibrated for the 0.250 inch (6.35 mm) SDH and the 2.000 inch (50.80 mm) deep SDH.

(h) Maximize the response from each hole, use linear translation without changing the water path and adjust the gain to set the amplitude of the response from each hole to a minimum of 80 percent of FSH. Record the gain and amplitude for each hole.

NOTE: The amplitude of the response must be set as close as possible to 80 percent but must not exceed 83 percent.

(i) Adjust the gain recorded for the 0.250 inch (6.35 mm) deep SDH by the appropriate correction factor for the specific material to be inspected (Table 7) and record the final gain and amplitude. Adjust the gain recorded for the 2.000 inch (50.80 mm) deep SDH by the appropriate correction factor and record the final gain and amplitude. These gains recorded must be the calibration gain used to set the inspection levels.

(j) Calibrate the DAC of the instrument for the 20-degree longitudinal mode from 0.250 inch (6.35 mm) through 2.000 inches (50.80 mm).

(9) Calibrate in the subsurface 20 degree longitudinal as follows with Type B Transducer:

(a) Adjust rectification to full wave. Adjust interface synchronization to artificial.

(b) Angle the transducer to create a 20-degree refracted longitudinal wave such that the sound is being directed from the shallow hole to the deep hole. Set the water path to 2.0 inches (50.80 mm).

(c) Set the peak of the front surface response to the first major division (1.0) on the CRT baseline.

NOTE: If a sufficient front surface response cannot be obtained, the edge of the block can be used.

(d) Position the transducer over the 2.000 inch (50.80 mm) SDH hole and maximize the response using linear axes only, without changing the water path.

(e) Use the range control and delay control, to calibrate the sweep range to 0.250 inch (6.35 mm) for each major division on the CRT baseline such that the peak of the front surface response is at the first major division on the CRT and the peak of the response from the 2.0 inch (51 mm) deep SDH is at the ninth major division on the CRT.

(f) Record all instrument settings.

(g) The instrument gain must be calibrated for the 2.000 inch (50.80 mm) deep SDH.

(h) Maximize the response from the 2.000 inch (50.80 mm) deep hole, use linear translation without changing the water path and adjust the gain to set the amplitude of the response from the hole to a minimum of 80 percent of FSH. Record the gain and amplitude of the response.

NOTE: The amplitude of the response must be set as close as possible to 80 percent but must not exceed 83 percent.

(i) To get the gain necessary at 1.000 inch (25.40 mm) use the gain value recorded for the 2.000 inch (50.80 mm) deep SDH and adjust by the appropriate correction factor for the specific material to be inspected (Table 7) for a depth of 1.000 inch (25.40 mm). This gain recorded must be the calibration gain used to set the inspection levels.

(j) Adjust the gain recorded for the 2.000 inch (50.80 mm) deep SDH by the appropriate correction factor for the specific material to be inspected (Table 7) and record the final gain and amplitude.

(k) Calibrate the DAC of the instrument for 20 degree refracted longitudinal from 1.000 inch (25.40 mm) through 2.000 inches (50.80 mm).

(10) Calibrate in the subsurface 45-degree shear as follows with Type B Transducer:

(a) Adjust rectification to full wave. Adjust interface synchronization to artificial.

(b) Angle the transducer to create a 45-degree refracted wave such that the sound is being directed from the shallow hole to the deep hole. Set the water path to 2.0 inches (50.80 mm).

(c) Set the peak of the front surface response to the first major division (1.0) on the CRT baseline.

NOTE: If a sufficient front surface response cannot be obtained, the edge of the block can be used.

(d) Position the transducer over the 2.000 inch (50.80 mm) SDH hole and maximize the response using linear axes only, without changing the water path.

(e) Use the range control and delay control, to calibrate the sweep range to 0.250 inch (6.35 mm) per major division on the CRT baseline such that the peak of the front surface response is at the first major division on the CRT and the peak of the response from the 2.0 inch (51 mm) deep SDH is at the ninth major division on the CRT.

(f) Record all instrument settings.

(g) The instrument gain must be calibrated for the 2.000 inch (50.80 mm) deep SDH.

(h) Maximize the response from the 2.000 inch (50.80 mm) deep hole, use linear translation without changing the water path and adjust the gain to set the amplitude of the response from the hole to a minimum of 80 percent of FSH. Record the gain and amplitude of the response.

NOTE: The amplitude of the response must be set as close as possible to 80 percent but must not exceed 83 percent.

(i) To get the gain necessary at 1.000 inch (25.40 mm) use the gain value recorded for the 2.000 inch (50.80 mm) deep SDH and adjust by the appropriate correction factor for the specific material to be inspected (Table 7) for a depth of 1.000 inch (25.40 mm). This gain recorded must be the calibration gain used to set the inspection levels.

(j) Adjust the gain recorded for the 2.000 inch (50.80 mm) deep SDH by the appropriate correction factor for the specific material to be inspected (Table 7) and record the final gain and amplitude.

(k) Calibrate the DAC of the instrument for subsurface 45-degree shear mode from 1.000 inch (25.40 mm) through 2.000 inches (50.80 mm)

(11) Calibrate Longitudinal Mode as follows with Type A Transducer:

(a) Install the Type A transducer.

(b) Set up the instrument to the initial Type A settings per Table 1.

(c) Normalize the sound beam on the 0.060-inch (1.52 mm) calibration block, away from FBH.

(d) Adjust the water path to 3.0 inches.

(e) Perform Type A Longitudinal Calibration as follows:

1 Locate the maximum responses from the 0.0600 inch (1.524 mm), 0.1250 inch (3.175 mm), 0.2500 inch (6.350 mm), 0.500 inch (12.70 mm), 0.750 inch (19.05 mm), 1.000 inch (25.40 mm), 1.250 inch (31.75 mm), and 1.500 inch (38.10 mm) deep flat bottom drilled holes (FBH) on the 4013316-417 calibration block and maximize each of the responses in turn and determine the gain required to set the amplitude to a minimum of 80 percent and no greater than 85 percent FSH. Record the instrument settings, gain and amplitude for each hole on the calibration form. At minimum a two point DAC curve is required using 0.125 inch (3.17 mm) and 1.5 inch (38.10 mm) FBH.

2 After locating the maximum responses from all flat bottom holes, assure the screen range is set to 0.250 inch per division. Using the delay and range controls adjust accordingly.

3 Construct a DAC to achieve an 80 to 83 percent amplitude across the range of the calibration standards and record the gain and time setting for each hole.

(12) Use the following guidelines to determine calibration frequency:

NOTE: After sufficient calibrations have been performed and data has been gathered over a sufficient period of time, the calibration frequency may be extended with the prior approval of GE Aviation.

(a) Calibration must be done at the beginning of each part or each shift, the calibration must be checked at the end of each part or each shift or whenever a change in inspection material or equipment (including cables) is made, whenever a power outage occurs or whenever the operator suspects a problem.

(13) Calibrate for inspections to a depth of 3.000 inches (76.20 mm) in the longitudinal and shear mode as follows:

(a) Use this calibration only when inspections are required for depths greater than 2.000 inches (50.80 mm) and up to 3.000 inches (76.20 mm).

(b) Calibrate following the procedures detailed in Subtask 70-32-85-270-004 for the longitudinal mode and Subtask 70-32-85-270-005 for 45-degree shear mode with the following exceptions:

1 Use the range control and delay controls to calibrate the sweep range to 0.500 inch (12.70 mm) per major division on the CRT baseline.

NOTE: The peak of the front surface response must be at the first major division on the CRT and the peak of the response from the 2.000 inch (50.80 mm) deep SDH must be at the fifth major division on the CRT.

2 Plot the final gain for the two holes on a chart of gain versus depth.

NOTE: The depth range on the chart axis must be at least 3.000 inches (76.20 mm).

3 Join the two points with a straight line.

4 Extend the straight line to a depth of 3.000 inches (76.20 mm).

5 Plot the chart for both modes of inspection.

6 Determine the gain for both modes of inspection from the charts for a depth of 3.000 inches (76.20 mm).

7 Use this gain to construct a DAC from 0.0 to 3.000 inches (76.20 mm).

8 Calibrate the DAC of the instrument for each mode from 0.250 inch (6.35 mm) through 2.000 inches (50.80 mm) and 2.000 inches (50.80 mm) through 3.000 inches (76.20 mm) in two successive parts.

Subtask 70-32-85-270-006

B. Prepare the part as follows:

NOTE: The part to be inspected shall be clean and free of any foreign material or marking which will interfere with the sonic beam penetration and reflection or will obscure significant indications.

(1) Prior to inspection, locate the serial number. Mark on the forward and aft flanges the bolt holes which most closely line up with the "/" in S/N. This will be the 12 o'clock position.

(2) Record the part number and serial number.
(3) Center the part in the tank so that the water path variation is 0.010 inch (0.25 mm) or less for a complete revolution of the part.

Subtask 70-32-85-270-007

C. Inspect as follows:

NOTE: The part to be inspected shall be clean and free of any foreign material or marking which will interfere with the sonic beam penetration and reflection or will obscure significant indications.

(1) Index rates are as follows, unless otherwise specified by engine manual.
Type A 0.020 in.
Type B 0.040 in.
(2) Inspect in all scan modes as follows:
(a) Calibrate per Subtask 70-32-85-270-002 as required.
(b) Inspect part per engine manual requirements.
(c) Set scanning gain per Subtask 70-32-85-270-002 and engine manual requirements.
(d) Set gates per engine manual scan plan requirements.
(e) As each scan is completed, initial the appropriate box referenced in engine manual inspection worksheet.
(f) C-scan palette must be gradient to show all pixels from 0 to 100 percent amplitude.
(g) Water path must not deviate more than plus or minus 0.100 inch (2.54 mm) from the calibration water path.

Subtask 70-32-85-270-008

D. Evaluate using the following criteria.
(1) Evaluate all repeatable responses which are equal to or exceed the following criteria:
(a) All repeatable responses which are equal to or exceed the evaluation criteria at scanning gains.
(b) All indications shall be evaluated at inspection gain with DAC on.
(c) Peak the response by translation and rotation only.
(d) Reject all hardware for indications which are repeatable, and are equal to or exceed the following criteria:
1 All responses which are equal to or exceed the reject limits at evaluation gains referenced in engine manual.
(e) Record the indication number, depth, mode, direction, amplitude, gain level, and location.

Subtask 70-32-85-270-009

E. Post calibration.
(1) A calibration check for each transducer must be done after completing the inspections or at the end of each shift with that transducer. Also, do a check of the calibration whenever any system component or operator is changed, after any loss of power and at any time the operator suspects a change in the system.
(2) If the amplitude of the response from any SDH's or FBH's has increased by more than 10 percent FSH above the corrected calibration amplitude, the system shall be re-calibrated prior to the inspection of additional hardware. It will be necessary to re-inspect any rejected hardware examined since the last acceptable calibration once correct calibration has been achieved.
(3) If the amplitude of the response from any SDH's or FBH's has decreased by more than 10 percent FSH below the corrected calibration amplitude the system shall be re-calibrated, and all hardware inspected since the last acceptable calibration or calibration check must be re-inspected.

Subtask 70-32-85-270-010

F. Document inspection as follows:
(1) Ensure that the calibration worksheet Figure 1 or equivalent is complete.
(2) Ensure that the operator's inspection worksheet for the part being inspected are complete.
(3) Record the following with each scan file.
(a) Part number.
(b) Part serial number.
(c) Date.
(d) Operator.
(4) Record the following data for each scan:
(a) Scan area number.
(b) Mode/Direction.
(c) Date.
(d) Operator.
(5) Document indications as follows:
(a) If an indication is found, carefully mark the beam entry point for the indication on the part.
(b) Record the scan area where the indication is located.
(c) Record the circumferential position as referenced from the "/" of serial number and recorded clockwise looking aft. Record the radial position as referenced from the ID bore surface to the nearest 0.100 inch (2.54 mm).
(6) It is the inspection facility's responsibility to maintain all inspection records. The records should be maintained with the permanent record of the part and shall be maintained

for the life of the part. The responsibility to maintain the permanent record for the life of the part lies with the owner/operator of the part.

*** * * FOR ALL**

DATE :
PART NUMBER:
INST. S/N :
CAL. STD. S/N :
OPERATOR :
PART S/N :
TRANSDUCER S/N:
SYSTEM :

LONGITUDINAL

FREQUENCY :
FILTER :
DISPLAY FULL/HALF:
ENERGY :
VOLTAGE :
DAMPING :
DELAY :
RANGE :
MODE FIX/INTERFACE:

	INITIAL		CORRECTION FACTOR	FINAL		DAC GAIN	DAC TIME	INSPECTION GAIN PLUS 6db/12db	ACCEPTABLE POST CAL.
	GAIN	AMP		GAIN	AMP				
0.2500 IN. (6.350 MM)									
2.000 IN. (50.80 MM)									

45° SHEAR

FREQUENCY :
FILTER :
DISPLAY FULL/HALF:
ENERGY :
VOLTAGE :
DAMPING :
DELAY :
RANGE :
MODE FIX/INTERFACE:

	INITIAL		CORRECTION FACTOR	FINAL		DAC GAIN	DAC TIME	INSPECTION GAIN PLUS 6db/12db	ACCEPTABLE POST CAL.
	GAIN	AMP		GAIN	AMP				
0.2500 IN. (6.350 MM)									
2.000 IN. (50.80 MM)									

65° SHEAR

FREQUENCY :
FILTER :
DISPLAY FULL/HALF:
ENERGY :
VOLTAGE :
DAMPING :
DELAY :
RANGE :
MODE FIX/INTERFACE:

	INITIAL		CORRECTION FACTOR	FINAL		DAC GAIN	DAC TIME	INSPECTION GAIN PLUS 6db/12db	ACCEPTABLE POST CAL.
	GAIN	AMP		GAIN	AMP				
0.2500 IN. (6.350 MM)									

6006740-00

Figure 1 (Sheet 1) Type B Calibration and DAC Worksheet

*** * * FOR ALL**

DATE	:	OPERATOR	:
PART NUMBER	:	PART S/N	:
INST. S/N	:	TRANSDUCER S/N	:
CAL. STD. S/N	:	SYSTEM	:

20° REFRACTED LONGITUDINAL

FREQUENCY	:	ENERGY	:	DELAY	:
FILTER	:	VOLTAGE	:	RANGE	:
DISPLAY FULL/HALF	:	DAMPING	:	MODE FIX/INTERFACE	:

	INITIAL		CORRECTION	FINAL		DAC	DAC	INSPECTIION GAIN	ACCEPTABLE
	GAIN	AMP	FACTOR	GAIN	AMP	GAIN	TIME	PLUS 6db/12db	POST CAL.
0.2500 IN. (6.350 mm)									
2.000 IN. (50.80 mm)									

SUBSURFACE 20° REFRACTED LONGITUDINAL

FREQUENCY	:	ENERGY	:	DELAY	:
FILTER	:	VOLTAGE	:	RANGE	:
DISPLAY FULL/HALF	:	DAMPING	:	MODE FIX/INTERFACE	:

	INITIAL		CORRECTION	FINAL		DAC	DAC	INSPECTIION GAIN	ACCEPTABLE
	GAIN	AMP	FACTOR	GAIN	AMP	GAIN	TIME	PLUS 6db/12db	POST CAL.
0.2500 IN. (6.350 mm)									
2.000 IN. (50.80 mm)									

SUBSURFACE 45° SHEAR

FREQUENCY	:	ENERGY	:	DELAY	:
FILTER	:	VOLTAGE	:	RANGE	:
DISPLAY FULL/HALF	:	DAMPING	:	MODE FIX/INTERFACE	:

	INITIAL		CORRECTION	FINAL		DAC	DAC	INSPECTIION GAIN	ACCEPTABLE
	GAIN	AMP	FACTOR	GAIN	AMP	GAIN	TIME	PLUS 6db/12db	POST CAL.
0.2500 IN. (6.350 mm)									

6042085-00

Figure 1 (Sheet 2) Type B Calibration and DAC Worksheet

*** * * FOR ALL**

DATE :
PART NUMBER :
INST. S/N :
CAL. STD. S/N (SDH):
CAL. STD. S/N (FBH):

OPERATOR :
PART S/N :
TRANSDUCER S/N:
SYSTEM :

LONGITUDINAL

FREQUENCY :
FILTER :
DISPLAY FULL/HALF:

ENERGY :
VOLTAGE :
DAMPING :

DELAY :
RANGE :
MODE FIX/INTERFACE:

	INITIAL		CORRECTION FACTOR	FINAL		DAC GAIN	DAC TIME	ACCEPTABLE POST CAL.
	GAIN	AMP		GAIN	AMP			
0.0600 IN. (1.524 MM)								
0.1250 IN. (3.175 MM)								
0.2500 IN. (6.350 MM)								
0.500 IN. (12.70 MM)								
0.750 IN. (19.05 MM)								
1.000 IN. (25.40 MM)								
1.250 IN. (31.75 MM)								
1.500 IN. (38.10 MM)								

6006741-00

Figure 1 (Sheet 3) Type A Calibration and DAC Worksheet

*** * * FOR ALL**

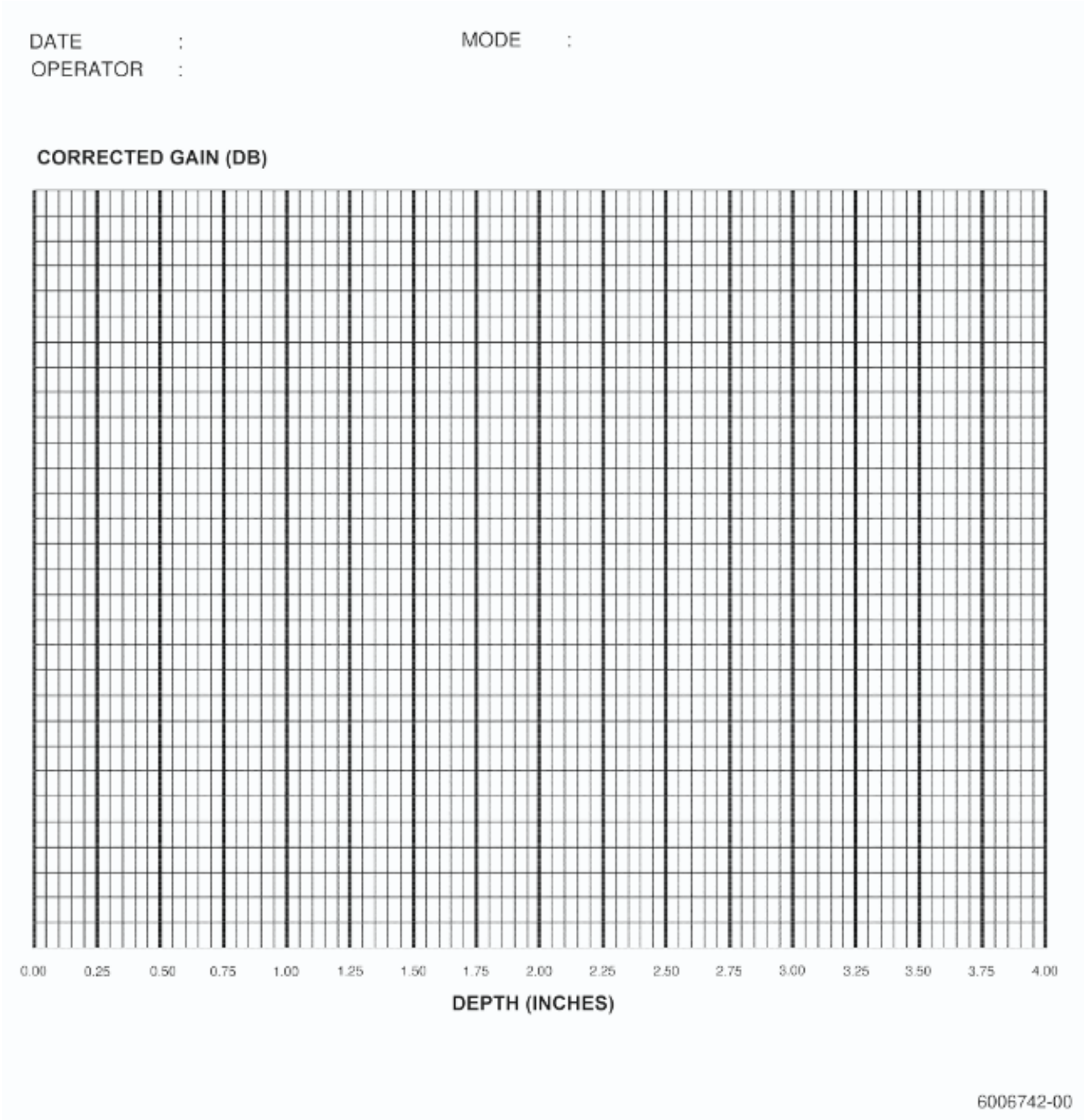

Figure 2 Calibration Chart