International Aero Engines
NON-MODIFICATION
SERVICE BULLETIN

Date: Feb.14/2007

ENGINE – HP COMPRESSOR, STAGE 4 ROTOR – ULTRASONIC INSPECTION OF AEROFOIL, EDDY CURRENT INSPECTION OF BLADE LEADING EDGE – NON-MODIFICATION SERVICE BULLETIN

V2500-A1 SERIES PROPULSION SYSTEMS NON-MODIFICATION SERVICE BULLETIN

This document transmits Revision 3 of Non-Modification Service Bulletin V2500-ENG-72-0484

Document History

Service Bulletin Revision Status

Initial Issue	Oct. 7/04
Revision 1	Mar.18/05
Revision 2	Jul.28/06

Bulletin Revision 3

Remove	Incorporate	Reason for change
All pages of the Service Bulletin	Pages 1 to 26 of the Service Bulletin	To allow for eddy current inspection and ultrasonic inspection to be carried out during an engine overhaul shop visit.

List of Effective Pages

The effective pages to this Service Bulletin following incorporation of Revision 3 are as follows:

Page	Revision Number	Revision Date
Bulletin		
1	3	Feb.14/2007
2	3	Feb.14/2007
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1. Planning Information

A. Effectivity

In-Service Engines

(1) Airbus - A320
V2500-A1 engines prior to Serial No. V0362
For all operators.

B. Reason

1. Problem

R The purpose of this Non-Modification Service Bulletin is to introduce three inspections for cracking of the stage 4 HPC rotor blade aerofoil.

Cracking has been found on the aerofoil of HPC stage 4 rotor blades. The cracking initiates at the forward edge or mid-chord of the blade. To date there have been several occasions where this cracking has propagated sufficiently for the remainder of the blade to be released causing significant secondary damage to the engine.

R A means of inspecting the stage 4 blades has been developed. This inspection utilises a specially designed kit including an ultrasonic probe and a leading edge eddy current probe that are inserted into the engine through the borescope access port at stage 4.

C. Description

R This Non-Modification Service Bulletin instructs three types of inspection

Part 1 Details an eddy current procedure that can be used to inspect the blade aerofoil leading edge.

Part 2 Details an ultrasonic procedure that can be used to inspect the blade aerofoil at mid-chord.

R Part 3 Details additional inspection for used blades that are reinstalled during an
R overhaul shop visit. Reused blades are to be inspected in accordance with the
R Engine Manual, TASK 72-41-15-200-002-A00.

R Accomplishment of this Non-Modification Service Bulletin can be claimed for engines in
R service that satisfactorily comply with the relevant criteria of Part 1 and Part 2 detailed in 1.C
R and for engines at overhaul that satisfactorily comply with the relevant criteria of Part 1, Part 2
R and Part 3.

D. Compliance

Category Code 3

In-Service Engines

Part A For engines that have not embodied SB ENG-72-0449, the inspection is to be accomplished at the next maintenance opportunity and repeated every 3000 cycles.

Part B For engines that have embodied SB ENG-72-0449 but did not have the entire set of stage 4 rotor blades replaced with new when the Service Bulletin was embodied, the inspection is to be accomplished at the next maintenance opportunity. There is no requirement to repeat the inspection thereafter.

Part C For engines that have embodied SB ENG-72-0449 and had the entire set of stage 4 rotor blades replaced with new when the Service Bulletin was embodied, there is no requirement to accomplish this Non-Modification Service Bulletin.

NOTE: The ultrasonic and eddy current inspections must only be performed by suitably qualified persons who have received specialist training to the appropriate national standard (EN4179, NAS 410 or equivalent) at level 2 or higher. The specialist training must be provided by IAE instructors or by holders of an IAE certificate of competence for this inspection.

R Overhaul Engines

R Part D For engines that have embodied SB ENG-72-0449 but did not have the entire set of
R stage 4 blades replaced with new, the eddy current and ultrasonic inspection is to be
R carried out during engine overhaul shop visit.
R During overhaul shop visit the inspection can be carried out when the HPC is at
R module level. Engines or HPC modules which have used stage 4 blades installed
R during overhaul shop visit need Part 1 (Eddy current inspection), Part 2 (Ultrasonic
R inspection) and Part 3 (Refer to the Engine Manual, TASK 72-41-15-200-002-A00).
R For engines or HPC modules that satisfactorily complete the inspection during
R overhaul shop visit, there is no need to repeat the inspection in service.

E. Approval

The compliance statement at 1.D and the procedures in Section 3. of this Non-Modification Service Bulletin comply with the Federal Aviation Regulations and are FAA-approved for the engine model listed.

F. References

(1) Airbus A319/A320/A321 Aircraft Maintenance Manual (AMM), Chapter Section 72-00-00, Inspection/Check.
(2) Airbus A319/A320/A321 Aircraft Maintenance Manual (AMM), Chapter Section 72-00-00-860-010, Rotation of HP Compressor with hand turning tool.
R (3) V2500A1 Engine Manual (EM), Chapter 72-41-15.
R (4) Engineering Change No. 04VR857C.

G. Concurrent Requirements

None.

H. Manpower

Estimate of man-hours necessary to embody this Service Bulletin in full:

(1) In Service

	Est. Manhours
(a) To gain access	1 hour
(b) To embody	4 hours
(c) To close up	30 minutes
(d) Total	5 hours and 30 minutes

(2) At overhaul

R Applicable (Hours not affected).

2 Material Information

None.

3. Accomplishment Instructions

R A. General

R (1) The eddy current inspection and the ultrasonic inspection of stage 4 blades can also be
R carried out during an overhaul shop visit, on an assembled engine or with an assembled
R HPC module.

R (2) Alternatively, eddy current inspection of the stage 4 blades can be carried out at
R piece part level. For piece part inspection carry out steps B.(1), B.(3), B.(4)(a), B.(4)(b),
R B.(4)(c), B.(4)(d), B.(4)(f) and B.(5).

NOTE: In order to reduce the potential for multiple-engine in flight shutdown, power loss, or other anomaly due to maintenance error, IAE recommends that operators avoid performing maintenance on multiple engines installed on the same aircraft at the same time. If it is not possible to avoid maintenance on more than one engine at the same time, IAE recommends that additional controls are applied in order to ensure that maintenance tasks have been completed as defined.

R B. Part 1 – Eddy current inspection of stage 4 blades

(1) Tools and Equipment

(a) Inspection Kit IAE2R19778 comprising:

Ultrasonic Probe assembly (See Fig.1).	IAE2R19779
Leading Edge Eddy Current Probe.	IAE2R19780
Blade Mid Chord and Leading Edge Working Standard.	IAE2R19781
Water feed Bottle.	IAE2R19782
Borescope hole adaptor.	IAE2R19753

(b) Turning Tool and Borescope Inspection Kit. IAE2R19544
Alternatively use a 6 mm rigid 45° to 115° swing prism borescope and hand turning tool (reference 2).

(c) Ultrasonic flaw detector frequency selectable in the 5-10MHz range. Not supplied

(d) Phase analysis Eddy Current Instrument (Phasec 2200 or similar). Not supplied

(e) Rigging pin IAE 1R18254

(f) PTFE tape. Comat 06-170

(2) Installation of Turning Tool and Borescope Inspection Kit

WARNING: YOU MUST PUT A WARNING NOTICE ON THE INSTRUMENT PANEL IN THE COCKPIT TO TELL PERSONS NOT TO START THE ENGINES.

WARNING: YOU MUST MAKE SURE THAT THE ENGINE HAS BEEN SHUT DOWN FOR AT LEAST 1 HOUR BEFORE STARTING THE INSPECTION.

WARNING: YOU MUST MAKE SURE THAT THE RED WARNING PENNANTS ON THE WORKMAT CAN BE SEEN AT A DISTANCE FROM THE AIRCRAFT.

(a) Follow manufacturer's instructions to install the engine turning tool.

(b) Ensure that you familiarise yourself with the operation of the engine turning tool.

R (c) Prepare the engine for borescope access – refer to AMM TASK 72-00-00 for in-
R service engines and to EM TASK 72-41-15-200-002-A00 for overhaul engines.

(d) Borescope access port cover B (ATA 72-41-31, 01-100 part no. 6A2330) and the tooling blank immediately behind access port cover B (ATA 72-41-31, 01-120 part number 6A1069) are the only access port covers that need to be removed. The clip holding the wiring harness to the pipe immediately in front of access port B will need to be loosened and the clip removed.

(e) Install the borescope hole adaptor IAE2R19753 to the HPC front casing at borescope access port B.

(f) Torque the bolts sufficiently to secure the support tool in place.

CAUTION: BEFORE INSERTING THE BORESCOPE PROBE THE VSV'S WILL HAVE TO BE MOVED TO THE FULLY OPEN POSITION TO ENABLE PROPER ACCESS.

(g) Move the VSV's to allow proper access.

(i) Use a suitable spanner on the wrench flats of the crankshaft and move the VSV's to the fully open position.

(i) Check the VSV's are at the correct position by inserting the rigging pin (IAE 1R18254) through the hole in the crankshaft into the high speed rigging position in the crankshaft housing.

(ii) Remove the rigging pin (IAE1R18254)

(h) Insert the borescope into the engine through the brass hole adaptor installed at access port B (See Fig. 2). The borescope should be inserted with the viewing lens pointing rear and will be fully inserted when the shaft rotation collar contacts the rear edge of the fan case.

(i) Attach the video camera to the borescope and connect the monitor to the camera in accordance with the manufacturers instructions.

(j) Adjust the camera/borescope until it is looking rearwards through the open stage 3 VSV's. Ensure camera and borescope are correctly adjusted and the rotor blade to be inspected is in the correct position. Move the HPC rotor to the correct inspection position. (See Fig. 6).

(k) Using the engine turning tool in jog mode, set the power level at 9, the speed at 10 minutes per revolution (MPR) and take up the backlash in the drive assembly. Rotate the HPC rotor at least two blades to ensure that the drive is running smoothly.

(l) Ensure the blade aerofoil is in the correct position for inspection i.e. as per Para 2 (j) and note the digital readout number of the first blade to be inspected on the hand controller.

(3) Calibration of Eddy Current Equipment

(a) To prevent damage to the rotor blade leading edges and the coils, apply PTFE tape (CoMat 06-170) to the probe spring guide and probe coil surface.

CAUTION: PTFE TAPE CONDITION IS TO BE MONITORED THROUGHOUT INSPECTION AND REPLACED IF WORN.

(b) Phasec 2200 settings:

Mode:	Differential
Frequency:	2 MHz
Hi pass filter:	2 Hz
Lo pass filter:	50 Hz

NOTE: Any suitable phase analysis eddy current instrument may be used provided the inspection sensitivity can be achieved.

(c) Place the probe on the working standard away from the leading edge EDM notch (See Fig. 4). Balance/null the instrument and ensure spot is centralised on screen.

(d) Move probe repeatedly over leading edge EDM notch and identify the figure of eight type signal on the instrument.

(e) Whilst still moving the probe, adjust phase angle such that the figure of eight signal is vertical. Adjust gain control to produce 4 divisions of deflection peak to peak (See Fig.5).

(f) Activate any audio or audible alarms.

(g) The eddy current instrument is now calibrated.

(4) Insertion of the Eddy Current probe and inspection

CAUTION: BEFORE INSERTING THE PROBE AND WITH THE BORESCOPE /CAMERA PREVIOUSLY INSTALLED (PARA 2 REFERS), MOVE THE HPC ROTOR TO THE CORRECT INSPECTION POSITION. (See Fig. 6).

VISUALLY INSPECT THE BLADE LOWER LEADING EDGE AREA FOR EVIDENCE OF LARGE CRACKS AS THESE MAY DAMAGE PROBE DURING SCANNING.

(a) Insert probe into engine through tooling port (See Fig. 2) and position probe spring guide onto the blade approximately mid way along the leading edge. Observe monitor for correct engagement of probe (See Fig. 7).

CAUTION: DO NOT TWIST THE PROBE, DAMAGE TO THE SPRING GUIDE MAY OCCUR.

(b) Balance/null the instrument with the probe located approximately mid way along the leading edge and ensure spot is centralised on the screen.

(c) Ensuring the probe remains fully engaged with blade leading edge, push the probe gently down the leading edge, until blade platform is contacted.

NOTE: Probe lift off will be experienced as the probe contacts the blade platform radius. Cracks are not expected in the radius

(d) Note the number of the blade inspected on the hand controller, annotate the accomplishment chart (Appendix 1) and remove the probe from the engine.

CAUTION: THE PROBE MUST BE REMOVED FROM THE ENGINE FOLLOWING INSPECTION OF EACH BLADE. FAILURE TO REMOVE THE PROBE WILL RESULT IN DAMAGE TO THE ENGINE WHEN THE HPC ROTOR IS MOVED. CHECK THE CONDITION OF THE PTFE TAPE WHEN THE PROBE HAS BEEN REMOVED FROM THE ENGINE AND RENEW IF WORN.

(e) Ensure the HPC rotor is positioned for the next blade to be inspected (See Fig. 6).

(f) Repeat Paragraphs (a) through to (e) on all remaining blades.

(g) Remove the probe from the engine.

(h) Carry out a calibration and ensure technique sensitivity can still be achieved.

(i) If calibration is satisfactory, remove the camera/borescope and borescope hole adaptor from the engine.

(5) Reject / Acceptance Criteria

(a) Cracks will produce a rapid deflection in the form of a figure of eight trace or similar, in the vertical direction.

(b) Blades with crack indications are to be rejected.

(c) Indications not attributed to cracks should be noted and further investigated.

(d) If a rejected blade is found

(i) In service – reject the engine

(ii) During inspection of an engine or an HPC module during an overhaul shop visit - the engine or the HPC module is to be stripped and the rejected blade is to be replaced.

(iii) During piece part inspection - the blade is to be rejected.

R C. Part 2 - Ultrasonic inspection of stage 4 blades

(1) Tools and Equipment

(a) Inspection Kit IAE2R19778 comprising:

Ultrasonic Probe assembly (See Fig.1).	IAE2R19779
Leading Edge Eddy Current Probe.	IAE2R19780
Blade Mid Chord and Leading Edge Working Standard.	IAE2R19781
Water feed Bottle.	IAE2R19782
Borescope hole adaptor.	IAE2R19753

(b) Turning Tool and Borescope Inspection Kit. IAE2R19544
Alternatively use a 6 mm rigid 45° to 115° swing prism borescope and hand turning tool (reference 2).

(c) Ultrasonic flaw detector frequency selectable in the 5-10MHz range. Not supplied

(d) Phase analysis Eddy Current Instrument (Phasec 2200 or similar). Not supplied

(e) Rigging pin IAE 1R18254

(a) (f) PTFE tape. Comat 06-170.

(2) Calibration of ultrasonic equipment and couplant supply connection

(a) Prior to calibration, ensure the bottle is full of deionised water and that water is flowing freely from the end of the plastic tube without evidence of air bubbles.

(b) Support the bottle on a convenient point on the engine, ensuring the bottle is slightly higher than the probe and connect the plastic supply tube to the brass tube on the end of probe handle.

(c) Open the brass valve on the probe handle and ensure water flows freely from the probe head.

(d) Close the valve.

NOTE: If the bottle is located too high with respect to the probe, water usage will be excessive.

(e) Ensure flaw detector is set to pulse/echo, single crystal operation and select frequency to 10 MHz.

NOTE: Nominal setting for USN 52 flaw detector to achieve approximate signal positions:

Material Velocity	3100m/s
Delay	0.00µs
Range	37mm

(f) Connect probe lead to flaw detector.

(g) Position the edge of the probe against the guide on the working standard (See Fig. 8) and open the brass valve allowing water to flow.

NOTE: To ensure the first skip signal is detected, the front edge of the probe should be approximately 5.0mm from the calibration notch.

(h) By sliding the probe against the guide, identify and maximise the large signal reflected from the EDM notch. Ensure the signal is the first skip reflection.

(i) With zero delay selected, adjust the range control to position the signal at position 4 on the time base, adjust this signal amplitude to 80 per cent screen height. Increase the gain level by 3dB (See Fig. 9).

(j) Set the monitor gate at 40% screen height at time base 4. Adjust the monitor gate width to extend between 3 and 4.8 divisions on the time base. Adjust any audible or visual alarms to trigger at 40 per cent screen height.

(3) Installation of ultrasonic probe

CAUTION: ENSURE HPC ROTOR IS IN THE CORRECT INSPECTION POSITION BEFORE ATTEMPTING TO INSERT PROBE (See Fig. 3).

(a) Before inserting the probe into the engine (See Fig. 2), check the ultrasonic probe attachment screws for security.

(b) Push the sliding part of probe inwards and ensure that the flat on brass collar is located fully forward on the flat area of the guide tube bush.

(c) Ensure cam lever is in position 1.

(d) Ensure probe guide tube is unhooked from retaining clip.

(e) With the active face of the probe facing rearwards and the indexing mechanism facing upwards at approximately 45º, offer the probe assembly to the engine (See Fig. 10).

(f) To ensure no mechanical contact with any blades and before securing the bolts, ensure the face of the mounting plate and the engine casing are in physical contact without any interference from any internal engine parts.

g) Use the bolts to secure the probe to the engine casing (use light pressure only).

(h) The probe is now installed and in the un-parked position ready to inspect.

(4) Scanning the blade

(a) Ensure cam lever is in position 1 and open the water valve.

(b) Using slight pressure, push the probe handle forward (towards the front of the engine) and ensure the guide tube bush is in contact with the brass cam. Also, apply slight upward pressure and check monitor, ensuring probe is in contact with blade aerofoil (See Fig. 11).

(c) To scan the blade aerofoil, slide the probe inwards and outwards, ensuring the probe remains in contact with the blade aerofoil and sufficient coupling is flowing. Observe signals on time base of flaw detector to check for adequate coupling.

NOTE: With probe withdrawn to full outwards extent of travel, probe lift off will occur. This is normal and is not in the scan area.

(d) To scan remainder of the blade aerofoil, move cam lever to positions 2 through to 6 repeating scans at each position.

(e) With the probe at full extent of inward travel, a geometry signal from the blade platform may appear at approximately 4.8 to 5 on the time base. The gate should be adjusted to ensure this signal does not trigger the gate.

(f) On completion of last scan at index position 6, close the water valve and prepare to park the probe before rotating the HPC rotor. Note the number of the blade inspected on the hand controller and annotate accomplishment chart (Appendix 1).

CAUTION: THE PROBE MUST BE IN THE PARKED POSITION BEFORE ROTATING THE HPC ROTOR. EXCESSIVE FORCE MUST NOT BE USED ON THE PROBE MECHANISM DURING THIS PROCEDURE.

(5) Probe parking procedure

(a) Ensure cam lever is in position 6.

(b) Withdraw the sliding part of the probe outwards and upwards whilst rotating the probe handle approximately 45° clockwise.

(c) Withdraw the sliding part of the probe outwards a few more millimetres and hook the retaining clip around the guide tube **in front of the brass collar (See Fig.1)**.

(d) The probe is now in the parked position and the upper face of the probe head should be visible on the monitor (See Fig. 12).

(e) To verify correct parking, temporarily adjust the prism control on the borescope to view the tooling port on the engine casing, the probe entry point should be visible. Ensure the guide tube is positioned at the edge of the tooling port (See Fig. 13). Return borescope prism control to original position.

CAUTION: BEFORE ROTATING THE HPC ROTOR, VIEW THE MONITOR AND ENSURE THE PROBE IS IN THE PARKED POSITION, CLEAR OF THE ROTOR PATH AND WITH THE RETAINING CLIP IN FRONT OF THE BRASS COLLAR. VIEWING THE MONITOR AND USING LIGHT HAND PRESSURE ON THE PROBE HANDLE WHILST THE ROTOR IS BEING ROTATED, WILL ALLOW ANY PROBE MOVEMENT OR BLADE CONTACT TO BE DETECTED.

(6) Scanning of subsequent blades and probe un-parking procedure

(a) Ensure the rotor has been rotated to the next blade to be inspected (See Fig. 3).

(b) Move cam lever to position 1.

(c) Unclip the retaining clip and lower the probe slightly.

(d) Rotate the probe anti-clockwise and push the sliding part of the probe gently inwards to align the flat on the brass collar with the flat on the guide tube bush. (Slight rotation of the plastic guide tube by hand may be necessary to achieve alignment).

(e) With the flat on the brass collar and the flat on the plastic guide tube aligned, the probe is now in position to begin scanning the next blade (See Fig. 11).

(f) Repeat paragraphs 4 through to 6 on all remaining blades.

(7) Ultrasonic probe - removal from the engine

(a) On completion of inspection and before removing the probe, move the index pin from position 6 to position 1.

(b) Undo the bolts.

(c) With the brass collar engaged on the guide bush and with the guide tube bush held against the cam, partially withdraw the probe assembly. Rotate the indexing mechanism clockwise approximately 45° and completely withdraw the probe from the engine.

(d) Check the ultrasonic probe attachment screws for security.

(e) Carry out a calibration and ensure technique sensitivity can still be achieved.

(8) Reject/Acceptance criteria

(a) Observe the flaw detector screen.

(b) If the blade geometry signal is evident during inspection with no signal in the gated area, accept the blade.

(c) Signals in the gated area in excess of 40% full screen height, which cannot be attributed to geometry or couplant signals, shall be cause for rejection of the blade.

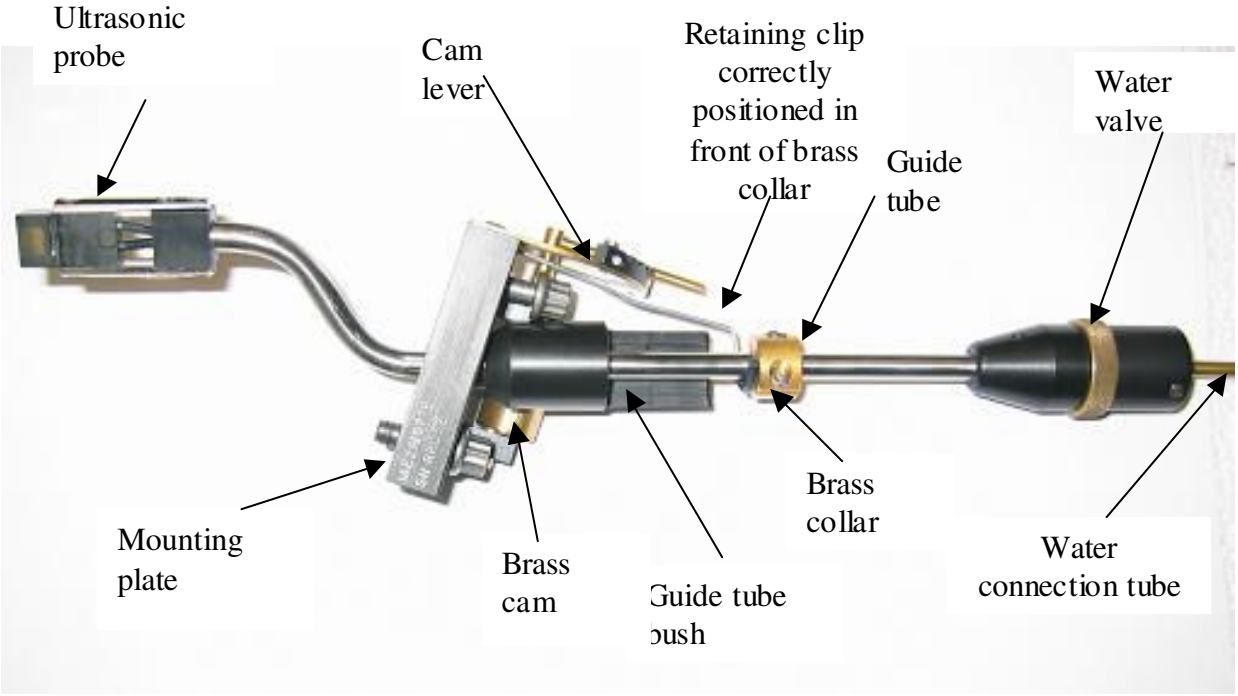
(d) If a rejected blade is found, reject the engine.

NOTE: During the inspection, some signals, due to couplant, may be seen within the gated area. Signals due to couplant are not repeatable and are seen only momentarily. Signals from real cracks are repeatable and can be held on the screen for evaluation.

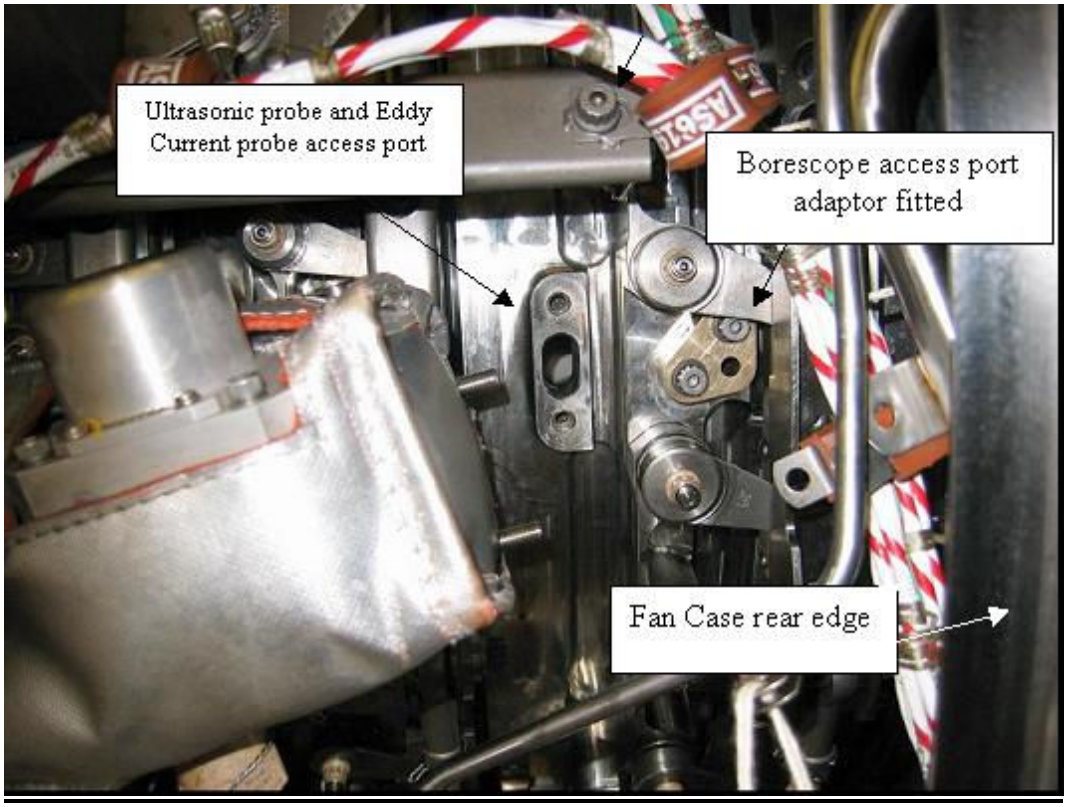
NOTE: The probe and flaw detector should be re-calibrated after completion of the inspection. If the calibration is under-sensitive by more than 3dB, re-calibrate and re-inspect all blades inspected since initial calibration.

R D. Part 3 – Inspection of stage 4 blades as per Engine Manual TASK 72-41-15-200-002-A00

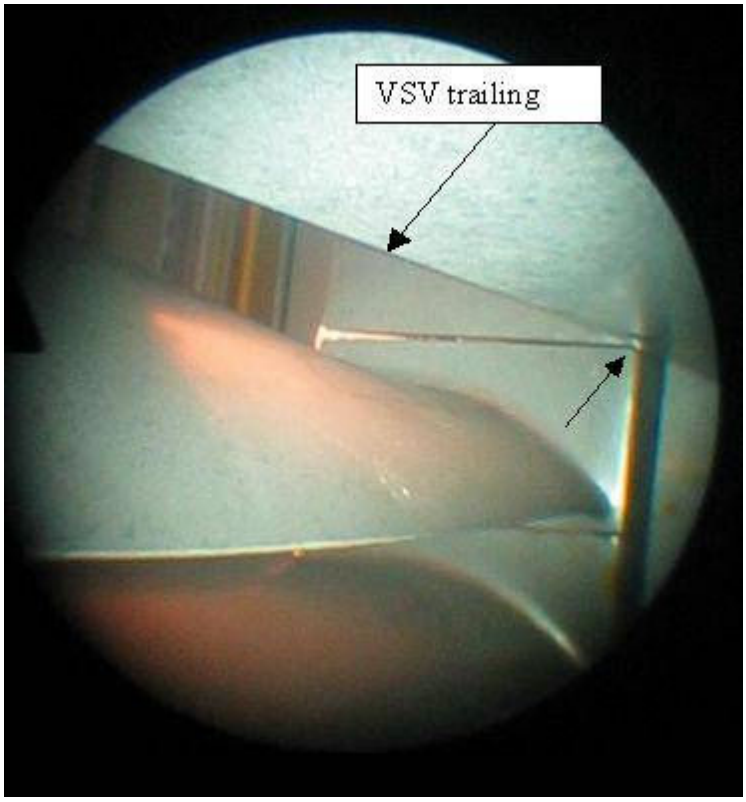
R If used or previously run blades are reinstalled in an engine or HPC module during an
R overhaul shop visit, prior to performing Part 1 and Part 2 when the HPC module is
R assembled, overhaul shops must ensure that each stage 4 blade is inspected in accordance
R with the Engine Manual TASK 72-41-15-200-002-A00.



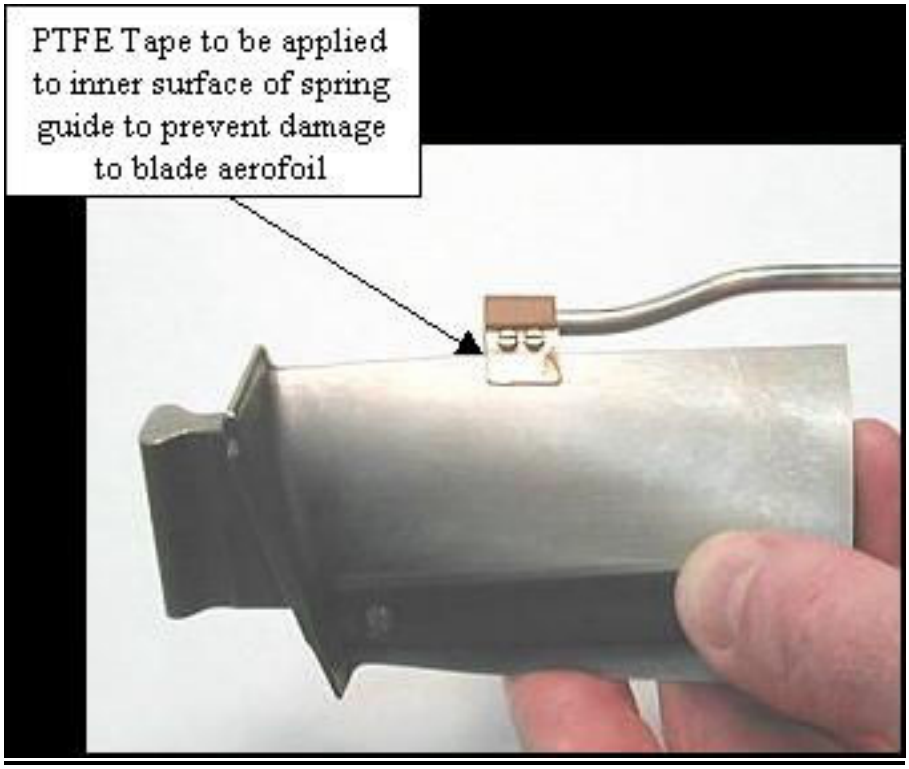
Ultrasonic probe assembly main parts
Fig. 1.



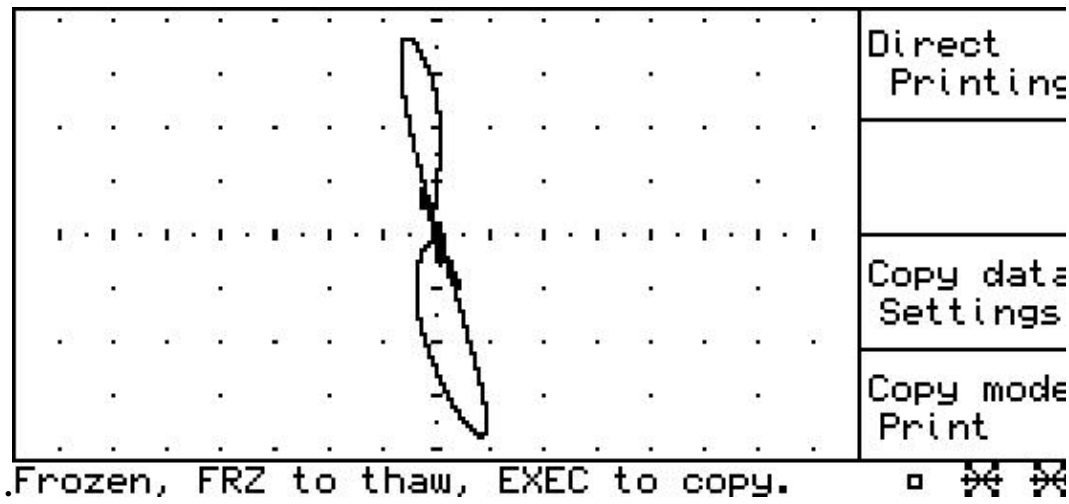
View of Borescope, Ultrasonic probe and Eddy Current Probe access
Fig. 2



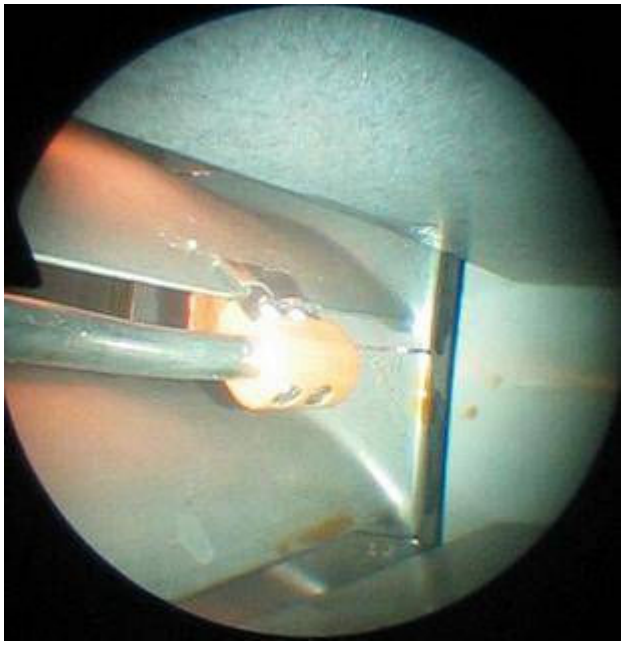
View showing blade in correct positionCorner of blade platform in line with VSV trailing edge
Fig. 3



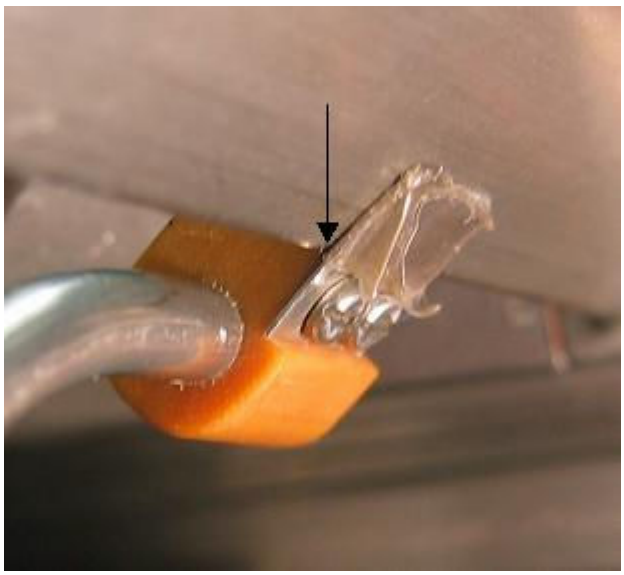
Eddy Current calibration
Fig. 4



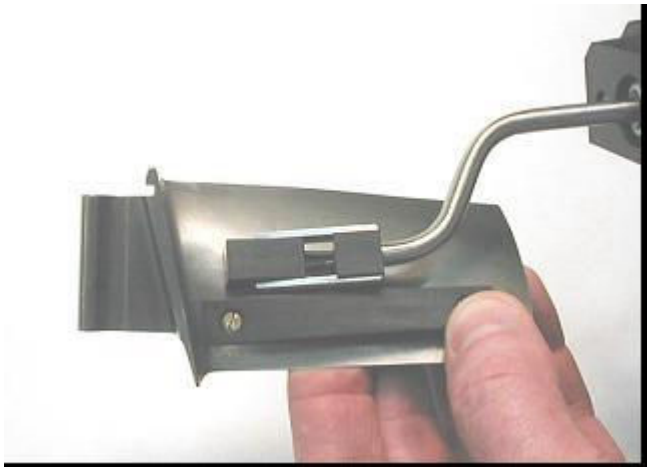
Eddy Current response from calibration notch.
Fig. 5



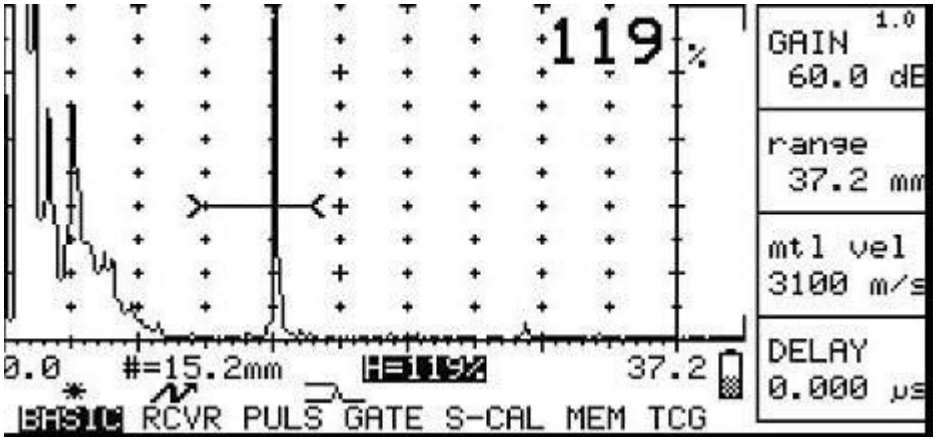
View showing blade in correct position for Eddy Current scanning with probe fully engaged on leading edge. Note blade platform corner position relative to VSV trailing edge.
Fig. 6



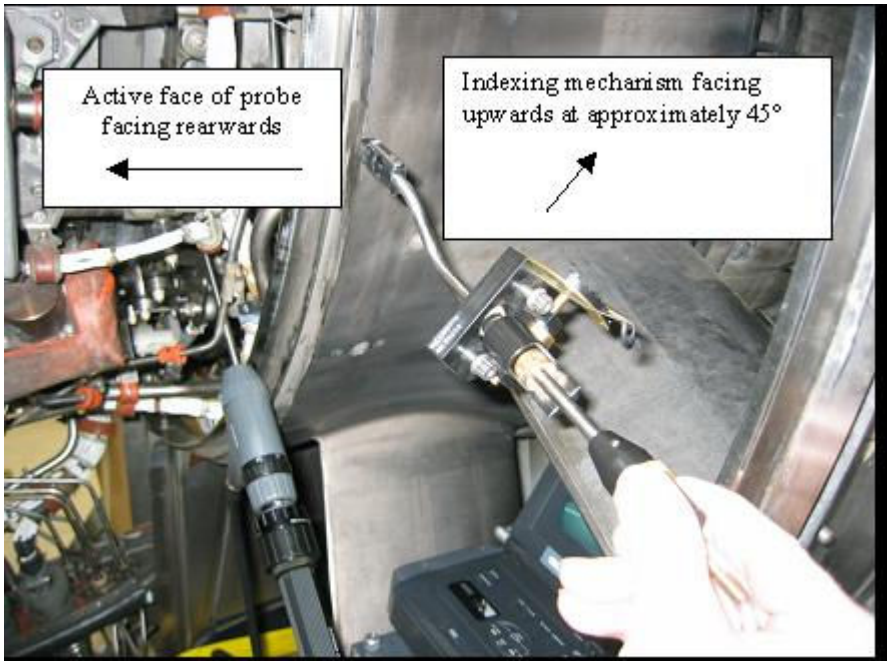
View showing probe fully engaged on leading edge of blade
Fig. 7



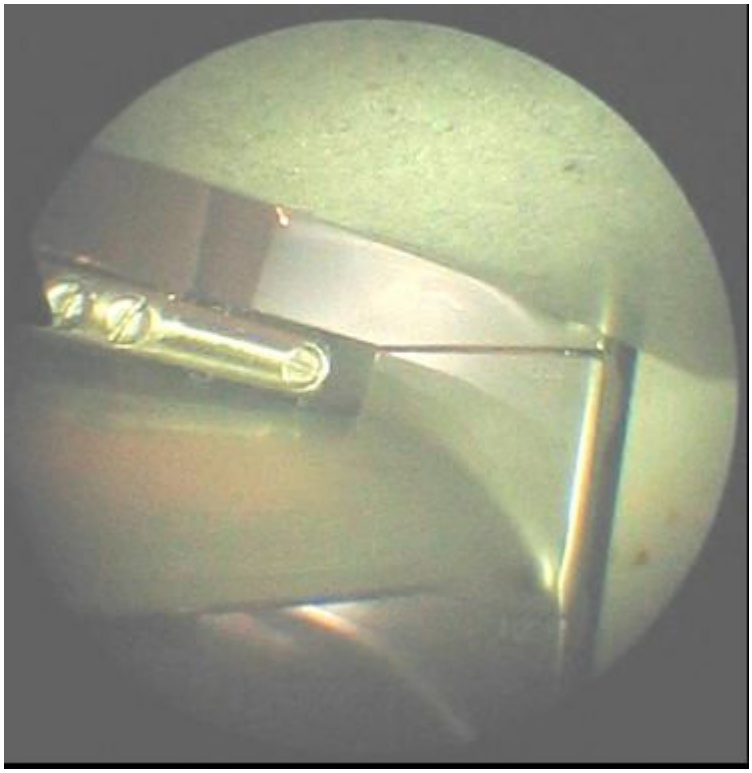
Ultrasonic calibration. Note position of probe approximately 5.0mm from notch
Fig. 8



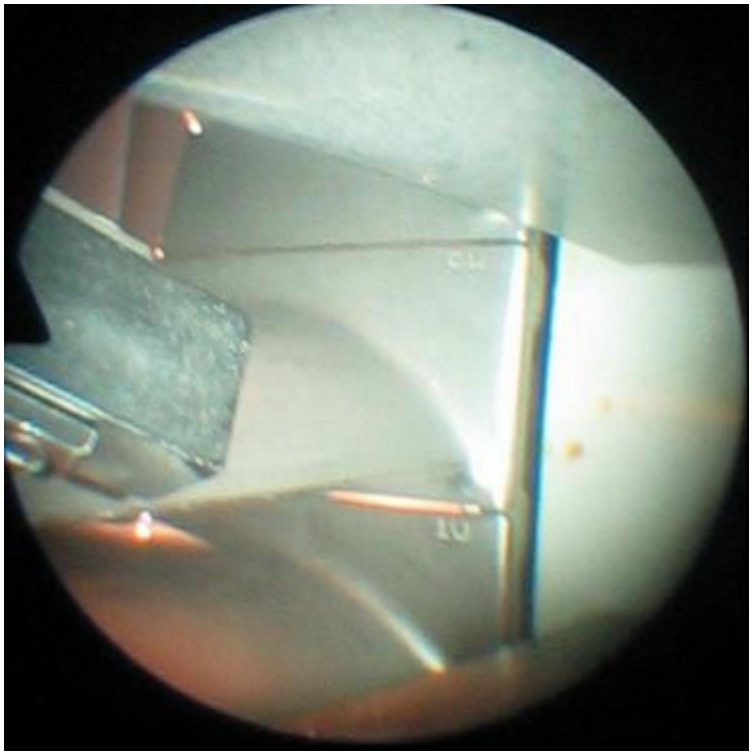
Calibration notch signal
Fig. 9



Installation of ultrasonic probe
Fig. 10



Probe in contact with blade aerofoil
Scan index position 1.
Fig. 11



Ultrasonic probe in parked position.
Fig. 12

View looking outwards at tooling port in casing. Verification of correct probe parking. Note position of guide tube at edge of port
Fig. 13

Appendix 1

V2500 HPC STAGE 4 BLADE ACCOMPLISHMENT CHART

ULTRASONIC INSPECTION OF AEROFOIL

EDDY CURRRENT INSPECTION OF BLADE LEADING EDGE

AIRCRAFT NO. / ENGINE POSITION:	
Engine serial No:	
Date:	
Inspector:	

Blade No.	Pass/Fail		Blade No.	Pass/Fail	
	U/T	E/C		U/T	E/C
1			20		
2			21		
3			22		
4			23		
5			24		

6			25		
7			26		
8			27		
9			28		
10			29		
11			30		
12			31		
13			32		
14			33		
15			34		
16			35		
17			36		
18			37		
19			38		