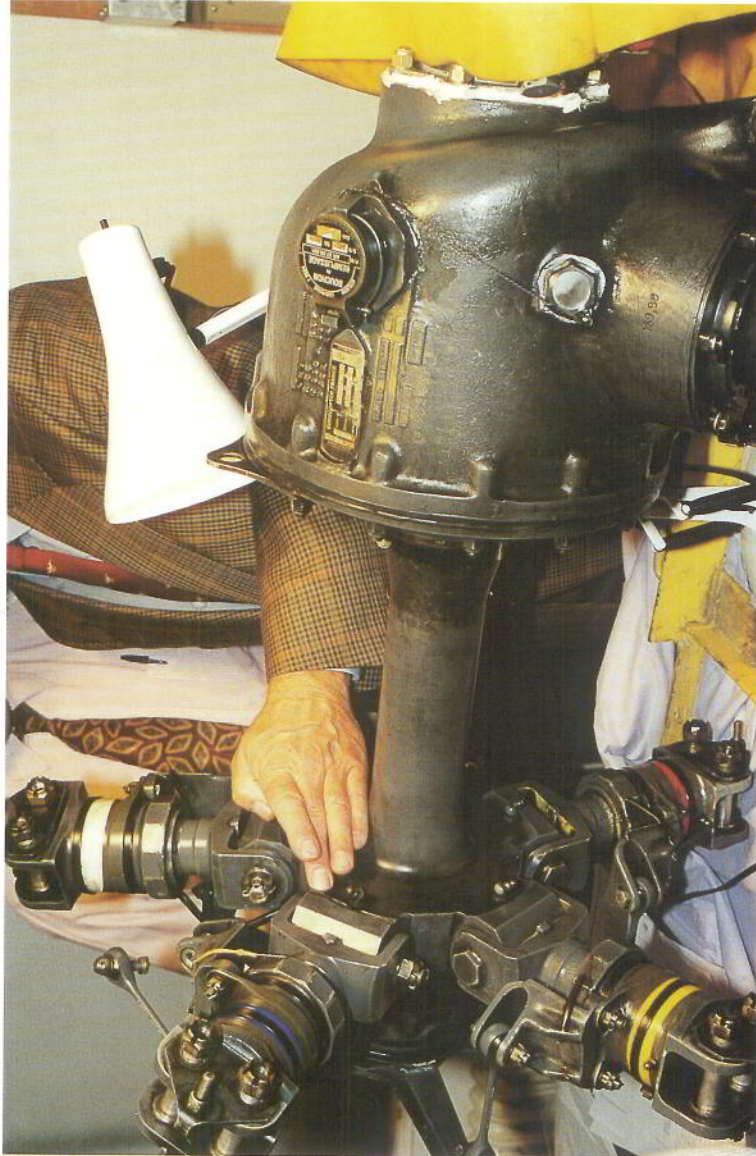


**HISTORY OF TAIL ROTOR SHAFT**  
**part number 330A.33.3165 E1, serial number M1941**

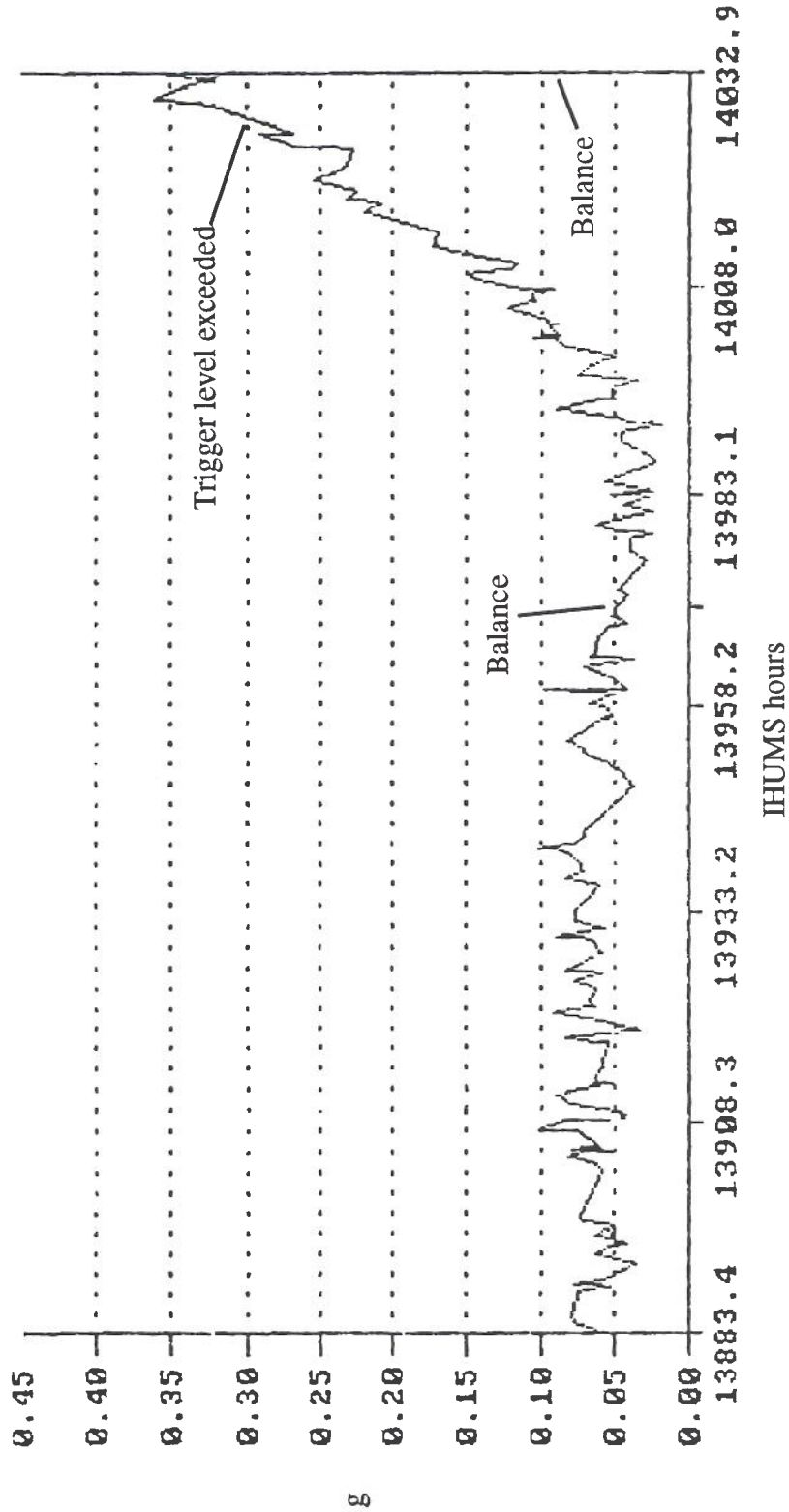
DATE	EVENT	GEARBOX	AIRCRAFT a/frame hrs	Total Time Since New	Total Time Since Overhaul	Time to Overhaul	Total Life Remaining
Oct 84	New manufacture			0	0	3,000	16,500
Oct 84	Fitted to gearbox	M290		0	0	3,000	16,500
Jan 85	Installed on a/c	M290	G-BLXR zero hours	0	0	3,000	16,500
Nov 87	Removed for overhaul	M290	G-BLXR	2,965	2,965	35	13,535
Mar 88	Fitted to gearbox	M296		2,965	0	3,000	13,535
Oct 90	Removed from a/c for overhaul	M296	G-TIGJ	5,996	3,031	(-31)	10,504
Oct 92	Fitted to gearbox	M187		5,996	0	3,000	10,504
Jan 93	Installed on a/c	M187	G-PUMH 11,151.15 hrs	5,996	0	3,000	10,504
Sep 95	Incident	M187	G-PUMH 14,105.25	8,951	2,955	45	7,549



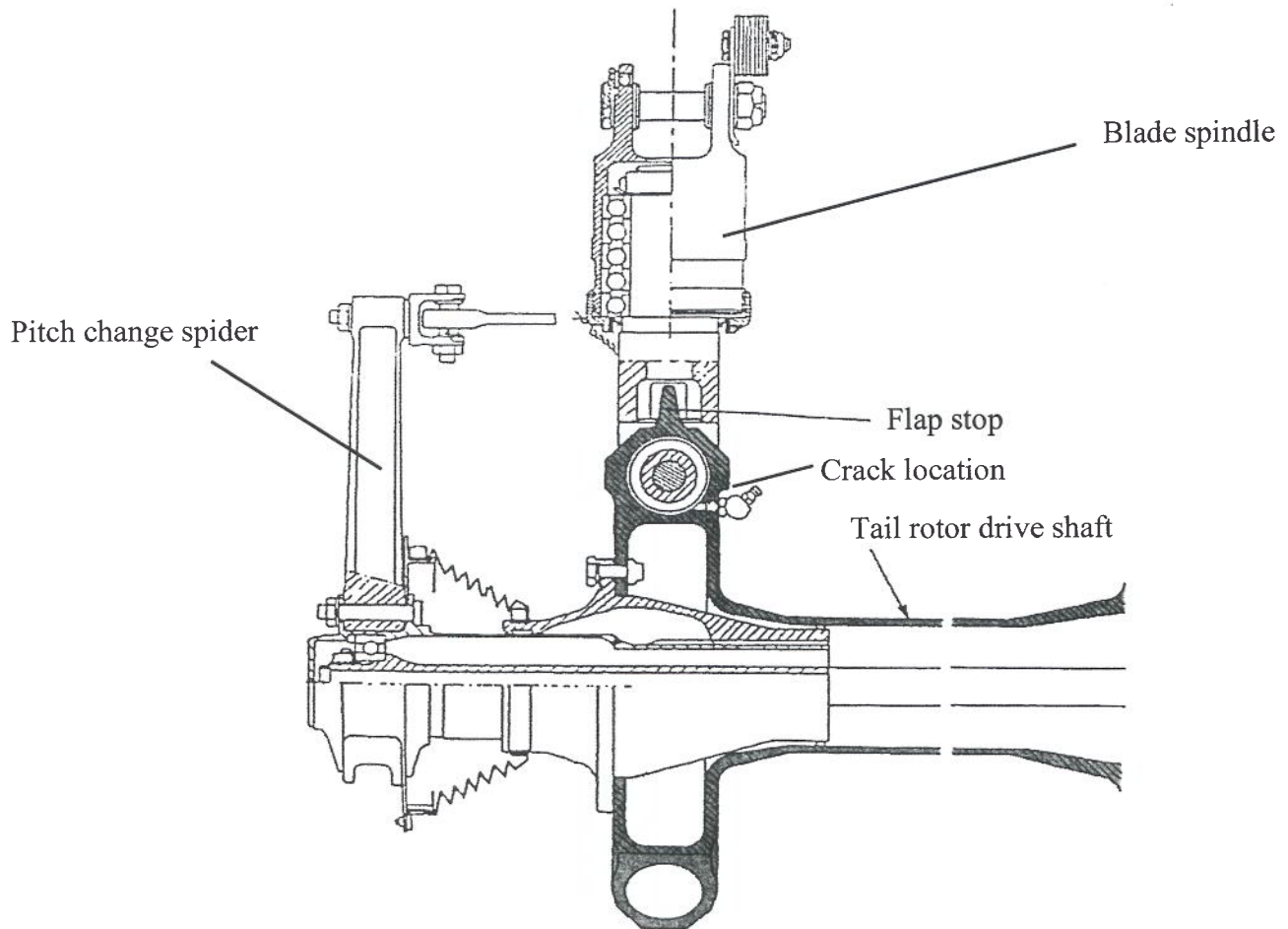
**THE DAMAGED TAIL ROTOR SHAFT WITH GEARBOX S/N 187  
AFTER REMOVAL FROM G-PUMH**

The crack, clearly visible at the grease point, is being indicated

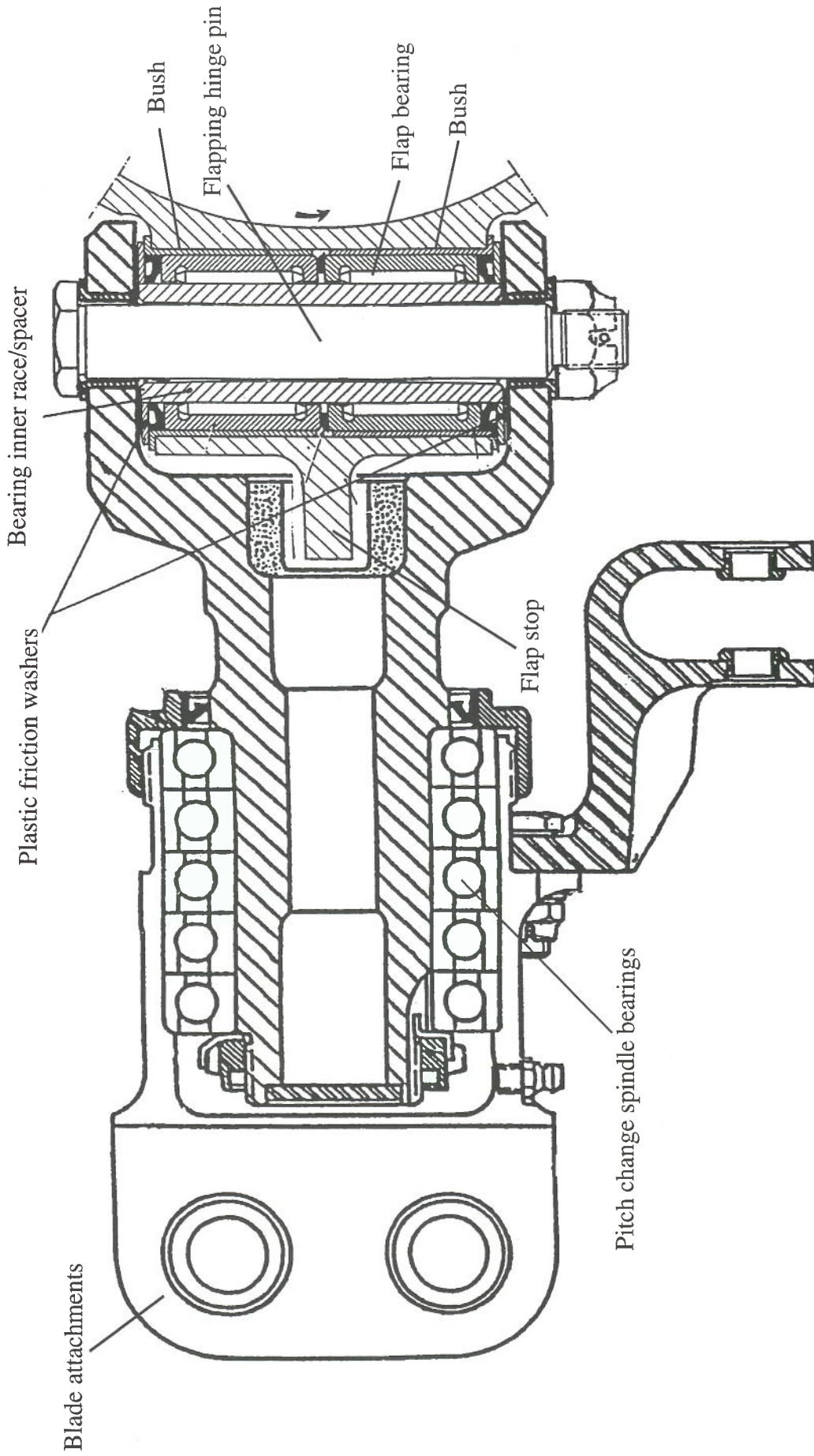
Fundamental shaft order  
(showing 8% of points)



IHUMS TRACE  
TAIL ROTOR GEARBOX OUTPUT, G-PUMH

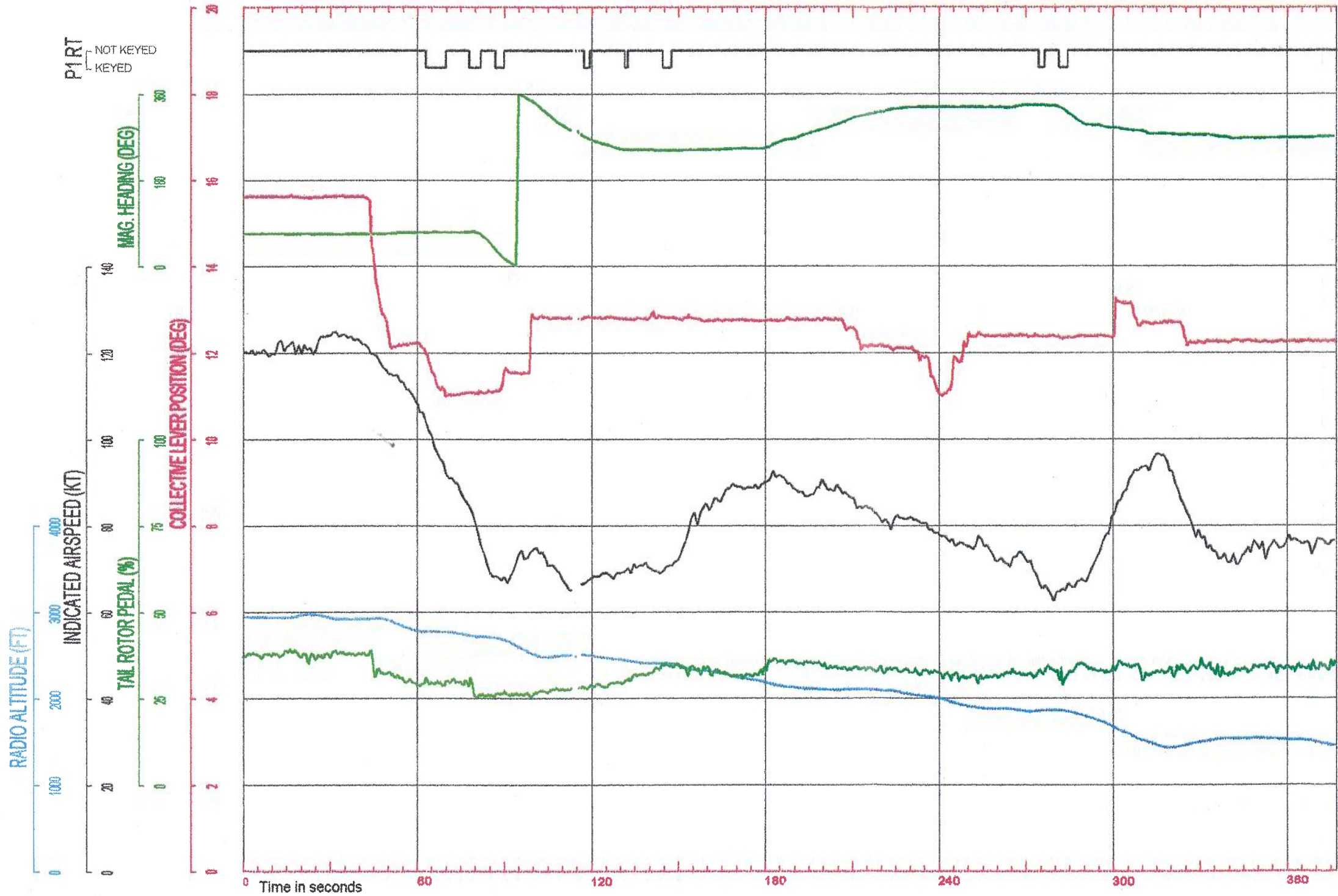


TAIL ROTOR DRIVE SHAFT ASSEMBLY



ASSEMBLY OF FLAP BEARING

SELECTED CVR TRANSCRIPT  
(RT IN RED)



(P1) REDUCE PITCH, REDUCE PITCH

(P1) WE HAVE A MAJOR VIBRATION...  
(RADAR) MAKE A LEFT OR RIGHT TURN...  
...MAINTAIN 5000 FEET...

(P1) TURNING LEFT, ROUTING BACK TO ABERDEEN  
(RADAR) BUCHAN IN 12 O'CLOCK... 22 MILES

(PA) ATTENTION GENTLEMEN PLEASE...  
RETURNING TO ABERDEEN...  
ZIP SUITS UP, HOODS ON, SEAT BELTS FASTENED

(RADAR) WOULD YOU LIKE AN ESCORT?  
(P1) AFFIRM

(P1) DESCENDING TO 2000 FEET

(P1) MIGHT BE A FREQUENCY ADAPTOR FAILURE  
(P2) YEAH  
(P1) BRING THE PITCH RIGHT DOWN...  
...TO BELOW 12 PLEASE

(P1 READS FREQUENCY ADAPTOR FAILURE CHECKLIST)

(RADAR) WHATS YOUR INTENTIONS...  
(P1) TURNING LEFT... AVOIDING SOME WEATHER

(P1 BRIEFS PASSENGERS)

ONSET OF VIBRATION

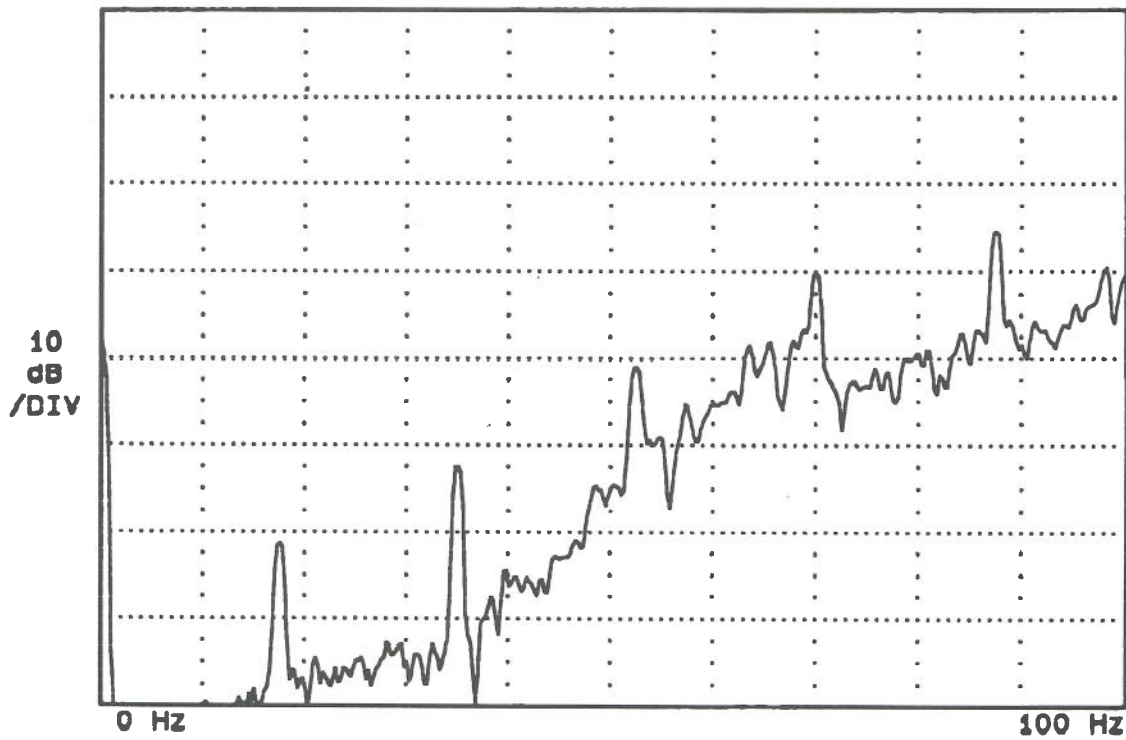


FIGURE 1 - NOISE SPECTRUM BEFORE VIBRATION

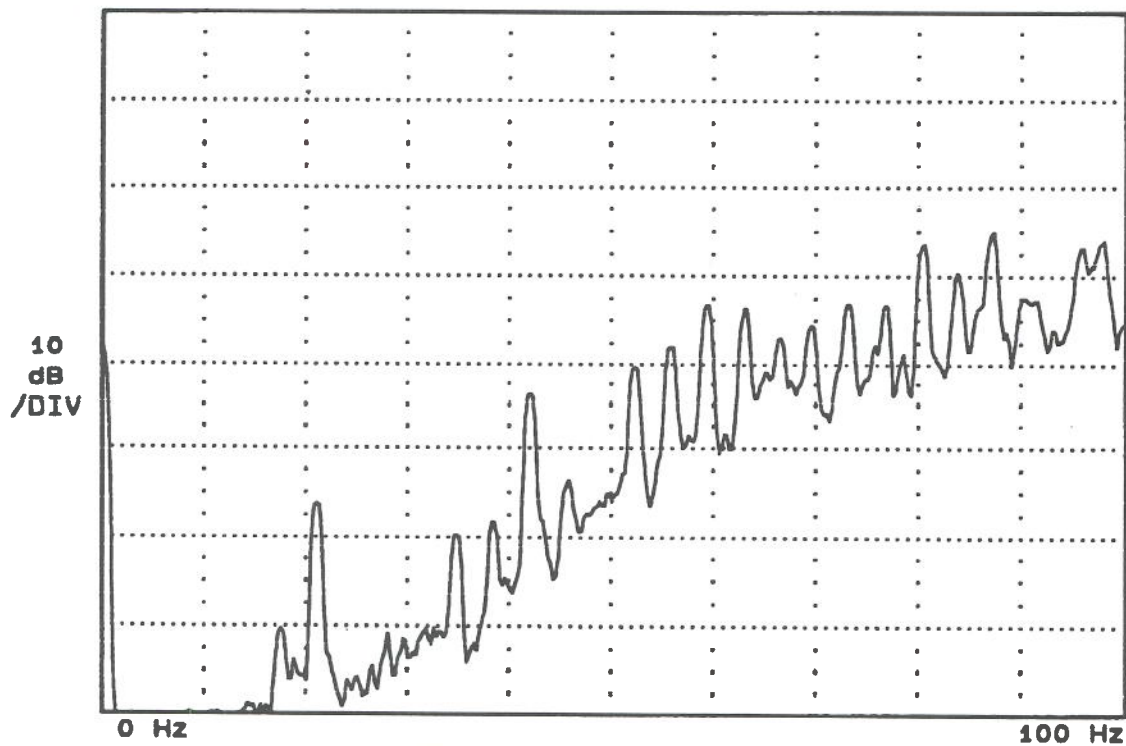
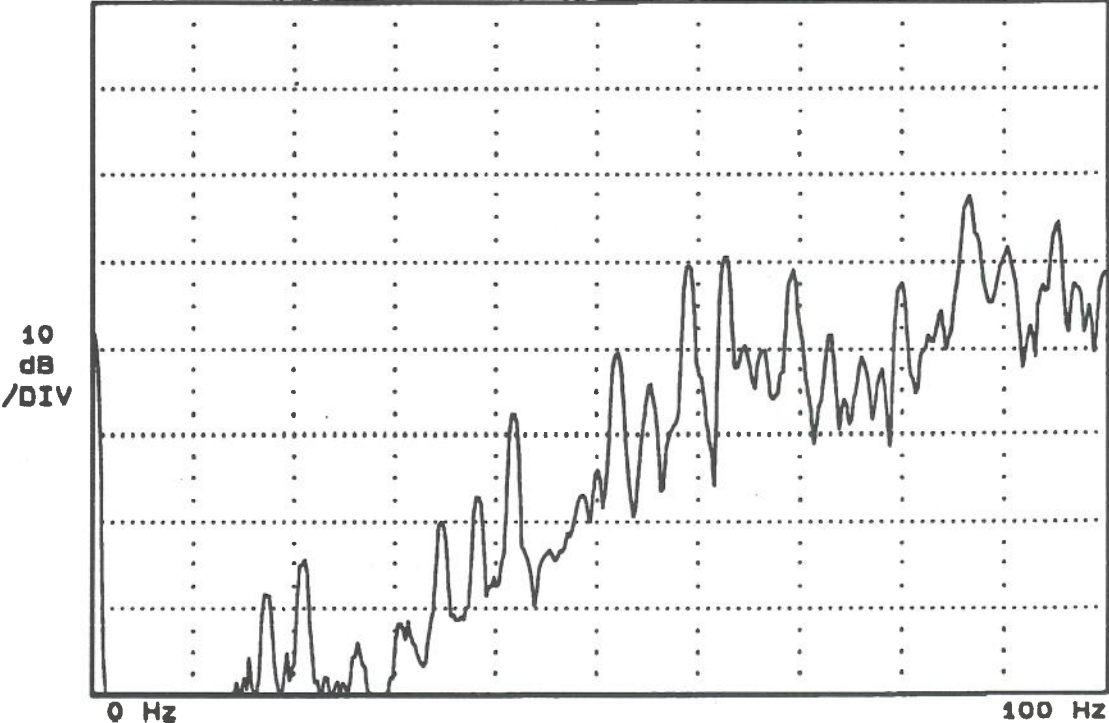


FIGURE 2 - NOISE SPECTRUM WITH VIBRATION,  
COLLECTIVE POSITION 12.2 DEGREES



**FIGURE 3 - NOISE SPECTRUM WITH VIBRATION,  
COLLECTIVE POSITION 11.1 DEGREES**



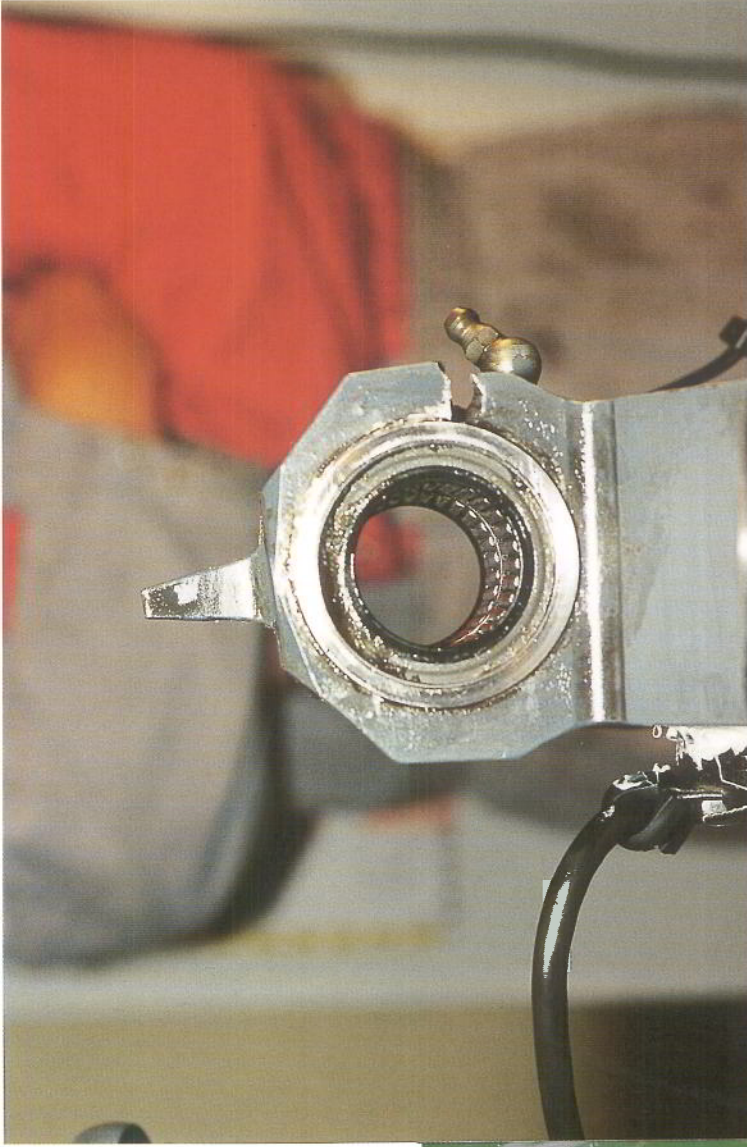
**FRACTURE FACE**

This photograph of the fracture face is taken from the DRA metallurgical report DRA/SMC2/R51AP027/E2144

**KEY**

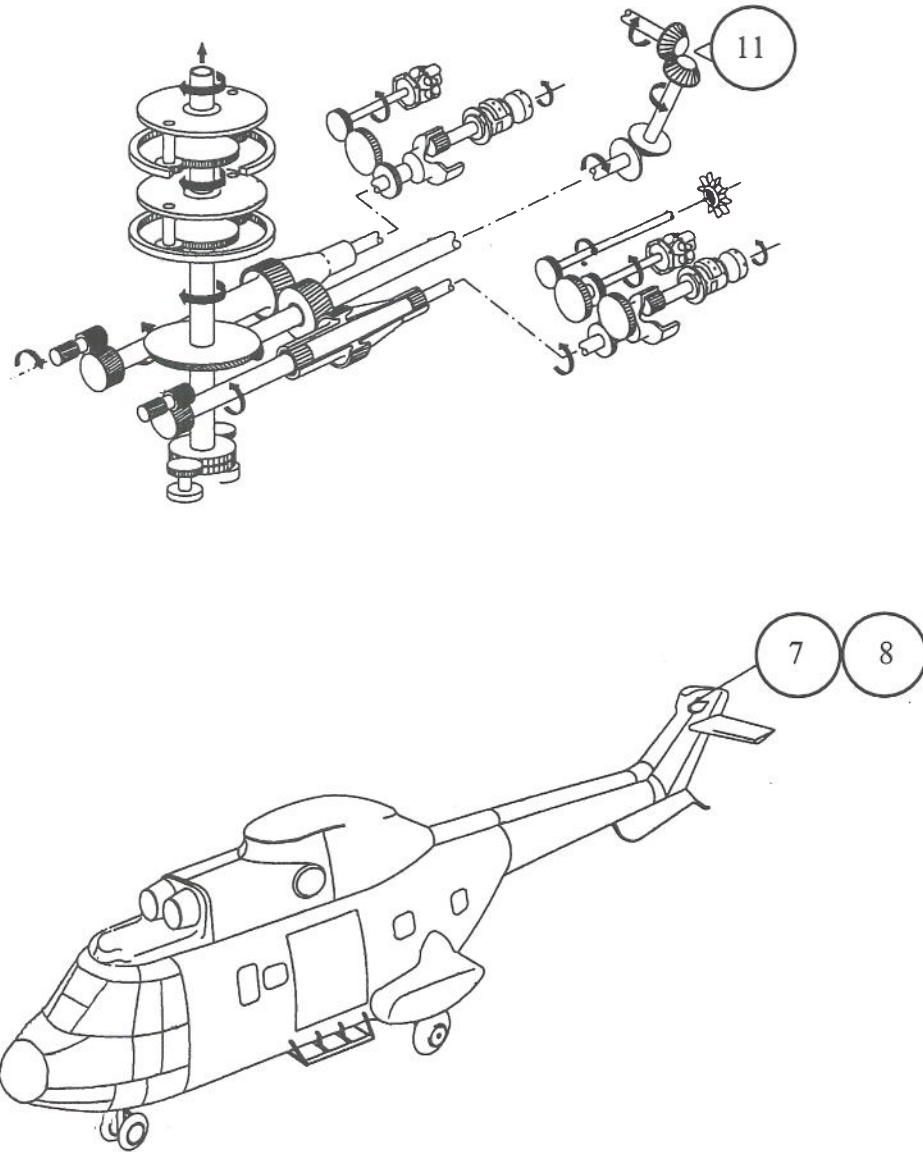
- A crack initiation
- B stained area
- C ductile rupture zone
- D "ripple" marks at edges of fracture.

Below - the aluminium insert in the blade spindle has sustained heavy wear as a result of repeated contact with the flap stop. Note the aluminium debris generated by this process



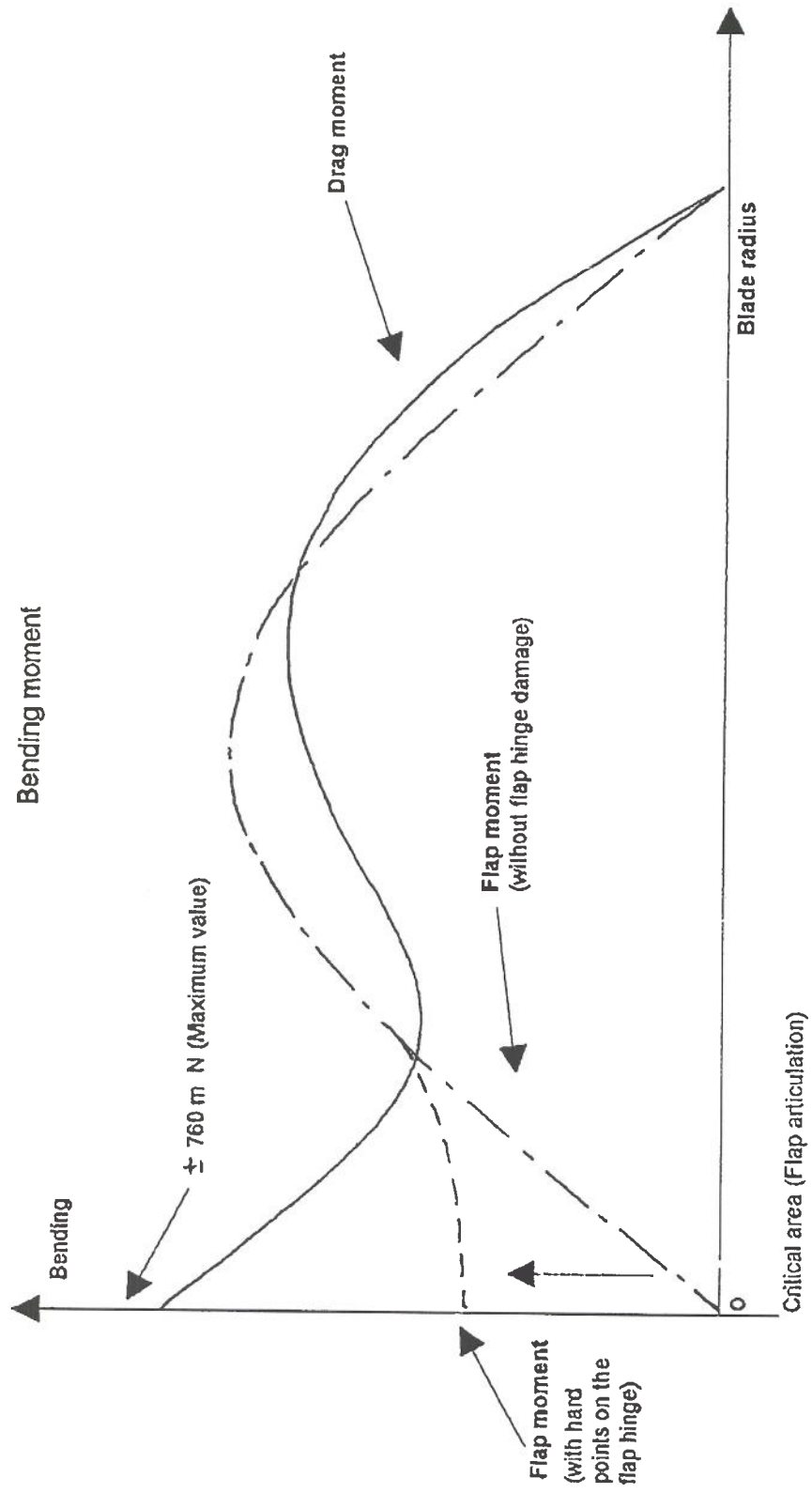
Above - with the blade and inner race of the flap bearing removed, the extent to which the crack has opened up can be seen. Note also the angle made by the flap stop, causing contact between the blade spindle and the flap stop with the attendant relief of the bending moment in the flapping hinge retainer.

FLAP STOP DAMAGE



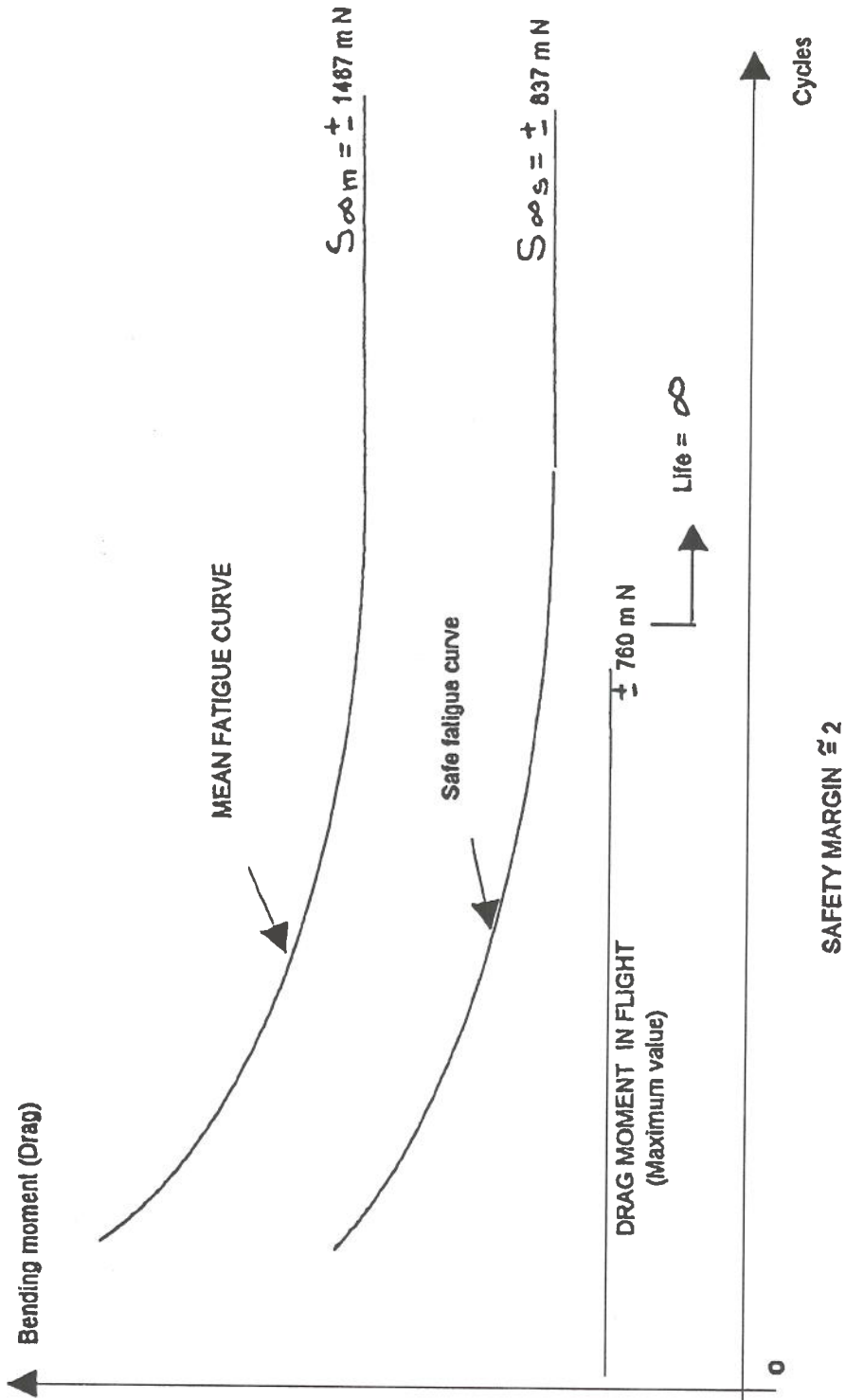
ACCELEROMETER	MOUNTING POSITION	MEASUREMENT
Accelerometer 7	On Airframe	Vertical Airframe Vibration
Accelerometer 8	On Airframe	Lateral Airframe Vibration
Accelerometer 11	On Tail Rotor Gearbox	Transmission Vibration

Tail Rotor Accelerometer Locations

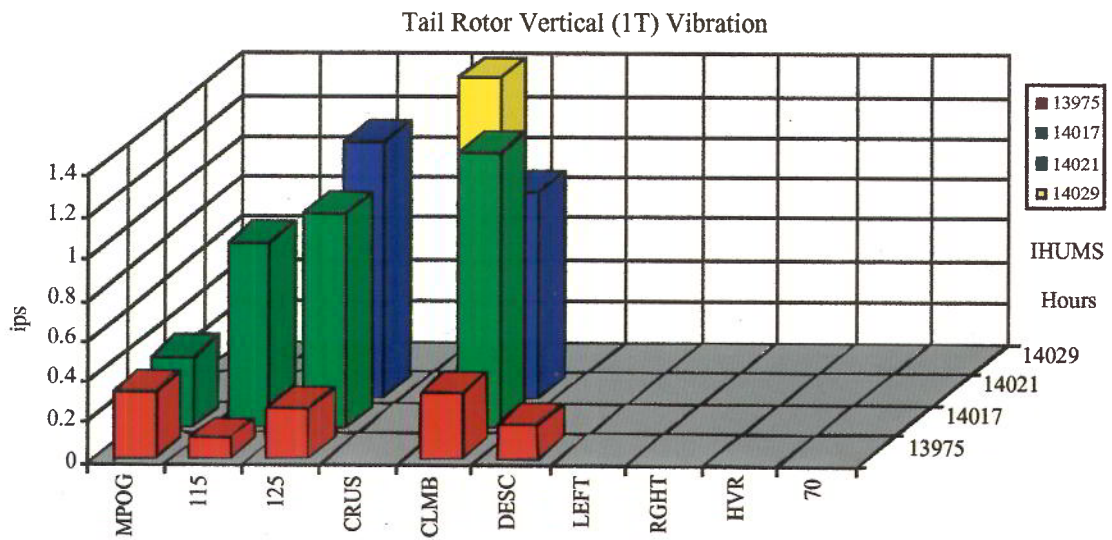
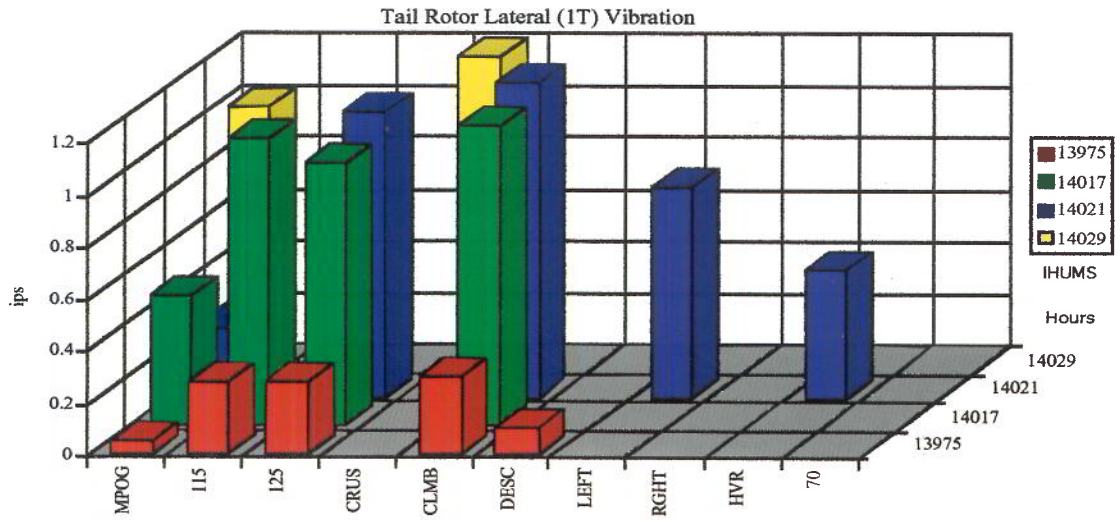


BENDING MOMENT v. BLADE RADIUS

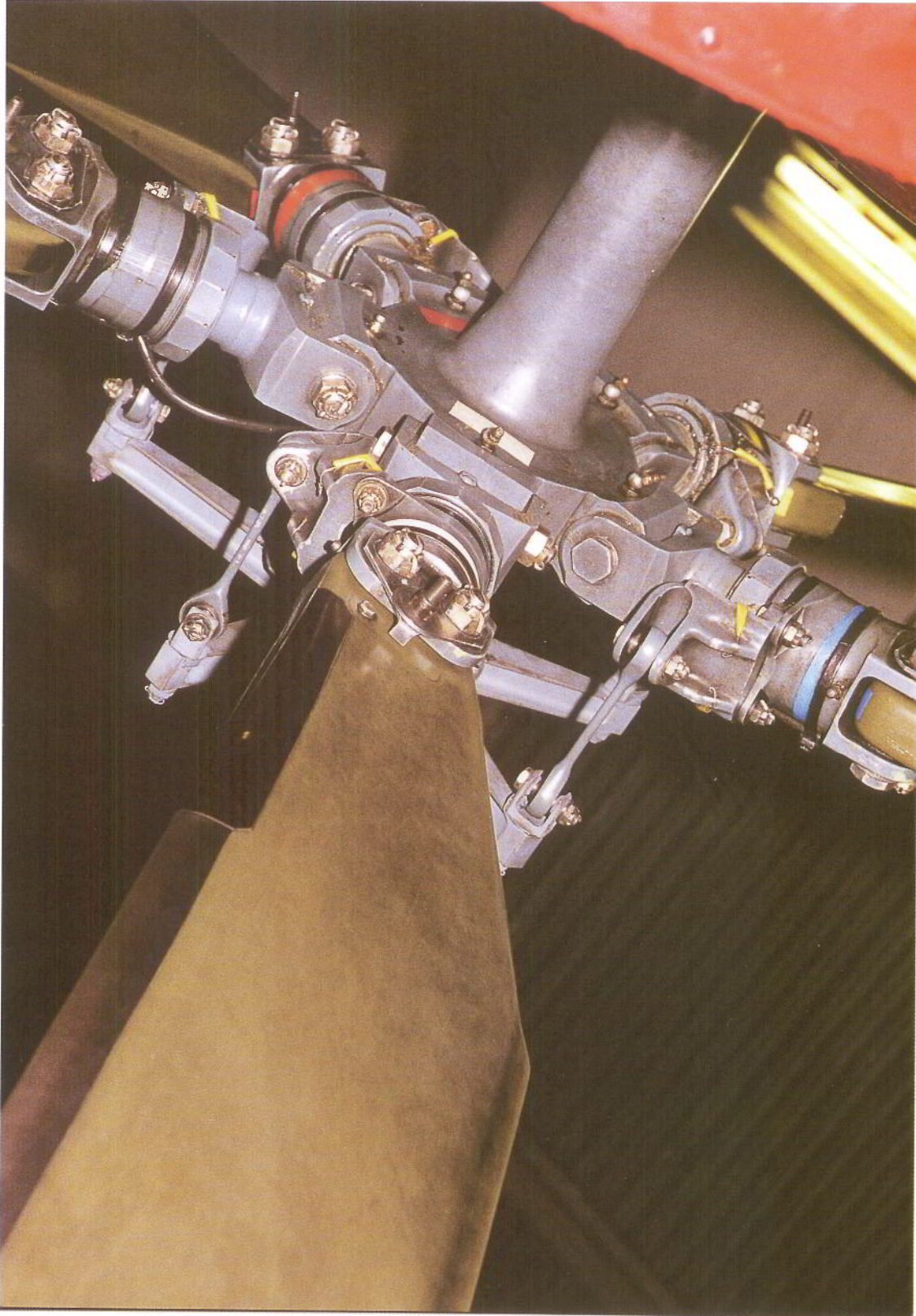
data supplied by Eurocopter - read in conjunction with Appendix J page 2



BENDING MOMENT v. CYCLES  
 data supplied by Eurocopter - read in conjunction with Appendix J page 1

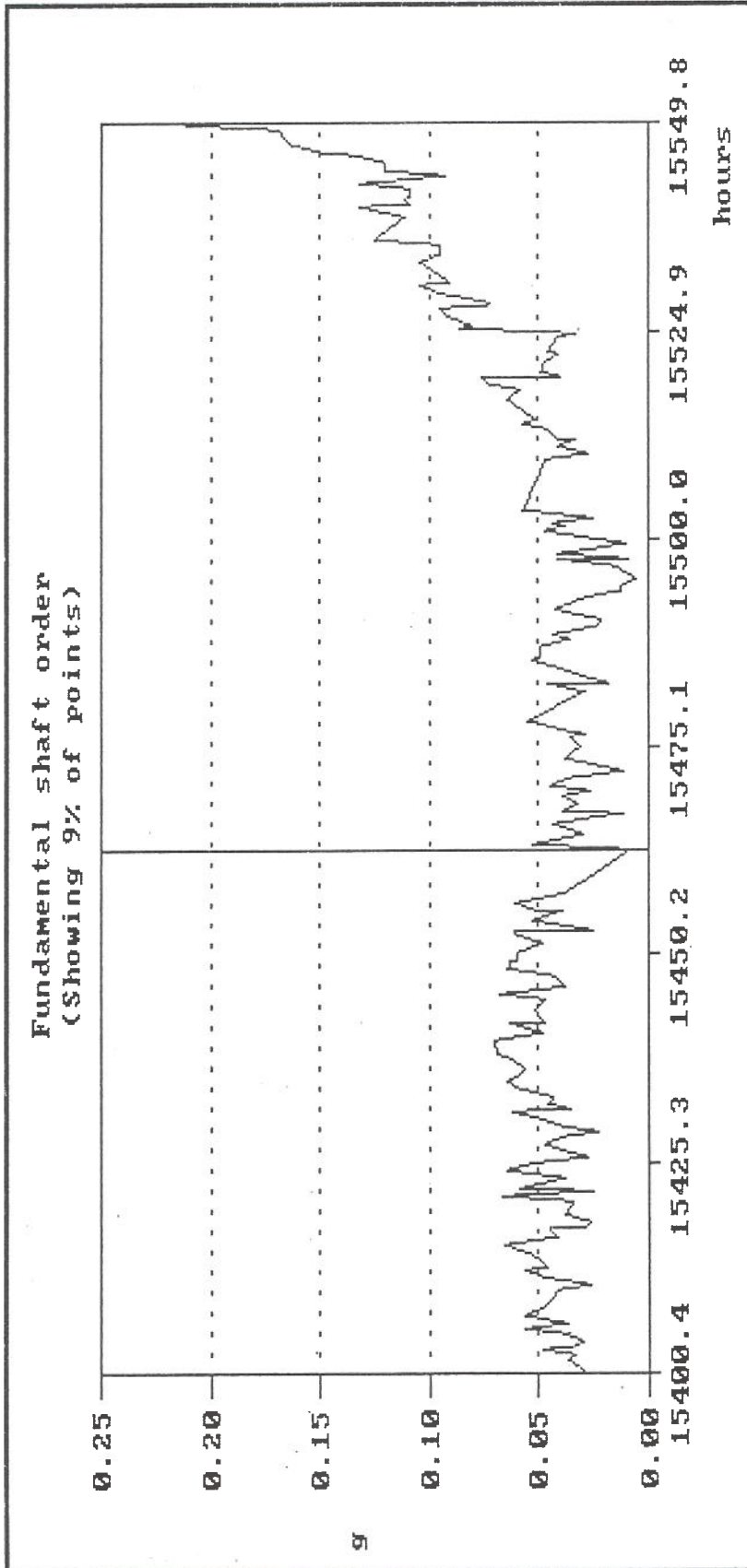


Composite Tail Rotor Vibration



**TYPICAL VIEW OF TAIL ROTOR AVAILABLE  
TO ENGINEER FROM STAGING**

Note that the crack location on the nearest blade is completely obscured,  
and partly obscured on the more distant blades



**G-PUMB IHUMS TRACE**

This trace, from another AS332L, is visually very similar to that of G-PUMH, however the cause was found to be a steadily deteriorating flap hinge bearing.