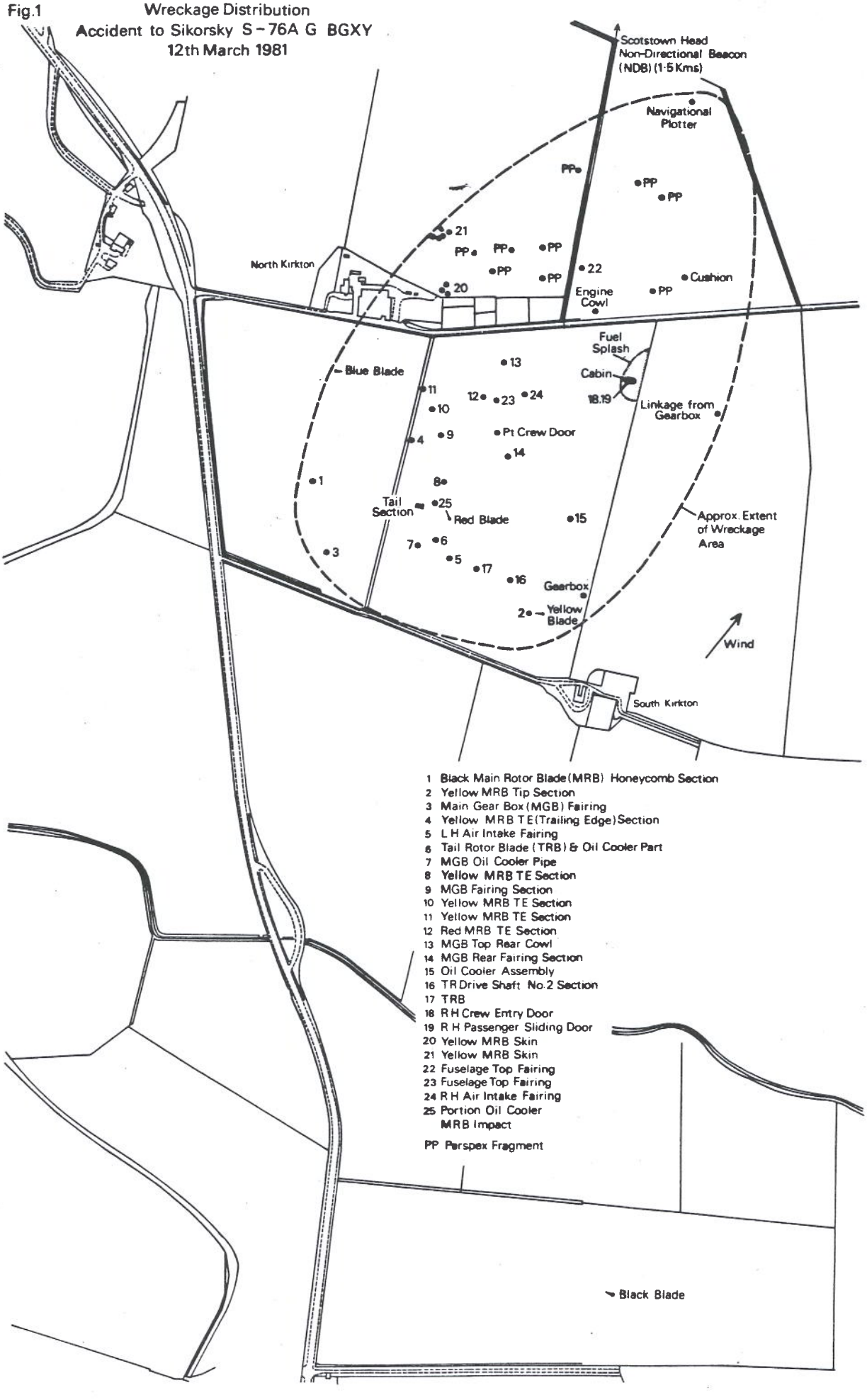
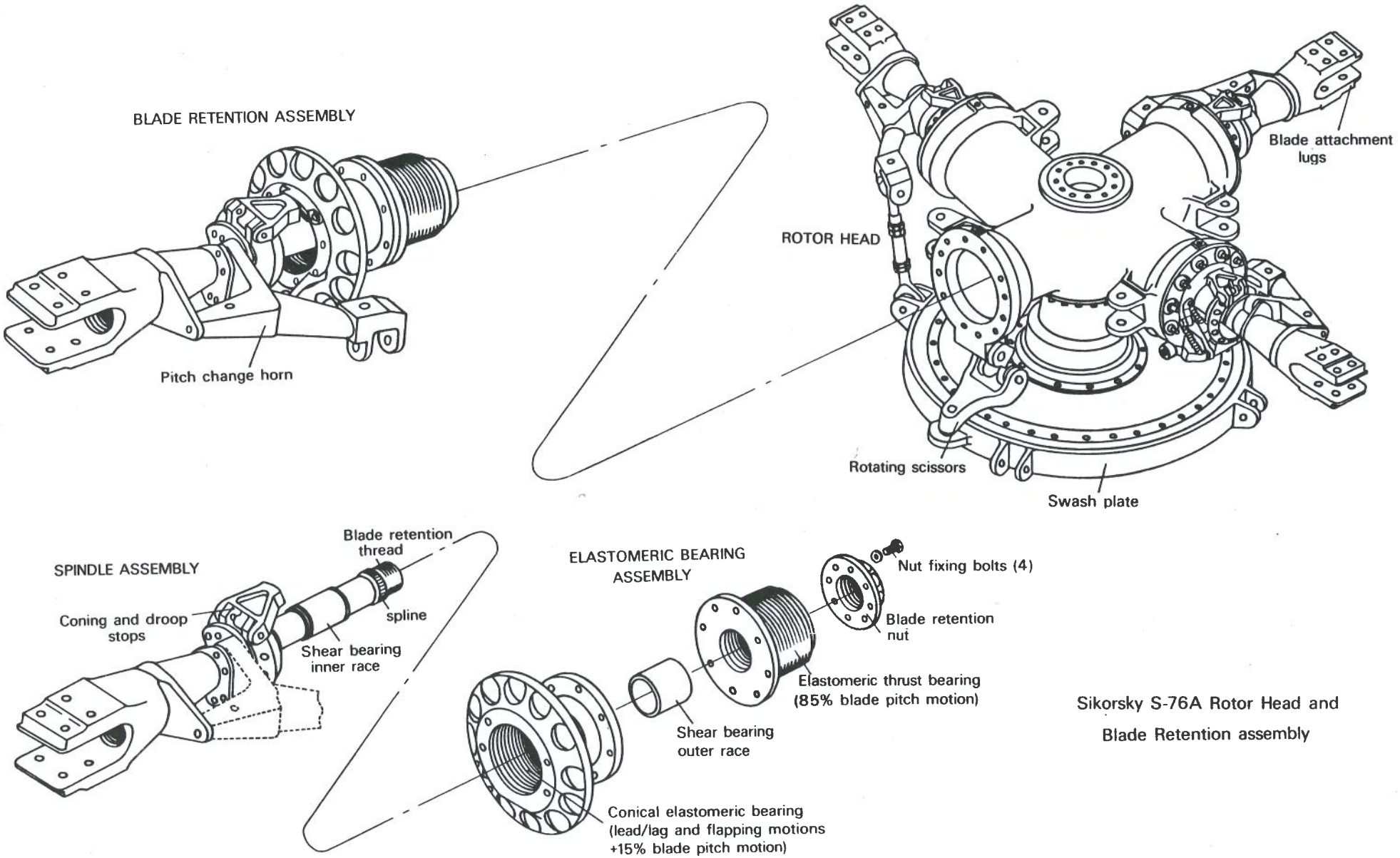
Fig.1 Wreckage Distribution
Accident to Sikorsky S-76A G BGXY
12th March 1981



1 Black Main Rotor Blade (MRB) Honeycomb Section
2 Yellow MRB Tip Section
3 Main Gear Box (MGB) Fairing
4 Yellow MRB T E (Trailing Edge) Section
5 L H Air Intake Fairing
6 Tail Rotor Blade (TRB) & Oil Cooler Part
7 MGB Oil Cooler Pipe
8 Yellow MRB TE Section
9 MGB Fairing Section
10 Yellow MRB TE Section
11 Yellow MRB TE Section
12 Red MRB TE Section
13 MGB Top Rear Cowl
14 MGB Rear Fairing Section
15 Oil Cooler Assembly
16 TR Drive Shaft No 2 Section
17 TRB
18 R H Crew Entry Door
19 R H Passenger Sliding Door
20 Yellow MRB Skin
21 Yellow MRB Skin
22 Fuselage Top Fairing
23 Fuselage Top Fairing
24 R H Air Intake Fairing
25 Portion Oil Cooler
MRB Impact

PP Perspex Fragment



Sikorsky S-76A Rotor Head and Blade Retention assembly

Figure 3

Sikorsky S-76A
Blade Retention Assembly
(longitudinal section)

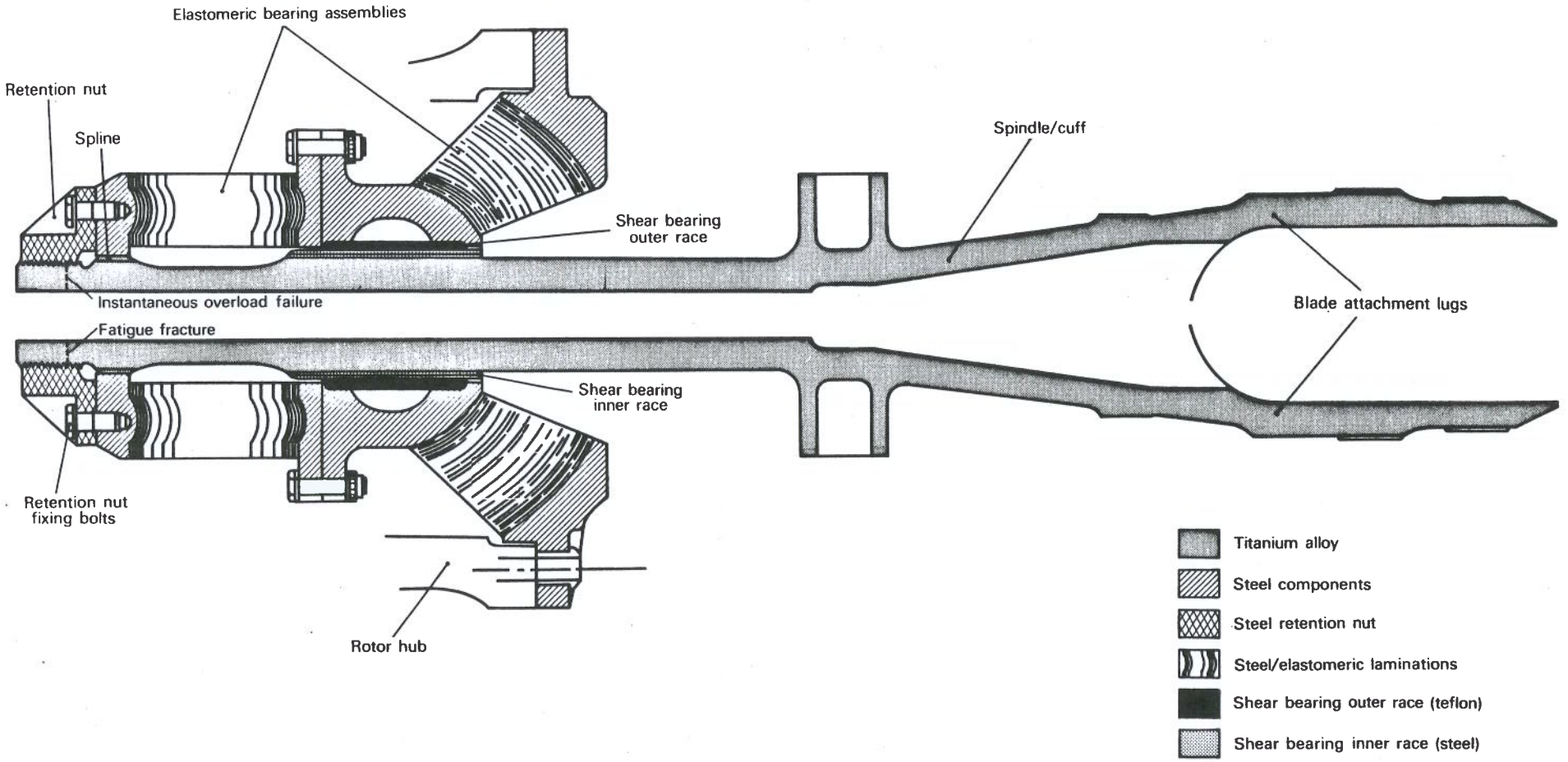
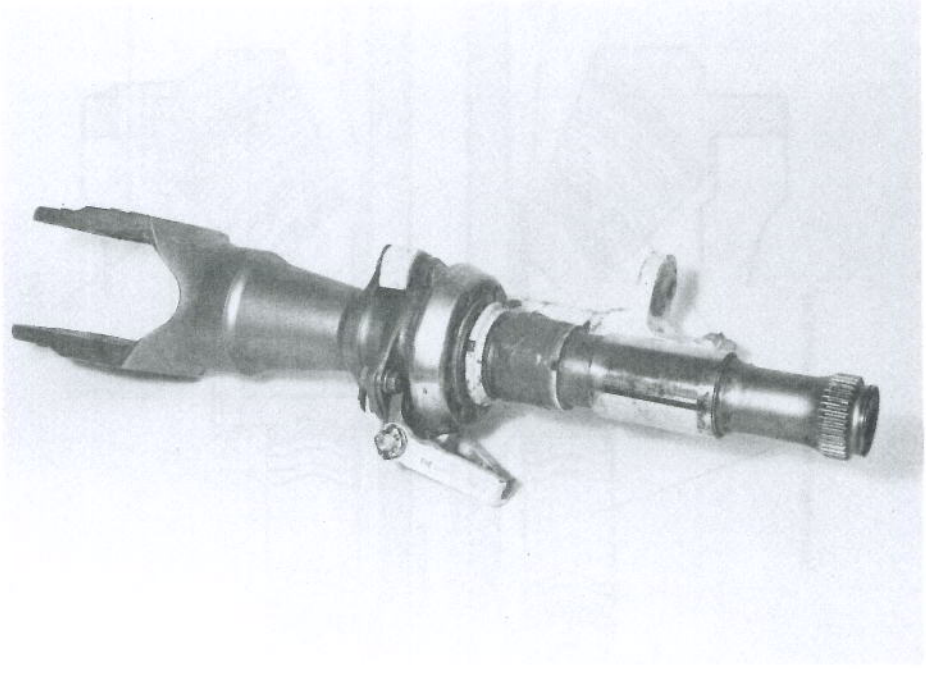


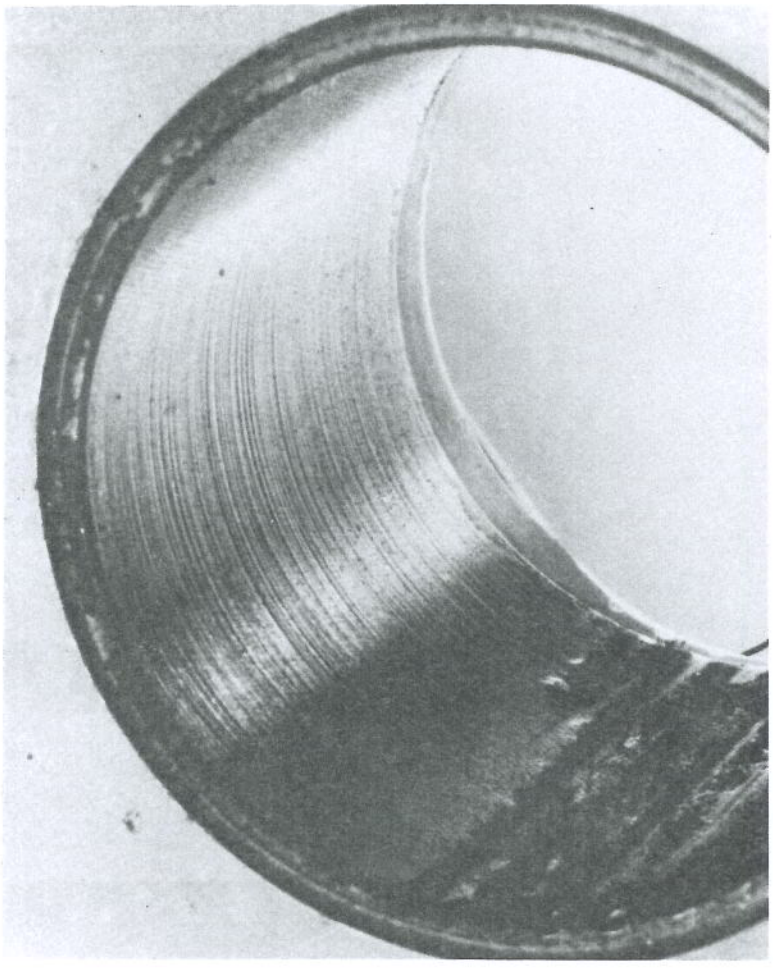
Figure 4

'Black' Main Rotor Blade Root Fitting (As found)

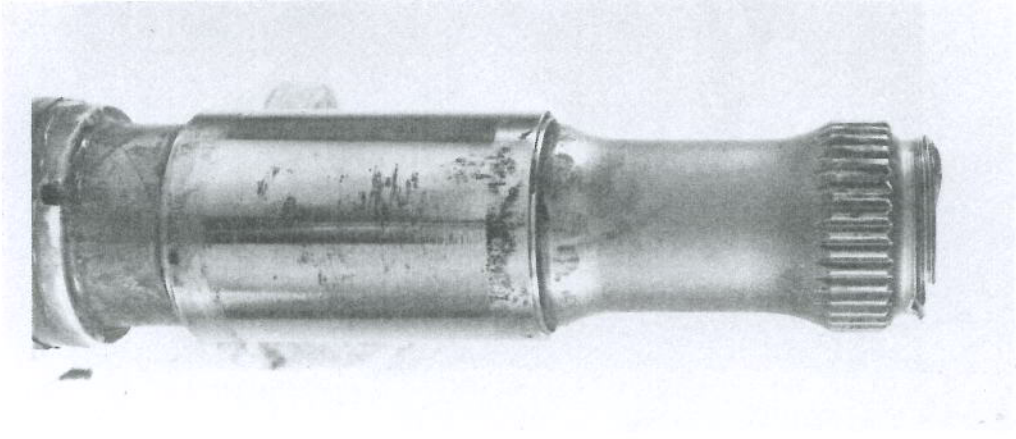


'Black' Main Rotor Blade Spindle/Cuff

Figure 5

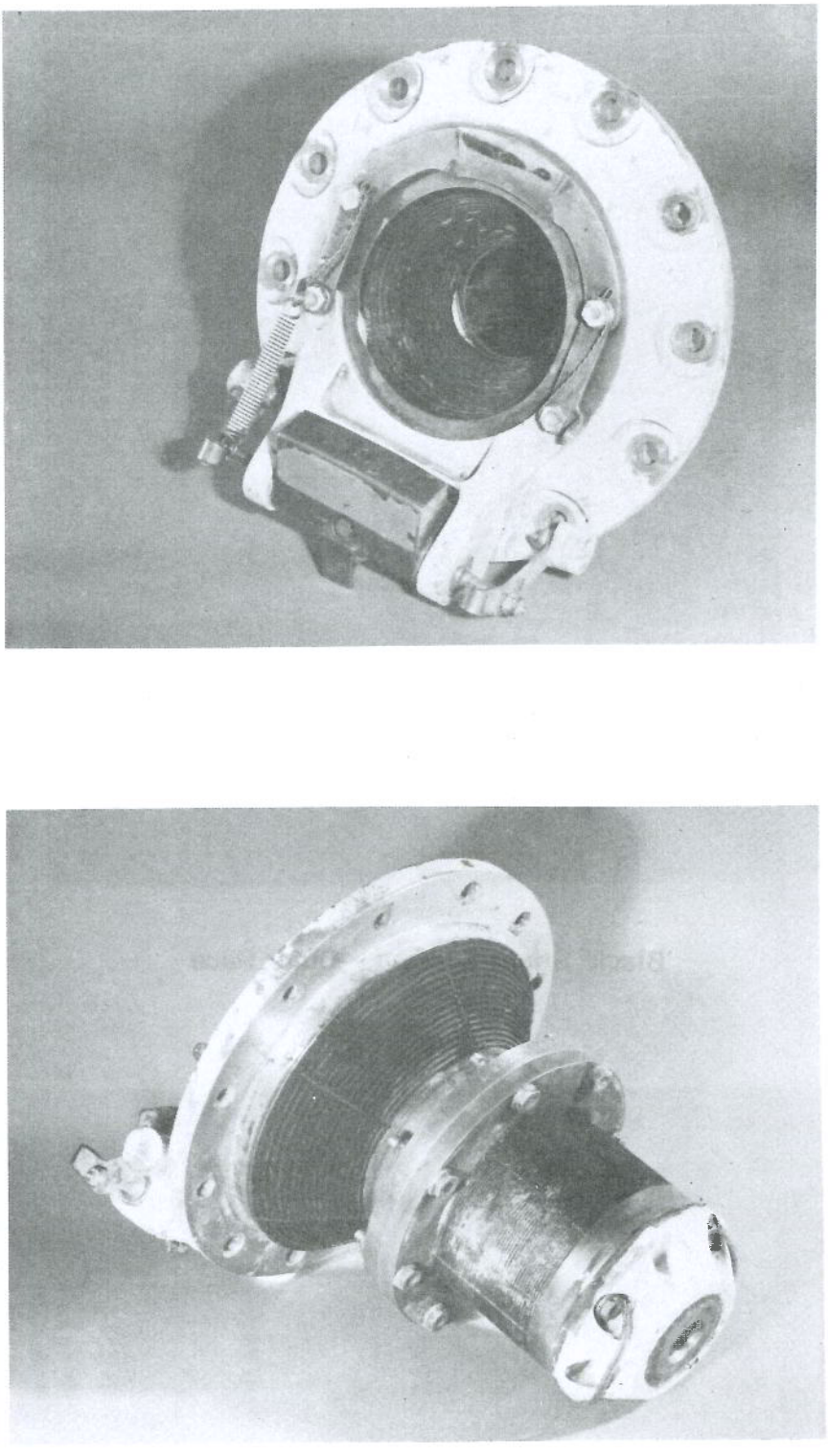


'Black' Shear Bearing —Outer Race



'Black ' Shear Bearing — Inner Race

Figure 6



'Black' Elastomeric Bearing Assembly

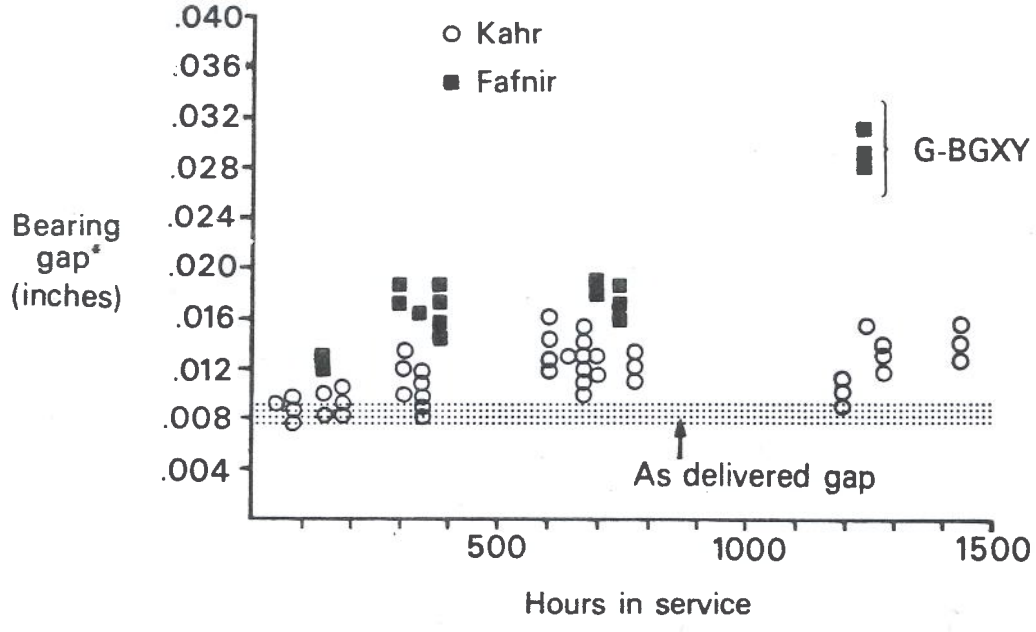
TABLE 1

SHEAR BEARING DIMENSIONS* – G-BGXY

Blade Identification Colour		Black	Yellow	Blue	Red	Drawing Requirements
Outer Race Internal Diam	Ins	2.028	2.027	2.026	2.017	2.009/2.010
Inner Race Outer Diam	Ins	1.999	1.998	1.999	2.002	2.000/2.001
Difference 'Bearing Gap'	Ins	0.029	0.029	0.027	0.015	0.007/0.009 (as installed)

FIGURE 7

BEARING GAP MEASUREMENTS FROM S–76A FLEET



*Gap=inside diameter of bearing-OD of spindle race

*Note:- These dimensions summarised in terms of measurements taken in the vertical plane near outboard end of outer race; in all cases wear less marked in horizontal plane and at mid and inboard station in bearings. Measured dimensions are for installed bearings.

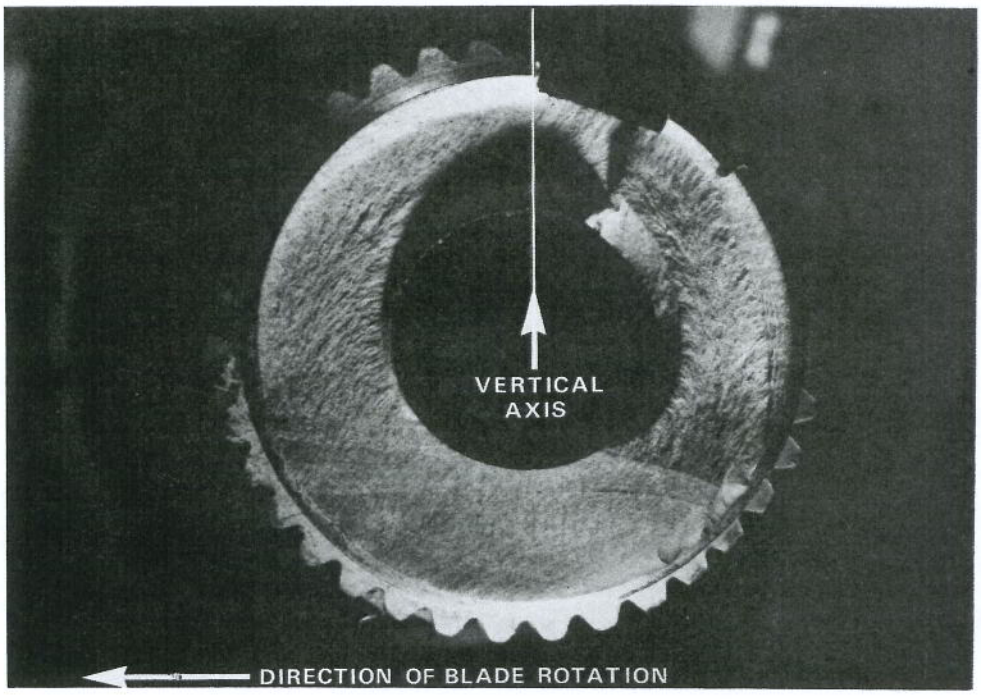
Table 2 Small scale coupon test results

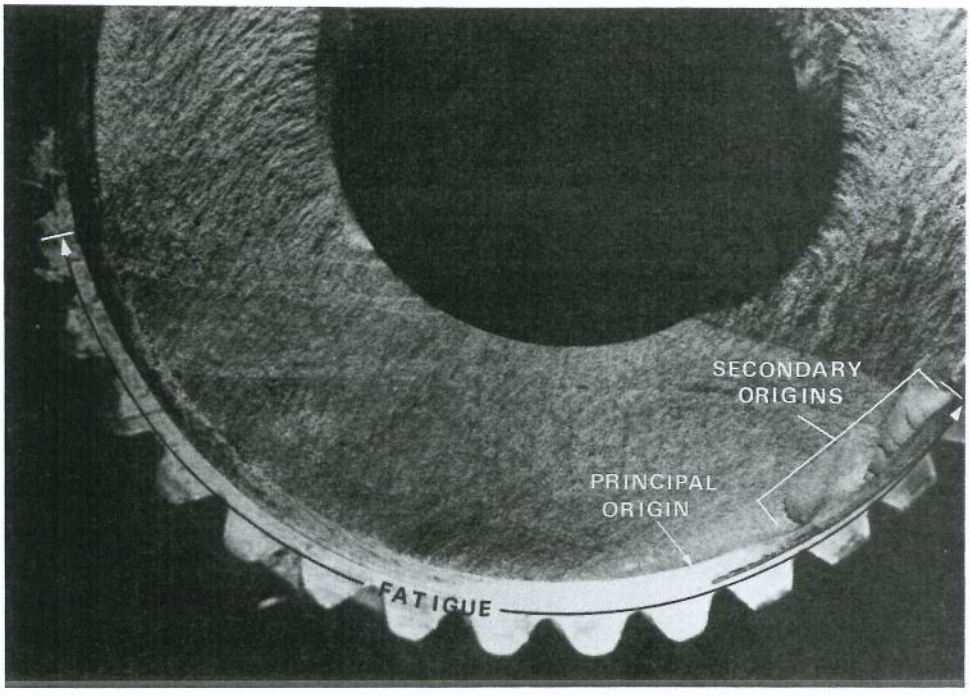
Condition	Sample No.	Fatigue endurance limit (P.S.I.)	%Scatter-calculated standard deviation	Relative fatigue strength %
As machined	18	16,700	12	100
Scotchbrite	18	12,300	25	74
Stress-relieved	5	8,600	4	51
Scotch-brite + stress-relieved	4	8,900	10	53
Combined stress-relieved	9	8,800	7	53

Table 3 Full scale spindle test results

Condition	Sample No.	Fatigue endurance limit (P.S.I.)	%Scatter-calculated standard deviation	Relative fatigue strength %
Certification data	6	16,200	13	100
Scotchbrite	8	13,200	15	81
Stress -relieved	3	10,410	8	64
Torsion	5	14,480	18	89

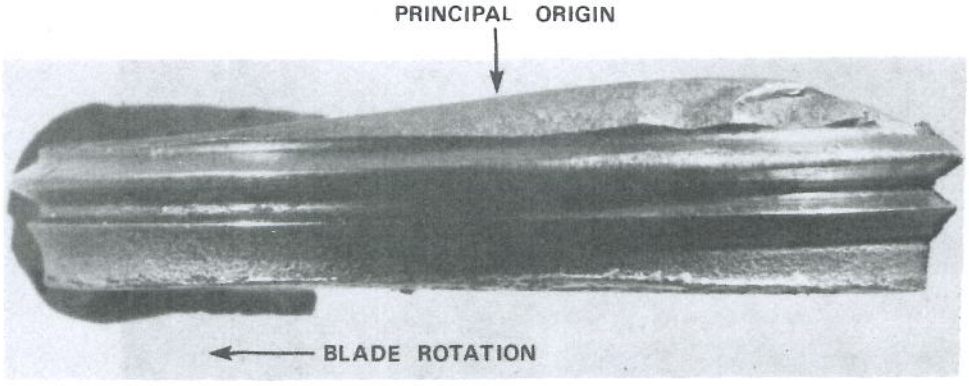
Figure 8



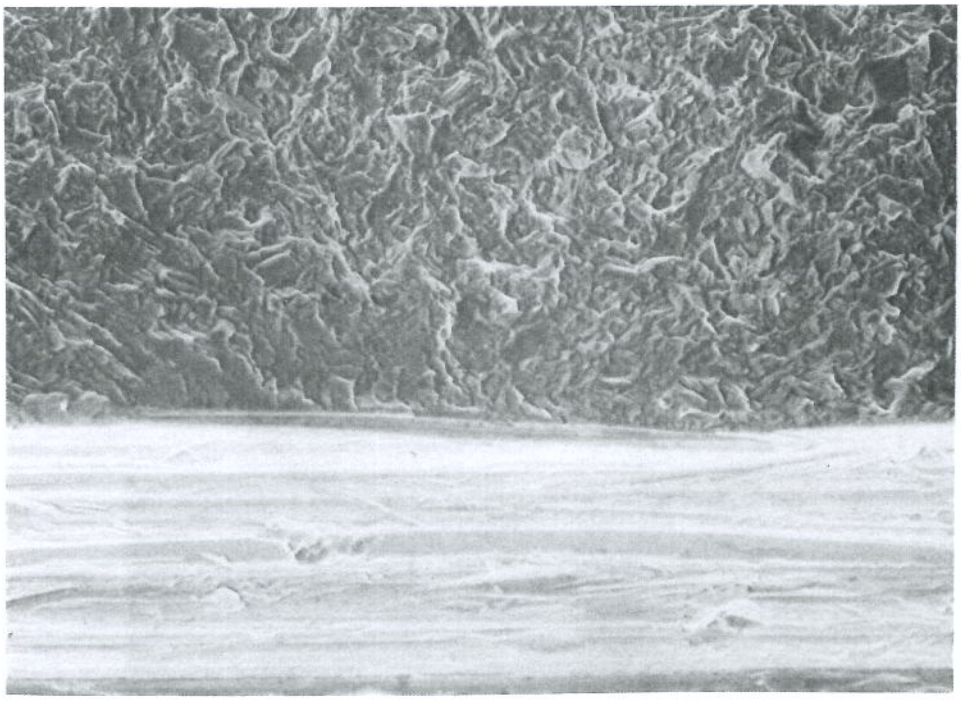


'Black' Spindle-Fracture Face

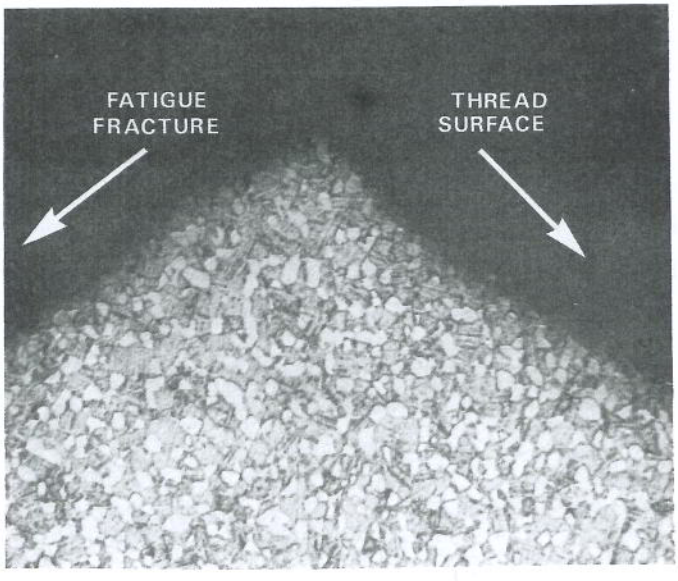
Figure 9



'In-plane' View of Fatigue Fracture



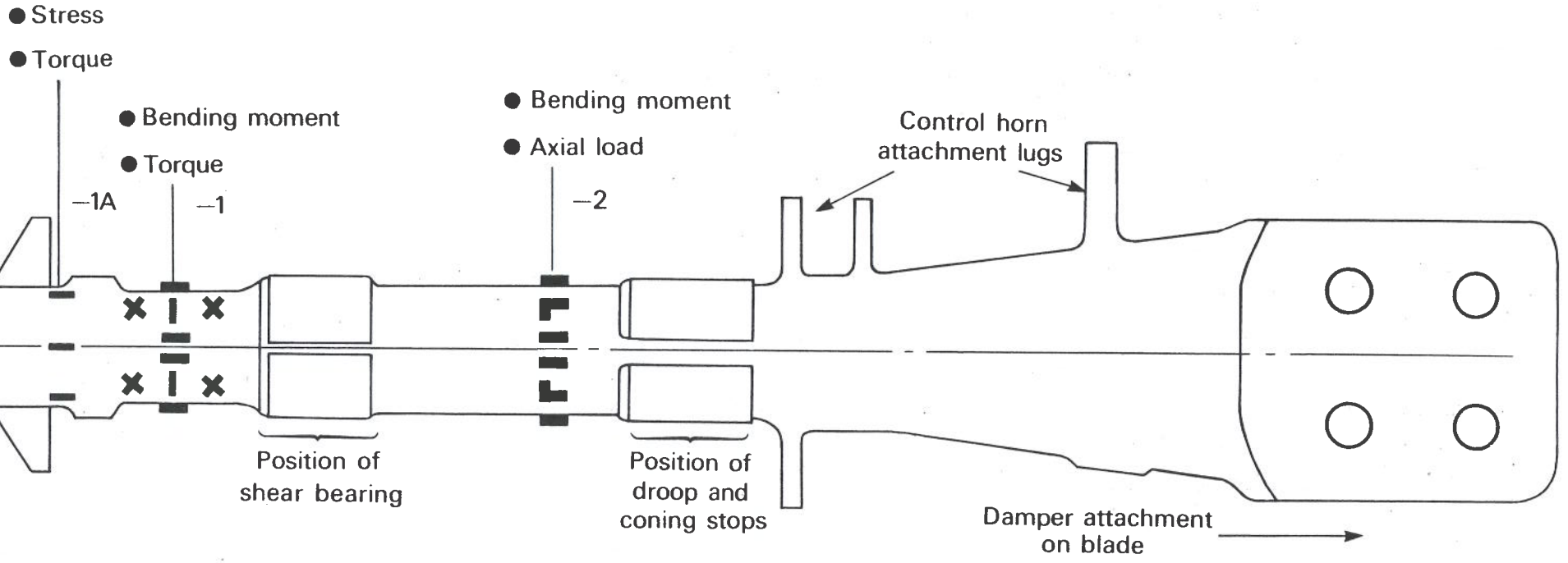
Principal Origin
× 500
Magnification



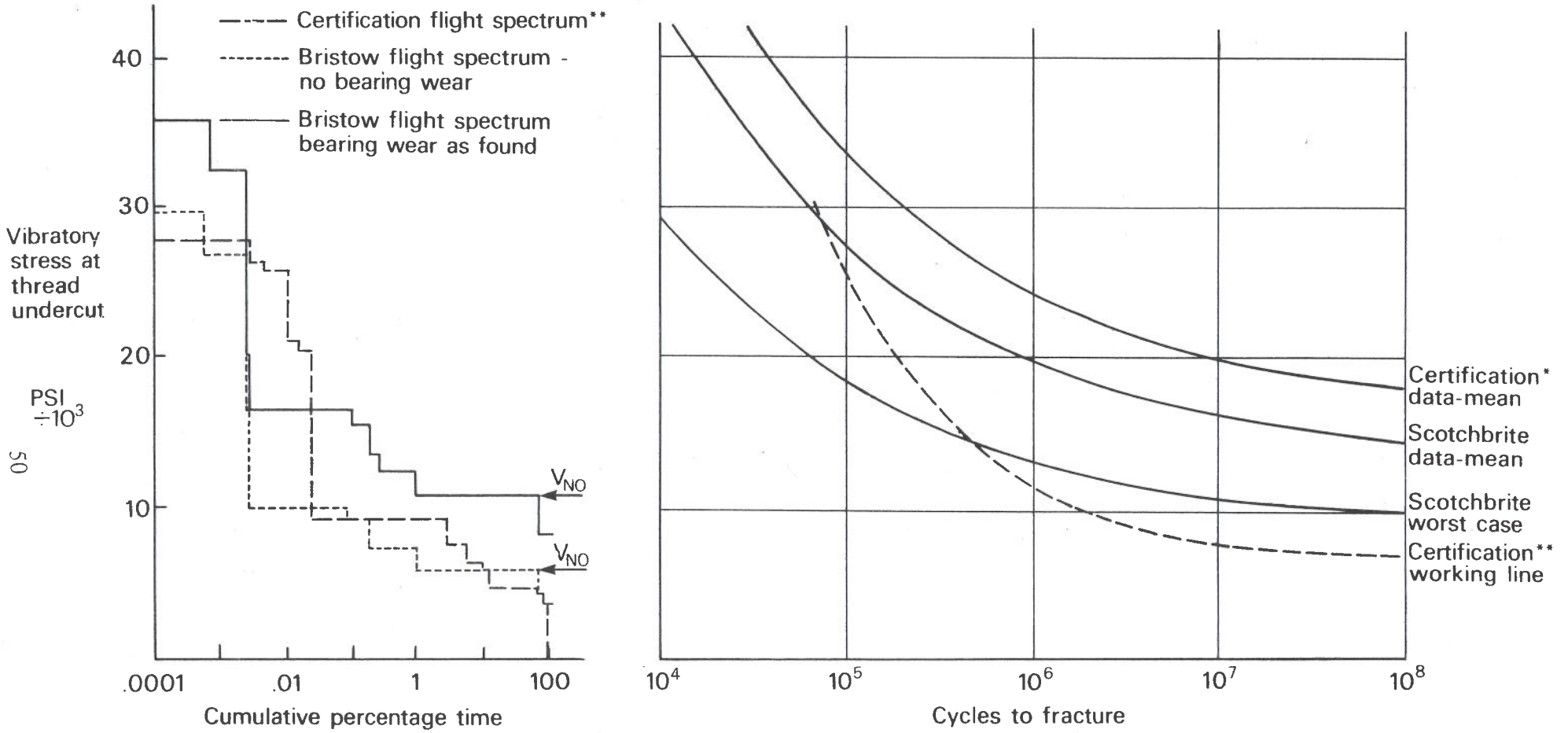
Micro-sections near plane of principal origin
× 200 Magnification

'Black' Spindle Fatigue Details

Figure 10



Main Rotor Spindle instrumentation



Notes: *Calculated stresses, revised curve shape

**Stresses equivalent to bending moments used during certification-original assumptions and curve shape -approximate only

Relationship of Flight Loads to Spindle Fatigue Strength

Figure 11