MINISTERE DES COMMUNICATIONS ET DE L'INFRASTRUCTURE

MINISTERIE VAN VERKEER EN INFRASTRUCTUUR

REPORT ON THE ACCIDENT B707 - REG. 5N-VRG AT OSTEND AIRPORT ON 14TH NOVEMBER 1998

CELLULE D'ENQUETES D'ACCIDENTS ET D'INCIDENT D'AVIATION

CEL VOOR ONDERZOEK VAN LUCHTVAART ONGEVALLEN-EN INCIDENTEN

MINISTRY OF COMMUNICATIONS AND INFRASTRUCTURE
Belgian Civil Aviation Administration
Air Accident Investigation

your letter:
your referenties:
our references:RT/vb/98-71
annex:
info: R. TAVERNIERS
Chief Inspector of Accidents
2 : (32)2/206.32.70

11 December, 1998

Subject : Accident B707 Reg.5N-VRG at Ostend Airport on le November 1998.

REPORT

1. SYNOPSIS

The 14th of November 98 at 2.28 (UTC) the cargo flight RCN 302 with destination LAGOS took off from OSTEND Airport. After ± 30 min of flight, the engine #3 separated from the wing and was recovered 3 days later in a forest in Belgium close to the French border. Just after the separation of the engine a complete hydraulic failure occurred.

The aircraft turned back to Ostend, after jettisoning fuel above the North Sea, it landed on runway 26 at 4.44 (UTC), using emergency brake pressure (Air). During the landing, the aircraft overruns the runway by 100 m and is destroyed.. Nobody is injured. It is only after the landing that the crew realized that the engine #3 was missing.

2. AIRCRAFT INFORMATION

Model:	B707-355C
SN:	19654
Year of manufacturing:	1967
Total hours:	67.790
Total cycles	15.984
Certificate of airworthiness:	Valid til/ 31st January 1999. (Nigeria)

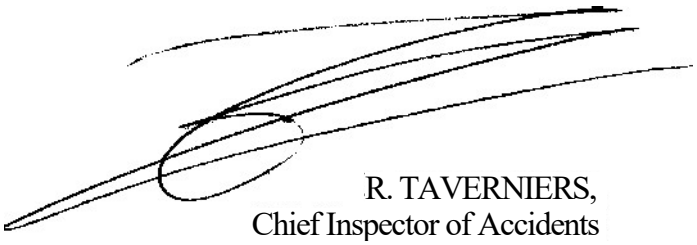
3. FIRST FINDINGS

Laboratory analyses revealed the presence of a fatigue crack on the inner mid spar fitting of engine #3 (see appendix). The crack has been present for a reasonable time. The airworthiness Directive 93-11-02 asks the replacement of the fittings by improved model at least for July 97. The fittings of engine #3 were from the old design.

Due to the non application of AD 93-11-02, the aircraft was in a non-airworthy condition.

4. MAINTENANCE OF THE AIRCRAFT

The FDR was not working during this flight and probably since a long time before
The last "C" Check was carried out on 9th August 1997 at 66.075 hours and 15.645 cycles; The next "C" check was due at 69.075 hours. However due low utility was limited to 31st January 1999 by the Nigerian Authority. A check A+ B + C.P.C.P (corrosion) + SSID (aging aircraft) was carried out on 19 October 98 at 67.672 hours and 15.961 cycles.
According to the records provided by the Nigerian Authority, the AD 93-11-02 was carried out in August 1994. But we have noticed that the AD was not accomplished (see §3).



R. TAVERNIERS,
Chief Inspector of Accidents

Centre Communication North - 4th floor - Rue du Progrès 80, P.O. Box 5, B – 1030 Brussels
☎ : (32)2.206.32.11 - Fax : (32)2.206.32.90 — e-mail : ccn.aa.blv@vici.fgov.be
internet : www.vici.fgov.be

Pratt & Whitney
400 Main Street
East Hartford, CT 06108

Pratt & Whitney
A United Technologies Company

To: Richard Taverniers – IIC, CAA, Belgium
Cc: Bob Shinkle – P&W Brussels Office
Al Weaver – P&W
Mike Romanowski –P&W
Dick Parker – P&W
Jim Sunamoto – P&W
Mike Young – P&W
Allan Shiffler – P&W
file

From: Michael Bartron – P&W

Date: 1 March 1999

Subject: Engine Inspection Report

Event:	Engine Separation from Aircraft
Operator:	IAT
Aircraft:	Boeing 707 (B707) cargo configuration
Engine:	JT3D-3B (s/n: P645361 BAB)
Location:	Brussels, Belgium
Date:	14 November 1998

Highlight:

The attached report covers the factual findings, findings, and discussion of the engine inspection of P&W JT3D-3B, s/n: P645361, accomplished in January 1999, in Brussels, Belgium.

Pratt & Whitney
400 Main Street
East Hartford, CT 06108

Pratt & Whitney
A United Technologies Company

Engine Inspection Report
IAT B707 Engine Separation, Brussels, Belgium, 14 November 1998

Background:

On 14 November 1998, a B707 cargo aircraft, powered by Pratt & Whitney JT3D-3B engines and operating as IAT flight RCN302, experienced the separation of the Number 3 engine and pylon structure from the aircraft during climb. Having departed Osstend, Belgium at 02:28 UTC, flight RCN302 reported a hydraulic failure about 30 minutes after departure. At an altitude of roughly 23,000 feet and during moderate turbulence, the pilot reported an audible bang, an engine surge, and the loss of all instrument readings for number 3 engine. The aircraft returned to Osstend, Belgium and landed. During landing, the emergency braking system was employed. The aircraft departed the runway into a grass field where all landing gear collapsed. No injuries were reported. Aircraft inspection found that engine number 3 and pylon had separated from the aircraft. It was reported that the tailpipe of engine number 4 showed severe impact damage and the wing leading edge between engines number 3 and number 4 showed minor damage.

Landing Gear Damage

Engine Number 3 Position

Engine number 3 was located and transported to a warehouse of the Belgian Civil Aviation Authority. Components of the pylon structure were removed under the authority of Belgium investigator, Mr. Richard Taverniers and analyzed by the Materials Lab of Sabena Technics. The remaining engine and pylon were examined on 14 January 1999 by Mr. Jim Sunamoto – P&W, Mr. Michael Bartron – P&W, Mr. Michael Holland – Boeing, and Mr. Richard Taverniers – Belgian CAA.

Findings:

1. There was no evidence of gas path distress prior to the engine impacting the ground.
   There was no evidence of engine uncontainment prior to pylon separation.
   Engine damage was consistent with engine impact with terrain.

2. There was evidence of a cowl fire at some time in the engine history. There was no mating soot or fire damage evidence on the engine.

3. The engine was still mounted to the aircraft pylon.
   The engine did not have any hush kit nacelle modification.

Discussion:

The examination was conducted under the direction of Mr. Richard Taverniers, Chief Inspector of Accidents, Belgium Civil Aviation Administration. Mr. Michael Holland, Belgium Boeing Customer Service Representative was also present.

The R-1 fan blade rear tip section was examined by mirror and no evidence of fatigue was found. The tip fracture section about the 2/3 chord could not be examined because lack of space.

The R-1 fan case, the 1st vanes, R-2 fan, and fan exit guide vane did not show any evidence of fan blade liberation witness marks. The OD of the crushed side of the fan case, centered at 3:00 o'clock viewed from rear, did not show evidence of a piece of fan blade impact from the inside outward.

A viewing window was cut into the diffuser case in front of the burner cans. Two burner can domes showed no evidence of metal splatter, suggesting no upstream damage. The relatively clean condition of viewed burner can domes and fuel nozzle supports was consistent with the absence of any compressor gas path distress during engine operation, prior to engine impact with terrain.

The last low-pressure turbine (T-3) and the turbine exhaust case struts showed no evidence of upstream distress prior to engine/pylon liberation.

It was reported that the pylon cracked in an area that was not modified to a Boeing Service Bulletin to fix a know problem. It was reported that there was a fatigue crack in the pylon that had secondary impact damage from the mating surfaces. The pylon fatigue fracture surface was in the metallurgical lab and was not available for viewing.

At the request of Mr. Taverniers, a determination was made on the potential time of continued engine operation following separation from the aircraft. Providing that 100% of the fuel, estimated at 7.6 lbs., contained between the bulkhead connection at the wing front spar and the engine driven pump is consumed by the engine, the engine could operate for roughly 5 seconds at a maximum climb power setting and a 23,000 ft. altitude. If the fuel flow changed from maximum climb to minimum idle during the separation event, as might occur from control hardware distress, the engine could then operate at minimum idle fuel flow for up to 42 seconds. These estimated times assume that there would be no significant mechanical interaction that would hinder rotation.

Jim Sunamoto
Flight Safety Engineer
Pratt & Whitney

Charles Shinkle
Customer Service Representative
Pratt & Whitney

Michael Bartron
Flight Safety Engineer
Pratt & Whitney

Factual Findings: **JT3D-3B Engine No. 3, S/N: P645361 BAB**

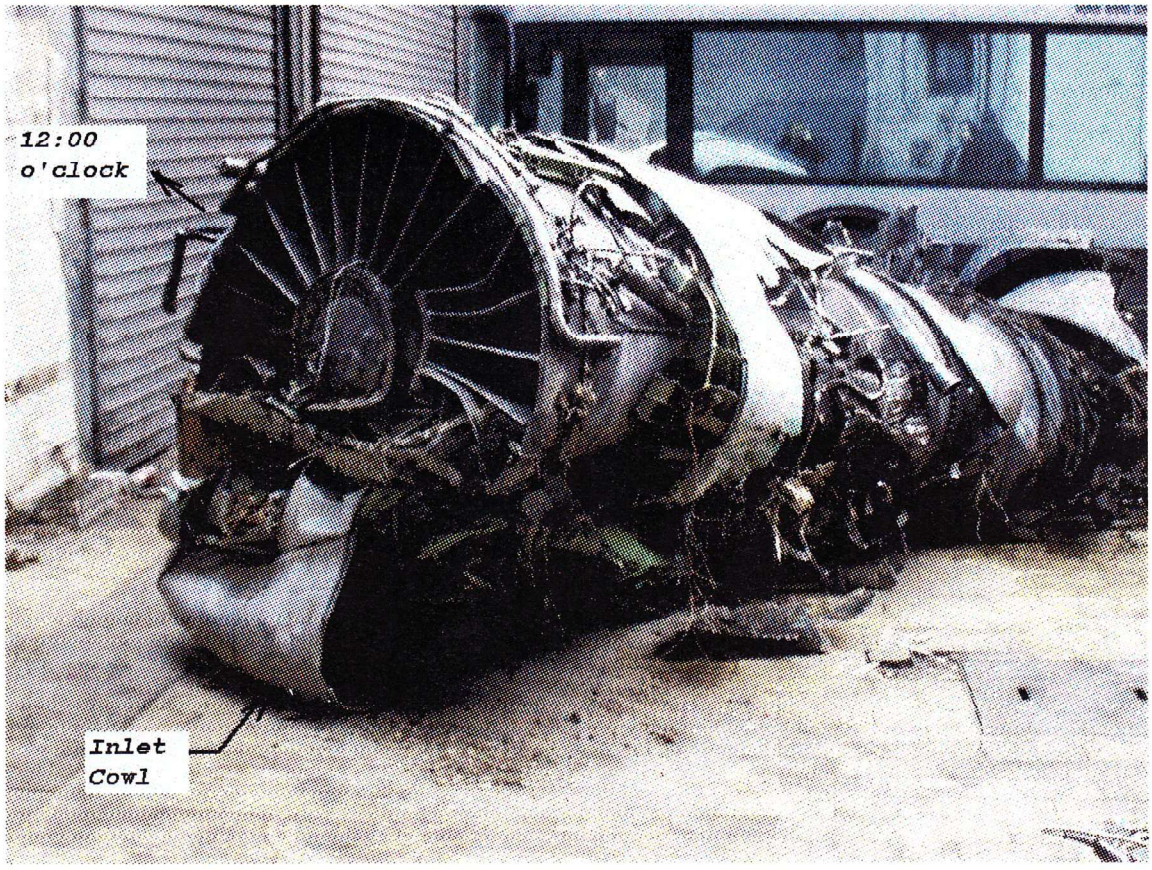
GENERAL

The engine Low-Pressure Compressor (LPC) case, High-Pressure Case (HPC) case, Diffuser case, and Combustion Chamber Outer case (CCOC) were crushed radially inward at the engine 9:00 location.

The fan inlet and gearbox were severed from the engine.

There were no case ruptures or case penetrations from the inside out on the examined cases.

There was no evidence of fire on the examined case material.



LOW PRESSURE COMPRESSOR (LPC)

The R-1 fan case, the 1st vanes, R-2 fan, and fan exit guide vane did not show any evidence of fan blade liberation witness marks.

INTERMEDIATE CASE

No signs of distress other than impact with terrain.

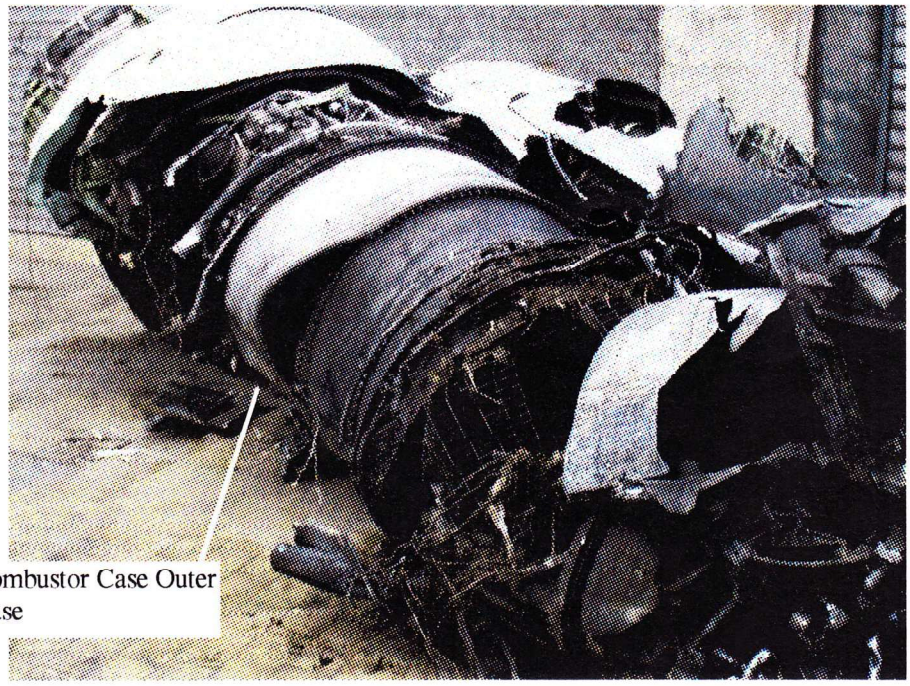
HIGH PRESSURE COMPRESSOR (HPC)

No signs of disk rupture through examined case.

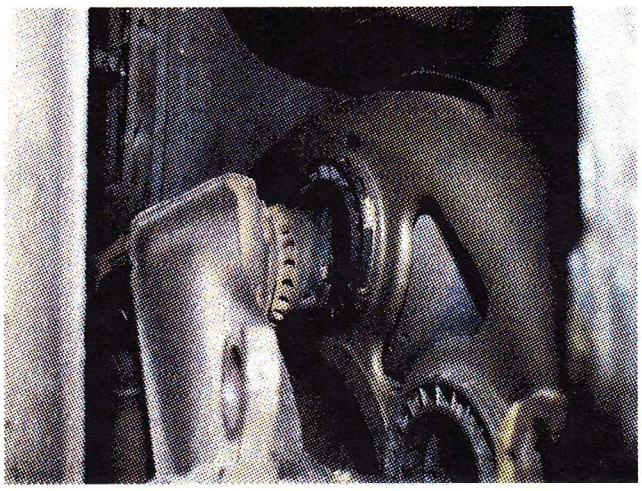
No signs of fire on examined exterior case material.

BURNER SECTION

The Combustor Case Outer Case was intact. However, it was deformed radially outward, centered at the 5:00 o'clock location, with the rear flange bolt strap torn out.



A section of CCOC was cut to view into the burner. Four burner cans were exposed for viewing through the cut out section. There were no visible indications of burner section distress and there was no metal debris splatter on the front of the fuel nozzles, fuel nozzle supports, or burner can domes.



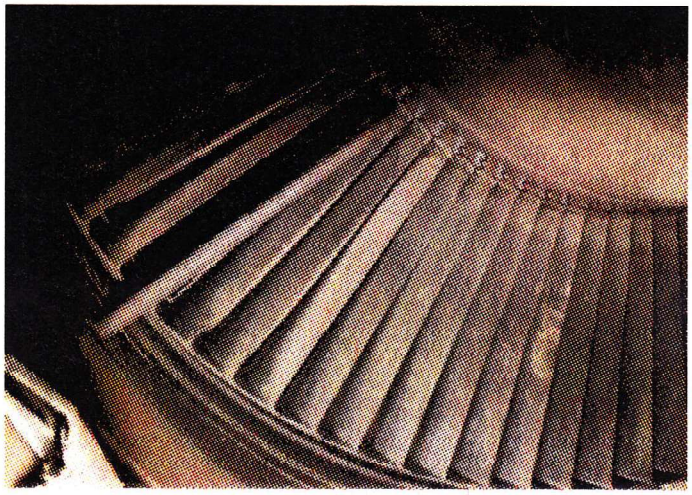
HIGH PRESSURE TURBINE (HPT)

No signs of disk rupture through examined case.

No signs of fire on examined exterior case material.

LOW PRESSURE TURBINE (LPT)

The last low-pressure turbine (T-3) and the turbine exhaust case struts showed no evidence of upstream distress prior to engine/pylon liberation.



sabena

Our Ref: 54/981120

Your Ref: wo 35763

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Requester:

Belgian Civil Aviation Administration

ATTN Mr. R. Taverniers
Chief Inspector of Accidents

SABENA
TESTING LABORATORY
Materials Engineering Department
Brussels National Airport
Building 12/012
B-1930 Zaventem (Belgium)
Phone: 32.2/723 40 84
Telex: 63697 SABCOM B Attn BRUMLSN
Fax: 32.2/723 45 98

SUBJECT: B707 - INVESTIGATION ON SEPARATED ENGINE

1- References

B707 IAT Cargo Airlines immatriculation 5N-VRG flight hours 67790 flight cycles 15984

Received for investigation on 20 Nov. 98: all parts having a fractured surface were cut from the separated engine, i.e. overwing fitting, structure containing parts from both midspar fittings, diagonal brace (broken at both ends through lugs, and the corresponding structure on the engine. Refer to pictures 1 and 2.

Received for investigation on 3 Dec. 98: remains of the midspar fittings cut from the pylon on the aircraft.

Further reference documents:

(1) B707/720 Service Bulletin Number 3183

(2) AD 93-11-02 Inboard engine separation, effective date 6 July 1993.

(3) Fitting assy- mid spar, inbd nacelle strut drawing 65-2536

(4) SUV-BRU-98-002R 30 NOV 98

2- Problem description

Incident of 14 Nov. 98, aircraft looses pos 3 engine during flight near French-Belgian frontier after departure from Ostend Airport. Aircraft returned and had to make an emergency landing.

Sabena Materials Engineering was asked by the Belgian CAA to perform a fractographical investigation on received parts.

3- Investigations and results

All parts cut from the separated engine were analysed and found to have failed in static overload, except for the inboard midspar fitting. Pictures 3 and 4 detail the fracture surfaces from both midspar fittings as visible on picture 2. The outboard fitting is an overload failure while the inboard fitting reveals **stress-corrosion cracking** at the upper tang and an almost 100 % fatigue crack at the lower tang. See pictures 5 to 8 for more detail. Note also the mechanical damage on the upper tang indicating beating of both parts against each other after cracking (beating caused by engine vibration).
Picture 9 reveals the mating part of the fitting removed from aircraft relative to the fractured upper and lower tang. Pictures 10 and 11 reveal the fracture surfaces of the outboard respectively inboard midspar fittings removed from aircraft. Note the brown corrosion which is post-incident. Note the abscence of corrosion on the stress-corrosion fracture surface. This can be explained by the fact that this surface has accumulated dirt and greasy substance during operation, preventing corrosion. This proves it concerns a crack which has been present for a reasonable time. The stress-corrosion cracking of the upper tang has induced higher stresses on the lower tang which developed a fatigue crack.

4- Discussion and further investigations

Fracture of the midspar fittings resulting in separation of the strut and engine from an airplane in flight has been experienced before on B707 (see ref (1)). To address this problem the ref (2) AD has been issued. Replacement of the midspar fittings with new, improved fittings, iaw ref (1), constitutes terminating action for the inspections required by the AD.

The ref (4) Boeing message indicates that the data airplane was delivered with P/N 65-2536-9, -10 opposite mid-spar fittings. The ref (1) recommended replacements for the midspar fittings are P/N 65-2536-15(-16 opposite) or P/N 65-2536-25(-26 opposite).

The material of both old and new fittings is the same, i.e. 4330M steel, heat treated to 220-240 ksi.

The only visible differences are a larger transition radius at the top (1.00" instead of 0.38") and a smaller flat area on the large lug (2.1" instead of 3.0"). See also drawing on last page of this report.

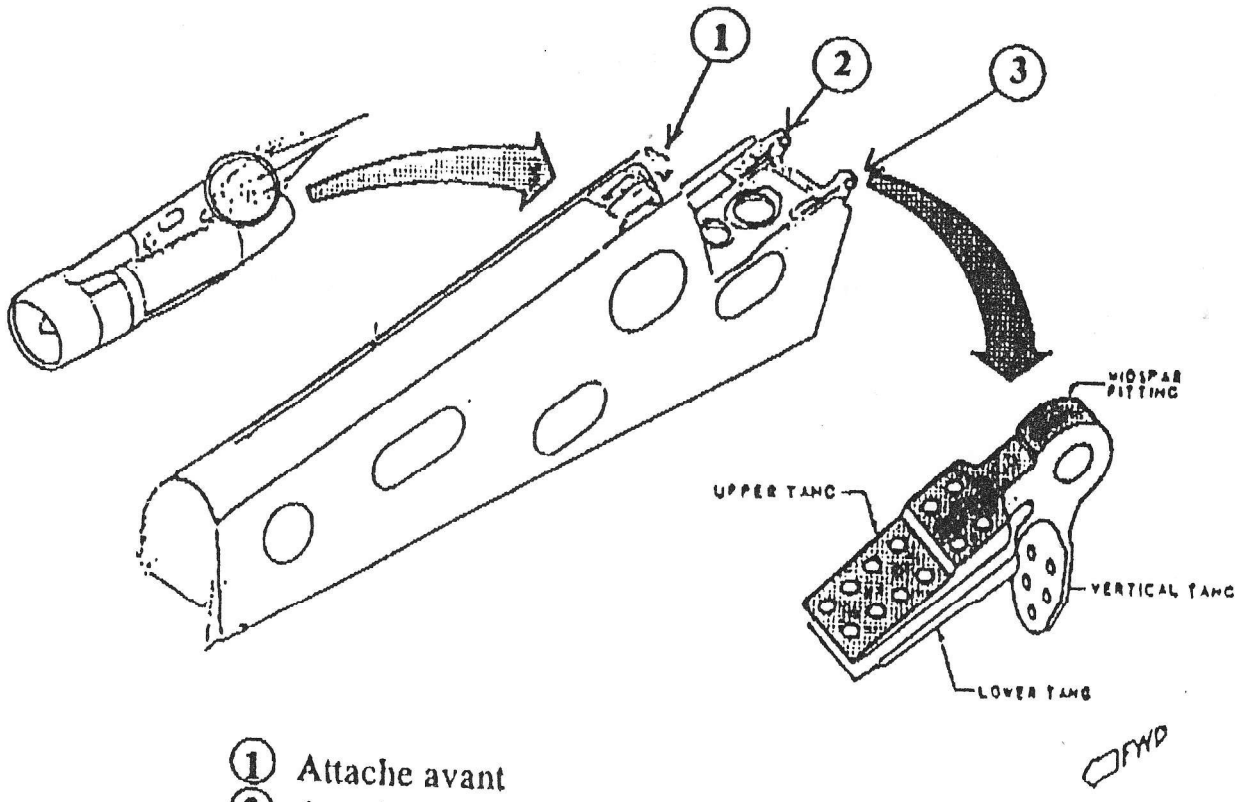
Review of the received fittings reveals a .38" transition radius (see picture 12) and a 3.0" flat area, **proving** that the midspar fittings have never been replaced by new, improved fittings.

CONCLUSION:

THE OLD, NON-IMPROVED MIDSPAR FITTINGS FAILED BY STRESS CORROSION CRACKING (UPPER TANG) AND FATIGUE CRACKING (LOWER TANG).

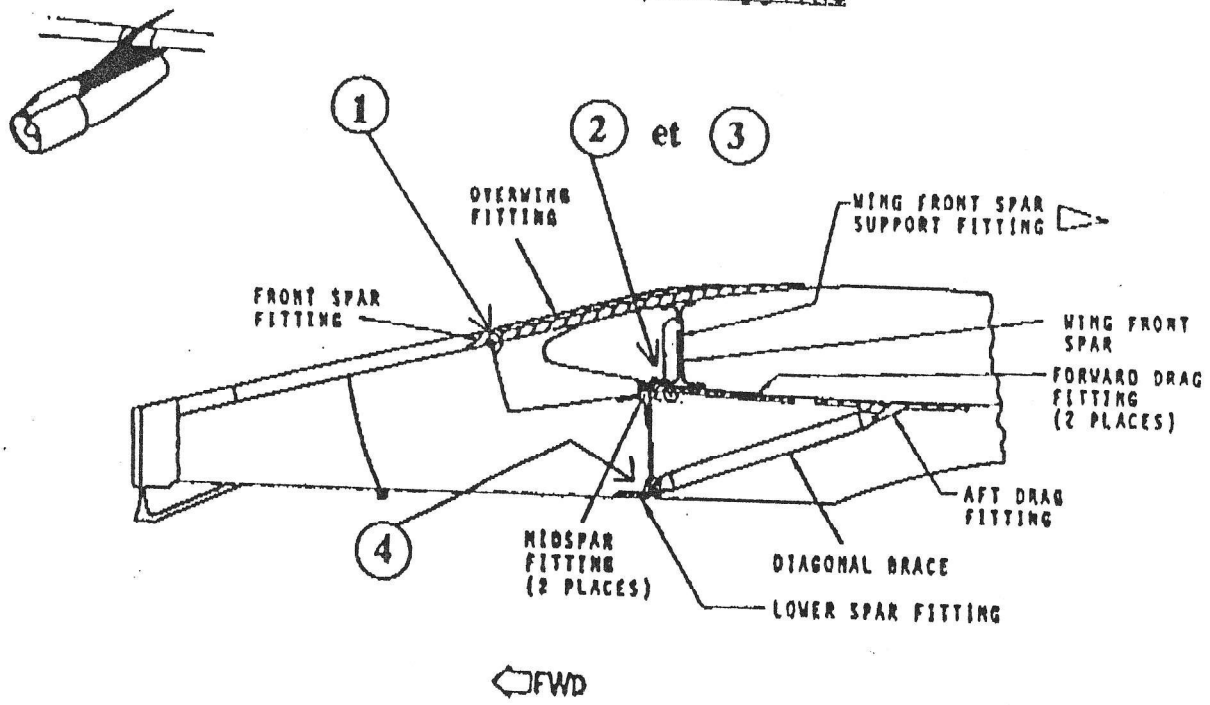
ir. Ivo PAULUS
8 December, 1998

Picture 1: indicates engine attachments, relative position of parts and nomenclature.

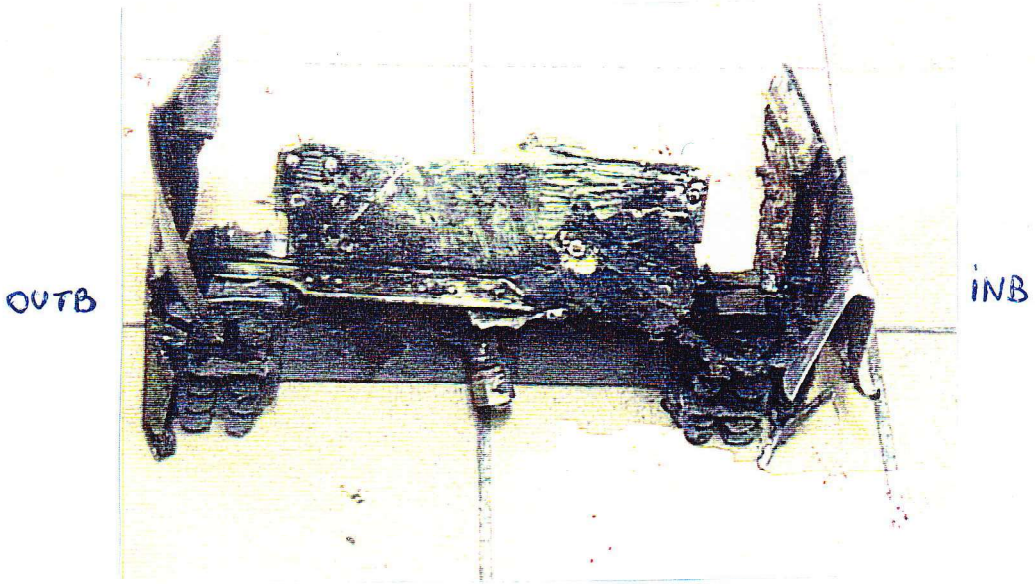


① Attache avant
② Attache médiane extérieure
③ Attache médiane intérieure
④ Attache inférieure (bras diagonal)

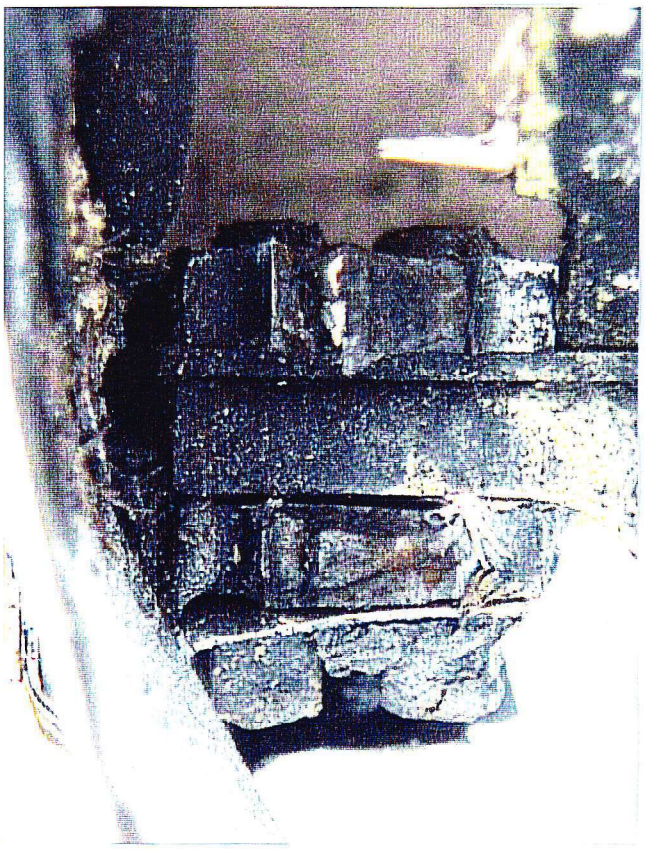
Vue en coupe du pylône



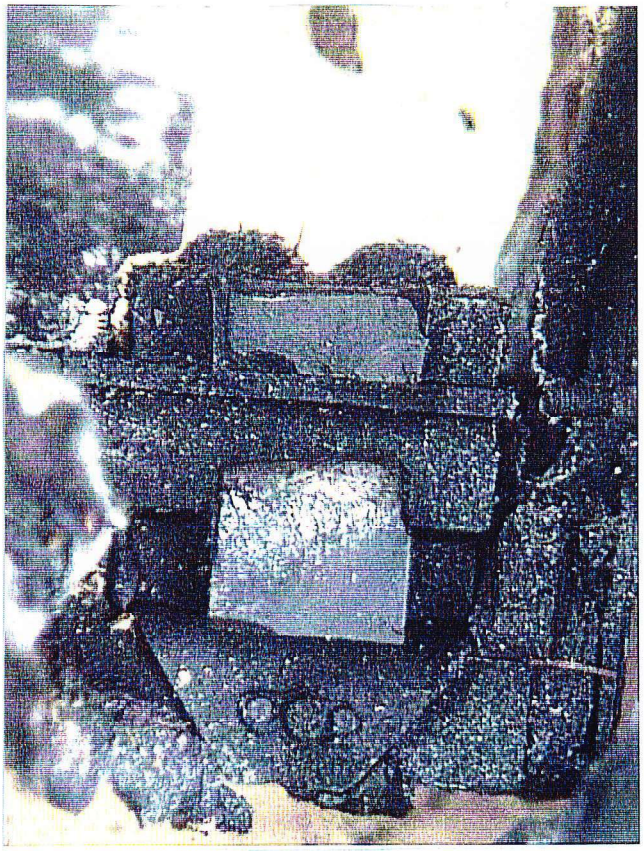
707/720 ENGINE NACELLE STRUT
(TYPICAL)



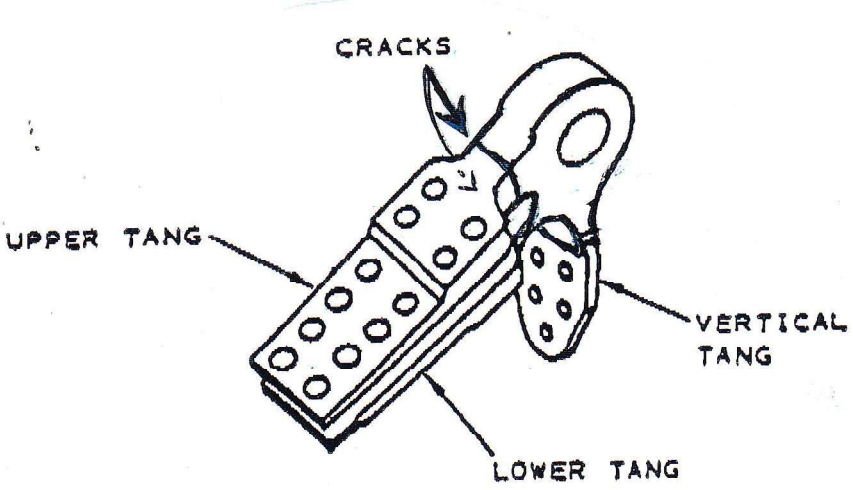
Picture 2: View on as-received structure containing upper and lower tangs fractured from inboard and outboard midspar fittings. This section was cut from the engine that had separated.



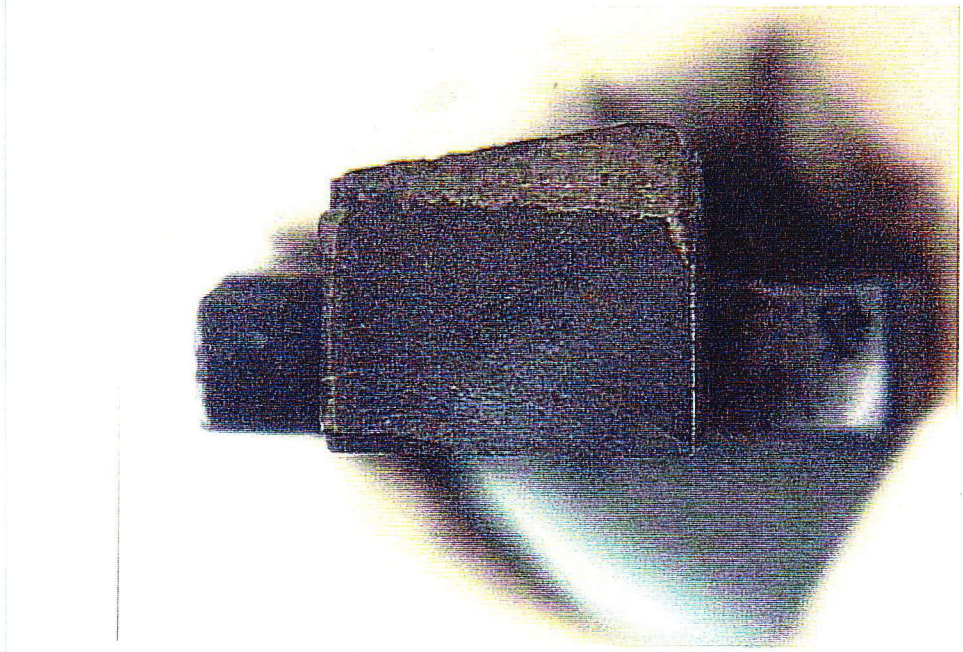
Pictures 3 & 4: Detail of fracture surfaces of midspar fittings on the part from picture 2.



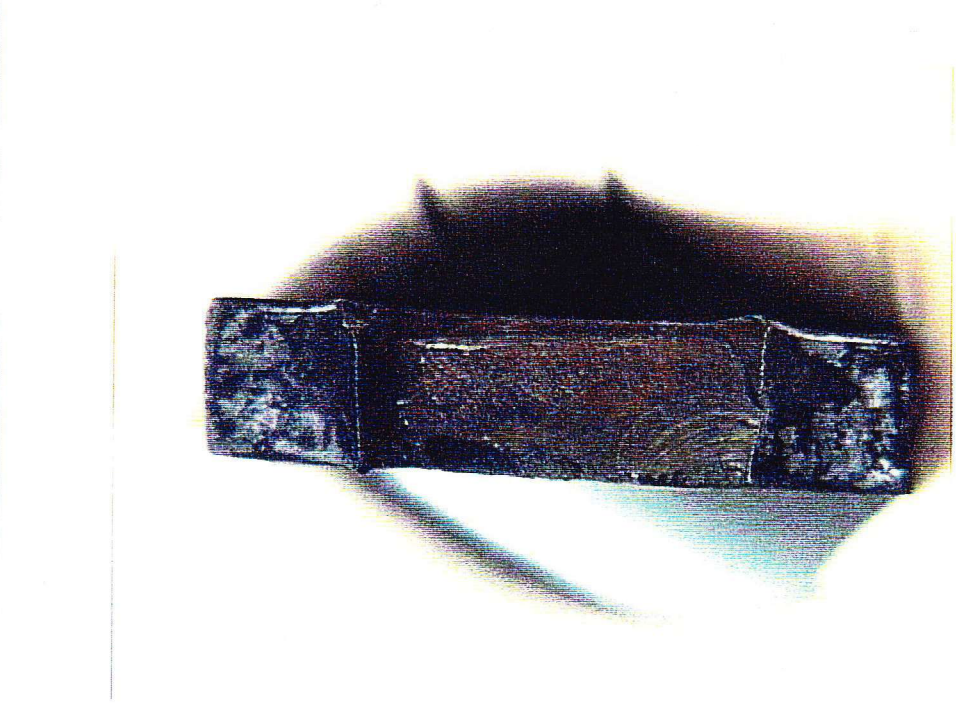
Picture 5: More detail of picture 4. Magn. 0.83x.



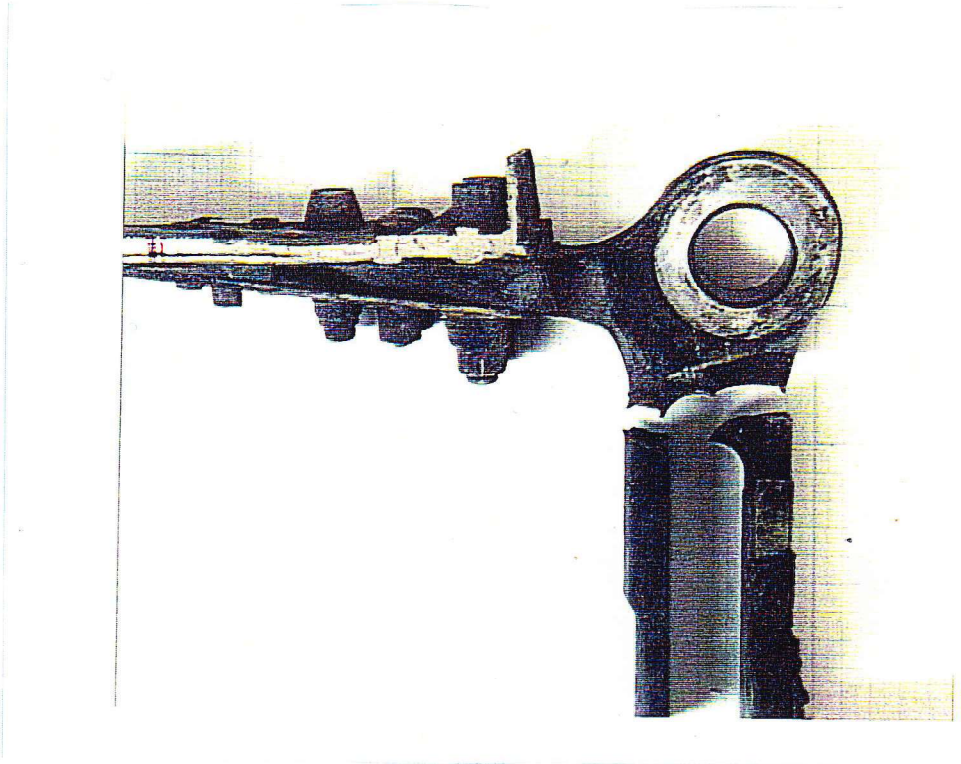
Picture 6: Sketch indicating fracture location on midspar fitting.



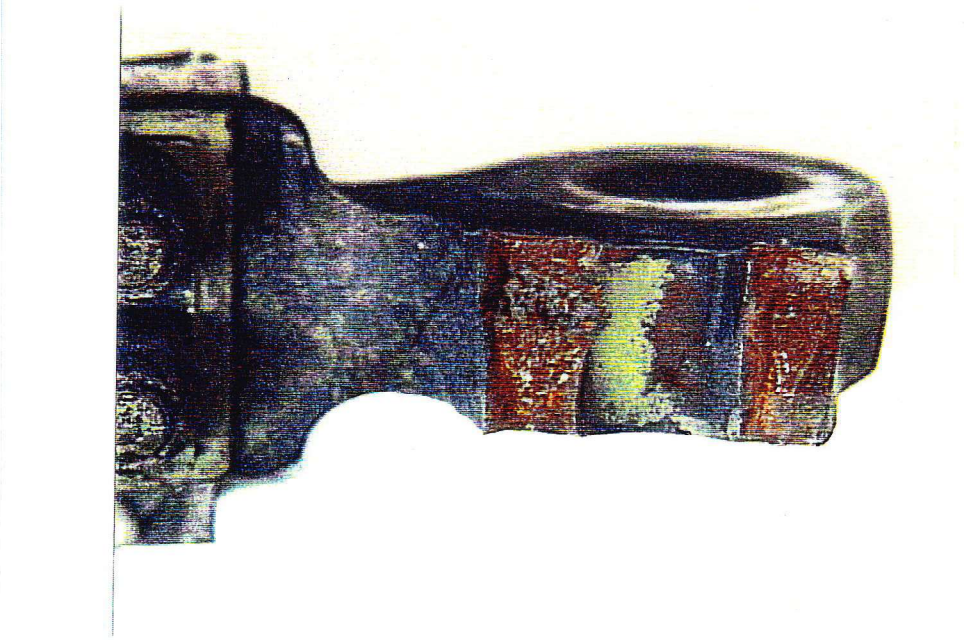
Picture 7: View on fracture surface of upper tang typical of stress-corrosion cracking starting from the corner. Note the beaten area on top. Magn. 1.5x.



Picture 8: View on fracture surface of lower tang typical of fatigue cracking starting from the corner. Fatigue progresses almost to 100 % of fracture surface. Magn. 1.5x.

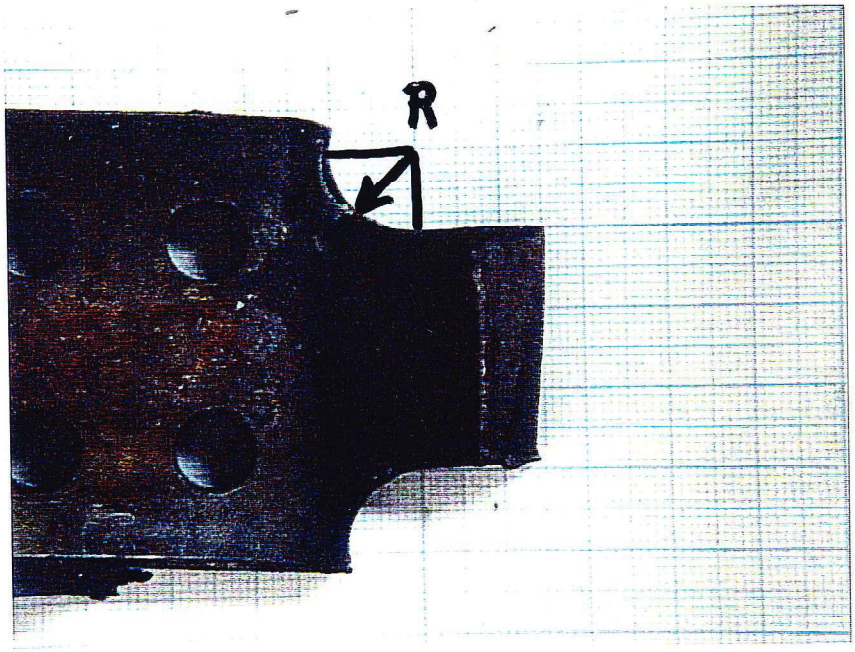


Picture 9: Mating part of the fitting removed from aircraft relative to the disassembled fractured upper and lower tangs.



Picture 10: Fracture surface of outboard midspar fitting as removed from aircraft.

Picture 11: Fracture surface of inboard midspar fitting as removed from aircraft.



Picture 12: View on transition radius of as-received fittings. Radius is 9.7 mm (0.38") and not 25.4 mm (1.00").

ANNEX TO 54/88M20