CIVIL AVIATION ACCIDENT
REPORT NO 04/368

FEDERAL REPUBLIC OF NIGERIA
MINISTRY OF AVIATION

FINAL REPORT ON THE ACCIDENT TO THE FEDERAL MINISTRY OF CIVIL AVIATION FLYING UNIT(CAFU) CESSNA CITATION 501 AIRCRAFT REGISTERED 5N - AVM AT MURTALA MOHAMMED AIRPORT RUNWAY 19L, IKEJA

ON THE 20TH OCTOBER, 1998

Federal Ministry of Aviation
Accident Investigation and Prevention Bureau

FEDERAL SECRETARIAT, SHEHU SHAGARI WAY, ABUJA

Tel: 5238568

Ref NO 941244/S.1/C3/ Vol. 1/133

13 April,2000.

The Honourable Minister of Aviation,
Federal Secretariat,
Shehu Shagari Way,
P. M. B. 5012 Wuse,
Abuja.

CIVIL AVIATION ACCIDENT REPORT

Sir,

1 have the honour to present the Final Report on the Accident to the Pan African Airlines Cessna 208 Caravan 1 Amphibian Aircraft Registered SN - PAN at Warri Airstrip on the 25th November 1998.

K. K. O. SAGOE DIRECTOR ACCIDENT INVESTIGATION AND PREVENTION BUREAU.

ACCIDENT TO THE PAN AFRICAN AIRLINES CESSNA 208 CARAVAN I AMPHIBIAN AIRCRAFT REGISTRATION 5N-PAN AT WARRI AIRSTRIP ON THE 25TH NOVEMBER 1998.

Aircraft Data	
Aircraft Type:	Cessna - 208 Caravan-I Amphibian
Manufacturer:	Cessna Aircraft Company Wichita, Kansas, USA
Serial No:	208-00200
Registration Marks:	5N-PAN
Date of Construction:	31 st January, 1991
Total Airframe Time:	4613 hours 15 minutes
C of A Validity:	29th December, 1998
Owner:	Pan African Airlines (Nig.) Ltd. General Aviation Terminal Murtala Muhammed Airport P.M.B. 21054 Ikeja, Lagos.
Operator:	Owner
Engine	
Type:	PT6A-114A
Manufacturer:	Pratt and Whitney Canada Inc. 1000, Marie-Victorin Longueil, Quebec Canada, JAG IAl

Serial Number:	PCE-17442
Date of Construction:	30th January, 1991
TSN:	4,351 Hours 58 minutes
TSO:	609 Hours 10 minutes
CSN:	6815 cycles
CSO:	928 cycles

Bleed Off Valve (BOV)

Part Number	302-1248-03
Serial Number	5W683
Time Since New (TSN)	4352 hours

Manufacturer

Propeller

Type:	3 GFR 34 C 703 0 B
Manufacturer:	McCauley
Serial No:	96'_'444
Place of Accident:	Final Approach - Runway 03 - Warri Airstrip.
Coordinates:	N 05" 32'62"
	E005`46' 16"
Date and Time:	25th November, 1998 at 0925 hours UTC.

1.0 FACTUAL INFORMATION

1.1 History of Flight

On the 25th November, 1998 at about 0730 hours UTC, 5N-PAN departed Murtala Muhammed Airport, runway 19L on a chartered flight to Warri with a scheduled stop-over at Lekki and had two (2) souls onboard. The aircraft endurance was 3 hours 30 minutes. The aircraft was airborne at 0734 hours UTC and was cleared to 1,000ft by Lagos Tower and landed at Lekki at 0742 hours UTC. The flight duration was 8 minutes.

At 0820 hours UTC, the aircraft departed Lekki and called Lagos Approach which cleared it to 3,500ft with further instructions for the aircraft to report at TMA. The aircraft reported at TMA and continued its normal flight at 3,500ft. On contact with Escravos Tower, it requested for a descent from 3,500ft to 700ft in order to over-fly the Chevron facility at Opuekaba for an aerial inspection. After the inspection, the aircraft was cleared to 2,500ft to resume its normal flight to Warri.

After the aerial inspection of the Chevron facility and the aircraft was climbing back to 2,500ft from 700ft towards Warri, the pilot observed, that an aircraft - a Twin Otter - was departing Escravos at about 0904 hours UTC for Warri. Through radio communication, the pilot observed that another Twin Otter was behind his aircraft (PAN).

Still at 2,500ft, PAN called zone-in to the tower and also observed that the first Twin Otter was landing while the second Twin Otter was calling zone- in. For a more positive separation, PAN decided to fly to the 5 mile fixed point to hold; yielding way to the second Twin Otter behind PAN to come down from 1,000ft to land.

By the time the latter Twin Otter was touching down, PAN was making its out-bound turn to line up for the final. At the in-bound, PAN was about 5 nm DME from Warri runway 03 threshold. Procedurally, the pilot chose to reduce speed to 120 knots and he selected gear down with flap 15°.

At 3 nautical miles out, the aircraft was about 900 feet high above the approach path, when the tower called PAN to advise that the runway was

clear and gave the landing clearance. The aircraft was now finally configured for landing by selecting flap 30° and reducing speed to between 85 and 90 knots.

At about 1.5 miles out, the aircraft was between 350 - 400ft high, gliding with 400 Ibs of torque, when the first indication of problem emerged. The pilot felt a small shudder from the engine which was instantaneously followed by a need for power input, so he advanced the throttle but there was no response from the engine. The captain's next reaction was to quickly estimate the distance to attain the threshold, which to his bewilderment, was very insignificant because of the interspersing structures on the approach path He then quickly retracted the flaps and feathered the propeller.

In a quick chain of reactions, the pilot re-selected flap 30° and also unfeathered the propeller, peradventure, the latter action would restore the engine to full torque. All within the split of a second of decision-making, the pilot decided to abandon the approach mainly because of the last building structure, which incidentally, is the local chief s residential quarters. The chief s compound lies only quarter of a mile 1/1 nm) to the threshold. So the pilot chose to veer the aeroplane to the left of the approach path centerline and ditched into the swampy terrain of runway 03, cutting through some scattered trees and shrubbery. The accident occurred in daylight time.

1.2 Injuries to Persons.

Injuries	Crew	Passenger	Others
Fatal	0	0	0
Serious	0	0	0
Minor/None	0/1	0/1	-

1.3 Damage to Aircraft

The aircraft was destroyed. Only the engine could be salvaged from the wreckage.

Other Damage

Apart from the trees and shrubs which the aircraft ran through, there were fuel and oil spillage giving rise to environmental pollution of the rural swamp.

Personnel Information

The commander of the aircraft is a 56 year old American male national. He had his U.S. Airline Transport Pilot License validated in Nigeria and was issued with an ATPL number 4505. The license was valid till 18th May, 1999. He had ratings on:

Cessna - C-425.
- C-208 Caravan,
- C-207,
- C-185,
- C-172RG;

Beechcraft - 1900
Twin Otter - DHC-6
Boeing - 737.

He also had his re-currency and proficiency checks in September 1998. As at the time of the accident, he had a total flying time of 20,326 hours out of which 3,000 hours were on type. He was fully qualified to take the flight. It should also be noted that the aircraft was certificated for one-man crew operation.

Aircraft Information The Cessna amphibian aircraft was brought into Nigeria at the total airframe time of 349 hours and started operation in January 1993. It had accumulated 4,613 hours and 15 minutes before this accident. There was no known; deferred defects registered in its maintenance or operation record. It is a single engine power-plant with a Pratt and Whitney turbo-prop engine type PT6A-114A which had delivered engine power for 4,351 hours and 49 minutes and 6,815 cycles total time before the crash. It had a current "Certificate of Airworthiness", which was valid till 29th December-1998; both the airframe and the powerplant were maintained by the operator who is also the owner.

1.6.1 The Powerplant

The engine PT6A-114, serial numbered PCE-17442 was manufactured in January 1991 by Pratt and Whitney Canada Inc. The normal time (TBO) before the engine can be removed from the aircraft for overhaul is 3,500 hours, but this TBO time can be escalated and have an extended time to 4,000 hours subject to the manufacturer's approval after some critical escalation evaluation.

This engine had such an approval granted it by United Technologies - Pratt & Whitney Canada Inc. and also had the consent approval of the local Airworthiness authority-Directorate of Safety Regulation and Monitoring (DSRAM) to escalate the TBO by 200 hours. Although the engine had the manufacturer's TBO escalation approval (in principle) to 4,000 hours, but this extension had to be actualised in progressive bits of 200 hours at a time for proper evaluation before the next approval is given until the whole 4,000 hours are fully attained, hence the first installment from the normal TBO of 3,500 hours to the current 3,700 hours.

Just before these 3,700 hours were fully utilised, the operator applied to DSRAM for a fractional extension of another 60 hours and such approval was conveyed via letter reference DSRAM/AD.15/96Nol.ii/36 dated January 31, 1997. Out of the 60 hours extension, only 42 hours were utilised before the engine was removed and shipped to Dallas Airmotive for overhaul and power up-grade to PT6A - 114A.

1.7 Meteorological Information

Weather was not a factor to the accident. However, the prevailing wind, in sunlight conditions, was recorded as 270°/5kts.

1.8 Aids to Navigation.

Navigational aids were not contributory factor in the accident. The flight was by Visual Flight Regulations.

1.9 Communications.

There was good radio communication between the aircraft and the Warri Airstrip Tower on 129.1MHZ frequency.

1.10 Aerodrome Information

Warri Airstrip is privately owned by Aero Contractors Company of Nigeria Limited. The landing strip is 830 metres by 23 metres (2722ft by 75ft) and the field elevation is 19 metres (63ft) above sea level. Warri airstrip has a paved runway of orientation 03/21. While public footpaths crisscross the

runway, residential buildings are situated as close as less than half a nautical mile to the threshold of runway 03 (please see appendix 2). A new and better runway is under construction in another location at Warri environs.

Flight Recorders.

The aircraft was neither equipped with Cockpit Voice Recorder nor Flight Data Recorder. These equipment are not mandatory but optional for the aircraft weight category under the Nigerian Civil Aviation Regulations.

1.12

Wreckage and Impact Information.

The aircraft ditched into swamps cutting through trees and shrubs off the approach path of runway 03. It was evident that the starboard wing struck a large tree on impact which caused the aircraft to swing 180°. The starboard wing was severed off at the wing root by the impact while the port wing was submerged in the 4ft deep-swamp waters.
There was no obvious damage on the engine; neither was there any oil nor fuel leaks on it. The propeller blade tips were only slightly bent rearwards. The landing gear and airframe structure were both severely damaged.

***1.13 Medical and Pathological* Information**

The two (2) souls on board did not sustain any injuries, therefore, no, medical information was sought.

1.14 Fire.

There was no fire outbreak due to the low speed impact even though there were fuel and hydraulic fluid spillage on the rural swamp.

1.15 Survival Aspects

The aircraft ditched into the swampy area off the extended centerline of runway 03 and got severely damaged. The two (2) souls on board were rescued by two sympathetic villagers, who helped them wade through

waters for about 500 metres before getting to dry land.

Due to the low speed descent, the airframe - especially the cockpit area, remained fairly intact with the seats and seat-belt attachments unimpaired. This probably explains why the captain and the passenger left the wreckage site uninjured.

1.16 Tests and Research

The engine serial number PCE - 17442 was shipped to Pratt and Whitney Service Investigation Facilities at Benedum Industrial Park, Bridgeport, West Virginia in the United States for stripping and detailed investigations. The following individuals participated in the investigation as representatives of their respective organisations:

1.	Paul F. Crosby -	Lead Engine Investigator Pratt and Whitney Canada Inc.
2.	R. Faminu -	Aeronautical Engineer Federal Ministry of Aviation, Nigeria
3.	D.O.Adeosun -	Metallurgist Federal Ministry Aviation, Nigeria.
4.	John F. Benjamin -	PT6 - Customer Service Manager Pratt and Whitney Engine Services
5.	Bruce Fullerton -	President, Africair Inc. (Representing Pan African Airlines)
6.	W.B. Buck Welch -	Air Safety Investigator, Snr. Analyst Cessna Aircraft Company
7.	Joe R. Hernandez -	Surveyor and Adjuster GAB Robins Aviation Ltd.
8.	William Rieger -	Project Engineer Dallas Airmotive Inc.

1.16.1Fuel and Pneumatic Lines

On the bench, the engine fuel and pneumatic lines were inspected for physical conditions and obstructions which were found satisfactory. The pneumatic lines were pressure tested at 100 Psi with nitrogen and no leaks were detected. The Py- line to prop governor was pressure- tested to about 90 Psi and the result was also satisfactory.

1.16.2Compressor and Turbine Sections

The compressor section was not accessed. A visual inspection of the l" stage compressor blades was satisfactory. The compressor assembly was free to rotate. The power section was separated from the gas generator at the "C" flange and it was free to rotate normally. The power turbine, as observed in-situ, did not reveal any abnormalities. The turbine section was visually inspected as installed, it also did not reveal any blade tip rub or other anomalies. Both the power and the compressor sections were removed but not disassembled. The compressor BOV was removed for inspection.

1.16.3Chip Detector and Oil Filter

Magnetic chip detectors are located at strategic points in the lubrication [illegible] ferrite-based metal particles which may be in the lubricating oil system as a result of possible bearing failures and excessive wears on the engine. By examining the chip detectors for metallic particles, the condition of the engine can thus be health-monitored. The chip detector on this engine showed no metallic contaminants and the oil filter did not reveal any contamination.

1.16.4 Fuel Control Unit

The Fuel Control Unit was forwarded to the Pratt and Whitney facilities

in Canada where better facilities were available for detailed investigations.

A function test on the FCU in the "as-received condition" was performed and no abnormalities that could have precluded normal operations were observed.

1.16.5 Bleed Off Valve (BOV) : (S/N 5W683; P/N 302-1248-03)

The BOV was tested for pressure leakage by applying *55 Psi* of air pressure allowing for *2.5Psi* of air leakage in 5 minutes. The result of the BOV leakage test was satisfactory. A function test was performed on it and the valve failed to operate as expected. This necessitated the disassembling of the BOV where an obstruction was discovered on the final orifice (appendix 7). This obstruction was identified as a portion of a cotter pin used to retain the guide shaft pin. When the obstruction was removed and the valve was re-tested, the BOV performed according to specifications.

1.16.6 The inspection of the BOV cover plate revealed the remaining portion of the fractured cotter pin as depicted in appendix 6.

1.16.6 *Metallurgical Examination of the Cotter Pin*

By visual observation, half of the fractured surface of the cotter pin has been oxidized. Under close examination however, the fracture of the cotter pin occurred as a result of low cycle fatigue. The deformation of the cotter pin was observed at the interface of the guide shaft pin and the BOV cover's cotter pin hole (See Appendix 5). No metallurgical abnormalities were observed on the fractured cotter pin.

1.17 *Organisation and Management Information.*

Pratt and Whitney Canada Inc. is the engine manufacturer and therefore is responsible for the release of Service Bulletins (SB) on this engine. The Federal Aviation Administration (FAA) is the authority responsible for the issuance of Airworthiness Directives (AD) based on the appropriate Service Bulletins.

The Dallas Airmotive is the engine overhaul station approved by the manufacturer for this engine and therefore, is qualified to maintain and overhaul the engine. After the job was performed, a Modification Certificate was issued by Dallas Airmotive showing details of the work carried out on the engine under the work-order document no.VT0064 (See appendix 8).

1.18 Additional Information

1.18.1 Compressor Bleed Off Valve - Description and Operation

The compressor bleed valve is bolted to the ported flange on the gas generator case at the 7 O'clock position (appendix 1). It consists of a piston type valve operating in a ported housing. The piston is supported in the bore by a rolling diaphragm and a guide shaft pin which permits full travel of the piston in either direction to open or close the ports while at the same time effectively sealing the air chamber at the top of the piston. The guide shaft pin is held in place by a cotter pin. A hollow spring pin protruding from the valve mounting flange serves to align the compressor discharge (P_3) air hole in the gas generator case flange with the bleed valve

Compressor discharge $(P3)$ air is taken through a primary metering plug to a convergent-divergent metering (final) orifice, which vents to ambient atmosphere. The convergent-divergent orifice is designed to create a choked flow over the necessary engine operating range, resulting in fixed pressure ratio $P3/P.1$ where P_X is the control pressure between the primary metering plug and the convergent-divergent orifice acting on the top of the piston. Theposition of the floating piston is dependent on the balance of forces between much greater than Px the valve is fully open. *As engine power increase compressor inter-stage ($P_{2.}$) air and P,.* At low engine power, where $p_{2.5}$ is the force from the P_X pressure increases at a greater rate than the $p_{2.5}$ and therefore the piston starts to close; the closure is progressive due to the $P_3/P_{2.5}$ ratio. At higher power demand, the piston is completely closed.

1.18.2 Service Bulletins

Service Bulletins are series of publications and instructions issued by an aircraft and/or any of its component's manufacturer as a matter of safety awareness concerning the serviceability and maintainability of such product.

There were series of Service Bulletins issued by Pratt and Whitney of Canada the engine manufacturer as pertaining to its engine type PT6A-114, the model mounted on this subject aircraft. There were also series of Service Bulletins issued affecting the Compressor Bleed Off Valve, the

type installed on the engine. There are two significant Service Bulletins (among many) which the engine overhaul facility claimed on its "Inspection and Modification Certificate" to have been accomplished in the overhaul and modification of up-grading the engine

i P & WC SB. No. 145382 issued on July 18, 1995

ii P & WC SB. No. 151082 issued on July 2, 1996

1.18.2(i) ***Service Bulletin No. 145382***

This bulletin refers to the conversion of PT6A-114 to PT6A-114A configuration. In the conversion process, the compressor rotor balancing assembly and compressor bleed valve(BOV) are to be replaced with similar parts in order to conform to PT6A-1 14A configuration. Incorporation of this Service Bulletin can only be accomplished at a Pratt and Whitney Canada approved overhaul facility. It should be noted that SB 1510 must be accomplished in conjunction with SB 1453).

1.18.2(ii) ***Service Bulletin No. 151082***

The effectivity of the Bulletin is to PT6A-114A engines which are before and include serial no. PCE-19322 and all engines converted to engine model PT6A-114A (Ref. P &WC engine conversion SB1453). This Service Bulletin is to be carried out if the PT6A-114A engines have had a compressor stator assembly replacement between June 1993 and November 1994.

1.18.2(iii) ***Service Bulletin No. 153883***

This Bulletin refers to the Inspection/Replacement of BLEED OFF VALVE (BOV) COVER of Turboprop engines. The Bulletin was issued on December 2, 1996. In its effectivity list, the Bulletin states among other things that "PT6A-I 14A engines which are between and include Serial No PCE-19307 and PCE-19423 and all engines converted to Engine Model PT6A-114A (Ref. P & WC engine conversion SB 1453)"

The SB No. 153883 was issued sequel to the malfunction of BOV (Ref. Supplier Code No. 8070) due to the possible movements of guide shaft pin which can result in wear indications or fracture of the cotter pin. The Service Bulletin specifies that during the inspection, any defect such as marks, dents, grooves, or any evidence of pitting, pinching or any wear at

the middle section on the cotter pin is a true indication of movement of the guide shaft pin in the bore while the valve is in operation. If any of these conditions is found, a new compressor bleed valve cover assembly must be installed.

1.19 New Investigation Techniques

No new techniques were employed in the investigation of this accident.

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2. ANALYSIS

2.1 The airframe/powerplant of the aircraft's maintenance and the overall performance of the aeroplane were impeccable during its four thousand plus hours operation on the Nigerian register. The engine's health was monitored both by the Nigerian airworthiness authority and the engine manufacturer. The result of this monitoring was the joint approval of the two monitoring bodies to escalate the Time Between Overhaul (TBO) of the engine from the normal 3500 hours to, initially, 3700 hours. A further one time 60 hours extension was granted by the local airworthiness authority out of which 42 hours were utilised before the engine was shipped out for overhaul.

The operator also got an upgrading approval from the engine manufacturer, to modify and convert the engine to model PT6A-114A. The bleed-off valve (BOV) was, normally not a part of engine shell or core for overhaul, but the operator left the BOV on the engine shell and shipped it along for overhaul. Doing this was not by chance, as later explained by the operator, the BOV was for the purposes of "overhaul and the incorporation of PWC SB 1453 and 1510 both of which were claimed to have been accomplished by the engine overhauler - Dallas Airmotive and a certificate of modification was issued to that effect.

Service Bulletin No. 1510 Revision 2

SB. 1510, which Dallas Airmotive claimed to have been incorporated into the engine at the overhaul/up-grading period and which was signed off on the modification certificate. The bulletin was issued to highlight the problem of the possibility "for the third-stage compressor-stator assembly to show signs of high cycle fatigue at the vanes", the cause of which "there can be a high vibratory stress level in the engine power range."

AM decides to isolate this aspect from its investigations since it has not been determined to be a cause factor of the accident to 5N-PAN. Nor was there any investigation conducted on the third-stage compressor-stator assembly itself.

2.3 Service Bulletin No. 1453 Revision 2

To convert the engine model from PT6A-1 14 to PT6A-I 14A configuration, the engine manufacturer, through its service bulletin no. 145[3]) revision 2, dated 18°' July 1995, specified that the compressor rotor balancing assembly and the compressor bleed-off valve assembly, should be replaced with new part numbers which are conforming to PT6A-1 14A configuration. The bulletin also hints that the quantity of materials listed below (next page) is on a per engine basis.

Without this accident, one would still be assuming that all the necessary recommended new parts for the engine's conversion had been installed according to service bulletin no. 1453 revision 2 and probably, this accident would not have occurred. But the Old BOV, with the inherent cotter pin problem, no longer has relevance either to the old or to the new quoted
P/N on the SB no. 1453's list and therefore should have been discarded at

the overhaul period. If the bleed valve had been replaced at that juncture of re-assembling the overhauled engine, the valve would not have failed and this accident would not have occurred.

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(This page is an extract from the Pratt and Whitnev Service Bulletin No. 1453 Rev. 2)

	NEW PIN.	KEYWORD	OLD PIN	QUANTITY
1	3102425-01	Rotor Balancing *Assembly,* Compressor	3020911	1
2	*3027798*	*Impeller, Centrifugal*	*3013176*	*1*
3	*3027799*	*Housing, Impeller*	*3021182*	*1*
4		*Vane & Shroud,*	*3013663*	*l*
5		*Compressor Assembly*		
		Compressor Stator Assembly of	*or 3019463*	
6	*3101818-01*	*Spacer Compressor Disc*	*3014679*	*1*
7	*3036701*	*Blade Compressor*	*3012801*	*16*
8	3114735-01	Valve Assembly, *Compressor Bleed*	3100829-01	1
9	*ST3007-047*	*Metering Plug*	*ST3007-045*	*1*
10	*3024862 CL*	*Stator Assembly, Power Turbine*	*30248662 CL*	*1*
	3024852 CL	*Vane Ring, Power Turbine*	*3024852 CL*	
12	*3032151 CL*	*Vane Ring Assembly, Compressor Turbine*	*3032151 CL*	

Service Bulletin No. 1538 Revision 3

In early December 1996, Pratt & Whitney of Canada released another service bulletin No. 1538R3 titled INSPECTION/REPLACEMENT OF BLEED-OFF VALVE COVER. In the bulletin, the "effectivity" list included PT6A - I I 4A engines which are between and include Serial No. PCE - 19307 and PCE - 19423 and all engines converted to engine model PT6A - 114A (Ref. P & WC engine conversion SB 1453)". Dallas Airmotive would have had this bulletin in its possession before the engine's arrival at its facility sometime after January 1997. So the manufacturer's appointed overhauler has the knowledge of the existing service bulletin and, therefore, aware of the consequences of not accomplishing the inspection of the BOV before installing it on an upgraded engine type PT6A-114A model.

Service bulletin 1538R3 stated that the reason for raising the bulletin is to alert the industry about the malfunctioning tendencies of the BOV (ref. Supplier's code no. 8070) and that there is possible movement of guide shaft pin (please see appendices 4 and 5), which can result in wear indication or fracture of the cotter pin. The solution to the problem, according to the bulletin, is to perform an inspection on the cotter pin and check for any movement of BOV guide shaft pin. The bulletin prescribes replacement of the BOV cover assembly, if any wear indications are found on the cotter pin or any movement of the guide shaft pin is apparent. The bulletin affects all engines converted to model PT6A-114A (ref. P&WC engine conversion SB 1453). But why this bulletin is circumvented by the authorised overhauling agent is surprising.

It is the belief of the AIB that, if this latest SB had been carried out in details, Airmotive would have been able to identify the wear indications and the tendencies of the fracture on the cotter pin. In the same vein, the apparent movement of the guide shaft pin would have been identified and remedied to forestall the sudden failure of the BOV while in service.

It, therefore, appears that there was an oversight or some other extrinsic reasons, which are acting on Dallas Airmotive for not carrying out this important service bulletin while the engine was still in its facility. Why the

same old part numbered BOV was unilaterally reinstalled on the newly converted engine without the detailed inspection of SB No. 1538R3, is totally incomprehensible.

Modification Certificate No. YRRR491L.

On the modification certificate issued by Dallas Airmotive after the engine overhaul job had been completed, the company claimed to have embodied SB numbers 1453 & 1510 into the engine serial numbered PCE-17442. But the service bulletin did not prescribe any measure other than total replacement of this BOV with one that has an equally corresponding new part number from the given list in the above table (page 16).

What action or which service bulletin, if one may ask, had Dallas Airmotive then accomplished or embodied into the subject BOV installed on this newly converted engine?. AlB refuses to agree with the company's accomplishment of these service bulletins as claimed by the company in signing off the modification certificate. Dallas Airmotive should have followed the directives of service bulletin 1453R2 and replaced the old BOV P/N 31-00829-01 with the new part number 31-14735-01; or should have just ordinarily performed the inspection of the BOV in accordance with the service bulletin no. 1538R3 and the culprit cotter key's fracture tell-tale-marks could have been easily apprehended at the nick of time. When considering the fact that, there exists a conflict between engines' serial numbers and the serial numbers of the affected BOVs, Dallas Airmotive or any manufacturer appointed engine overhaul shop surely knows when and where to call for help. Dallas Airmotive should have clarified from Pratt and Whitney Canada since there were complications in the engine part number and that of the BOV. Actually, the BOV's part number does not bear any relevance both to the condemned old BOV and the preferred new one as quoted on the list in the table on page 16. Part number 3021248-03 on the subject BOV is totally alien to the engine both in its pre overhaul condition and in its up-graded model PT6A-114A and that would have been a cogent reason for clarification with Pratt and Whitney Canada.

2.6 The events of the last flight.

It was evident that the aircraft's engine was still performing creditably well throughout the flight prior to the final approach profile. The aircraft took off twice from Lagos - one time from runway 19L and the second time off the water-way on Lekki Lagoon and climbed to its VFR assigned altitude of 3,500ft. It also descended from 3,500ft down to 700ft, in order to over-fly the Chevron Facility at Opuekaba for an aerial inspection. To continue the flight to Warri-its intended destination, the aeroplane mustered the power required and ascended, effortlessly, to 2,500ft to join the traffic en-route. The power modulation was still perfectly responsive to the pilot's command to maneuver the aircraft in and out of the holding pattern to align the airplane for the final approach for the intended landing.

All the while, the BOV had had the inherent problem of the gradually failing cotter key, which was neither apparent to the pilot, nor to any maintenance personnel unless the relevant service bulletin instructions were accomplished. The low cycle fatigue failure/fracture of the cotter pin is not something of a sudden impetuous occurrence, the wear indication had been developing over time, which should have been appropriately arrested and the necessary remedy should have been accordingly applied; if, and only if, service bulletin number 1538's apprehension had been resolutely heeded.

Anyway, 5N-PAN was coming in to land, making its approach to the runway 03 threshold and gliding with reduced power which dictated that the BOV's valve should be fully open. But at a stage when more power was demanded for the amount required to sustain the flight, the cotter pin had fractured without the pilot's apprehension, causing the BOV valve to remain fully open instead of partially and no amount of coaxing by the pilot could make the valve close to enable the engine produce more power output. Subsequently the engine compressor now stalled that, in effect, the engine could not develop enough power to make the runway 03 threshold.

The pilot showed a lot of airmanship in his handling of the ditching. Investigation portrays that it would have been more catastrophic, if the captain had insisted on keeping the flight path onto the threshold which was merely v/2 nautical miles away upstream when the problem first surfaced, but the chief's large living compound lays downstream only Y4 nm from the

threshold. A graphical interpolation of the flight pattern on the glide performance chart shows that, at the 5N-PAN's height above the terrain and its approach profile when the engine failed, the aeroplane could not have made it to the threshold of runway 0 3 if the pilot had insisted on pressing on. Instead, the aircraft could have, probably, dropped right into the chief's large compound, which might have. endangered lives and property. (Please see appendix 2).

In a bid to ditch, the pilot selected a clear but water logged area, which unfortunately, could not contain the ditching of the aeroplane until a tree was struck and that reversed the directional heading of the, airplane. The tree snapped off the aircraft's starboard wing at the root and caused the total destruction of the aircraft which resulted into this accident.

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3.0 CONCLUSIONS

3.1 Findings.

3.1.1. The commander of the aircraft was certified and qualified to take the flight.

3.1.2. The aircraft was properly maintained, its documentation was in order and had a current certificate of Airworthiness.

3.1.3 The engine had a TBO extension of 200 hours and a further one-time 60 hours extension before it went for overhaul.

3.1.4 In April 1997, at the engine lilt of 3,742 hours 29 minutes and 5,688 cycles, the engine was sent along with its BOV to Dallas Airmotive for overhaul.

3.1.5 At the time of the shipping, the engine owner requested that the engine be overhauled and upgraded from PT6A-1 14 to PT6A-1 14A in accordance with the manufacturer's specification.

3.1.6 The Dallas Airmotive Maintenance Shop did perform both jobs and issued a *modification certificate* dated April 16'°, 1997 in attestation to the work done. In the certificate, the engine's TSO was reset to 000 hour and also certified the conversion to PT6A-1 14A.

3.1.7 AM finds out that the BO\ was only partially serviced at the overhaul shop thereby precluding the inspection of the culprit cotter pin for "marks, dents, grooves, or any evidence of pitting, pinching or any wear".

3.1.8 The cotter pin eventually failed because "the marks. dents, grooves, and evidence of pitting, pinching or wear" was not timely apprehended at the time of the engine's conversion from PT6A-1 14 to PT6A-1 14A and also at the BOV overhaul.

3.1.9The engine was re-installed on the aircraft at the airframe time of 4,004 hours and operated for 609 hours before this crash at 4,613 airframe time.

3.1.1 OThe aircraft was on its final approach to runway 03 when the engine failed to respond to the pilot's throttle command at the moment when more power was required.

3.1.11 Non-availability of more power from the engine to propel the aircraft safely to the threshold led to the pilot's decision to ditch.

3.1.12 There were residential buildings as close as half a mile to the threshold of runway 03 at Warri Airstrip.

3.1.13 Owing to these residential structures between the aircraft's precarious position and the threshold, the captain had to yaw the aeroplane off the runway centerline and chose what seemed to be a less hazardous area for the imminent emergency ditching event.

3.2 **Probable cause of the accident**

The probable cause of the accident was the little old fractured cotter pin which lodged itself in the orifice and caused the BOV to malfunction at the very critical instance when more power output was demanded from the powerplant. The engine did not completely flameout, because of the position of the BOV valve in partially/fully open position which, could only sustain idle running of the engine.

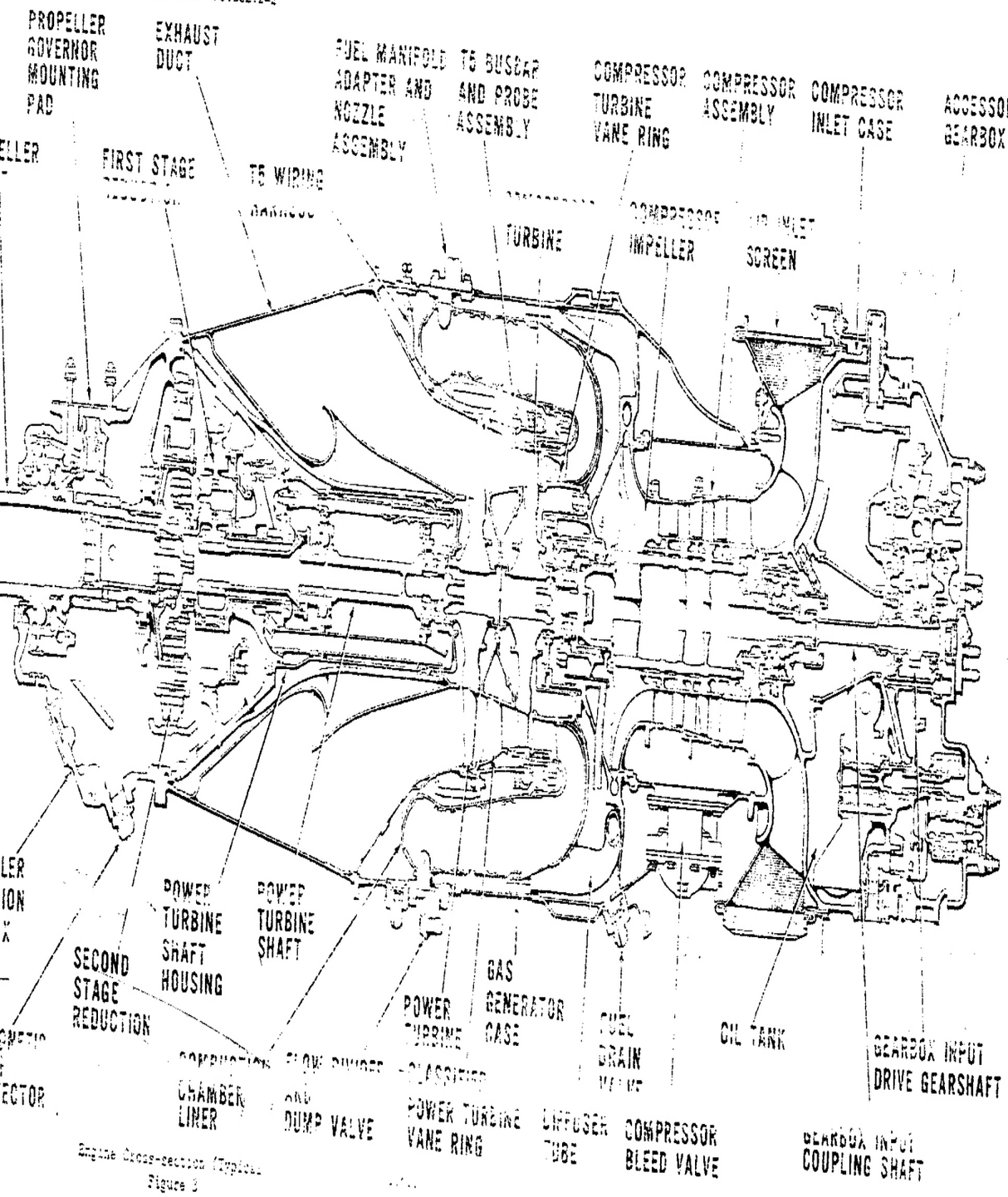
Recommendation

AIB has no recommendations besides absolute removal of the living quarters, but this is no longer tenable because the airstrip has now become obsolete since a more modern, longer and better aerodrome has been constructed somewhere at a new location away from the presently imposing obstacles of the chief" s compound and other man made obstructions.

Intentionally left blank.

5. Appendices.

Appendix 1	The engine diagram showing the position of the BOV at 7o'clock position on the engine.
Appendix 2	The Visual Contact Approach Plate for runway 03 used by all operators indicating the proximity of the chief's house to runway 03 threshold.
Appendix 3	The pictorial diagram of the BOV showing the internal mechanisms and the relating parts.
Appendix 4	Diagram showing the BOV cover plate assembly with the guide shaft and the retaining cotter pin (View A).
Appendix 5	Diagram showing the cross section of the BOV cover assembly and the cotter pin in-situ. Note the deformation process of the cotter pin interface areas in detail A.
Appendix 6	Photograph picture of the disassembled BOV cover showing the guide shaft pin and the remaining portion of the cotter pin.
Appendix 7	Picture showing the discovery of the fractured cotter pin blocking the final orifice of the BOV.
Appendix 8	The inspection and modification certificate issued by Dallas Airmotive after the overhaul and the conversion process.



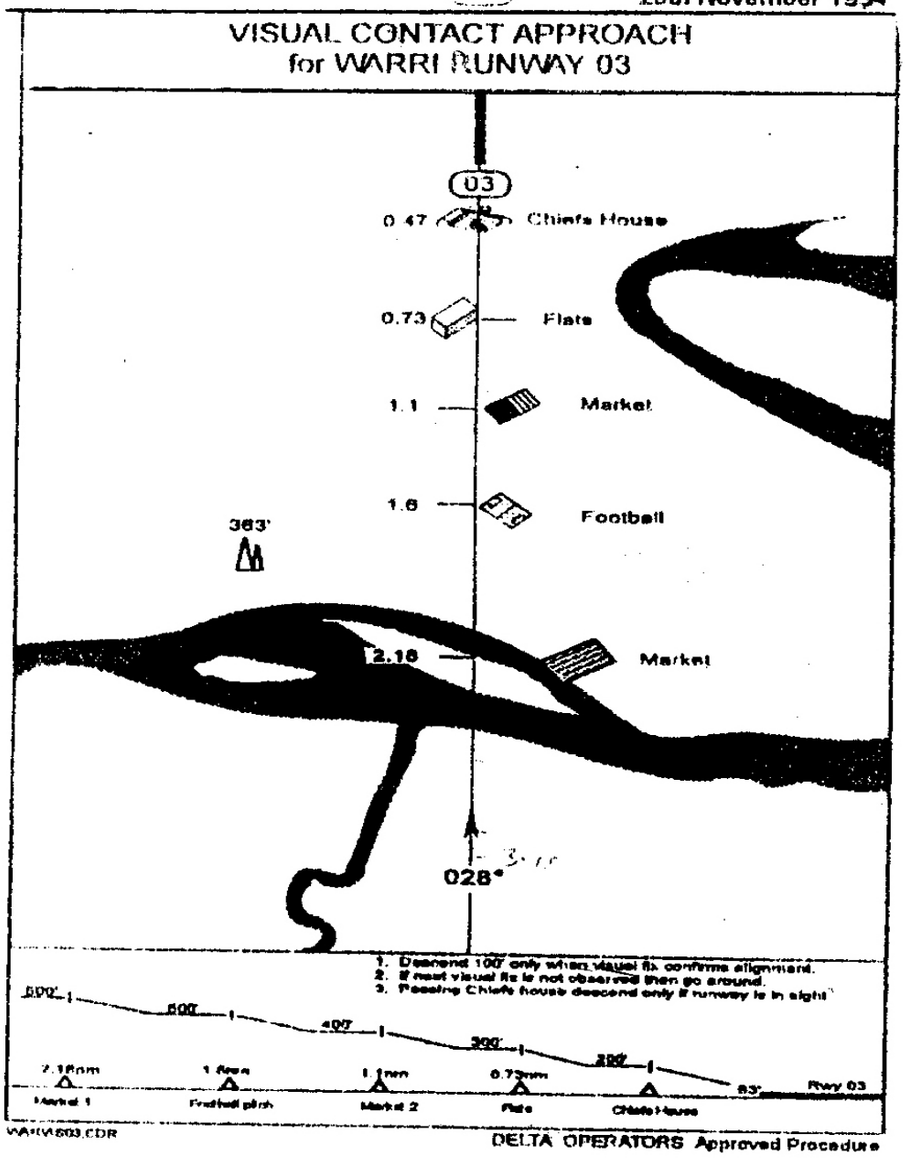
Engine Cross-section (Typical)
Figure 1

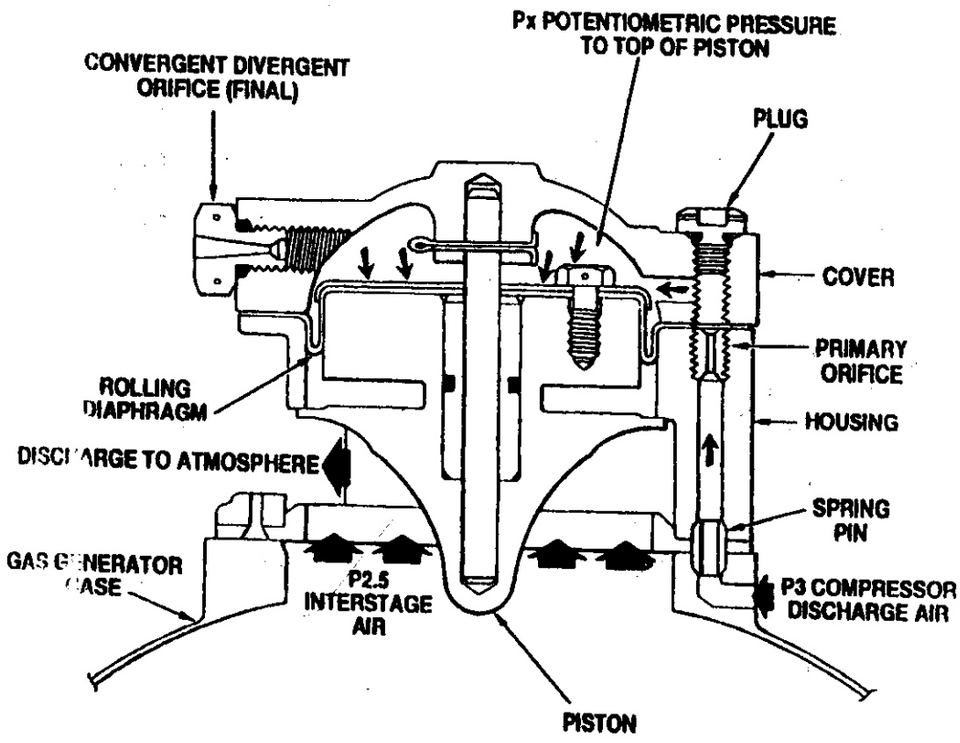
72-00-10

APPENDIX 1

APPENDIX 2

(13 - 2) 29th November 1994




Px POTENTIOMETRIC PRESSURE TO TOP OF PISTON
CONVERGENT DIVERGENT ORIFICE (FINAL)
PLUG
COVER
PRIMARY ORIFICE
HOUSING
ROLLING DIAPHRAGM
DISCHARGE TO ATMOSPHERE
SPRING PIN
GAS GENERATOR CASE
P2.5 INTERSTAGE AIR
P3 COMPRESSOR DISCHARGE AIR
PISTON

PRATT & WHITNEY CANADA

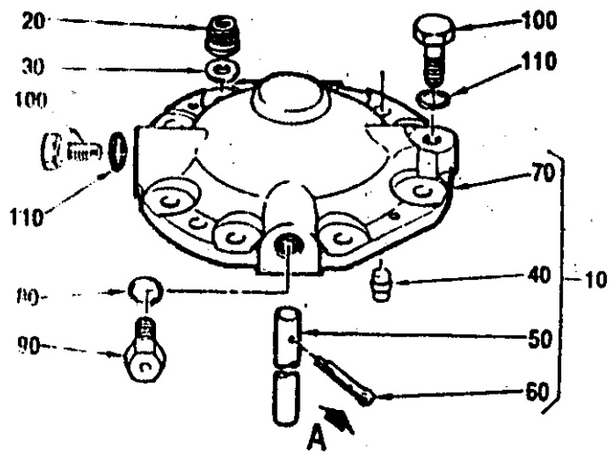
APPENDIX 4

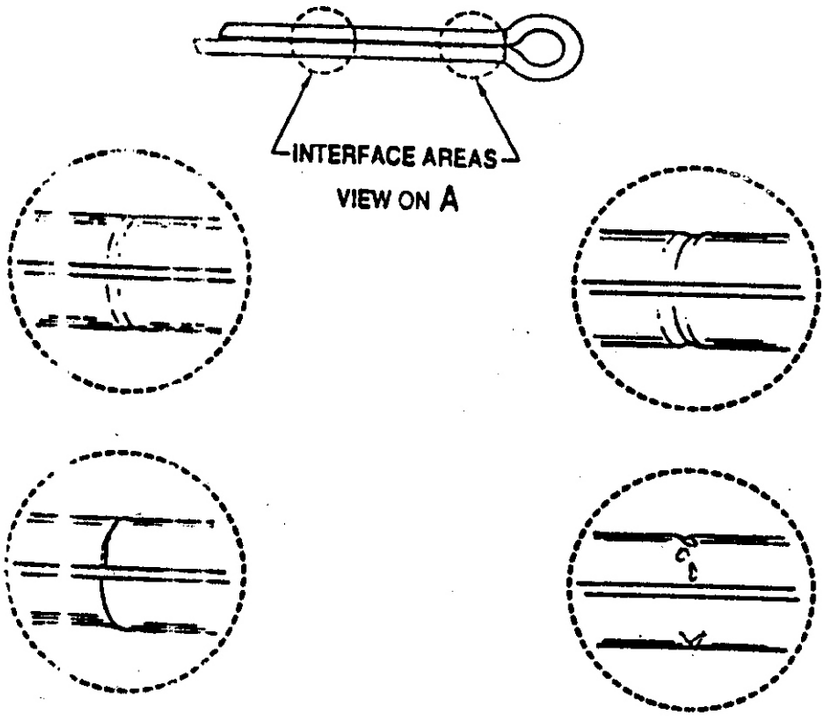
SERVICE BULLETIN

P&WC S.B. No. 1538R3

TURBOPROP ENGINE

BLEED OFF VALVE (BOV) COVER - INSPECTION/REPLACEMENT OF





C36198

Compressor Bleed Valve Cover Inspection and Replacement Area
Figure 1

/96

Photo. No.3, Engine BOV cover and guide pin shaft.

0114 FOREST PARK RD, DALLAS, TX 75235

440 **CERTIFICATE NO. YRRR491L**

INSPECTION AND MODIFICATION CERTIFICATE

MANUFACTURER	UNIT NAME	MODEL	SERIAL NUMBER
PRATT & WHITNEY			
T.S.N.	C.S.N.	T.S.O.	08.0.
3742.48	5000	00.0	ZERO

OVERHAULED I/A/W MANUFACTURER'S SPECIFICATIONS AND DALLAS AIRMOTIVE, INC. WORK SPECIFICATIONS AS-01,1476A. 114 ISSUE 95 ANDAS-AO-PT6A-I14ISSUE 015 CONVERTED TO PT6A(AA-114A
TURBINE VANE RING AREAS: CT: 6.03 PT 12
70 L.

AI airworthiness DIRECtive "AD 97-04-12. AMEND $30-99M, DATED 03-14-97-N/A TO S/N INSTALLED.

SERVICE BULLETINS ACCOMPLISHED: POWER SECTION:
1407, 1476, 1487,1518 GAS GENERATOR: 1473,
1489, 1501, 1510 ACCESSORY *GEARBOX* 1446,
1478 *GENERAL:* 1453, 1477, 1487,
1488,1490.1493 CONSTANT SPEED CONTROL
(S/N 2346834AD)1476 FUEL PUMP: (SIN 1281) 73-1
COMPRESSOR BLEED VALVE: (S/N 54683) 1453, 1510
TEMPERATURE SENSING SYSTEMS i EMS: (SIN

.HIS ENGINE OR APPLIANCE HAS SEEN REPAIRED A\D INSPECTED IN ACCORDANCE WIIH CURRENT REGULATYIONS OF THE FEDERAL AVIATION ADMINISTRATION PERTINENT DETAILS OF THIS REPAIR ARE ON FILE AT THIS REPAIR STATION UNDER WORK ORDER NO. VT0064

7

17

DATE: **SIGNATURE:**