AIRCRAFT ACCIDENT REPORT

AIB/NCAT 2006/10/10/F

Accident Investigation Bureau

Report on the Accident involving TAMPICO Club 9 Aircraft, Reg. 5N-CBF at Zaria, Kaduna State, Nigeria On 10 October 2006

This report was produced by the Accident Investigation Bureau (AIB), Murtala Muhammed Airport, Ikeja, Lagos.

The report is based upon the investigation carried out by Accident Investigation Bureau, in accordance with Annex 13 to the Convention on International Civil Aviation, Nigerian Civil Aviation Act 2006, and Civil Aviation (Investigation of Air Accidents and Incidents) Regulations.
In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident/serious incident investigations to apportion blame or liability.

Readers are advised that Accident Investigation Bureau investigates for the sole purpose of enhancing aviation safety. Consequently, Accident Investigation Bureau reports are confined to matters of safety significance and should not be used for any other purpose.

As the Bureau believes that safety information is of great value if it is passed on for the use of others, readers are encouraged to copy or reprint for further distribution, acknowledging Accident Investigation Bureau as the source.

Recommendations in this report are addressed to the regulatory Authorities of the state (NCAA). It is for this authority to decide what action is taken.

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C Engine Storage Procedure

D Lycomming Operators Manual

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AIB	Accident Investigation Bureau
AIPB	Accident Investigation & Prevention Bureau
AMO	Approved Maintenance Organization
CDCCL	Critical Design Configuration Control Limitations
FMD	Flight Maintenance Department
NAMA	Nigerian Airspace Management Agency
NCAA	Nigerian Civil Aviation Authority
NCAR	Nigerian Civil Aviation Regulation
NCAT	Nigerian College of Aviation Technology
NDB	Non – Directional Beacon
NIMET	Nigerian Meteorological Agency
NM	Nautical Miles
MOE	Maintenance Organization Exposition
MEL	Minimum Equipment list
MMEL	Master Minimum Equipment list
SB	Service Bulletin
SOP	Standard Operating Procedures
UTC	Universal Time Coordinate
VFR	Visual Flight Rules
VP2A	Manufactures Code for 50 HRS Inspection where A = 25 HRS.
QNH	Sea Level with the prevalent atmosphere pressure
Sector 4A	Sector designated for flight training of students pilots.

References

Jim Mckenna	Safety Management System CAA International Ltd 2008
Chris Drew	Human Factors and Maintenance and Maintenance Error Management System
TB9 Socata Maintenance Manual	Aircraft Storage and Destorage Procedure September 2004
Lycomming Engine Manufacturer (0320) – D2A)	Engine Storage Procedure

Aircraft Accident Report No:	**(NCAT/2006 /10 /10/F)**
Registered Owner and Operator:	Nigerian College of Aviation Technology (NCAT)
Aircraft Type and Model:	TAMPICO CLUB 9
Registration:	5N-CBF
Place of Accident:	Fanfulani village, Zaria
Date and Time:	10 October, 2006 at 1015 Local Time. *All the times in this report are local time (equivalent to UTC + 1 unless otherwise stated)*

SYNOPSIS

The Accident Investigation Bureau (AIB) was notified of the accident at 1200hrs on the 10th of October, 2006 and investigators arrived the scene at 1700hrs same day. Before the arrival of AIB investigators, the Nigerian College of Aviation Technology (NCAT) acting head of Flight Training Department, in company of the safety officer, had located the crash site.

NCAT, Zaria is charged with the responsibility of providing approved training for commercial pilot licence, instrument and multi-engine ratings, in addition to other courses.

At 0941hrs, 5N-CBF TB-9 aircraft belonging to NCAT, Zaria with five hours endurance on a scheduled training flight, had an instructor pilot, a student pilot and two other student pilots who were observers on board. The instructor requested start-up clearance. The instructor later requested taxi clearance and was cleared to Runway 24. The aircraft departed at 1004hrs to Sector 4A. The student was at the controls and the aircraft was cleared to 4000ft and to report maintaining.

On passing through 3500ft, at 1008hrs, the crew observed a drop in the engine RPM with associated engine vibration and subsequent loss of altitude. The instructor took over controls. At 1012hrs, the crew declared ***MAYDAY*** and thereafter informed the tower of their intention to return to the aerodrome. The instructor later informed the tower that they would find a place to land the aircraft. At 1015hrs, the aircraft crash-landed into a farmland in Fanfulani village, 2NM southwest of Zaria aerodrome. All persons on board disembarked without any injury but the aircraft was substantially damaged.

The investigation identified the following causal and contributory factors:

Causal Factor

The cross-threading of 90^0 fitting at the carburetor end of the fuel hose that runs from the engine fuel pump to the carburetor fuel inlet filter, resulted to fuel leakage, loss of fuel pressure to the engine and consequent engine fuel starvation.

Contributory Factors

1. Non performance of leak test on the engine fuel system after maintenance task in accordance with the approved maintenance manual.

2. The absence of duplicate inspection after carrying out maintenance task on fuel control system.

Three safety recommendations were made and the operator's responses are in Appendix I.

1.0 FACTUAL INFORMATION

1.1 History of the flight:

On the day of the accident, the three students jointly carried out a pre-flight inspection on 5N-CBE aircraft in preparation for the training exercise at 0800hrs. Thereafter, the students went to invite the instructor to carry out pre-flight inspection. On their return, they discovered that the aircraft (5N-CBE) had been towed away from the flight line by the maintenance engineers.

Another aircraft 5N-CBF was assigned for the training flight. Pre-departure inspection was also carried out on the newly assigned aircraft. At 1004hrs, the aircraft was airborne with five hours fuel endurance. The student was at the controls and the aircraft was cleared to 4000ft and to report maintaining.

On passing through 3500ft, at 1008hrs, the crew observed a drop in the engine RPM with associated engine vibration. At this point, the instructor took over controls. At 1012hrs, the crew declared ***MAYDAY***, due to loss of engine power with consequent loss of altitude. The instructor thereafter informed the tower of their intention to return to the field. The crew later informed the tower that they would find a place to land the aircraft in sector 4A.

At 1015hrs, the aircraft crash landed in a farm land in sector 4A at Fanfulani village, 2 NM southwest of Zaria aerodrome, Kaduna State. All persons on board disembarked without any injury, but the aircraft was substantially damaged.

1.2 Injuries to Persons:

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/None	4	Nil	Nil

1.3 Damage to Aircraft:

The aircraft was substantially damaged as a result of ground impact. (See fig 1.3).

Fig 1.3 Photograph showing damaged aircraft

1.4 Other damage:

Damage was done to crops and farm land (See fig 1.4).

Fig 1.4 Photograph showing damage to farm land

1.5 Personnel Information:

1.5.1 Flying Instructor

Age:	49 years
Gender:	Female
Nationality:	Nigerian
Licence:	Airline Transport Pilots Licence (ATPL)
Licence validity:	Until 30th November, 2006
Aircraft Ratings:	TB-9, TB-20, BE-58, C-172, C-150, PIPER AZTEC, SENECA
Licence Proficiency check:	28th June, 2007
Last Recurrency:	31st August, 2006
Medical Certificate:	30th May, 2007
Flying Experience:	Total 4000 hrs
Hours on Type:	504 hrs 30 mins
Last 90 days:	22 hrs 30 mins
Last 28 days:	22 hrs 30 mins
Last 07 days:	14 hrs 55 mins
Last 24 hours:	3 hrs 15 mins

The last instrument recurrency was on the 1st September, 2006 at the facility of Phoenix East Aviation, Daytona Beach, FL, USA.

1.5.2 Student Pilot

Age:	19 years
Gender:	Female
Nationality:	Nigerian
Flying Experience:	8 hours

1.5.3 Student Observer (I)

Age:	19 years
Gender:	Female
Nationality:	Nigerian
Flying Experience:	8 hours

1.5.4 Student Observer (II)

Age:	22 years
Gender:	Male
Nationality:	Nigerian
Flying Experience:	8 hours

NOTE: The student pilot and observer 1 are twin sisters.

1.5.5 Licenced Aircraft Engineer (I) (who released the aircraft for Service):

Age:	42 years
Gender:	Male
Location:	Zaria Aerodrome.
Licence/Ratings:	CAT 'A' & 'C' /TB-9 Land Plane, Lycoming 0320-D2A Engines.
Approvals:	CAT 'A' & 'C', TB-9 & TB-20. Lycoming 0320-D2A & Lycoming IO – 540 engines.
Experience:	8 years.
Duty Pattern:	3 days morning, 3 days afternoon and 3 days off.

1.5.6 Licenced Aircraft Engineer (II) who carried out the last VP 50-hour inspection on the aircraft.

Age:	44 years
Gender:	Male
Location:	Zaria Aerodrome
Licence/ratings:	CAT'A'&'C'/ TB-9 Land Plane Lycoming 0320-D2A engines
Approvals:	CAT 'A' & 'C' TB-9, Lycoming 0320-D2A engines
Experience:	12 years
Duty pattern:	3 days morning, 3 days afternoon and 3 days off

1.6 Aircraft Information

1.6.1 General Information:

Registration:	5N-CBF
Type:	TAMPICO CLUB TB-9
Serial number:	1854
Year of aircraft manufacture:	1998
Airframe life at time of accident:	904 hours
Engine:	Lycoming 0-320-D2A
Year of engine manufacture	1993
Serial number	L-17995-39A
Hours:	904 hours
Type of fuel used:	AVGAS

1.6.2 Maintenance Inspection and Log Book Entries:

The engine was manufactured in 1993 by Lycoming of U.S.A. while the aircraft was manufactured in 1998 by Socata (Group Aerospatiale) in France and entered the Nigerian register on 24th October, 2000. As at the time of arrival in Zaria from France, it had airframe time of 38 hours 10 minutes and engine time of 40 hours.

The annual inspection was carried out on the 27th May, 2006 at Airframe time of 904.00 hours and certificate of release to service issued the same day. The last VP 50 (2A) inspection was carried out on the 24th of September, 2006 at 904.00 hours and a certificate of release to service issued the same day.

The next VP 50 (2A) hours inspection would have been due by midnight of January 23, 2007 or upon completion of 50 aircraft flying hours.

1.6.3 Pre-flight Inspection Performed Prior to the Flight:

5N-CBF was scheduled for the first flight of the day. A pre-flight check was carried out and the aircraft duly released for flight training at 0745hrs on the 10th of October, 2006. The usual practice in the college is that pre-flight checks are normally performed in the morning before the commencement of any scheduled training flight.

1.6.4 Aircraft Flyable Storage:

The flyable storage procedure carried out on the aircraft did not meet the recommended manufacturer's standard. The investigation revealed that the aircraft was out of service from the 9th of June, 2004; therefore a long-term storage ought to have been adopted.

1.6.5 Time Between Overhaul Period

Service experience, variations in operating conditions and frequency of operations are some of the factors taken into consideration when time between overhaul is considered. Therefore, all engines that do not accumulate hourly period of time between overhaul as specified by the manufacturers are placed on hard time. The manufacturer's Service Instruction (SI) on TB 9 Lycoming engines recommends a twelve year do-not-exceed overhaul period.

1.6.6 Minimum Equipment List (MEL)/ Deferred Defects

An approved MEL document allows the operator of an aircraft to defer allowable defects and operate the aircraft safely. It enables maintenance to operate a proper deferred defect/ rectification procedure. MEL is normally drawn from the Master Minimum Equipment List (MMEL) and approved by the Regulatory Authority.

1.7 Meteorological Information

1.7.1 Trend in meteorological conditions:

Time:	**0800hrs UTC**
Wind:	Calm
Visibility:	20 km
Weather:	Nil
Cloud:	BKN 3600m
QNH:	1015
Temp/Dew:	24°c/21°c
Time:	**0900hrs UTC**
Wind:	Calm
Visibility:	20 km
Weather:	Nil
Cloud:	BKN 3600m
QNH:	1015
Temp/Dew:	24°c/21°c

1.8 Aids to Navigation:

NDB (336KHZ) was serviceable.

1.9 Communication:

There was good communication between the aircraft and the Control Tower throughout the duration of the flight.

1.10 Aerodrome Information:

The aerodrome is situated to the south of Zaria – Sokoto Road and to the north of Kufena hills. It has coordinate of 110800N 0074057E, 4km North-west of the city. It is a controlled airfield limited to daylight operations. There was adequate fire coverage at the aerodrome. The runway was 46 meters wide and 1646 meters long. See fig.1.10a and fig.1.10b (Zaria aerodrome training sectors).

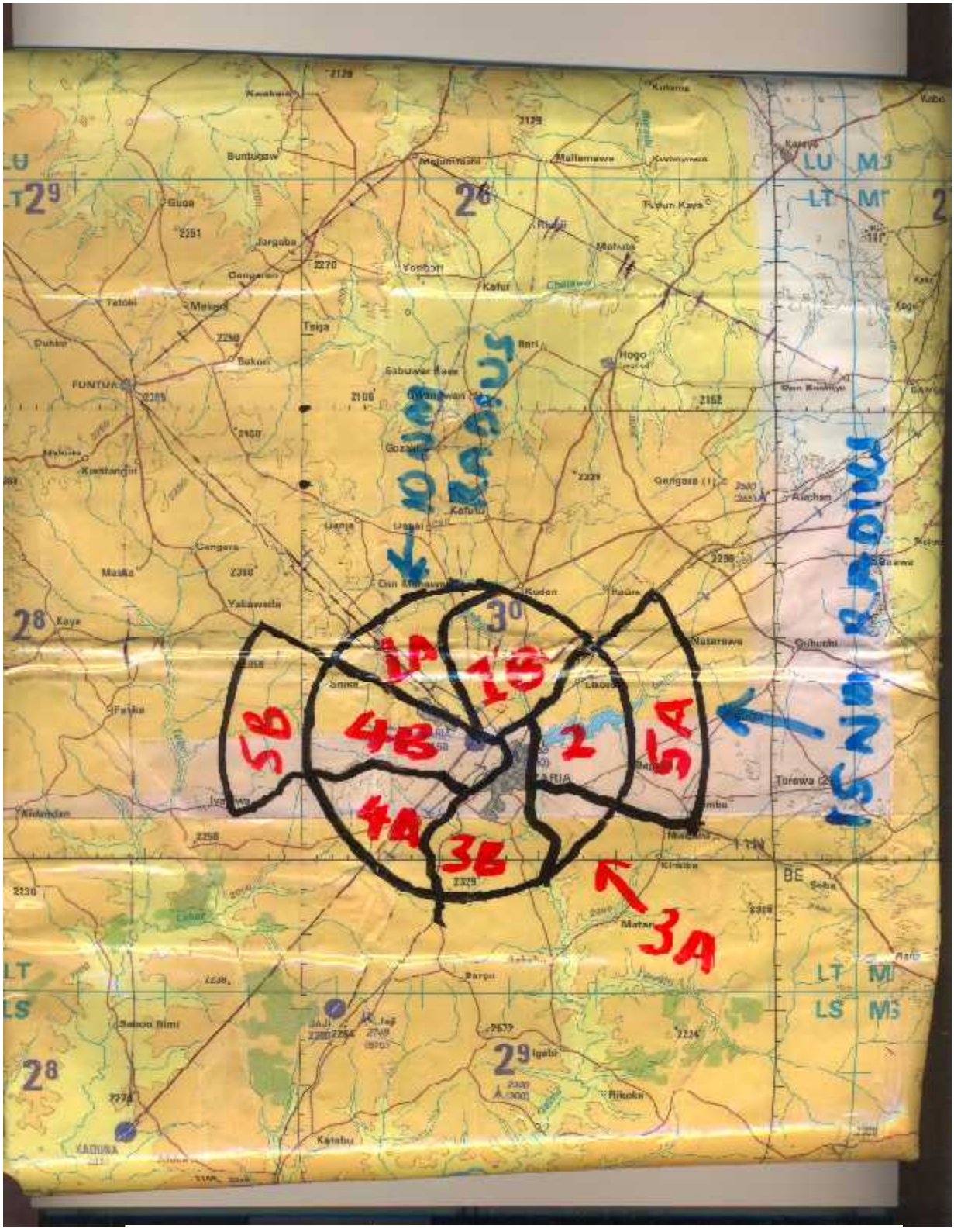


Fig.1 Photograph showing Zaria aerodrome area map

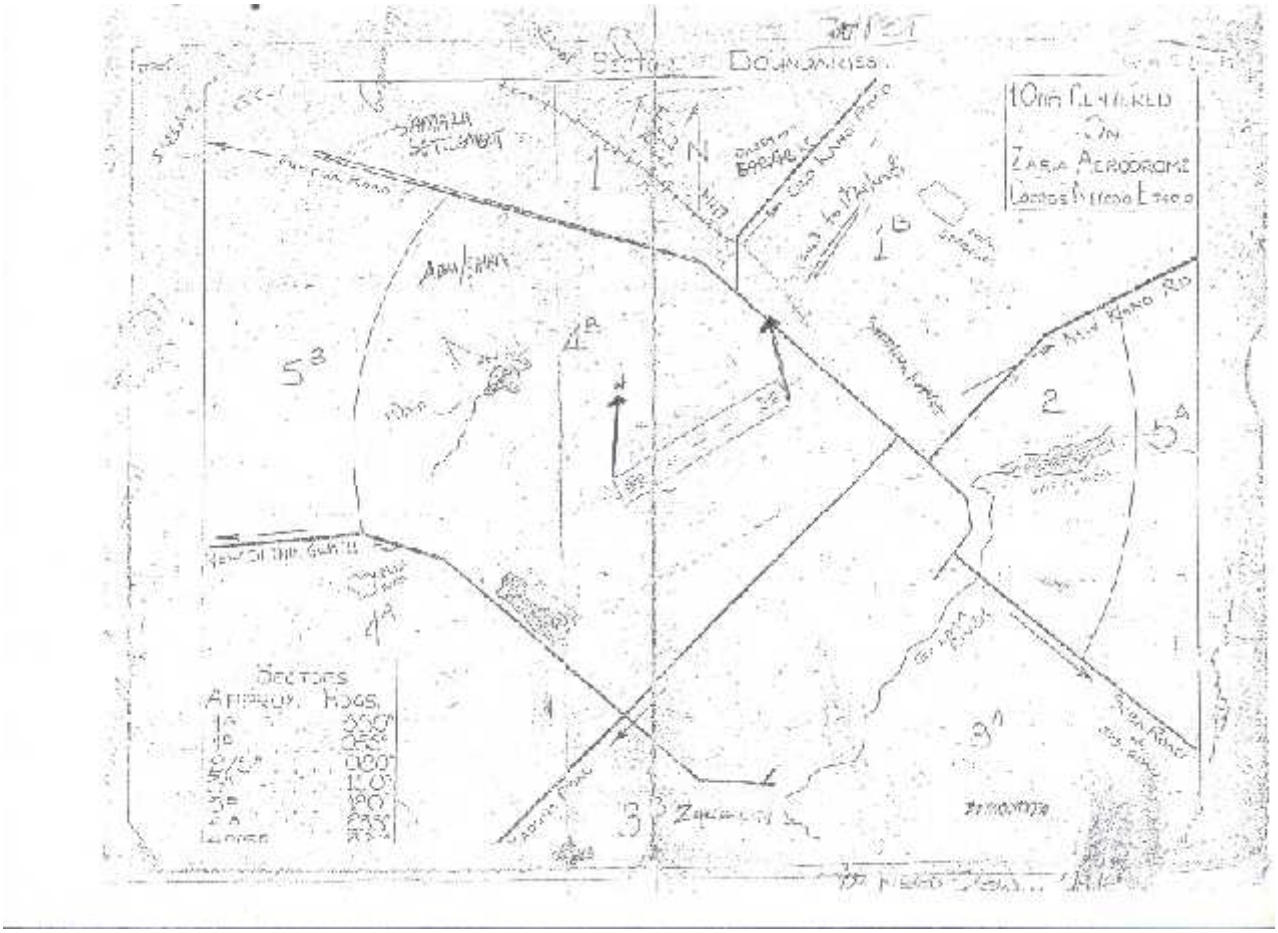


Fig. 1.10b sketch of the training sectors and their dimensions

1.11 Flight Recorders:

Not applicable.

1.12 Wreckage and Impact Information

The aircraft first point of contact was with millet crops at a farm land in Fanfulani village, 2NM southwest of Zaria aerodrome. The aircraft was largely in one piece except for the landing and taxi lamps which were recovered 50 meters from the aircraft. The propeller blades were bent rearwards and the right main landing gear was buried in the ground (See fig.1.12a & 1.12b).

Fig. 1.12a Photograph showing nose landing gear sheared off from its attachment point

Fig. 1.12b Photograph showing the Main Wreckage

1.12.1 Cockpit Readings

Carburetor Heat:	Mid position (Hot)
Throttle:	Idle
Fuel Selector:	Closed (selector was closed after the Crash)
Flap:	Up position
Magneto:	Off position
Altimeter Setting:	1015 hpa
Master switch:	Off

All circuit breakers were in off position. Physical check of fuel for the right and left wings shows there was fuel in both tanks; landing and taxing lamps were missing (See fig 1.12.1a-b).

Compass Heading - 190°

Electronic gyro - 190°

Fig. 1.12.1 Photograph showing right wing taxi and landing light destroyed

Fig. 1.12.1b Photograph showing carburetor heat control knob in mid hot position

1.13 Medical and pathological Information:

The instructor, the student and the two student observers were examined by the NCAT chief medical officer soon after the accident and were certified physically and psychologically fit.

1.14 Fire:

Fire services responded but there was no fire outbreak.

1.15 Survival Aspect

The accident was a survivable one because the aircraft crash landed at a low speed. The damage to the cockpit and cabin was such that a liveable volume existed where the occupants were. In response to the crash alarm activated by Zaria control tower, the Acting Head of Flight Training Department, in company of the Safety Officer, immediately took off on a search mission in a TB-9 aircraft. On locating the crash site, the aerodrome fire services team was immediately dispatched to the site. Before the arrival of search and rescue, the villagers had rushed to the site and rescued the crew.

1.16 Test and Research

Engine Stripping/Tear Down:

The aircraft engine was taken to Lycoming engine factory in Williamsport, USA where the stripping exercise revealed the cause of the engine power loss. (See Figures 1-8, 1-9,1-10,1-11, 1-12, and 1-13).

Fig.1-8 Photograph showing 5N-CBF Engine 0320-D2A in the facility of Lycoming USA for Tear Down/Stripping

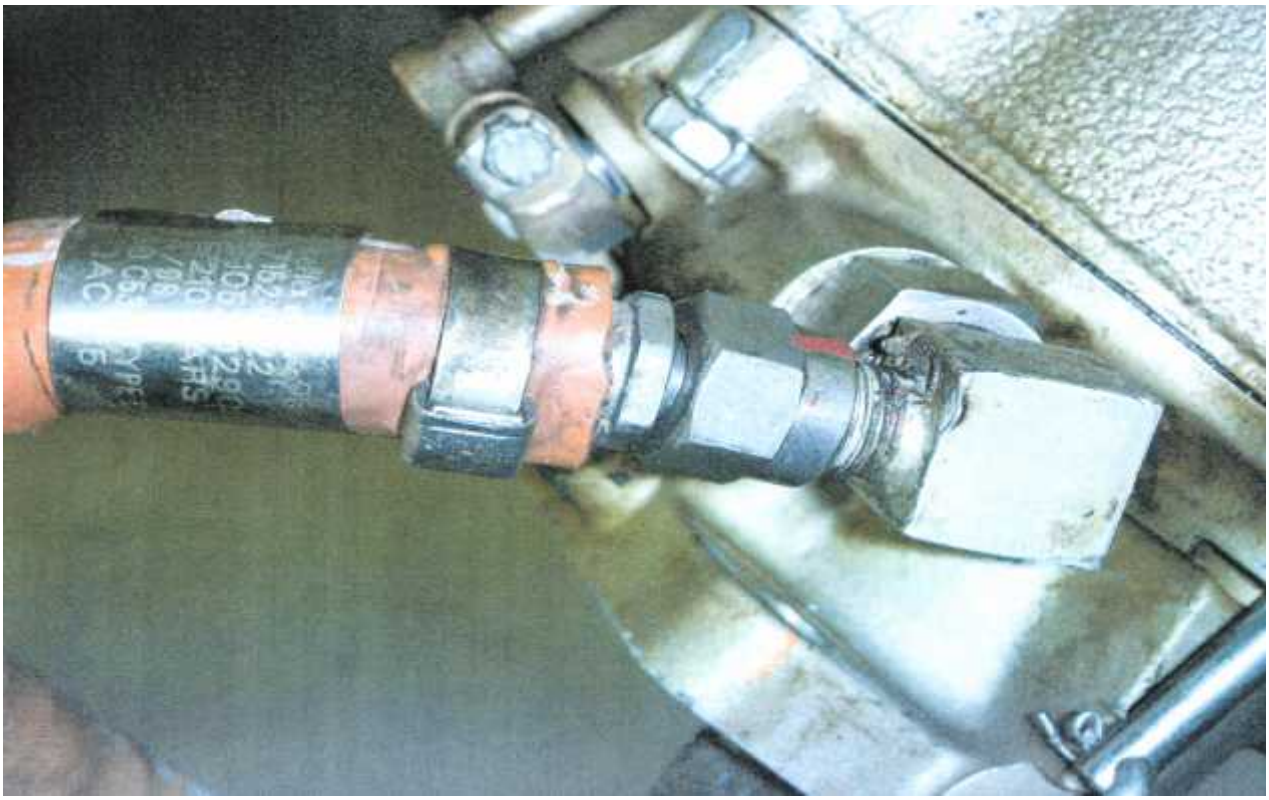


Fig. 1-9 Photograph showing cross threaded end of the fuel hose

Fig.1-10 Photograph showing the hose leaking fuel under pressure

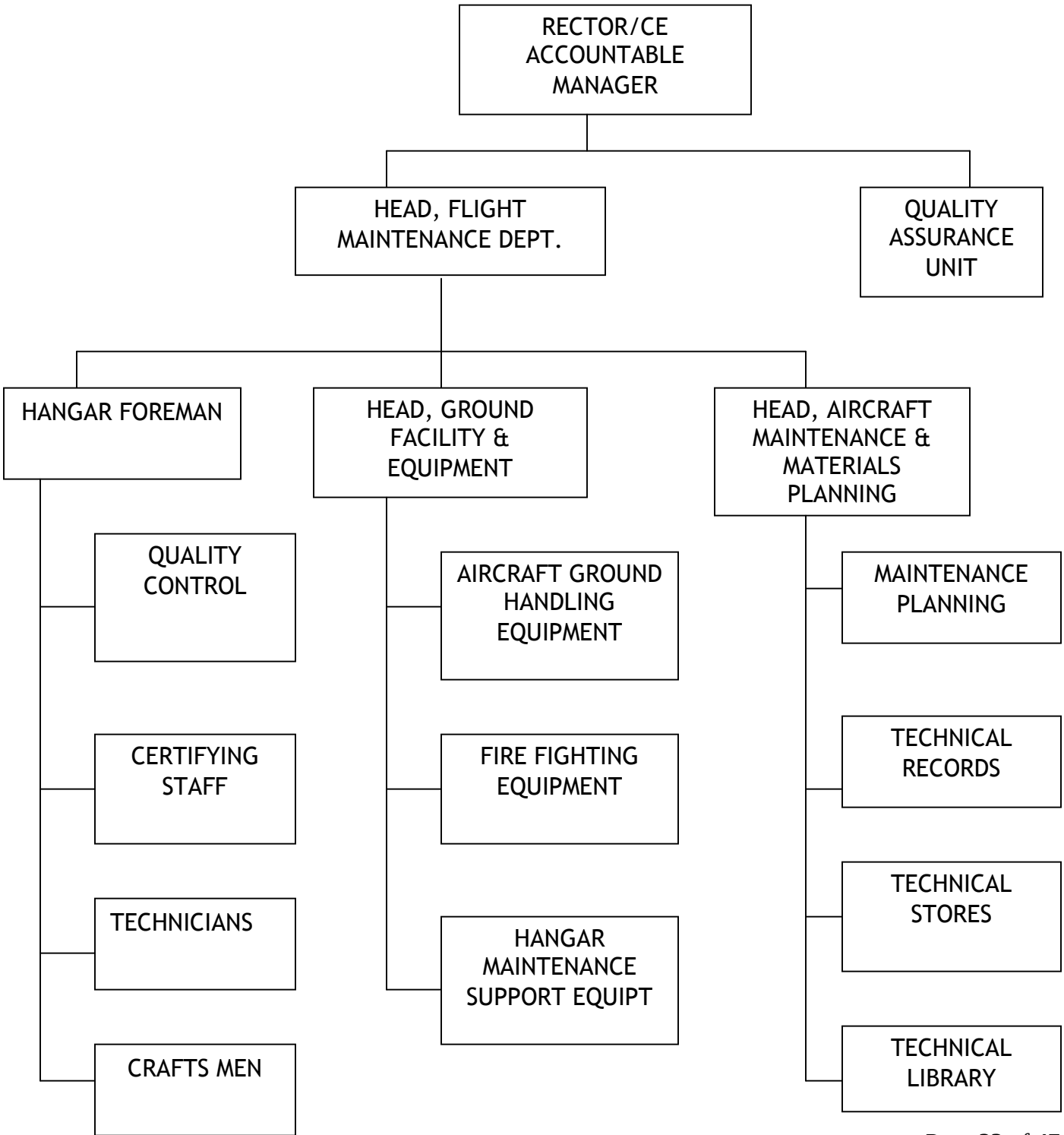
Fig. 1-11 Photograph showing fuel hose and 90^{o} fittings

Fig. 1-12 showing loose and cross threaded 90^{0} ends of the fuel hose.

Fig. 1-13 showing hose connecting the fuel pump that supplies fuel to the Carburetor

1.17 Organizational and Management Information:

1.17.1 *Maintenance Management Structure*



The Rector/Chief Executive is responsible for the complete overall operations and management of NCAT and is the accountable manager for the Company as required by the Nigerian Civil Aviation Regulations 2006 – Part 9.

1.17.2 *The maintenance exposition and standard operating procedure clearly describes the roles, procedures and responsibilities of the accounting manager i.e. the Rector, the quality assurance unit, the head flight maintenance department and the flight training departments of the college so that college aircraft are maintained and operated efficiently in a safe airworthy condition.*

1.17.3 Flight Maintenance Department

The Head, Flight Maintenance Department is responsible to the Accountable Manager for all aspects of aircraft maintenance services and ensuring that all maintenance is carried out on time and to approved standards. This is done by "ensuring that the quality system required by the Nigerian Civil Aviation Regulation 2006 part 6 13(2) is effective in its application and any follow up action required to address findings are complied with";

(i) Provision of serviceable aircraft to meet the requirement of the flying programme produced by the flight training department.

(ii) *The review and evaluation of airworthiness directives, manufacturer's SB's, AOL, etc for fleet applicability ensuring that appropriate action is taken to maintain and enhance fleet operating technical standards.*

(iii) *Liaison with the flight training operations department on all issues relating to day-to-day operation of the fleet of aircraft.*

(iv) *Reporting any occurrences of maintenance nature to the Accountable Manager, quality assurance unit and where applicable the aircraft manufacturer. These include both mandatory occurrences and occurrences related to maintenance findings which fall outside the mandatory scheme.*

(v) Quality Assurance Manager (Head, Quality Assurance Unit):

(a) *Responsible to the accountable manager for the airworthiness accountability.*

(b) *To liaise and negotiate with the NCAA and other authorities on all policy matters relating to safety, airworthiness and the approved maintenance organization approval.*

(c) *Carrying out quality surveillance of the Company's base and ramp operations to ensure airworthiness and safety standard are maintained.*

(d) *Monitoring Flight Maintenance Department Technical stores quality assurance procedures.*

1.17.4 Flight Training Department

Order No. 2.18 of Flying School Standard Operating Procedures states that "the pilot in command shall at all times be responsible for ensuring that the provisions of the pertinent air traffic rules, orders and instructions are observed. Subject to these provisions, he shall be sole authority for any decisions affecting the safety of his aircraft. The Pilot-in-command shall at no time operate or permit the operation of his aircraft in a careless or reckless manner which might endanger life or property".

1.18 ADDITIONAL INFORMATION

Duplicate Inspection

A duplicate inspection is an inspection first made and certified by a qualified aircraft maintenance engineer and then re-inspected and re-certified by another qualified aircraft maintenance engineer.

Specific Item Audit/ Tool Control Programme and Task Handover

Specific item audit: This is an audit exercise/programme conducted by NCAA.

Tool control programme: Is a programme used to monitor the movement of tools used during or after maintenance activities.

Task Handover programme: Is a programme used to handover maintenance tasks.

AIB Interview of Head of Flight maintenance Engineers and Flight Training Instructors. During the above interview, AIB discovered that the relationship between Flight maintenance engineer and flight training instructors was not cordial.

Professional rivalry and inadequate communication were established. Training aircraft were withdrawn from flight line without passing mutual information to the relevant group. The College Authority agreed that a cordial and enabling environment was necessary to operate safe flight training and resolved to redress the situation.

2.0 ANALYSIS

2.1 Aircraft release/dispatch aspect

On Monday 9th of October, 2006, the instructor observed that the main wheel **oleo pneumatic shock strut** of 5N-CBE was **uneven/low** which the instructor reported to the flight maintenance department and an engineer from the flight maintenance was drafted to check the oleo and possibly recharge the strut. After the engineer had recharged the shock strut, the instructor proceeded to fly without any problem.

The next day, 10th of October, 2006, an engineer carried out a pre-flight check on 5N-CBE but did not observe any problem and hence released the aircraft for flight training. Thereafter, the students carried out pre-flight on 5N-CBE and did not observe the problem. Since the same engineer from the flight maintenance department and some student pilots were aware of the problem the aircraft had the previous day, it would be right to think that they would have looked out to see if the uneven/low main wheel oleo pneumatic shock strut persisted. That the students accepted the aircraft signified that the snag had been cleared.

Subsequently, the instructor arrived at the flight line to pre-flight 5N-CBE for the purpose of acceptance and in preparation for scheduled flight training for the day. The instructor observed that 5N-CBE earlier assigned and released for service by a licenced engineer had been replaced with 5N-CBF.

2.2 Aircraft flyable storage

From the records made available to AIB by the flight maintenance department, the flyable storage procedure was not carried out on 5N-CBF, instead a propeller swing was carried out which was not in conformity with the requirements

of TB-9 manufacturer's maintenance manual for long storage procedures.

The recommended procedures for long term flyable storage is as follows:

(1) *Preserve the engine as recommended in the engine manufacturer's hand book (LYCOMING).*

(2) Blank off the carburetor air inlet and exhaust pipes.

(3) Top up the fuel tanks to prevent condensation.

(4) Jack up the aircraft if stored in a hangar.

(5) If the aircraft is stored outside, moor it and rotate the wheels every 2 weeks in order to prevent deformation of the tyres.

(a) On the side of the tyre, mark with a chalk the part of the tyre in contact with the ground.

(b) Pull the aircraft over a few meters and then put it back in its previous place so that another part of the tyre comes in contact with the ground.

(6) Remove and store the battery.

(7) Remove magnetic compass.

(8) Install the control surfaces locking device.

(9) Safely and efficiently ground the aircraft.

(10) Install protective covers on the seats.

(11) Close all doors.

(12) Install the static port plugs, the pitot tube protective cover and the cabin protective cover.

(13) Periodically check the tyres for correct pressure and rotate the wheels every two weeks in order to prevent permanent deformation of the tyres.

(14) Optional equipment (Radio, Navigation, etc) store according to relevant hand book.

Carburetor Heat

The operation of the carburetor heat in mid position in a non-carburetor icing condition, causes a drop in engine power and can also increase the vibration level of the engine. The use of carburetor heat is essentially to prevent ice from forming in the carburetor. Carburetor icing leads to a power rating /manifold pressure drop and slight vibration.

2.3 Aircraft Handling During Engine Power Loss:

While passing 3500 ft ASL, the instructor was asked to call the tower maintaining 4000 ft ASL. At that point, the engine RPM had started dropping with consequent engine vibration and loss of altitude and engine power.

From the pilot information manual of TB-9 aircraft, the following could have caused the engine to vibrate:

(i) Carburetor icing
(ii) Defective spark plugs
(iii) Too rich mixture

2.3.1 Engine Stripping Report

The engine was retrieved and sent to Lycoming factory in U.S.A for stripping and analysis.

The report showed that during the last VP 2A inspection, the 90^0 fitting at the carburetor end of the fuel hose that runs from the engine fuel pump to the carburetor was cross threaded into the hose and was not properly seated. As a result, fuel leaked under pressure and the carburetor got less fuel than required to run the engine smoothly. The spark plugs were found to be in good working condition.

The instructor employed forced landing procedures and crash landed in a farm. The forced landing procedure in the operations manual is as follows:

Radio	-	*Mayday call*
Harnesses, Seat belt	-	*adjusted and secured.*
Transponder	-	*Set at 7700*
Mixture	-	*Idle cut off*
Fuel Selector	-	*Off*

When landing is secured:

Flaps	-	*Landing*
Approach speed	-	*65/70 KIAS*
Main Switch	-	*Off*

2.4 Deferred Maintenance

The subject of deferred maintenance was better understood by aircraft operators, maintenance organizations, maintenance personnel and Civil Aviation Authorities. Defer maintenance was defined as scheduled/unscheduled maintenance that was deferred while an aircraft continue in operation. As a result, maintenance personnel who defer maintenance should obtain approval from Regulatory Authorities before making such decisions.

However, the maintenance organization exposition operated by Nigerian College of Aviation Technology (NCAT), Zaria does not contain any procedure by which an operator can delay specific planned maintenance inspections or servicing as recorded in this accident of 5N-CBF. The engine of 5N-CBF had never been overhauled since new either by flying hours of 2000 hours or 12 calendar years. But in this case the engine was 13 years old, and no overhaul had been carried out on the engine before the accident.

Operational and Airworthiness Regulation allows for operation with unserviceable equipment or system provided it is in accordance with an approved minimum equipment list (MEL). Operator of aircraft is allowed to defer defect based on MEL. However, TB9 aircraft being operated in NCAT does not have an approved MEL.

Master Minimum Equipment List (MMEL) is a document provided by the manufacturer determining equipment or functions that can be inoperative while maintaining the safety level of the aircraft, while Minimum Equipment List (MEL) is document prepared by an operator from MMEL and approved by the Regulatory Authority, but which reflects the aircraft equipment configuration and the operator's particular operational needs. The MEL is more restrictive than the MMEL.

2.5 Specific Item Audit/Tool Control Program and Task Handover

It is the responsibility of the Regulatory Authority to periodically carry out specific items audit in flight maintenance department. This audit is very essential so as to ensure the validity of the Aircraft Maintenance Organisation (AMO) granted to the college.

Most aircraft maintenance organizations are required to develop a tool control program. This program helps to monitor the movement and position of tools during or after

maintenance activities on aircraft to prevent accident. All licenced engineers of flight maintenance department have tool boxes assigned to each personnel, but there was no mechanism/procedure to monitor the movement of these tools which can cause accident or damage when a particular tool is forgotten in a closed engine or airframe areas. Although the flight maintenance department operates two shifts daily, there was no programme in place for handing over of scheduled maintenance tasks to the incoming shift.

During most scheduled and unscheduled maintenance inspection that involves flight and engine controls, the shift leader who is a licenced engineer on type will sign-out the aircraft and another type Licenced engineer will sign the duplicate inspection. However, investigation revealed that this was not the practice in NCAT as at the time of the accident.

3.0 CONCLUSIONS

3.1 Findings:

3.1.1 The aircraft had Certificate of Airworthiness (C of A) and was duly registered in accordance with the Civil Aviation Regulations.

3.1.2 There was good weather condition as at the time of the accident.

3.1.3 The aircraft was out of service on 9th of June, 2004. However, it was reported to have been preserved by the Flyable Storage Procedures from 9th of February, 2005 to 26th of September, 2006. The Flyable Storage carried out did not follow the recommended procedures laid down by the aircraft manufacturer.

3.1.4 A test flight was carried out on the aircraft on 27th of May, 2006, and found to be satisfactory.

3.1.5 On the day of the accident, three serviceable aircraft were prepared for the flight training (5N-CBA, 5N-CBE and 5N-CBF). While 5N-CBE was withdrawn to the hangar, 5N-CBF was used for the flight and 5N-CBA was on standby.

3.1.6 At 4000ft ASL, the crew reported loss of engine power and decided to return to base, but due to rapid loss of altitude, the crew made a force landing at Fanfulani village, 2NM southwest of Zaria aerodrome.

3.1.7 All persons on board the aircraft disembarked without sustaining any injury, but the aircraft was substantially damaged.

3.1.8 AIB discovered that three students were onboard for training with an instructor. There was no provision for such practice in the flying school standard operating procedure.

3.1.9 The engine hard time overhaul requirement of 2000 hours or 12 calendar years was not complied with. At the time of the accident the engine was more than 13 years in service, with reference to Lycoming Service Instruction No. 1009 AS May 25, 2006, superseded by S.I. No. 1009 AU of November 18, 2009.

3.1.10 AIB investigators on arrival at the accident site observed that the flaps were in the **UP** position instead of the **DN** position as stipulated in the checklist.

3.1.11 The position of the carburetor heat was found to be at mid position by AIB investigators.

The investigation identified the following causal and contributory factors:

3.2 Causal Factor

The cross-threading of 90^0 fitting at the carburetor end of the fuel hose that runs from the engine fuel pump to the carburetor fuel inlet filter, resulted to fuel leakage, loss of fuel pressure to the engine and consequent engine fuel starvation.

3.3 Contributory Factors

1. Non performance of leak test on the engine fuel system after maintenance task in accordance with the approved maintenance manual.

2. The absence of duplicate inspection after carrying out maintenance task on fuel control system.

4.0 SAFETY RECOMMENDATIONS

4.1 SAFETY RECOMMENDATIONS 2010 – 013

NCAT Quality Assurance (Engineering) must ensure that certifying engineers carry out mandatory duplicate inspection whenever engine or aircraft control systems are disturbed in course of maintenance activity, in accordance with relevant manual.

4.2 SAFETY RECOMMENDATIONS 2010 – 014

NCAT Quality Assurance (Engineering) must ensure that maintenance remains compliant with the requirements of the approved maintenance schedule and respective manuals on:

(a) Aircraft and Engine overhaul hard time requirements.

(b) Engine flyable storage procedures.

4.3 SAFETY RECOMMENDATIONS 2010 – 015

NCAT Quality Assurance (Engineering) should put in place an approved Minimum Equipment List (MEL) to enable maintenance engineering operate a proper deferred defect/rectification procedures.

APPENDIX I

RESPONSE TO SAFETY RECOMMENDATIONS

SAFETY RECOMMENDATION 2010 – 013

NCAT Quality Assurance (Engineering) must ensure that certifying engineers carry out mandatory duplicate inspection whenever engine or aircraft control systems are disturbed in course of maintenance activity, in accordance with relevant manual.

RESPONSE TO SAFETY RECOMMENDATION 2010 – 013

The institution accepts this recommendation and has initiated the following implementation

1 *Quality Control Inspectors have been designated in the Flight Maintenance Department to ensure that certifying staff carry out all maintenance including duplicate inspection in accordance with the relevant manual.*

2 Duplicate inspection stamp has been produced to ensure that the activity is done and documented.

Appendix 'F' refers.

SAFETY RECOMMENDATION 2010 – 014

NCAT Quality Assurance (Engineering) must ensure that maintenance Remains compliant with the requirements of the approved Maintenance schedule and inspection manuals on:

(a) Aircraft and Engine overhaul hard time requirements.

(b) Engine flyable storage procedure

RESPONSE TO SAFETY RECOMMENDATION 2010 - 014

The organization accepts this recommendation and responded as follows:

1. *NCAT adheres strictly with the inspection calendar specified in the NCAA approved maintenance programme for the fleet of aircraft.*

2. *Aircraft and Engine overhaul hard time requirements are complied with in accordance with the time and operating limits specified by the manufacturers*

3. *Aircraft that are to be in storage for longer than 30 days are now put on long term storage.*

4 *All certifying aircraft engineers are properly trained and current.*

Appendix 'G' refers.

SAFETY RECOMMENDATION 2010 – 015

NCAT Quality Assurance (Engineering) should put in place an approved Minimum Equipment List to enable maintenance engineering operate a proper deferred defect/rectification procedures.

RESPONSE TO SAFETY RECOMMENDATION 2010 – 015

The organization accepts this recommendation with the following responses:

1. *NCAT will liaise with SOCATA and work with NCAA on the MEL issue.*

2. *The TB-9 and TB-20 single engine aircraft manufactured by SOCATA do not have Master Minimum Equipment List (MMEL) issued by the aircraft manufacturer. The only SOCATA aircraft with MMEL is the TBM 700 single engine turbine aircraft.*

SAFETY ACTION

The carriage of multiple students for training has been addressed by the college in a memo to all Flight Instructors reference Appendix 'H'. Therefore no safety recommendation is made.

2) Aircraft stored for a maximum period of 30 days or those which are intermittently flown during the first 25 hours are considered in short term storage with flight possibility.

WARNING : CHECK THAT THE MAGNETO SWITCH IS SET TO "OFF", THE THROTTLE IS CLOSED, THE MIXTURE CONTROL IS IN THE IDLE CUT-OFF POSITION, AND THE AIRCRAFT IS CORRECTLY MOORED BEFORE ROTATING THE PROPELLER BY HAND. DO NOT STAND WITHIN THE ROTATION AXIS OF THE PROPELLER BLADES WHILE ROTATING THE PROPELLER.

CAUTION : DO NOT ROTATE THE PROPELLER IN THE REVERSE DIRECTION TO AVOID DAMAGING THE VACUUM PUMP FINS.

3) Every seven days during these periods, the propeller shall be hand-rotated several revolutions. This makes oil circulate and thus prevents accumulation of corrosion on engine cylinders walls.

4) After 30 days storage, the aircraft shall be flown for at least 30 minutes, or a ground runup shall be performed until the oil temperature reaches the lower green arc range. Avoid prolonged runups.

5) Engine runup helps eliminate excessive accumulations of water in the fuel system and other air spaces in the engine. Keep fuel tanks full to minimize condensation in the tanks. Keep the battery fully charged to prevent the electrolyte from freezing in cold weather.

6) Every two weeks, rotate the wheels in order to prevent permanent deformation of the tires.

a) On the side of the tire, mark with a chalk the part of the tire in contact with the ground.

b) Pull the aircraft over a few meters, then put it back in its previous place so that another part of the tire comes into contact with the ground (the opposite part, if possible).

D. Long term storage (more than 6 months)

WARNING : PRIOR TO ANY OPERATION, ENSURE THAT THE KEY IS REMOVED FROM MAGNETO SELECTOR AND THAT "MAIN SWITCH" IS OFF.

IF AIRCRAFT IS EQUIPPED WITH DISCONNECT PLUG ON FIREWALL, DISCONNECT "MAGNETO DISCONNECT" PLUG AND CONNECT IT TO "GROUND MAGNETO FOR SERVICING" PLUG.

1) Preserve the engine : refer to engine maintenance handbook – refer to Service Letter L180 published by LYCOMING (latest current revision).

2) Blank off the carburettor air inlets and the exhaust pipes.

CAUTION : THE AIRCRAFT SHALL BE STORED WITH FULL TANKS TO AVOID EXCESSIVE CONDENSATION.

3) Top up the fuel tanks to prevent condensation – refer to 12-11-01.

4) Jack up the aircraft if stored in a hangar – refer to 07-10-00.

5) If the aircraft is stored outside, moor it – refer to 10-20-00, and rotate the wheels every two weeks in order to prevent permanent deformation of the tires.

a) On the side of the tire, mark with a chalk the part of the tire in contact with the ground.

b) Pull the aircraft over a few meters, then put it back in its previous place so that another part of the tire comes into contact with ground (the opposite part, if possible).

6) Remove and store the battery – refer to 24-30-02, and the emergency lighting battery (if installed).

7) Remove the magnetic compass – refer to 34-20-01.

RETURN TO SERVICE

MAINTENANCE PRACTICES

1. SERVICING – RETURN TO SERVICE

A. Tools and consumable materials

- Wheel chocks

B. Destorage procedure

CAUTION : BEFORE RETURNING THE AIRCRAFT TO SERVICE AFTER A LONG-TIME STORAGE (MORE THAN 6 MONTHS), THE AIRCRAFT MUST BE DESTORED AND AN OVERALL INSPECTION CARRIED OUT IN ACCORDANCE WITH THE PERIODIC INSPECTIONS PROTOCOL, 100-HOUR INSPECTION – REFER TO 05-20-04, OR THE MAJOR INSPECTION PROTOCOL – REFER TO 05-20-05, DEPENDING ON STORAGE DURATION AND CONDITIONS.

1) Untie the mooring ropes – refer to 10-20-00.
2) If the aircraft is stored in a hangar, lower the aircraft to ground and remove the jacks – refer to 07-10-00. Install the wheel chocks.
3) Remove all protective covers and blanking plugs.
4) Clean the aircraft if necessary – refer to 12-20-03.
5) Lubricate the aircraft – refer to 12-21-00.
6) Bleed the fuel tanks and the fuel system – refer to 12-11-02.
7) Check the fluid level of the brake reservoir – refer to 12-13-01.
8) Apply the parking brake. Check for hydraulic fluid leaks or oozing.
9) Remove the control surfaces locking device – refer to 10-10-00.
10) Check the shock-absorbers – refer to 12-14-02.
11) Check the tires – refer to 12-14-01.
12) Install the battery – refer to 24-30-02.
13) Install the magnetic compass – refer to 34-20-01.
14) Destore the radio-navigation equipment in accordance with the relevant user's manuals.
15) Depreserve the engine – refer to the manufacturer's maintenance manual.

APPENDIX C

1. PREPARATION OF ENGINE FOR STORAGE OR SHIPMENT.

General - The following procedure is intended for application to installed engines, which are being removed from aircraft and will provide protection from corrosion for a period of 30 to 60 days.

Preservation Run - Immediately prior to removal of the engine from the aircraft, the engine should be given a preservation run under the following operating conditions.

Fuel - Normal service fuel.

Oil - Fill sump to normal capacity with preservative type lubricating oil (Socomy's Avnox 901, Esso's "Rust-Ban 626" or equivalent).

Duration of Run - Operate the engine for a period of four minutes, holding the engine speed to a maximum of 1800 RPM. All precautions pertaining to ground running should be carefully observed. Cylinder head, ignition harness, and magneto temperatures should not be allowed to exceed the prescribed limits.

Compound Injection - Upon completion of the preservation run, drain the preservative oil from the engine and remove, clean and replace the oil suction and oil pressure screens. Perform any of the engine checks, such as valve clearance or ignition timing, which require rotation of the crankshaft. Disconnect the ignition harness and remove the spark plugs. Starting with cylinder No. 1, make certain piston is at the bottom of compression stroke. Fill cylinder with preservative oil (use same oil as specified for preservation run) and rotate crankshaft until piston is at top center. Oil will spill out of spark plug hole. In order to preserve the top wall of the cylinder, it will be necessary to either rock the engine, or blow compressed air with very light pressure into the spark plug hole. Following the engine firing order, preserve the remainder of the cylinders in the same manner. When all cylinders have been treated, then spray the exhaust port and valve of each cylinder with the piston 1/4 turn before top center on the exhaust stroke. When absolutely certain that no further need exists for turning the crankshaft, again spray each cylinder through the spark plug holes. (Maintain spray nozzle temperature at 200°F. to 220°F. (93°C. to 104°C.) for all spraying operations.)

Installation of Seals and Plugs - Install cylinder dehydrator plugs (Avco Lycoming P/N 40238 or equivalent) in spark plug holes. Install ignition cable protectors (Avco Lycoming P/N 40239 or equivalent) over the spark terminal of each ignition cable and secure by attaching to the end of the dehydrator plug. Flush oil accessory drives for which oil seals are provided with preservative oil before assembling the drive covers. Suitable covers should be used in sealing the exhaust ports; moisture resistant tape (Minnesota Mining and Manufacturing Company, 711 Acetate Fibre Tape or equivalent) will be sufficient for the ground connections and similar openings. Install a plug (Avco Lycoming P/N 1540 or equivalent) in the thermometer well at the rear of the oil pressure screen housing. Install sealing caps (Avco Lycoming P/N 61595 or equivalent) over the breather opening and (Avco Lycoming P/N 61596 or equivalent) over the generator or alternator blast tube. Install tachometer drive cap (Avco Lycoming P/N 51545 or equivalent) over tachometer drive. Make sure all other openings are properly sealed.

Exterior Surfaces - All exposed cadmium plated and machined surfaces should be coated with soft-film corrosion-preventative compound (E. F. Houghton and Company, Cosmoline 1059 or equivalent). The starter ring gear and propeller mounting surfaces in particular should receive a liberal coating of the compound.

Carburetor - Drain all residual gasoline from the carburetor, fill with flushing oil (MIL-C-16173, Grade 2) and flush the interior surfaces by rocking the carburetor. Drain excess oil from the fuel passages and replace plugs. Lock the throttle in the closed position and pack the carburetor in a cardboard container.

Fuel Injector - Any unit taken out of service, or units being returned for overhaul, must be flushed with preserving oil (Specification MIL-O-6081, Grade 1010), using the following procedure.

Remove plugs and drain all fuel from the injector. If available, apply 10 to 15 psi air pressure to the fuel inlet, until all fuel is discharged from the injector.

Replace plugs and apply flushing oil filtered through a 10 micron filter at 13 to 15 psi to the fuel inlet until oil is discharged from the servo line.

Replace fuel inlet plug.

CAUTION

To not exceed the recommended air pressure as internal damage to the injector may result.

After filling with preservative oil the injector should be protected from dust and dirt, and given such protection against moisture as climatic conditions at the point of storage require.

The injector shall be tagged as follows: "The fuel chambers and passages of this fuel injector were preserved with oil conforming to Specification MIL-O-6081, Grade 1010. Before using de-preserve in accordance with instructions in operator's manual."

Shipping Case - Upon completion of the preceding steps, the engine should be secured in a suitable engine shipping container. The date of preservation and the following legend should be legibly marked on the side of the container:

"On (Date) the engine was preserved for 30 days short term storage with preservative oil and cylinder and crankcase dehydrator plugs shall be inspected on arrival at destination or 30 days after the above date (whichever occurs sooner) to determine if renewal of the dehydrating agent is necessary."

4. RECOMMENDED PROCEDURE FOR RE-PRESERVATION. The engine shall be examined every 30 days (or less, depending on weather and locality). If any evidence of corrosion is present, the affected area should be cleaned free of corrosion and the engine re-preserved.

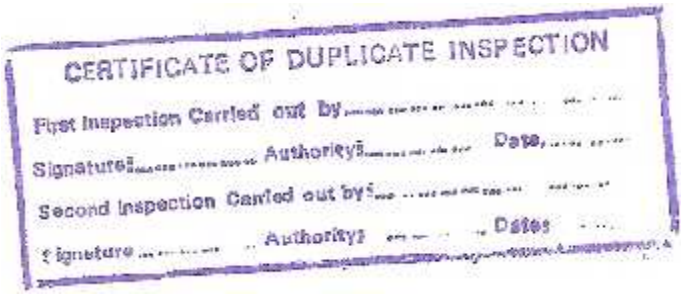
Engines prepared in the preceding manner are not adequately protected for extended periods of storage. If at the end of 60 days, it is found that the engine must remain in storage for an additional period, the engine must be re-preserved according to the foregoing procedure.

NOTE

Inspection and re-preservation will not be the responsibility of the engine manufacturer after engines have been shipped from the engine manufacturer's plant. It shall be the responsibility of the consignee to put engines into service in the order of storage preparation date to reduce the storage period to a minimum.

ATA	"2A" INSPECTION - 50 HOURS ENGINE COMPARTMENT INSPECTION (AREA 100)	AREA	OTHER	INSPECTION PERFORMED BY
71-00	ENGINE COMPARTMENT INSPECTION (AREA 100)	100		
71-00	1) Perform an overall visual inspection of area 100.	100		
32-40	2) Visually inspect the brake hydraulic reservoir. Check fluid level - refer to 12-13-01 301.	100		
24-30	3) Check the condition and tension of the alternator belt - refer to 24-30-01 201. Check the tension of a new belt after the first 25 operating hours. Refer to the latest issue of LYCOMING Service Instruction 1129, for belt tension adjustment.	100		
28-20	4) Clean or replace the fuel filter on the electric pump, check the support - refer to 28-20-01 201.	100		
28-20	S / N 1 - 730 5) Clean or replace the additional fuel filter (if installed) located close to the electric pump, check the support - refer to 28-20-02 201.	100		N/A
73-10	S / N 1 - 9999 6) Visually inspect the mechanical fuel pump. Check attach fittings and connections on the engine pump and the pressure switch.	100		
73-20	7) Remove and clean the carburetor fuel inlet filter. Install the filter - refer to 73-20-01 301.	100		
73-00	8) Check the fuel system for leaks and security of the clamps.	100		
37-00	9) Visually inspect the vacuum system vacuum pump, the unions, fittings and pipes (if installed). Check the drive for oil leaks.	100		
74-20	10) Remove and thoroughly inspect the upper and lower spark plugs. If the spark plugs are fouled, clean and adjust gap, then permute upper and lower spark plugs - refer to 74-20-02 201.	100		
74-20	11) Check the conductors and the ceramics for corrosion and deposits. Clean the cable ends, spark plug walls and ceramics with a dry clean cloth or a clean cloth moistened with methyl-ethyl-ketone. Dry.	100		
74-20	12) Check ignition harness clamps for security and spark plug and magneto terminals for tight connection.	100		

Appendix ‘F’



Specimen of Duplicate Inspection Stamp

Appendix 'G'

NIGERIAN COLLEGE OF AVIATION TECHNOLOGY
ZARIA AERODROME
P. M. B. 1031, Zaria, Kaduna State, Nigeria

APPENDIX IF APPENDIX 'G'

CURRENCY STATUS OF CERTIFYING STAFF AS AT 31 MARCH, 2010

Licence Number	Currency Status(validity)				Remarks
	Tampico TB 9	Trinidad TB 20 GT	Baron 58	TBM 850	
2032	14/06/2009	14/06/2009	18/05/2008	NIL	Completed structural repairs training in Singapore in March 2010. To proceed for TB9/TB20 Mechanics training in May 2010 and Baron 58 training June, 2010.
971	14/06/2009	14/06/2009	NIL	NIL	Completed training at NITT in December 2009 & returned in January 2010. Scheduled for TB9/TB20 Mechanics training in May, 2010.
988	NIL	NIL	NIL	NIL	Obtained TB9 rating in January 2010. Scheduled for TB9/TB20 Mechanics training in August, 2010.
1642	07/06/2009	07/06/2009	20/08/2011	NIL	Scheduled for TB9/TB20 Mechanics training in May, 2010.
1254	26/03/2011	26/03/2011	18/12/2010	NIL	Scheduled for Baron 58 training in November, 2010.
2494	26/03/2011	26/03/2011	NIL	03/12/2011	
2235	26/03/2011	26/03/2011	NIL	03/12/2011	
1457	26/03/2011	26/03/2011	NIL	NIL	Scheduled for TBM850 Mechanics training in June, 2010.
2049	26/03/2011	26/03/2011	NIL	NIL	
2639	09/07/2011	09/07/2011	NIL	NIL	Scheduled for TBM850 Mechanics training in June, 2010.
2771	09/07/2011	09/07/2011	NIL	03/12/2011	
1830	03/09/2011	03/09/2011	18/12/2010	NIL	Scheduled for Baron 58 training in November, 2010.
534	03/09/2011	03/09/2011	NIL	NIL	
1880	03/09/2011	03/09/2011	18/12/2010	03/12/2011	
2232	03/09/2011	03/09/2011	18/12/2010	NIL	
2024	NIL	NIL	NIL	NIL	Remedial training at AME School in progress.
1672	NIL	NIL	NIL	NIL	Remedial training at AME School in progress.

Appendix 'H'

NIGERIAN COLLEGE OF AVIATION TECHNOLOGY, ZARIA.

November 25, 2009

To: All Flight Instructors,

From: Head, Flight Training Dept.

Subject: **CARRIAGE OF MULTIPLE STUDENTS FOR TRAINING**

No Flight Instructor should carry more than one student on board for training exercise, except for Air Familiarization exercise and exercise approved by Head of Flying School or Head, Flight Training Dept. Also no running change in the Air.

All Instructors to please comply.

Head of Flight Training Dept.