REPUBLIC OF NAMIBIA

MINISTRY OF WORKS AND TRANSPORT

DIRECTORATE OF AIRCRAFT ACCIDENT INVESTIGATIONS

CIVIL AIRCRAFT ACCIDENT REPORT

ACCID/011108/01-12

OPERATION	**:**	**COMMERCIAL**
AIRCRAFT	**:**	**V5-GWH**
LOCATION	**:**	**WINDHOEK**
DATE	**:**	**11 JANUARY 2008**

REPUBLIC OF NAMIBIA

MINISTRY OF WORKS AND TRANSPORT
DIRECTORATE OF AIRCRAFT ACCIDENT INVESTIGATIONS

Tel : (264) (61)208-8411
Fax : (264) (61)208-8495
Telex: (05-908) 811
E-mail: enengola@mwtc.gov.na

022

AIRCRAFT ACCIDENT INVESTIGATIONS
Private Bag 12042
Ausspannplatz
Windhoek
NAMIBIA

Enquiries: E. M. Nengola **Our Ref: 3/48** **Date: 16th September 2008**

To : **Minister of Works and Transport**
Deputy Minister of Works and Transport
PS: Ministry of Works and Transport

From : **Director: Aircraft Accident Investigations**

RE: FATAL AIRCRAFT ACCIDENT REPORT

Please find attached the final report on the above subject accident. In accordance with the International Civil Aviation Organization Annex 13 – Aircraft Accident and Incident Investigation – Standard 6.13, final reports shall be published as soon as possible in the interest of accident prevention.

It is recommended that copies of these final reports be made available to the public and other interested parties upon request. Your approval is therefore sought to release the said report.

Erickssson M. Nengola 28.09.08
DIRECTOR: AIRCRAFT ACCIDENT INVESTIGATIONS

AIRCRAFT ACCIDENT INVESTIGATION
Ministry of Works and Transport

FOREWORD

This Report presents the factual information, data analysis, conclusions, and safety recommendations reached during the investigation. The purpose of the investigation was to establish the circumstances surrounding this accident.

In accordance with the provisions of Annex 13 to the Convention on International Civil Aviation Organization, the accident's analysis, conclusions, and safety recommendations contained therein are intended neither to apportion blame nor to single out any individual or group of individuals. The main objective was to identify the systematic deficiencies and draw lessons, from this occurrence, which might help to prevent accidents and/or incidents in the future. To this end, many a time, the reader may be interested in whether or not an issue was a direct cause of the accident (that has already taken place), whereas the investigator is mainly concerned with the prevention of future accidents/incidents.

As a result, usage of this report for any purpose other than (the latter and spirit of Annex 13 and other relevant statutes) prevention of similar occurrences in the future might lead to erroneous interpretations and applications.

ABBREVIATIONS

ACCID	-	Accident
AD	-	Airworthiness Directive
ADF	-	Automatic Directional Finder
AGL	-	Above Ground Level
AMO	-	Aircraft Maintenance Organization
AMSL	-	Above Mean Sea Level
A&P	-	Airframe and Powerplant
ATC	-	Air Traffic Control
ATZ	-	Air Traffic Control Zone
BTDC	-	Before Top Dead Centre
°C	-	Degrees Celsius
CARS	-	Civil Aviation Regulations
CATS	-	Civil Aviation Technical Standards
C of A	-	Certificate of Airworthiness
C of R	-	Certificate of Registration
CAVOK	-	No clouds below 5000 feet Visibility 10 km or more, No precipitation, No thunderstorms Shallow fog; low drifting snow or dust devils.
CG	-	Centre of gravity
CVR	-	Cockpit Voice Recorder
DAAI	-	Directorate of Aircraft Accident Investigations
DCA	-	Directorate of Civil Aviation
EMFRV	-	Emergency Management Fire Fighting Rescue Vehicles
FDR	-	Flight Data Recorder
GPS	-	Global Positioning System
ICAO	-	International Civil Aviation Organization
KCAS	-	Calibrate Airspeed
Kg	-	Kilogram
KIAS	-	Indicated Airspeed
MHZ	-	Mega hertz
MTOW	-	Maximum Take-off Weight
MPI	-	Mandatory Periodic Inspection
msl	-	Mean sea level

NAMCARS	**-**	**Namibia Civil Aviation Regulations**
Nm	**-**	**Nautical miles**
PIC	**-**	**Pilot -In- Command**
POH	**-**	**Pilot Operating Handbook**
RWY	**-**	**Runway**
SABS	**-**	**South Africa Bureau of Standards***
SB	**-**	**Service Bulletin**
S/N	**-**	**Serial Number**
SPECI	**-**	**Special weather observation**
TCM	**-**	**Teledyne Continental Motors**
TWR	**-**	**Tower Control**
UTC	**-**	**Coordinated Universal Time**
V	**-**	**Velocity**
VFR	**-**	**Visual Flight Rules**
VHF	**-**	**Very High Frequency**
VOR	**-**	**Very High Frequency Omni-Directional Radio Range**

TABLE OF CONTENTS

PAGE

MINISTRY OF WORKS AND TRANSPORT | **ACCID/011108/01-12**

DIRECTORATE OF AIRCRAFT ACCIDENT INVESTIGATIONS
ACCIDENT REPORT – EXECUTIVE SUMMARY

Aircraft Registration	V5-GWH	**Date of Accident**	11 January 2008		**Time of Accident**	±15:20	
Type of Aircraft	CESSNA 210M			**Type of Operation**	Charter		
Pilot-in-Command License Type	Commercial	**Age**	24	**License Valid**	Yes		
Pilot-in-Command Flying Experience	**Total Flying Hours**	1214.9		**Hours on Type**	1006.0		
Last point of departure	Eros Airport (FYWE)						
Next point of intended landing	Mokuti lodge landing strip (FYMO)						
Location of the accident site with reference to easily defined geographical points (GPS readings if possible)							
In the residential area on the corner of Mosé Tjitendero and Esther Brand street							
Meteorological Information	Surface wind:120°/12 knots; Temperature:±31°C; Visibility: Unlimited; Cloud cover: Nil; Cloud base: Nil; Dew point: 3° C						
Number of people on board	1 + 5	**No. of people injured**	Nil	**No. of people killed**	6		

Synopsis

The aircraft, a single engine Cessna 210M took-off from Eros Airport at about 15:20 Coordinated Universal Time (UTC) on the 11th January 2008 with a pilot and 5 (five) passengers on board, for a chartered flight to Mokuti lodge, with a return flight the following day back to Eros airport and from Eros to the base airport of Swakopmund. Unfortunately the flight to Mokuti lodge did not materialize. The aircraft crashed and smashed through a garden wall of a residential house in the corner of Mose Tjitendero and Ester Brand street and exploded into flames. The pilot and his passengers were fatally injured. The aircraft was substantially damaged during impact sequence. Visual meteorological conditions prevailed at the time of the accident. According to Eros ATC, the pilot requested to taxi to Rwy 19 (the longest runway) but after being notified of down-draft south of the airport, reported by an aircraft taking-off on the same runway just prior to his own take-off, the tower controller told the pilot: "Runway 09 is available". The take off clearance was to turn left after take-off, climb to 7500 ft and report at point ATZ (7 miles north). The pilot asked the tower for the length of runway and as it was reported to him as 1.5 (one point five), he taxied to Rwy 09 threshold. While taxiing, the tower corrected the mistake and indicated that the actual length of the runway was 1005 meters. After a short delay, the pilot reported that he would stick to his original plan that he intended to take-off from Rwy 09. At approximately 14:58 UTC the pilot started the take-off run. The aircraft was with excessive weight and aft center of gravity and this quite clearly caused a lighter-than-normal nose. For this reason, the aircraft lifted its nose at a distance of 2200ft to 2400 ft, and the aircraft lifted off shortly after. In the first 200 meters beyond the runway end, the ground surface descends, consisting of flight over an urban area with high buildings, lighting posts, electrical lines and antennas. Since the pilot did not retract the landing gears and since it is doubtful that he retracted the flaps at this point, it could be determined that he could not gain any speed higher than 72 kts at an altitude above 50 ft and as a result, he could not achieve the figure allowing performance of these operations. After a short distance of about ½ mile from the runway, the pilot decided to turn left northbound, either because of the clearance or possibly the terrain north of the airport, which is somehow lower. Turning with a bank angle above 10°, the aircraft's actual performance and the environmental conditions caused it to stall with higher stalling figures than those calculated by the pilot, due to excessive weight, high altitude and high

temperature.

The aircraft may have entered a stall that worsened until it crashed. While turning left northbound, the pilot may have tried to lift the aircraft nose, but this was in vain. This conclusion is based on several eyewitnesses saying they saw the aircraft trying to lift its nose before the crash.

The aircraft at this point was uncontrollable. It continued its descent and hit the concrete slope of the house, with a slight crab, nose pointing left.

As it is known from the pilot log book, the pilot flew only once to Eros airport, about a month prior to the accident. On that flight he (pilot) landed at Eros airport with 5 passengers and took-off back to Swakopmund with no passengers.

The pilot was a holder of a Commercial Pilot Licence with no restrictions.

The last Mandatory Periodic Inspection (MPI) prior to the accident was certified on the 29 November 2007 at a total of 9867.6 airframe hours. The aircraft had flown a further 48.5 hours since the last MPI.

The AMO that certified the last MPI on the aircraft prior to the accident was audited by the Regulatory Authority on 21 August 2007 and was in possession of a valid Aircraft Maintenance Organization Approval No. 4 with an expiry date of 25 August 2008

There are no records available at the Regulatory Authority indicating when a Cessna 210M aircraft was type accepted in Namibia.

According to available records, all Airworthiness Directives and Service Bulletins were complied with as certified on the MPI of 29 November 2007.

Probable Cause

Probable Cause(s):

The investigation determined that the probable causes of this accident were:

The aircraft hit the ground at a speed significantly lower than stall speed which indicated with certainty that the pilot entered a slow stall resulting in a total loss of aircraft control upon impact. Heavy and marginal take-off performance from a high altitude airport with high temperature soaring above 30 degrees Celsius and choosing a short runway for take-off. Lack of experience as well as lack of briefing regarding the prevailing conditions and Eros airport limitations could explain the pilot's surprise at the premature nose lifting during the take-off run.

Contributing to the accident is attributed to:

i) Improper Flight Planning;
ii) Lack of situational awareness and poor airmanship;
iii) Unfamiliar with Eros airport data;
iv) Not compensating for density altitude and airport surface conditions.

AIRCRAFT ACCIDENT REPORT

Name of Owner/Operator	: Atlantic Aviation
Manufacturer	: Cessna Aircraft Company
Model	: Cessna 210M
Nationality	: Namibian
Registration Marks	: V5-GWH
Place	: Windhoek
Date	: 11 January 2008
Time	: 15:20

All times given in this report is Co-ordinated Universal Time (UTC).

Purpose of the Investigation:

In terms of ICAO Annex 13, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and ***not to establish legal liability****.*

This report contains facts relating to aviation accident or incident which have been determined at the time of issue. The report may therefore be revised should new and substantive facts be made available to the investigator(s).

Disclaimer:

This report is given without prejudice to the rights of the Directorate of Aircraft Accident Investigations, which are reserved.

1. FACTUAL INFORMATION

1.1 History of Flight

1.1.1 The aircraft a single engine Cessna 210M took-off from Eros Airport at about 15:20 Coordinated Universal Time(UTC) on the 11 January 2008 with a pilot and 5 (five) passengers on board for a chartered flight to Mokuti lodge, with a return flight the following day back to Eros airport and from Eros to the base airport of Swakopmund. Unfortunately the flight to Mokuti lodge did not materialize. The aircraft crashed and smashed through a garden wall of the residential house in Olympia and exploded into flames. The pilot and his passengers were fatally injured.

1.1.2 The aircraft was substantially damaged during impact sequence. Visual meteorological conditions prevailed at the time of the accident.

1.1.3 According to Eros ATC, the pilot requested to taxi to Rwy 19 (the longest runway) but after being notified of down-draft south of the airport, reported by an aircraft

taking-off on the same runway just prior to his own take-off, the tower controller told the pilot:"Runway 09 is available". The take off clearance was to turn left after take-off, climb to 7500 ft and report at Air Traffic Control Zone (ATZ), 7 miles north.

1.1.4 The pilot asked the tower for the length of runway 09/27 and as it was reported to him as 1500meters (one point five), he taxied to RWY 09 threshold. While taxiing, the control tower corrected the mistake and indicated that the actual length of the runway was 1005 meters. After a short delay, the pilot reported that he would stick to his original plan that he intended to take-off from RWY 09.

1.1.5 At 14:58 UTC (approx) the pilot started the take-off run. The aircraft was with excessive weight and aft center of gravity and this quite clearly caused a lighter- than-normal nose. For this reason, the aircraft lifted its nose at a distance of 2200ft to 2400ft, and lifted off shortly after.

1.1.6 In the first 200 meters beyond the runway end, the ground surface descends, consisting of flight over an urban area with high buildings, lighting posts, electrical lines and antennas. Since the pilot did not retract the landing gears and since it is doubtful that he retracted the flaps at this point, it could be determined that he could not gain any speed higher than 72 kts at an altitude above 50 ft and as a result, he could not achieve the figure allowing performance of these operations.

1.1.7 After a short distance of about ½ mile from the runway, the pilot decided to turn left northbound, either because of the clearance or possibly the terrain north of the airport, which is somehow lower.

1.1.8 Turning with a bank angle above 10°, the aircraft's actual performance and the environmental conditions caused it to stall with higher stalling figures than those calculated by the pilot, due to excessive weight, high altitude and high temperature.

1.1.9 The aircraft may have entered a stall that worsened until it crashed. While turning left northbound, the pilot may have tried to lift the aircraft nose, but this was in vain. This assumption is based on several eyewitnesses saying they saw the aircraft trying to lift its nose before the crash.

1.1.10 The aircraft at this point was uncontrollable. It continued its descent and hit the concrete slope of the house, with a slight crab (nose pointing left).

1.1.11 As it is known from the pilot's log book, the pilot flew only once to Eros airport, about a month prior to the accident. On that flight he (pilot) landed at Eros airport with 5 passengers and took-off back to Swakopmund with no passengers.

1.2 Injuries to Persons

Injuries	Pilot	Crew	Pass.	Other
Fatal	1	-	5	-
Serious	-	-	-	-
Minor	-	-	-	-
None	-	-	-	-

1.3 Damage to Aircraft

1.3.1 The aircraft was completely destroyed by the post impact fire.

1.4 Other Damage

1.4.1 The aircraft smashed through a residential garden wall and exploded into flames. The house sustained fire damage to the wall and windows. Moderate interior damage was caused by the flames. A small house which was located next to the main building also caught fire.

1.5 Personnel Information

Nationality		South African			
Licence No	0271043846 (RSA comm.)	Gender	Male	Age	24
Licence valid		Yes	Type Endorsed	Yes	
Ratings		Multi-engine and Instrument Rating			
Medical Expiry Date		30 March 2008			
Restrictions		no restriction			
Previous Accidents		none			

Note: The pilot was flying with a Namibian validation issued on 13 December 2007 valid until 25 March 2008.

Flying Experience:

Total Hours	1214.9
Total Past 90 Days	141.0
Total on Type Past 90 Days	141.0
Total on Type	1006

1.5.1 The Pilot's 72 hours history:

(i) During post-accident interviews, the pilot's friends told the investigators that the deceased was fit and his general health was excellent.

(ii) They further stated that he did not indicate any physical fatigue and his general diurnal cycle and sleep was very good with no significant changes.

1.5.2 The Air Traffic Controller(s)

Eros Tower was manned by a qualified controller at the time of the accident. He joined the regulatory authority in 1994 and was appointed as an Air Traffic Controller in 1996. He received training in Aerodrome Control, Procedural Approach and Area Control. He attended several aviation courses and is a holder of a valid ATC license, rated in Aerodrome Control, Approach Control and Area Control. He performed ATC services at several airports in Namibia. He was promoted to a post of a Principal Air Traffic Controller in 2008. In post accident interviews he stated that due to shortage of qualified Air Traffic Controllers in Namibia, he was alone on duty at the time of occurrence. The review of Air Traffic Control records indicated that several aircraft operated in and out of Eros Airport before the accident, at the time of accident, and after the accident flight. Apart from downdraft beyond rwy 19 reported by one departing aircraft prior to the accident aircraft; no other incident or control difficulties were reported. The investigations also revealed that there were no known or reported difficulties with air traffic control at the time of the accident.

1.6 Aircraft Information

Airframe:

Type & Serial no.	Cessna 210 M, 21061648	
Manufacturer	Cessna Aircraft Company	
Year of Manufacture	1977	
Total Airframe Hours (at time of accident)	9916.1	
Last MPI (Date & Hours)	29 November 2007	9867.6
Hours since Last MPI	48.5	
C of A (Issue Date)	12 October 2007	
C of R (Issue Date) (Present owner)	06 April 2005	
Operating Categories	Standard	

The aircraft was purchased from Cessna Aircraft Company on 31 January 1977 as N99113.The owner at the time of the accident purchased the aircraft on 05 February 1991. The aircraft was removed from the FAA's aircraft registry on 14 February 1991. The last phase inspection of the aircraft was carried out on 29 November 2007.

Engine:

Type	Continental IO-520-L (TB)
Serial number	294831R
Hours since New	4303.7
Hours since Overhaul	505.2

Propeller:

Type	Hartzell
Serial number	FP718A
Hours since new	5781.8
Hours since overhaul	980.9

1.6.1 Significant logbook information

The aircraft's engine was rebuilt by the manufacturer on 28 August 1997. The engine was first overhauled on 08 January 2001 at 1887.9 total hours. The # 2 cylinder was replaced due to a crack on 18 November 2002 at 596.0 hours since engine overhaul. The # 3 cylinder was overhauled on 15 October 2003 at 1189.9 hours since engine overhaul. All 6 cylinders were overhauled on 20 April 2004 at 1492.6 hours since engine overhaul. A second major overhaul was performed on the engine due to a "bad oil sample" (according to the engine logbook), 28 April 2005 at 1910.9 hours since initial engine overhaul. The engine was overhauled by a local AMO in Windhoek, Namibia. On 22 March 2007 the engine was re-installed with 00.0 hours since second overhaul. The # 5 cylinder was overhauled on 24 August 2007 at 256.3 hours since second overhaul. The # 3 cylinder was overhauled on 28 August 2007 at 256.3 hours since second overhaul. The last observed maintenance entry was dated 29 November 2007 with 456.7 hours accrued.

1.6.2 Weight and balance

1. Three weight and balance forms which were signed by the pilot were obtained from the operator.

   1st 11 January 2008, flight from Swakopmund to Eros + 2 passengers,
   2nd 11 January 2008, flight from Eros to Mokuti + 5 passengers (flight in question)
   3rd 12 January 2008, flight from Mokuti back to Eros + 5 passengers (not performed)

2. The investigation revealed that the weight and balance forms where completed by the pilot before he even flew to Windhoek to meet his passengers.

3. The flight in question, the following weight and balance figures were obtained:

Two front seats	400 lb	182 kg
Two middle seats	340 lb	155 kg
Two aft seats	262 lb	119 kg
Total	1002lb	456 kg

4. Different figures for the pilot and passengers weight were obtained as follows:

   a) Figures from families and relatives
   b) Figures from the police pathologic team
   c) Figures as filled by the pilot

5. In the wreckage of the aircraft, the investigating team came across the following:

   i) First aid pack
   ii) Tow bar
   iii) 2 Water containers (10 litres each – total of 20 litres
   iv) Light drink cans (containing 6 cans)
   v) Water bottle (1.5 litre)
   vi) Magazines
   vii) Passengers baggage
   viii) Debris of flight documents and maps (part of the pilot briefcase)

6. According to these figures, and since it was uncertain to us whether the first aid pack and the tow bar were included in the aircraft empty weight, we calculated the weight while taking into consideration three cases: maximal, actual and minimal.

   These figures serve as a basis for Weight and Balance calculation values.

7. At present further on, the figures obtained would point out that the aircraft weight before taking off from Eros airport was as follows:

Weight (lb)	Calculated	For performance calculation
Minimal	3871	3900
Actual for calculation	4030	4000
Maximal (at least)	4097	4100

In the calculation of performance, we took into account the weights' possible range and the Centre of Gravity values. The results were all similar, with minor deviations.

Note: We used a program retrieved from the Cessna Internet site, to calculate Weight and balance for most of the Cessna models. We used proper figures for C210M and we compared the result to the appropriate graphs, taken from the pilot handbook. The results were almost identical.

8. **Weight calculation**

The weight of the pilot and the passengers is defined according to three estimations: **Police pathological team**, **families/relatives** and as **filled by the pilot**. Values given in lb and (kg).

	Weight estimated by police pathologic team	Weight as estimated by relatives	Max weight calculation (includes 6 lbs (2 Kg) clothing)	Actual weight calculation (includes 6 lbs (2 Kg) clothing)	Min weight calculation (includes 6 lbs (2 Kg) clothing)	ARM (in.)
Pilot	-	202 (92)	208 (94)	208 (94)	200 (91)	37
Front passenger	220 (100)	231 (105)	235 (107)	225 (102)	200 (91)	37
Middle passenger 1	183 (83)	220 (100)	225 (102)	187 (85)	170 (77)	71
Middle passenger 2	176 (80)	165 (75)	180 (82)	169 (77)	170 (77)	71
Aft passenger 1	161 (73)	165 (75)	169 (77)	165 (75)	131 (60)	101
Aft passenger 2	154 (70)	150 (68)	158 (72)	154 (70)	131 (60)	101
Total lbs (kg)			**1175** (534)	**1110** (503)	**1002** (456)	

9. Aircraft total weight list

Values given in lbs (for three cases)

The **minimal** case represents the figures filled by the pilot.

	Maximal	Actual	Minimal
Aircraft empty weight [lb] (from aircraft documents)		2337	
Fuel (68 gal @ 5.85 lb/gal)		400	
Pilot + passengers [lb] (see table above)	**1175**	**1110**	**1002**
Sub total (aircraft + fuel + pilot + passengers) [lb]	**3912**	**3847**	**3739**
Luggage (estimated @ 7 or 5 kg per occupant)	92	92	66
Pilot brief case with flight documents		15	15
First aid kit [lb]		22	-
Tow bar [lb]		5	-
Water containers [lb]		44	44
Beverage cans and water bottle [lb]	7	7	7
Total weight [lb]	**4097**	**4030**	**3871**
Maximal take off weight [lb]	**3800**	**3800**	**3800**
Weight excess [lb]	**297**	**232**	**71**

(1) From aircraft weight and balance sheet (weight assumed with oil and unusable fuel).
(2) From aircraft loading graph – Figure 6-6(POH).
(3) Assumed at pilot seat station.
(4) Found located at baggage area station.
(5) For calculation of minimal value, assumed to be part of aircraft empty weight.

From the values obtained, the total weight for take off exceeds the maximal value specified in the C210M manual by **71** lbs (minimal) or **232** lbs (actual) or **297** lbs (maximal).

The calculated total moment **exceeds** the maximal value (**202000**) specified in the C210M manual by **8406** lb.in (minimal) or **123914** lb.in (actual) or **27881** lb.in (maximal).

Therefore, the C.G. was found **1.35** in. (**minimal**), **3.05** in. (**actual**) or **3.11** in. (**maximal**) **out of the aircraft aft limit**.

10 Center of gravity calculation

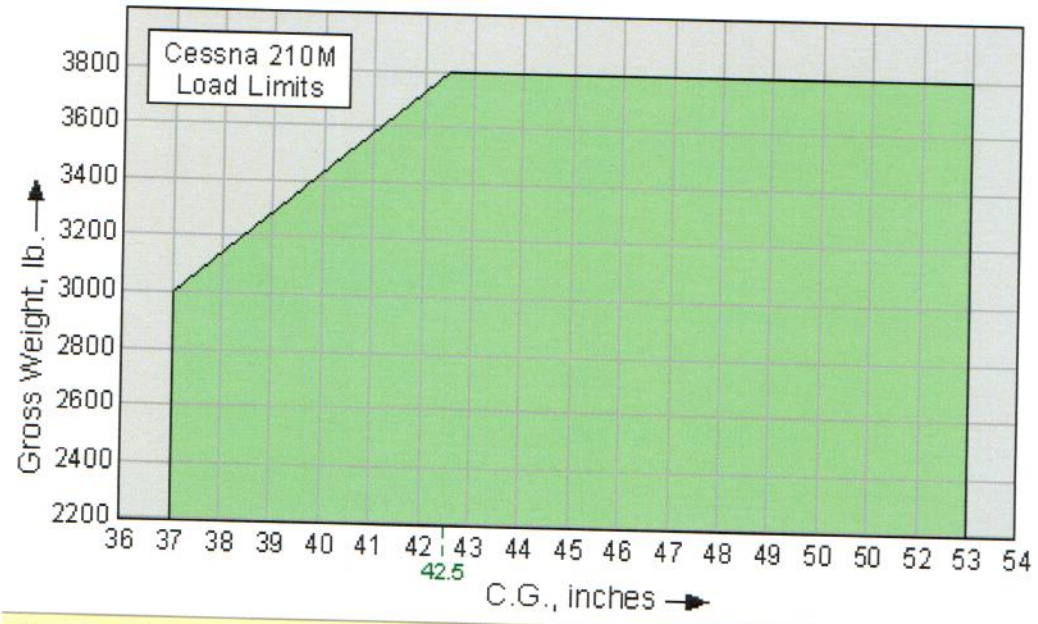
	Max	Actual	Min		Max	Actual	Min	
	Weight [lb]			ARM [in]	Moment [lb.in]			C.G. [in]
Aircraft (empty) (1)	2337				111797			
Fuel (2)	400				17000			
Pilot	208	208	200	37	7696	7696	7400	
Front pax 1	235	225	200	37	8695	8325	7400	
Middle pax 1	225	187	170	71	15975	13277	12070	
Middle pax 2	180	169	170	71	12780	11999	12070	
Aft pax 1	169	165	131	101	17069	16665	13231	
Aft pax 2	158	154	131	101	15958	15554	13231	
Luggage	92	92	66	138	12696	12696	9108	
Pilot brief case (3)	15	15	15	37	555	555	555	
First aid kit (4) (5)	22	22	-	138	3036	3036	-	
Tow bar (4) (5)	5	5	-	138	690	690	-	
Water containers (4)	44	44	44	138	6072	6072	6072	
Beverage cans + water bottle (4)	7	7	7	138	552	552	552	
Total maximal	4097				229881			
CG maximal								56.11
Total actual		4030				225914		
CG actual								56.05
Total Minimal			3871				210406	
CG minimal								54.35

11 Calculation and chart – Maximal values

http://home.new.rr.com/trumpetb/al

Form default data is for NXXXXX. Use your own AC data !		Weight (lbs)		Arm (inches)	Moment (in-lb)
Empty Weight		2337		47.838	111797
Oil (10 qt max, 7 lb/gal)	qt: 0	0		-12.5	0
Front Seat L & R		223	235	37	16946
Fuel (89 gal useable)	gal: 66.7	400		43	17209
Middle Seat L & R		225	180	71	28755
Rear Seat L & R		169	158	101	33027
Baggage (__ lb max)		170		138	23460
		Calculate	Reset		
Gross Weight (3800 lb max):		4097			231194
Loaded Center of Gravity:				56.43	
Maneuvering speed, **Va (kts):**		124		<=(decr. with decr. wt.)	

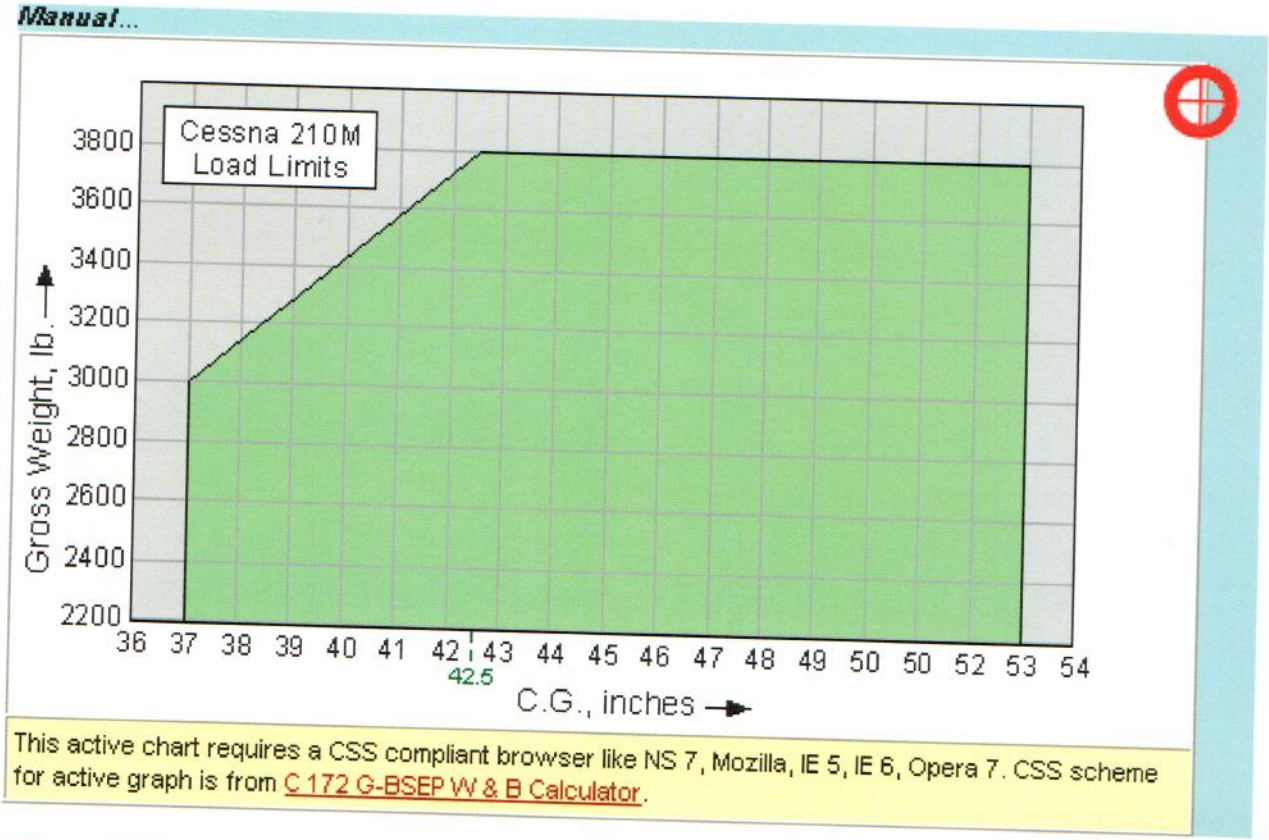
...Manual...



This active chart requires a CSS compliant browser like NS 7, Mozilla, IE 5, IE 6, Opera 7. CSS scheme for active graph is from C 172 G-BSEP W & B Calculator.

12 Calculation and chart – Actual values

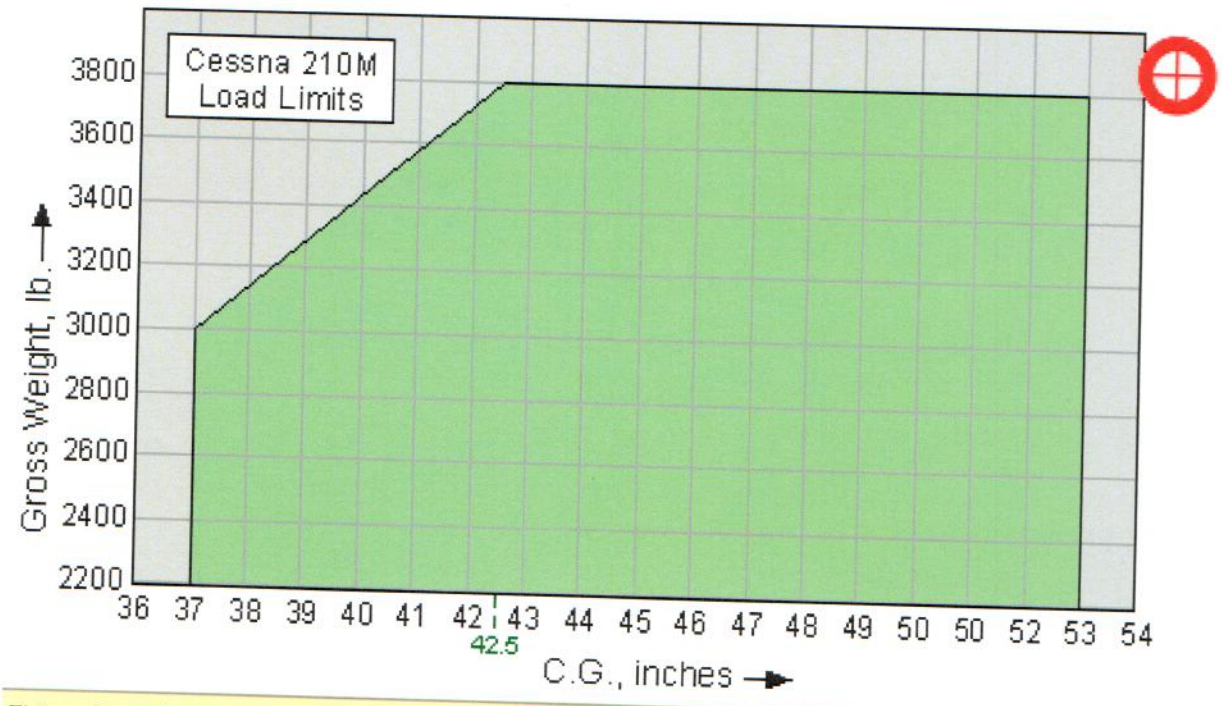
Form default data is for NXXXXX. **Use your own AC data !**		Weight (lbs)		Arm (inches)	Moment (in-lb)
Empty Weight		2337		47.838	111797
Oil (10 qt max, 7 lb/gal)	qt: 0	0		-12.5	0
Front Seat L & R		223	225	37	16576
Fuel (89 gal useable)	gal: 66.7	400		43	17209
Middle Seat L & R		187	169	71	25276
Rear Seat L & R		165	154	101	32219
Baggage (__ lb max)		170		138	23460
		Calculate	Reset		
Gross Weight (3800 lb max):		4030			226537
Loaded Center of Gravity:				56.21	
Maneuvering speed, **Va (kts):**		123		<=(decr. with decr. wt.)	



13 Calculation and chart – Minimal values

Form default data is for NXXXXX. **Use your own AC data !**		Weight (lbs)	Arm (inches)	Moment (in-lb)
Empty Weight		2337	47.838	111797
Oil (10 qt max, 7 lb/gal)	qt: 0	0	-12.5	0
Front Seat L & R		215 200	37	15355
Fuel (89 gal useable)	gal: 66.7	400	43	17209
Middle Seat L & R		170 170	71	24140
Rear Seat L & R		131 131	101	26462
Baggage (__ lb max)		119	138	16422
		Calculate Reset		
Gross Weight (3800 lb max):		3873		211385
Loaded Center of Gravity:			54.58	
Maneuvering speed, **Va (kts):**		120	<=(decr. with decr. wt.)	

Calculated **Gross Weight** and C.G. point must lie within the envelope limits per the ***Airplane Flight***



This active chart requires a CSS compliant browser like NS 7, Mozilla, IE 5, IE 6, Opera 7. CSS scheme for active graph is from C 172 G-BSEP W & B Calculator.

1.6.1.3 According to the available records all the Airworthiness Directives and Service Bulletins were complied with.

1.7 Meteorological Information

Wind direction	120°	Wind speed	12 knots	Visibility	unlimited
Temperature	±31°C	Cloud cover	nil	Cloud base	nil
Dew point	3°C				

1.8 Aids to Navigation

1.8.1 The standard equipments found in the aircraft were incompliance with aircraft type certificate.

1.8.2 No difficulties with Navigational equipment were known or reported.

1.9 Communications.

1.9.1 The aircraft was equipped with standard two way radio communication equipment.

1.9.2 Before the take-off clearance there were no communication breakdown reported by the pilot.

1.9.3 The pilot was transmitting on Eros Tower Control frequency 118.7 MHZ.

1.9.4 There was no further transmission from the aircraft after the acknowledgment of the take-off clearance.

1.10 Aerodrome Information

Aerodrome Location	Windhoek	
Aerodrome Co-ordinates	S22°36'26.9 E01°704'44.9	
Aerodrome Elevation	5584 feet	
Runway Designations	01/19	09/27
Runway Dimensions	1976m x 30m	1005m x 30m
Runway Used	09	
Runway Surface	tar	
Approach Facilities	Runway lights and PAPIS	

1.11 Flight Recorders

1.11.1 The aircraft was not fitted with a Cockpit Voice Recorder (CVR) or a Flight Data Recorder (FDR) and neither was required by the regulation to be fitted on this type of aircraft.

1.12 Wreckage and Impact Information

1.12.1 Breakup Sequence

a) Fuselage

A post-impact fire consumed the forward and upper portion of the fuselage from the firewall to Fs (Flight station) 138.0. According to the crash site findings, it was determined that landing gears were in the extended position prior to impact.

b) Flight Controls and Aerodynamic Surfaces

The post-impact fire consumed the wing center section. The left wing was observed separated into two pieces and the inboard section exhibiting heat and fire damage. A majority of the right wing was consumed by the post-impact fire with the remainder of the wing exhibiting heat and fire damage. The left horizontal stabilizer and elevator remained attached to the aircraft and exhibiting little damage. The right horizontal stabilizer was bent up and aft and had been cut at its mid point during recovery operations. The right elevator exhibited impact damage to the counterweight area. The vertical stabilizer and rudder remained attached to the aircraft with the exception of the top of the rudder where the counterweight was located.

Flight control cable continuity for the elevator and rudder was confirmed from the surfaces to the fuel selector area where the cables had been cut during the recovery process. Aileron control cable continuity was confirmed from the ailerons to the wing root and the pulleys on the firewall. The flap jackscrew measurement indicated a flap setting of approximately 15 degrees, however it was determined that the pilot left flaps in a take-off position of 10°degrees.

c) Seats/Restraint System/Cabin Environment

The post-impact fire consumed the cabin roof, sidewalls, and instrument panel area. The rear bench seat remained attached to the floor. Portions of the middle seats were found in the fuselage wreckage. The area of the cabin where the front seats are located was consumed by the post-impact fire. One latched seat belt was found in the recovered wreckage. The left front seat inboard seat rail was equipped with a

secondary seat stop.

d) Fuel Systems

The post-impact fire consumed the fuselage and wing portions of the fuel system The fuel selector valve and handle were not located.

e) Wreckage Examination

An extensive examination of the wreckage was conducted over a period of 4 hours. Initial examinations at the site were conducted to locate and identify as many of the remaining components as possible. Selected items were recovered from the wreckage and moved to a secured area for further examination.

1.13 Medical and Pathological Information

1.13.1 Toxicological Information

1.13.1.1 The post mortem examination was conducted at Police Mortuary in Windhoek on the 16 January 2008 at 10:00 hrs local time and cause of death was attributed to severe burn and injuries due to high impact forces.

1.13.1.2 The analysis on the eye fluid sample was that it contained a concentration of not more than 1 mg (i.e., 0.00 gram) of ethyl alcohol per 100 milliters of blood.

1.14 Fire

1.14.1 An intense fuel-fed post-crash fire developed. Substantial portions of the aircraft were consumed in the fire. Emergency Management Fire Fighting Rescue Vehicles (EMFRV) arrived at the site approximately 5 minutes after the accident. Fire suppression activities commenced immediately.

1.15 Survival Aspects

1.15.1 Immediately following the accident, emergency management control room operator receives an emergency call at about 16H26. She reported a plane crash in Olympia, Moses Tjitendero Street. Control room operator immediately dispatch nearest Fire Station. Diaz fire Station control room operator contacted W247M Fire engine, Apollo which was already on the road dispatched immediately to the accident address with two (2) fire fighters. Head Quarter control room operator dispatched one fire engine, Alpha with three (3) fire fighters and one Rescue vehicle, Lunar with two (2) fire fighter and five duty vehicles, one from Disaster Management. The first fire engine arrived at the accident site at about 16H30 and then the rest followed.

1.15.2 The accident was considered to be non-survivable due to the magnitude of the impact forces and the severity of the fire.

1.16 Tests and Research.

1.16.1 Engine Investigations

A) External Inspection of engine:

- There was thermal damage to the engine and all external components. The inspection occurred at the Aviation Center Ltd, facility. The engine was initially viewed on the ground in a hanger with the firewall and instrument panel section attached. The engine was removed via a forklift and taken to a secure and sterile environment for further inspection and disassembly. Thumb compression and exhaust was noted on all 6 cylinders. Crankshaft and valve train continuity was established, via multiple rotations. The engine external components were removed and the engine core was dissembled, with the exception of the counterweights from the crankshaft and the valves, rocker arms and valve springs from the cylinders.

1.16.2 DETAILED TECHNICAL ENGINE TEARDOWN AND COMPONENT EXAMINATION

1. Exhaust System

The exhaust system remained attached to the engine. The exhaust pipes and exhaust muffler assembly were bent and deformed and exhibited thermal damage. Corrosion was observed at the muffler. Deformation was observed to the exhaust pipe.

2. Induction system

The induction system remained attached to the engine. The induction tubes were thermal damaged and melted.

3. Ignition system

R/H Magneto:

The magneto was intact and remained attached to the engine mounting pad. Internal and external thermal damage was observed. During the bench test, coupling engagement was noted, although spark was not observed. The harness assembly could not be used during the test due to thermal damage.

L/H Magneto:

The magneto was intact and remained attached to the engine mounting pad. Internal

and external thermal damage was observed. During the bench test, coupling engagement was noted, although spark was not observed. The harness assembly could not be used during the test due to thermal damage.

Ignition harness:

The ignition harness was attached and thermally damaged. No sparks to any lead was observed.

Spark plugs:

The spark plugs were intact and secured prior to removal. The top and bottom plugs were inspected and gap checked. They all exhibited thermal damage. The plugs appeared new with the exception of #3 top plug which was worn. All other plugs exhibited normal wear according to the Champion check a plug chart.

4. Fuel System

Fuel pump:

The fuel pump was intact with thermal damage to the exterior as well as to the interior. The pump drive shaft would not rotate. Air or liquid could be circulated through the pump. The pump disassembly exhibited thermal damage to the vanes. The drive coupling was separated in two sections. The pump exhibited debris that resembled carbon material.

Fuel Manifold Valve:

The manifold assembly was intact. Thermal damage was observed. The TCM lead was not observed. The internal gasket, diaphragm and screen were thermally damaged.

Fuel Nozzles and Lines:

All injectors are intact. External thermal discoloration was noted. Numbers 2, 3, and 4 were clear of obstruction.

Throttle Body and fuel control:

The throttle body fuel control was intact, although, it was cracked. There was also thermal damage observed to the unit. The throttle plate was stuck open1/4 travel. The throttle and mixture control was bent and could not move. The screen was clear and thermally damaged.

5. Lubrication System

Oil Pump:

The oil pump was intact. The pump assembly was disassembled. Oil was observed within the pump assembly. The internal gears rotated and were intact. Rotational scoring signatures were noted to the pump internal housing walls. The relief valve spring was intact. The filter screen was intact and no metal contaminants were

observed.

Oil Sump:

The oil sump remained attached to the engine. The sump assembly was crushed inwards. The sump was breached. There was thermal discoloration to the outside and the inside of the sump assembly. Only residual oil was observed within the sump. No metal contaminants were observed in the sump.

Oil Pick-up Tubes & Screen:

The pickup tube and screen were intact and secured. The screen and tubes assembly was clear of debris and contaminants.

Oil Cooler:

The oil cooler was thermally damaged. It was intact and secured. There was oil inside the oil cooler.

6. Cylinders

Cylinder # 1:

The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts were loose. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves faces exhibited light combustion deposits.

Cylinder # 2:

The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts loose. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valve faces exhibited light combustion deposits.

Cylinder # 3:

The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts loose. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder # 4:

The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts loose. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder # 5:

The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts loose. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder # 6:

The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts loose. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

7. **Rocker Arm and Shaft:**

The rocker arms and shafts were not removed due to lack of tooling in the facility. They were intact and undamaged.

8. **# 1 Piston, Rings and Pin:**

The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

 # 2 Piston, Rings and Pin:

The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

 # 3 Piston, Rings and Pin:

The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

 # 4 Piston, Rings and Pin:

The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

 # 5 Piston, Rings and Pin:

The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

 # 6 Piston, Rings and Pin:

The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

9. Crankcase Assembly

Crankcase:

The crankcase halves were intact with thermal discoloration to the outside surfaces. Pitting was observed to the crankcase main bearing saddles. The oil galleys were visually clear of obstruction.

Main Bearings:

The bearings were all intact and light scoring signatures were observed to the surfaces.

10. Crankshaft Assembly

Crankshaft:

The crankshaft was intact and exhibited lubrication. The main journals and rod journals were lubricated and slightly discoloured. The oil galleys were visually free of obstruction.

Transfer Collar:

The transfer collar was intact and no binding was observed.

Counter Weights:

The counterweight was intact and the snap rings were correctly installed and intact. Movement of each counter weight was noted over the hangers.

Crankshaft to Camshaft Timing:

The timing marks were observed in alignment.

 # 1 Connecting Rod:

The connecting rod was intact and secured. The rod was able to move freely on the crankshaft.

 # 1 Connecting Rod Bearing:

The bearing was intact and no anomalies were visually observed.

 # 2 Connecting Rod:

The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

 # 2 Connecting Rod:

The bearing was intact and no anomalies were visually observed.

 # 3 Connecting Rod:

The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

 # 3 Connecting Rod Bearing:

The bearing was intact and no anomalies were visually observed.

 # 4 Connecting Rod:

The connecting rod was intact and secure. The rod was to move freely on the crankshaft.

 # 4 Connecting Rod Bearing:

The bearing was intact and no anomalies were visually observed.

 # 5 Connecting Rod:

The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

 # 5 Connecting Rod Bearing:

The bearing was intact and no anomalies were visually observed.

 # 6 Connecting Rod:

The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

 # 6 Connecting Rod Bearing:

The bearing was intact and no anomalies were visually observed.

11. Camshaft

The camshaft was intact and no anomalies were visually observed. The woodruff key was observed in place and intact.

12. Lifters

All the lifters were intact and no visual anomalies were observed. The lifters exhibited lubrication. The lifter piston had full travel up and down within the lifter body.

13. Starter

The starter was intact, although some case damage was observed and exterior thermal damage was observed. The starter shaft rotated without any binding. The wires were melted.

Starter Adapter:

The adapter was intact. The internal gear and clutch was intact and the shaft rotated. Signatures of lubrication were observed. The pulley was damaged.

14. Alternator/Generation

The alternator was intact. Thermal damage and corrosion was observed to the exterior. The pulley would not rotate. The wires were melted and damaged.

15. Accessory Gears

All accessory gears were observed intact and all gear teeth were observed intact.

16. Vacuum Pump

The pump was intact. Thermal damage was observed to the exterior. The coupling was separated and melted.

17. Propeller Governor

The McCauley governor was intact and thermally damaged. The propeller governor cable was damaged. The shaft rotates freely. The gasket and screen were intact and clear of debris.

18. Propeller

Blade: 1, 2, 3:

The propeller remained attached to the crankshaft flange. The hub assembly was crushed aft and twisted around the propeller hub. The propeller exhibited thermal damage. The three blades were attached although loose in the hub. All three blades tips separated. Once separated tip section was located about 350-400 meters from the wreckage site. The section was curled and exhibited heavy gouging and scoring signatures in a chordwise direction. The three blades exhibited curling, s-bending, twisting and chordwise scoring. There was also forward and aft bending signatures to the blades. The large quantity of sludge was observed inside the crankshaft flange.

1.17 Organizational and Management Information

1.17.1 The operator had a valid Air Operating Certificate at the time of the accident. The operator was authorised by the relevant authority to conduct a Non-Scheduled Air Transport Service conveying passengers with the aircraft specified in Scheduled 1 of the Operation Specification. The accident aircraft was included in the Scheduled 1 to Air Operating Certificate (00026).

1.17.2 The Investigator-in-Charge travelled to Swakopmund to investigate the operator to determine the level of compliance of the organisation with part 135 of the Namibian Civil Aviation Regulation, 2001 as amended. This included a review and evaluation of the company management system, operations manual, flight documents, aircraft maintenance and flight crew training. The witness who where present during the investigations where two official from the regulatory authority.

1.17.3 **During the investigations, the following findings were discovered:**

- The operator did not have a functional Quality Management System.
- The operator did not have an approved Operations Manual.
- The Operator did not have a Functional Safety Management System.
- The Operator did not have a Functional Emergency Response Plan.
- The Operator did not have trained personnel to provide operations support as part of its "Operational Control and Supervision" processes.
- The post flight records of the operator indicated that an ATS flight plan is not always filed as required by safety regulations.
- The Operator did not provide adequate supervision of this charter coordinator personnel to provide operations support as part of its "Operational Control and Supervision"processes.
- The post flight records of the operator indicated that an Operational Flight Plan is not always completed as required by safety regulations.
- The post flight records of the operator indicated fuel planning is not always carried out in accordance with safety regulations.
- The post flight records of the operator indicated that in-flight fuel management is not always carried out to ensure compliance with safety regulations.
- The post flight records of the operator indicated that it routinely understated standards weights used for calculating passenger weights.
- The Operator did not have a flight crew training programme nor did the Operator conduct flight crew training as required by safety regulations.

1.18 Additional Information

1.18.1 Performance Calculations

1) General

The calculations were performed on the assumption that aircraft performance was as it would be for a new aircraft and fully performing engine.

After take-off, the aircraft turned northward (left bank), increasing its stall speed.

Note: A stall will always occur when the critical angle of attack, CLmax, is exceeded. This can occur at any airspeed and in any configuration or attitude.

2) Relevant findings at crash site

The aircraft wreckage was found as follows:

- Extended landing gears
- Take-off flaps setting
- Elevator almost max. up (trim tab down)
- Unknown mixture setting
- Most probable at Max take off power(2850RPM)
- Speed at impact about 56.8 knots (calculated from prop marks)

3) Quoting from (POH) Pilot Operating Manual, page 4-8, (short field take off) (9), "The sequence is to retract the flaps after gear retraction and only after reaching 80KIAS". As gear was found extended, it was determined that the flaps were still at 10°.

4) Quoting from the manual, page 4-8, "(short field take off) (8), Mixture - lean for field elevation per fuel flow placard above 3000 feet)". With limited flight experience on a high altitude runway takeoff, we think that mixture was not leaned as advised, which further reduced engine power.

1.18.2 Stall speed

Distance from Rwy 09 threshold to intersection of Rwy 09 with:

Rwy 19 is 1850 ft,
Twy 19 is 2220 ft,

Abeam tower is 2500 ft.

Stall speed (figure). Most rearward center of gravity

Weight	Flap deflection	Angle of bank			
		0°		30°	
		KIAS	KCAS	KIAS	KCAS
3800	UP				
	0°	64	65	69	70
	10°	64	64	69	69

As the actual weight of the aircraft was above the MTOW, it was necessary to calculate the actual stall speed during the flight in question.
The formula for that calculation was as follow:

$$\sqrt{\frac{\text{Actual weight}}{\text{MTOW}}} \text{ X stall speed (MTOW) = actual stall speed}$$

Therefore, for a take off weight of 4100 lb:

$$\sqrt{\frac{4100}{3800}} \times 64 = 1.038 \times 64 = 67 \text{ knots}$$

Similarly, for a take off weight of 4000 lb:

$$\sqrt{\frac{4000}{3800}} \times 64 = 1.026 \times 64 = 66 \text{ knots}$$

1.18.3 Normal procedure during take-off

a) The aircraft lifted off close to the intersection of RWY 09 with RWY 19 and TWY 19, meaning a ground roll distance of about **1900-2200 ft**, short of the required distance, with a supposed lift off speed of **66** knots.

A Cessna 210M aircraft with maximum takeoff weight (MTOW) of **3800 lb** taking off from an altitude **of 5500 ft** and an ambient temperature of **30°C** requires a roll distance of **2350 ft** to reach a lift-off speed of **66KIAS** (stall speed: **64 knots**) and distance of **4300 ft** to clear a **50 ft** obstacle at a speed of **72 KIAS**.

As there was head wind resultant of about **10 knots**, the figures should be reduced by **10%.** Therefore:

Ground roll: 2350-235 = 2115 ft
Total to clear 50 ft obstacle: 4300-430 = 3870 ft

b) Similarly, the distances were calculated for a takeoff weight of **4100 lb**, while comparing to **3200 lb, 3500lb** and **3800lb** (steps of **300 lb**).

The results: 2800 ft roll to reach a speed of 67 knots.
5400 ft to clear a 50 ft obstacle.

Considering the wind resultant (reduction of 10%):
2520 ft roll to reach a speed of 67 knots
4860 ft to clear a 50 ft obstacle.

c) Simililary, the distance were calculated for a takeoff weight of **4000 lb**, while comparing to **3800 lb** and **4100 lb** as 2/3 of the differences.

The results: 2650 ft roll reach a speed of 66 knots, 5050 ft to clear a 50 ft obstacle.

Considering the wind resultant (reduction of 10%):

2400 ft roll reach a speed of 66 knots.
4550 ft to clear a 50 ft obstacle.

1.18.4 Actual takeoff

a) Considering the actual roll distance and our calculations, it was determined that the aircraft lifted off the runway due to its tendency to lift-off (excessive aft C.G.), slightly

above the stall speed (66-68 knots).

b) Due to excessive rear Center of Gravity, there is a possibility of the aircraft's tendency to lift its nose early on take off. As a result the pilot found him self in ground effect flight, with no margin left to manoeuvre the aircraft or to safely recover from the condition.

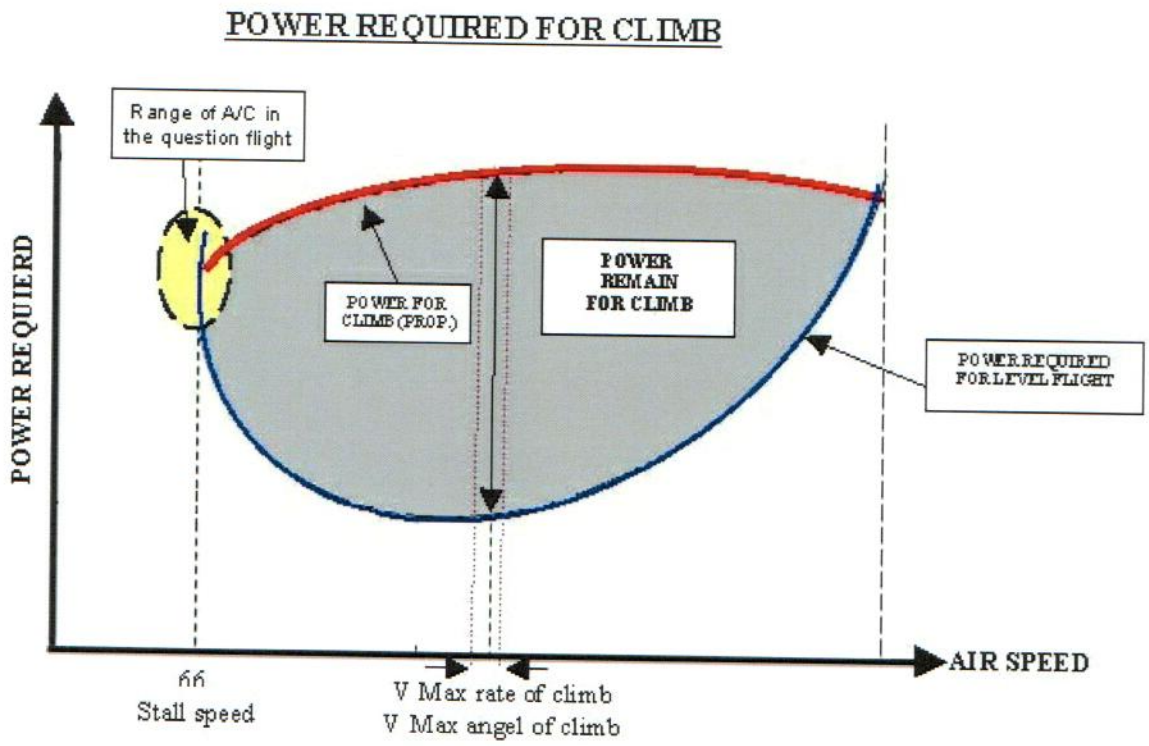
c) The eye witness said that he saw the aircraft lifting-off approximately between the intersection of Rwy 09 with Rwy 19 and Twy 19.

d) Having arrived at the conclusion that the aircraft lifted off by itself when it almost reached stall speed (in ground effect) it was concluded that what the eye witness saw was nose lifting while the aircraft actually continued its roll on ground until abeam tower.

Furthermore, this point strengthens our previous conclusion that the aircraft lifted off at a distance of 2200ft to 2400ft, from Rwy 09 threshold, with a minimal speed of 66 knots.

1.18.5 Rate of climb

Power required for climb chart



The rate of climb was calculated according to the figure 5-5 POH (rate of climb)

a) According to substantial information investigated so far, the aircraft lifted off from the runway at a minimal speed of **66** to **68** kts.

b) At that speed, the aircraft remained in Ground Effect **with a nose set at a relative high attitude** (high angle of attack) along the entire length of the runway, with no speed increase. The terrain past the runway descends and then ascends after about **600 ft.**

c) As the flaps were 10°, mixture setting was unavailable, and the landing gear was not up, it was impossible to calculate the actual rate of climb after take-off. However, for a density altitude of 8000 ft and a weight of 4000 lb (or above) and considering the fact that witnesses saw the aircraft flying very low and with full power during the entire flight from the airport, it was concluded that there was negligible rate of climb (if any).

1.18.6 Speed at impact

The Cessna 210M aircraft has a three-bladed propeller (variable pitch).
As the engine operates at a constant speed, calculations were made to determine the aircraft speed by measuring the distance between the blade marks at impact site. The investigations also revealed that the distance between the first two marks was 20.5 cm.

The formula for calculating the speed at impact was as follows:

$$S = \frac{V}{RPM \times 3 \times 60}$$

Where:

S is the distance between the blade first two marks (meters)
V is the speed of the aircraft (m/sec),

$$V = S \times RPM \times 3 \times 60$$

For an engine rate of 2850 RPM:

$V_{2850} = 0.205 \times 2850 \times 3 \times 60 = 105165$ m/h

V_{2850} = **56.8 knots**

For an engine rate of 2700 RPM:

$V_{2700} = 0.205 \times 2700 \times 3 \times 60 = 99630$ m/h

$V_{2700} = 53.8$

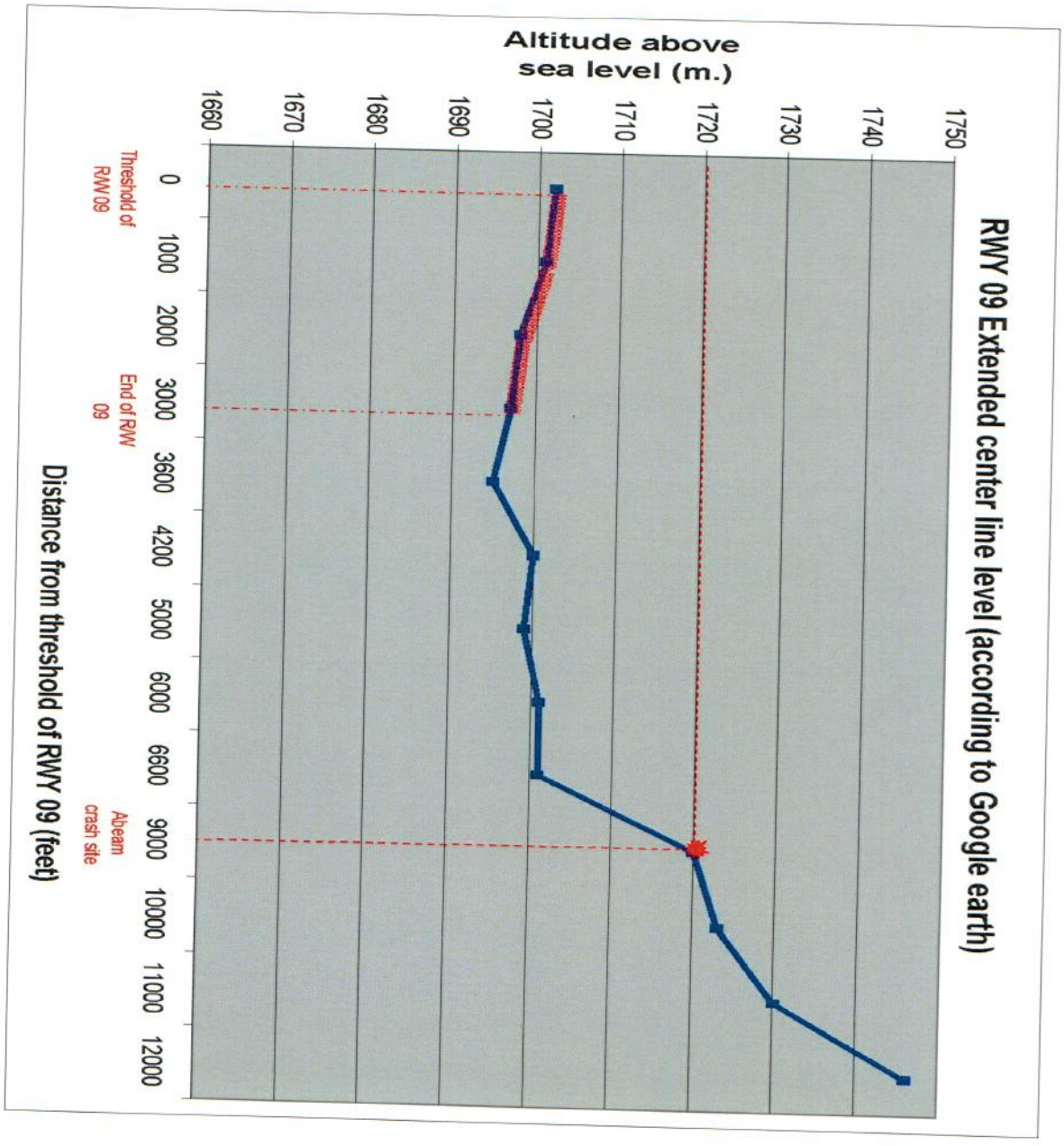
The fact that the aircraft hit the ground at a speed significantly lower than stall speed indicates with certainty that the aircraft was stalled when it crashed.

A. Airport and analysis of ground terrain

Eros airport (ICAO Location Indicator – FYWE) is Windhoek's civilian airport, located at the southern part of town. This airport serves as an alternate airport to Windhoek's international airport (Hosea Kutako Intl., ICAO Location Indicator – FYWH), located about 40 km North-East of town.
There are two runways for takeoff and landing and one taxiway: Rwy 01/19, serving as main runway, 1983meters [6506 ft] long; Rwy 09/27, serving as secondary runway, 1005meters [3297 ft] long; Taxiway parallel of Rwy 01/19 and west of it. Airport average elevation is 1699meters [5575 ft].

Eros airport serves mainly for general aviation (composed mostly of Cessna 210 aircraft) for Namibia's safari areas. Eros airport and Windhoek city are located at the center of a large valley of about 10 kilometers diameter. The valley is circumscribed by mountains and hills. These are highest at the south, descending counter clockwise. Northward, after a moderate ascent of the terrain, there is a continuous descent.
Rwy 09 descends slightly eastward, about 4ft from threshold. The terrain on runway centerline continues to descend for about 200meters and then, ascends. The terrain slightly ascends for about 3000ft and then accentuate for 3000ft more. About 1mile north of Rwy 09 end, the terrain descends slightly.
The terrain to the north of the extended runway centerline (Rwy 09) that continues eastward, and in particular in the direction of the perpendicular line descending from the crash site to the rest of the extended runway centerline – descend to the north.
This fact, combined with the fact that the skyline to the north is lower than it would be in all other directions – enabled the pilot and indeed encouraged him to turn north, as requested by the takeoff clearance, without fully analyzing the dangers inherent in such a maneuver.

Terrain cross section chart



1.19 Useful or Effective Investigation Techniques

1.19.1 None was considered necessary for this investigation.

2. ANALYSIS

A senior employee of NAMGEM, a local diamond company, was on his way to vacation at Mukoti Lodge (FYMO) along with four other passengers. Together, they were looking for a local operator to fly them from Windhoek.

All five employees were Israeli citizens (hereafter "the passengers").

As air operators in Windhoek had no aircraft available to perform this flight, Atlantic Aviation from Swakopmund (FYSM) was hired for the trip.

Aircraft Cessna 210M (registration V5-GWH) landed at EROS airport (FYWE), planned to fly the passengers to Mokuti Lodge.

The pilot boarded the five passengers with their gear. Upon starting the engine, the pilot requested clearance for taxi.

The pilot obtained clearance for Rwy 19 with a warning of down-drafts beyond the runway end, and the tower added that Rwy 09 is available.

The pilot asked for the length of Rwy 09 and was answered "**1.5**". This figure was later corrected to **1005meters**, but all the same, the pilot decided to take off from Rwy 09.

Taking into consideration the airport's altitude (**5575ft**) and the temperature at take off (**31°C**); aircraft performance was very limited (if not worse): density altitude for these conditions is about **8000ft**.

It appears that mixture control lever was set to "**rich**", and that the pilot had very little experience in high altitude and high temperature operation.

At take off, the aircraft lifted at approximately 2/3 of the runway, into the "ground effect" (a cushioning effect caused by the air between the wings and the ground) with minimal air speed for lift off.

After takeoff, the aircraft was unable to gain altitude or speed.

Shortly afterward, as a result of the raising terrain and the clearance to turn north, the aircraft began turning left and entered a stall.

The stall speed, due to banking – whether willingly or unwillingly – caused the aircraft to crash approximately **1 nm** from the runway.

As known from the pilot log book, the pilot flew only once to Eros airport, about a month prior to the accident.

On that previous flight, he landed at Eros airport with 5 passengers and took-off back to Swakopmund with no passengers.

The pilot boarded two passengers from the base airport (Swakopmund) close to sea level and flew for about 1:45 hours, finally landing at Eros,(a distance of 271nm) on Rwy 19.

The ATC gave the pilot the wrong length of the runway but he corrected him self, but the pilot reported that he will stick to his original plan that he intend to take off from Rwy 09.

It is clear that the accident flight was performed in marginal conditions, such as: Short runway – 1005meters [3295 ft]; Runway high elevation of 5575 ft; Runway located in a wide valley, surrounded by mountains and hills; High environment temperature at time of incident - 30°C (at least ISA+25); Aircraft heavy weight, exceeding the manufacturer limits; Aft C.G., beyond the aft limit.

As there was no evidence pointing to technical, engine or control surfaces failure, and as witnesses described the aircraft flying at a low altitude with the engine operating, it was immediately concluded that a dangerous combination of flying technique together with extreme conditions – for that particular flight and in those particular circumstances – caused the pilot to lose control of the aircraft. As a result, the aircraft finally stalled and crashed in a neighborhood close to the airport (about one nm).

Taking into consideration the fact that the pilot was young and with little experience – especially with regards to high altitude airport operation – it is strongly felt that the scenario given, describes with as much accuracy as can be expected, what has probably occurred.

Upon considering the information obtained, the investigation revealed that the said aircraft was in good condition, and serviceable. Therefore, performance was examined for the purpose of considering possible scenarios and causes that may have brought about the said accident.

Based on the measured distance left by the propeller blades on the concrete surface, the investigators were able to calculate with certainty that when the aircraft hit the ground, at the moment of impact it was in a stalled condition.

One explanation would be that the RPM was 2850 (max. take-off power), which would mean that aircraft speed was 56.8 kts. Alternatively, the RPM could have been 2700 (cruise power), which would imply that the speed was 53.8 kts.

The stall speed of a Cessna 210M, with max takeoff weight of 3800lb, is 64 kts.

Following the accident, the written comments of many pilots – some of them very experienced in flying to and from Eros airport – led the investigators to conclude that: In taking off from Eros airport, using Rwy 09 in a Cessna 210M, on a hot day with pilot and five passengers on board, the pilot would be forced to "struggle" in order to gain altitude after takeoff.

A heavy takeoff on a hot day from Rwy 09 would result with a liftoff in Ground Effect. However, even with tremendous experience it would not be possible to save the aircraft from a lack of climb power.

3. CONCLUSION

3.1 Findings

3.1.1 The aircraft had a valid Certificate of Registration and a Valid Certificate of Airworthiness.

3.1.2 The investigations revealed that the aircraft was maintained in accordance with existing regulations, according to the maintenance records available.

3.1.3 The aircraft had enough fuel on board to cover the intended flight.

3.1.4 The investigation of the engine did not reveal any abnormalities.

3.1.5 The fact that the pilot inquired with regard to the length of the runway indicates that he was unfamiliar with the airport data.

3.1.6 Toxicological test for common drug was found to be negative.

3.1.7 The investigations revealed that fatigue was not a factor in this accident.

3.1.8 The passengers were issued with air tickets for the flight.

3.1.9 Visual Meteorological condition prevailed at the time of accident.

3.1.10 Weather was not the factor in this accident.

3.1.11 The weight of the aircraft was above MTOW and the Center of Gravity was beyond aft limit.

3.1.13 Taking into account the fact that the weight was calculated based on recovered debris, investigators considered the possibility that the aircraft was – in reality – considerably heavier than that. Calculations were based on an actual weight of 4,000lbs.

3.1.14 The brief accident flight (just over a minute long from lift-off) was performed with extended landing gear. It is likely that wing flaps, too, were left at 10°.

3.1.15 As a result, the aircraft had an additional drag above the drag taken into account in the performance tables.

3.1.16 There is a strong possibility that the pilot was left with maximum power for takeoff (RPM = 2850) right up until crashing. It may be that the pilot reduced engine power after take-off to "maximum cruise power" (RPM = 2700), thus worsening his situation.

3.1.17 Although we could not obtain substantial information regarding mixture setting. The investigation revealed that the pilot remained in "RICH" setting prior to impact.

3.1.18 It was determined that with a temperature of 31°C, the airport altitude of 5575ft is equivalent to approximately 8000ft density altitude.

3.1.19 The pilot decided to take off from Rwy 09 due to reported down-drafts on runway 19.

3.1.20 The pilot's logbook showed takeoffs performed mostly at sea level, which would

indicate insufficient experience in taking off a C-210M in altitudes such as those present at Eros airport (**5575ft**).

3.1.21 Although the aircraft lifted off at a distance of 2200 to 2400ft from RWY 09 threshold, based on the calculations, there is a strong possibility that the aircraft could have flown almost only in Ground Effect.

3.1.22 With the above conditions, an experienced pilot could have possibly kept the airplane on the ground until reaching the end of the runway and added more speed into a safer climb.

Note: Investigators discovered that remaining on the runway to its end could have given him about 15 knots airspeed more, which would make all the difference.

3.1.23 As the crash site is located 1050meters north of the extended Rwy 09 centerline (at 90°), 1650meters from end of Rwy, it could be defined that the turning radius to the crash site was at most 1000meters. By using the tables of turn radius based on aircraft speed and bank angle, it was possible to determine the actual bank angle which was at least 10°. Such result has a great influence on the stall speed.

3.1.24 Investigations revealed that the aircraft was in overweight configuration, at too low speed and altitude. Therefore, when it banked, it stalled. At that altitude, conditions did not allow for any recovery.

(Note 1 in page 5-11(POH) states that maximum altitude loss during a stall recovery may be as much as **300 feet**).

3.2 Probable Cause(s):

3.2.1 The investigation determined that the probable causes of this accident were:

i) The aircraft hit the ground at a speed significantly lower than stall speed which indicated with certainty that the pilot entered a slow stalled resulting in a total loss of aircraft control upon impact.

ii) Heavy and marginal take-off performance from a high altitude airport with high temperature soaring above 30 degrees Celsius and choosing a short runway for take-off.

iii) Lack of experience as well as lack of briefing regarding the prevailing conditions and Eros airport limitations could explain the pilot's surprise at the premature nose lifting during the take-off run.

3.3 Contributing Factor(s):

3.3.1 Contributing to the accident is attributed to:

i) Improper Flight Planning;
ii) Lack of situational awareness and poor airmanship;
iii) Unfamiliar with Eros airport data;
iv) Not compensating for density altitude and airport surface conditions.

4. SAFETY RECOMMENDATIONS

4.1.1 It is strongly recommended that the operators (Atlantic Aviation/Pleasure Flight & Safaris) fully comply with Part 135 of the Namibia Civil Aviation Regulations, 2001. To fulfil this recommendation, the Regulator (DCA) should audit the operator as per Part 135 in order to determine whether the operator fully complies with NAMCARS. It is suggested that the regulator should give the operator a limited time to rectify discrepancies (if any).

4.1.2 It is recommended that both the Regulator (DCA) and all charter operators ensure that pilots are made aware of the conditions surrounding density altitude, temperatures and the effect on engine performance in a hot and high environment.

4.1.3 It is suggested that operators train their pilots about fuel management during take-off. For example, pilots to be vigilant at all times and ensure that sufficient fuel flow is maintained for the particular engine in order to maintain full power during take-off. Awareness surrounding engine sound and more importantly, initial acceleration, remains the most important means for a safe take-off. To satisfy this recommendation, it is suggested that the regulator should put measures in place regarding pilots training to include proper fuel management during take-off.

4.1.4 It is recommended that charter operators strongly encourage their pilots to do proper flight planning prior to every flight to be carried out. It is suggested that Company managers and Chief pilots be responsible for this recommendation.

4.1.5 It is strongly recommended that a strong emphasis need to be placed on the importance of operator proficiency checks. The following suggestions are made regarding operator proficiency checks. The regulator should put measures in place to successfully fulfill these suggestions.

a) Pilots need to conduct an operator proficiency check at least every 12 months regardless whether it is a part 121 or 135 operation.

b) The proficiency check should include the following sections:

- Aircraft systems and understanding thereof
- Weight and balance
- Air law and regulations
- Aircraft handling
- Short field take-offs and landings
- Maximum weight handling of aircraft
- Aircraft performance at higher elevation airfields

4.1.6 Pilots must always remain situational aware and should remember that the ultimate responsibility for every flight lies with the pilot and not with the Air Traffic Controller. It is therefore recommended that Air Traffic Controllers refrain from ideas of suggesting runways and/or any other actions to pilots. Chief Air Traffic Control Officer to encourage Controllers in this regard.

4.1.7 Regulatory Authority (DCA) should get adequate inspectors to monitor aircraft operators and the activities of the charter companies and take appropriate measures regarding those found not to be complying with NAMCARS (Namibia Civil Aviation

Regulations).

4.1.8 It is suggested that any commercial pilot obtaining a conversion onto type especially Cessna 210, should complete the following training: Dual conversion training and Route training.

A. Dual conversion Training.

i) He/she should obtain a minimum of 5 hours of experience on type, excluding the type rating test, before a rating will be issued.

ii) Two (2) hours of briefing will be done regarding the systems of the aircraft and gravel field operations, as well as other operations specific to Namibia (i.e. hot and high, short field operations etc).

iii) Written technical examinations regarding the aircraft and systems should be conducted.

iv) An oral examinations should be taken, which should include the following elements:

- Aircraft limitations
- Emergency procedures
- Technical systems of the aircraft
- Law and legislation on parts 61,91,121 and 135
- Company specific Operating Procedures

B. Route Training

i) The converted pilot should gain at least 50 hours of route experience with an experienced pilot.
ii) The route training should include at least 6 sectors.
iii) Three (3) of these sections should be conducted from airfields with an elevation greater than 3000 feet.
iv) Three (3) sections should be conducted from gravel fields.
v) At least one (1) section should be conducted at maximum all up weight of the aircraft.
vi) Each leg of the route training will require the completion of a route training progress sheet, recording the progress of the pilot. This training record should be kept in the pilots training file.
vii) Each progress sheet should be signed by both the pilot receiving route training and the senior pilot. This will indicate that the pilot receiving training has understood what is required of him/her and knows what the required standard is.
viii) Upon completion of the route training, the operator should conduct a proficiency check on the pilot.
ix) This proficiency check should be conducted by a Senior Pilot.
x) Pending the result of the proficiency check the pilot will be then allowed to fly online.
xi) The Designated Examiner, as well as the Accountable Manager and or Chief Pilot of the company should sign the proficiency report, acknowledging the

understanding of the requirements and indicating that the pilot meets such standards.

4.1.9 **Note:** The regulator should appoint professionals and/or Designated Examiners to decide on the suggestions of Dual conversion training and Route training.

5. APPENDICES

Appendix A, pages 1 – 43

Compiled by:

.....
Erickssson M. Nengola
Director of Aircraft Accident Investigations Date: 26/08/2008

Released by:

.....
Helmut K. Angula, MP
MINISTER: MINISTRY OF WORKS AND TRANSPORT Date: 27/08/2008

Ministry of Works and Transport
27 AUG 2008
Office of the Minister

DATE: 25-04-2006

AIRCRAFT TYPE: CESSNA 210M REGISTRATION: V5-GWH.

AIRCRAFT SERIAL NO.: 210-61648

OWNER NAME AND ADDRESS: ATLANTIC AVIATION.
P.O Box 537
SWAKOPMUND
NAMIBIA.

DATUM OF AIRCRAFT DEFINED AS FOLLOWS:

STATION. 0.0 TAKEN AT FIREWALL FRONT FACE LOWER PORTION.

DIGHING POINT:	OBSERVED MASS	ARM(as measured)	MOMENT
RIGHT MAIN WHEEL:	882	64.0	56448
LEFT MAIN WHEEL:	926	64.0	59264
NOSE WHEEL:	529	7,4	-3914,6
TOTAL AS WEIGHED:	2337		111797,4
ADJUSTMENTS:	0		
TOTAL EMPTY MASS:	2337	RESULTANT MOMENT	111797,4

CENTRE OF GRAVITY CALCULATION FROM THE ABOVE IS AS FOLLOWS:

C OF G = RESULTANT MOMENT / TOTAL EMPTY MASS = 111797,4 / 2337

C OF G = 47,83 INCHES FORWARD / AFT OF DATUM

ENGINEERS SIGNATURE _____ LICENCE/ A.M.E. NO. _____

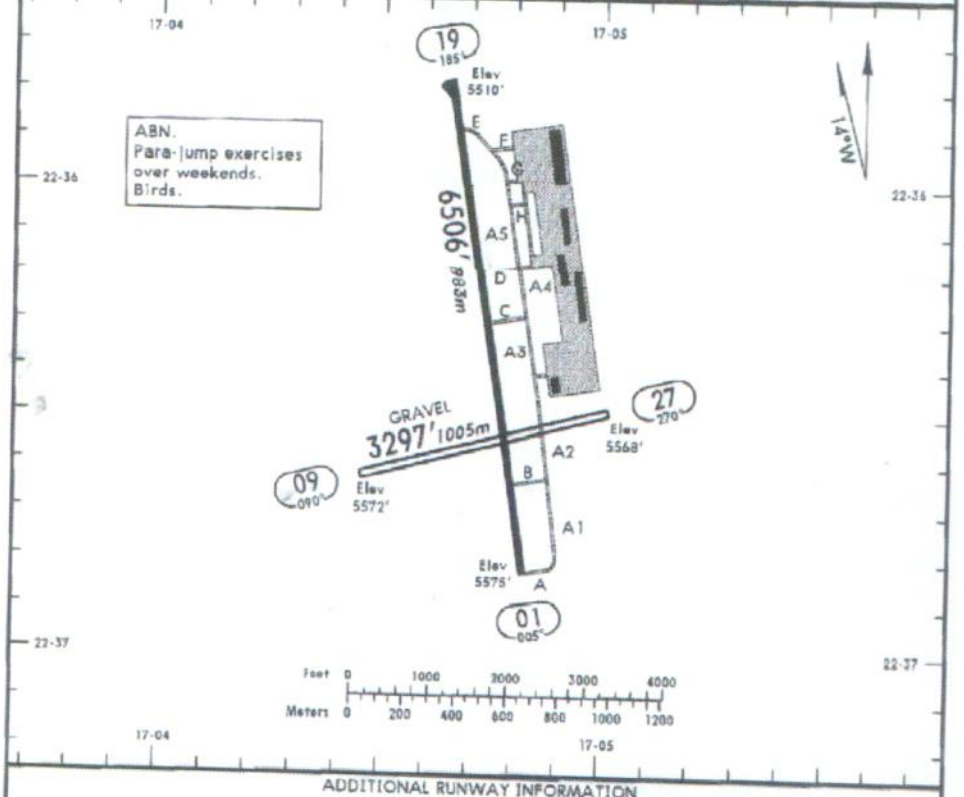
JEPPESEN
JeppView 3.5.2.0

FYWE/ERS
Apt Elev 5575'
S22 36.5 E017 04.8

JEPPESEN
11 NOV 05 (20-9) Eff 24 Nov

WINDHOEK, NAMIBIA
EROS INTL

*EROS Ground	*Tower
121.7	118.7



ADDITIONAL RUNWAY INFORMATION

RWY		USABLE LENGTHS — LANDING BEYOND Threshold	LANDING BEYOND Glide Slope	TAKE-OFF	WIDTH
01	HIRL (60m) PAPI (angle 4.3°)	NIGHT NA			98'
19	HIRL (60m) PAPI (angle 3.0°)			NIGHT NA	30m
09		NIGHT NA		NIGHT NA	98'

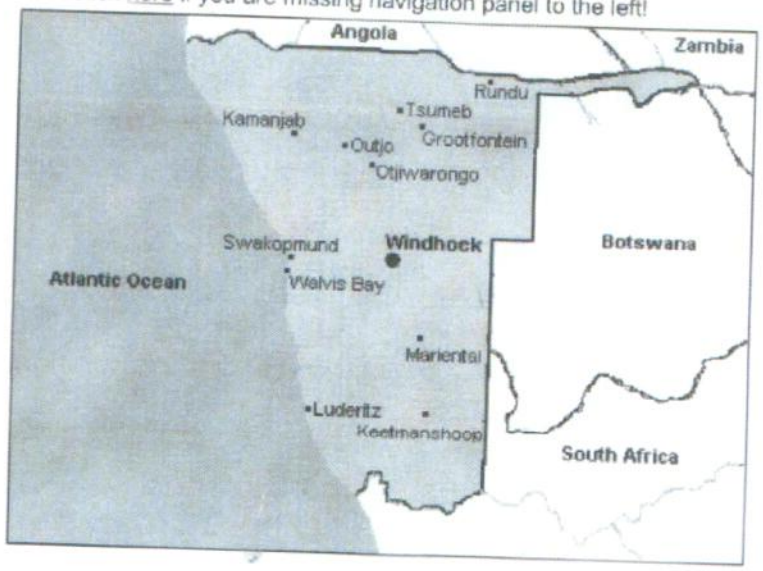
JAR-OPS

TAKE-OFF 1

	LVP must be in force	All Rwys	
	RCLM (DAY only) or RL	RCLM (DAY only) or RL	NIL (DAY only)
A			
B	250m	400m	500m
C			

Airports in Namibia

Click in the map or on the links listed to view airport web sites.
Click here for the map of Africa.
Click here if you are missing navigation panel to the left!



Click here for explanations on technical data

Town	Airport name	ICAO	IATA	Usage	Customs	Runway	IFR	Rwy length
Arandis	Arandis	FYAR	ADI	Priv.	No	Paved	Yes	6300 ft
Bethanien	Bethanien	FYBC		Priv.	No	Unpaved	No	3000 ft
Gobabis	Gobabis	FYGB		Civ.	No	Unpaved	No	7400 ft
Grootfontein	Grootfontein	FYGF	GFY	Civ.	Pto.	Paved	Yes	11600 ft
Kamanjab	Kamanjab		FYKJ	Civ.	No	Unpaved	No	6000 ft
Karibib	Karibib	FYKA		Civ.	No	Paved	No	8300 ft
Katima Mulilo	Katima Mulilo	FYKM	MPA	Civ.	O/R	Paved	No	6400 ft
Keetmanshoop	Keetmanshoop	FYKT	KMP	Civ.	No	Paved	Yes	7700 ft
Luderitz	Luderitz	FYLZ	LUD	Civ.	O/R	Paved	No	6000 ft
Mariental	Mariental	FYML		Civ.	No	Paved	No	6500 ft
Mokuti Lodge	Mokuti Lodge	FYMO		Civ.	No	Unpaved	No	7200 ft
Mount Etjo	Mount Etjo	FYME		Priv.	No	Unpaved	No	5600 ft
Namutoni	Namutoni	FYNA	NNI	Priv.	No	Unpaved	No	3500 ft
Okaukuejo	Okaukuejo	FYOO	OKF	Priv.	No	Unpaved	No	4800 ft
Ondangwa	Ondangwa	FYOA	OND	Civ.	O/R	Paved	No	9700 ft
Oranjemund	Oranjemund	FYOG	OMD	Priv.	Pto.	Paved	No	4200 ft
Otjiwarongo	Otjiwarongo	FYOW		Civ.	No	Unpaved	No	3500 ft
Outjo	Outjo	FYOJ		Civ.	No	Unpaved	No	6100 ft
Rundu	Rundu	FYRU	NDU	Civ.	O/R	Paved	No	7900 ft
Swakopmund	Swakopmund	FYSM	SWP	Civ.	No	Unpaved	No	5200 ft
Tsumeb	Tsumeb	FYTM	TSB	Priv.	No	Paved	No	4800 ft
Tsumkwe	Tsumkwe	FYTK		Civ.	No	Unpaved	No	5900 ft
Walvis Bay	Walvis Bay	FYWB	WVB	Mil.	No	Paved	Yes	6900 ft
Windhoek	Eros	FYWE	ERS	Civ.	No	Paved	Yes	6400 ft
Windhoek	Hosea Kutako Intl	FYWH	WDH	Civ.	Yes	Paved	Yes	15000 ft

Explanations on technical data

ICAO-code

International Civil Aviation Organization (ICAO), a 4-letter airport location indicator. The field above is left blank if no ICAO location indicator is available for the selected airport.

IATA-code

International Air Transport Association (IATA), a 3-letter identifier for the relevant airport. The field above is left blank if no IATA code is available for the selected airport.

Usage

Airports are classified in three categories: civil airports open for public use, military airports and private airports not open to the public. Airports that are joint use, both civil and military, are shown as civil airports.

Civ. Civil airport, open for public use (including joint use).

Mil. Military airport, not open for public use.

Priv.	Private airport, not open for public use.

Customs

Yes	Customs service available during airport operating hours.
No	Customs service not available.
O/R	Airport has customs service, prior notification is required.
Pto.	Airport has part-time customs service available, not necessarily identical to the airport hours.
ADCUS	An airport within the USA for which the FAA 'ADCUS' method of prior notification may be used.
ADCUS O/R	An airport within the USA for which the FAA 'ADCUS' method of prior notification may be used but where restrictions apply.

Runway

Identification of the surface of the longest runway available:

Paved	Paved (hard surface) runway
Unpaved	Unpaved (soft surface) runway (Only lighter aircraft)
Water	Water (for float planes)

IFR

This field indicates if the airport has any officially published instrument approach procedure.

Yes	Instrument approach procedure is published.
No	Instrument approach procedure is not published. (Airport not suitable for traffic during bad weather or darkness.)

Runway Length

Shows the length in feet of the longest runway available at the selected airport, rounded down to the next full hundred feet. If the airport has both hard (paved) and soft (unpaved) runways, the length of the longest hard surface runway is shown. If the longest runway is both, hard and soft surface, the length of the hard surface portion is shown.

Back to top of page

Windhoek Hosea Kutako International Airport

From Wikipedia, the free encyclopedia

Hosea Kutako International Airport

IATA: WDH - ICAO: FYWH

Summary	
Airport type	public
Operator	Namibian Civil Government
Serves	Windhoek
Elevation AMSL	5640 ft (1719 m)
Coordinates	22°29′12″S, 17°27′45″E (http://tools.wikimedia.de/~magnus/geo/geohack.php?pagename=Windhoek_Hosea_Kutako_International_Airport&params=22_29_12_S_17_27_45_

Runways

Direction	Length		Surface
	ft	m	
08/26	15,327	4,673	Asphalt
16/34	5,000	1,524	Asphalt

Hosea Kutako International Airport seen from the air

Windhoek Hosea Kutako International Airport (IATA: **WDH**, ICAO: **FYWH**) is the main international airport serving the Namibian capital city of Windhoek. Located 45 kilometres outside the city, it is Namibia's leading airport with international connections and handled 514,000 passengers in 2004.

Few, if any, domestic flights pass through Hosea Kutako Airport as those are predominantly handled at the smaller Windhoek Eros Airport. Public buses connect both airports to each other and to downtown Windhoek.

Airlines and destinations

- Air Namibia (Cape Town, Frankfurt, Johannesburg, London-Gatwick, Luanda, Maun, Victoria Falls)
- Air Botswana (Gaborone)
- British Airways
  - British Airways operated by Comair (Johannesburg)
- Kulula.com (Johannesburg)
- LTU International (Düsseldorf, Munich)
- South African Airways (Johannesburg)
  - South African Airways operated by South African Express (Cape Town)
- TAAG Angola Airlines (Luanda, Lubango)

Eros Airport

From Wikipedia, the free encyclopedia

Eros Airport (Windhoek Eros Airport)			
IATA: ERS - ICAO: FYWE			
Summary			
Airport type	Civil		
Operator	Namibia Airport Company Ltd.		
Serves	Windhoek		
Elevation AMSL	5,575 ft (1,699 m)		
Coordinates	22°36′44.06″S, 17°04′49.59″E (http://tools.wikimedia.de/~magnus/geo/geohack.php?pagename=Eros_Airport&params=22_36_44.06_S_17_04_49.59_E_type:airport)		
Runways			
Direction	**Length**		**Surface**
	ft	**m**	
01/19	7,381	2,250	Asphalt
09/27	3,297	1,005	Asphalt

Eros Airport or **Windhoek Eros Airport** (IATA: **ERS**, ICAO: **FYWE**) is an airport in Windhoek, Namibia. It is a busy hub of general aviation and one of the busiest airports in the SADC region. Eros is the host to commercial, private, and scheduled traffic ranging from high performance jet aircraft to Cessna 152 trainers.

The airport handles approximately 150 to 200 movements per day (around 50,000 per year).

The majority of traffic comes from the general aviation charter market, consisting mainly of the Cessna 210 aircraft, which is the most commonly used aircraft for charter and fly-in safaris in Namibia.

Eros is an alternate for Windhoek International Airport in VMC conditions. The largest passenger aircraft to land at Eros is the Boeing 737 on a diversion from Windhoek International due to strong crosswinds and windshear.

In 2004, the airport served 141,605 passengers.

Scheduled domestic services

- Air Namibia (Mpacha, Ondangwa, Oranjemund, Walvis Bay, Lüderitz, Cape Town)

External links

- Airport information for FYWE (http://worldaerodata.com/wad.cgi?airport=FYWE) at World Aero Data

Categories: Airports in Namibia | Khomas Region | Windhoek | Namibia stubs | African airport stubs

External links

- Hosea Kutako International Airport (http://www.airports.com.na/hosea_air.php) from Namibia Airports Company LTD (operators of the airport)
- Private site about Hosea Kutako International Airport (http://africa.cwsurf.de/HoseaKutako.htm)
- Airport information for FYWH (http://worldaerodata.com/wad.cgi?airport=FYWH) at World Aero Data

Retrieved from "http://en.wikipedia.org/wiki/Windhoek_Hosea_Kutako_International_Airport"

Categories: Airports in Namibia | Khomas Region | Windhoek | Namibia stubs | African airport stubs

---

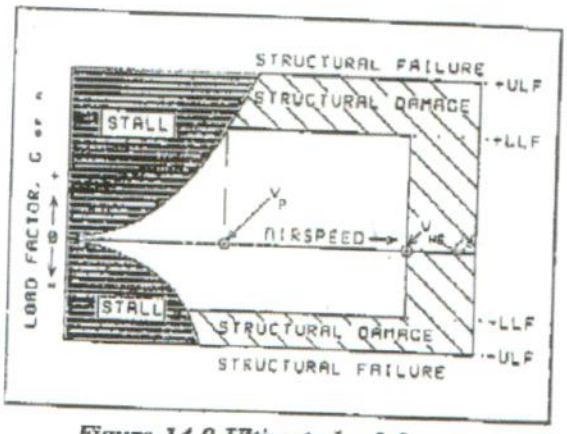


Figure 14.9 Ultimate load factors.

Radius of Turn

A body traveling in a circular path is undergoing an acceleration toward the center of rotation. This is called *radial acceleration*, a_R. It is a function of the velocity of the body, V, and the radius, r, of the circle:

$$a_R = \frac{V^2}{r} \tag{14.10}$$

As was shown in Figure 14.1, the horizontal component of the total lift is the centripetal force that causes the radial acceleration. Also, the reaction force to the centripetal force, called the *centrifugal force*, (CF) is equal in magnitude and opposite in direction to the centripetal force.

The centripetal force in an automobile, which is making a turn, is generated by the friction of the car's tires on the pavement. The force that pulls the driver outward, away from the center of the turn, is the centrifugal force.

Since the centrifugal force is equal to the centripetal force in magnitude and results from the radial acceleration, it is, according to Newton's second law, equal to the mass times the radial acceleration:

$$CF = ma_R = \left(\frac{W}{g}\right)\left(\frac{V^2}{r}\right) \tag{14.11}$$

Equation 14.4 showed that this force is:

$$CF = L \sin \phi$$

Equating CF values gives:

$$L \sin \phi = \frac{WV^2}{gr} \tag{14.12}$$

Equation 14.1 then can be rewritten as:

$$L \cos \phi = W \tag{14.13}$$

By dividing equation 14.12 by equation 14.13 we obtain:

$$\tan \phi = \frac{V^2}{gr} \quad or \quad r = \frac{V^2}{g \tan \phi} \tag{14.14}$$

This is the radius of turn equation.

Equation 14.14 was derived in basic units, and thus the velocity is in units of feet per second. If V is measured in knots:

$$r = \frac{V_K^2}{11.26 \tan \phi} \tag{14.15}$$

Where: r = radius of turn (ft)
V_K = velocity (knots TAS)
ϕ = bank angle (degrees)

Rate of Turn

The *rate of turn*, ROT, is primarily used during instrument flight and is, simply, the change in heading of the aircraft per unit of time:

$$ROT = \frac{g \tan \phi}{V_{FPS}} \quad (radians/sec)$$

If velocity is in knots and ROT is measured in degrees per second:

$$ROT = \frac{1091 \tan \phi}{V_K} \tag{14.16}$$

The importance of bank angle and velocity can be seen in equations 14.15 and 14.16. High bank angles and slower airspeeds produce small turn radii and high ROT.

The maneuver speed is the speed at which highest bank angle can be achieved at minimum airspeed. Minimum turn radius and maximum rate of turn will be realized at this speed.

Figure 14.10 is a chart that shows turn radii and rates of turn for various bank angles and airspeeds for an aircraft making a coordinated, constant altitude turn.

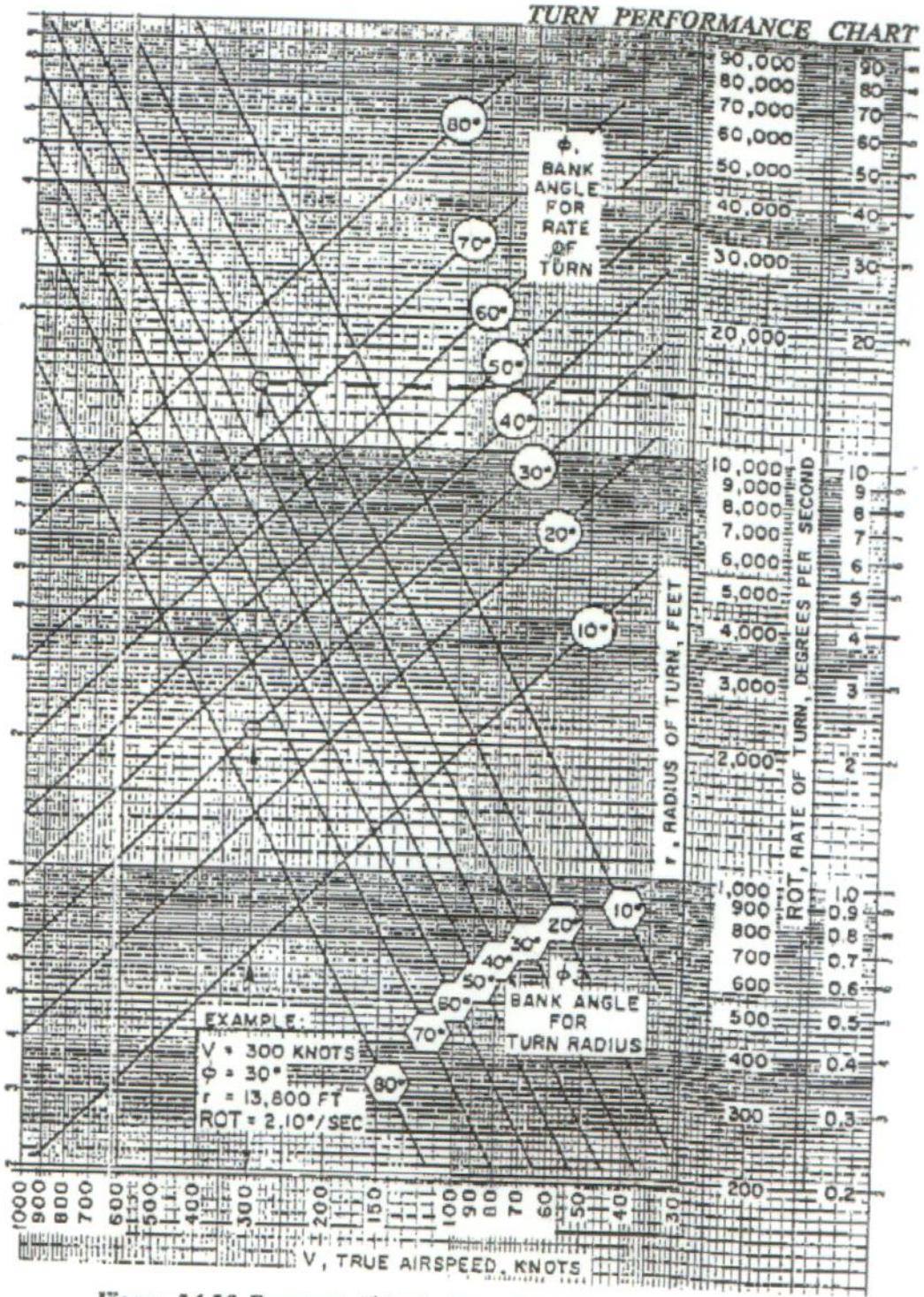


Figure 14.10 Constant Altitude Turn Performance.

(9) Throttle -- 1700 RPM.
   a. Magnetos -- CHECK (RPM drop should not exceed 150 RPM on either magneto or 50 RPM differential between magnetos).
   b. Propeller -- CYCLE from high to low RPM; return to high RPM (full forward).
   c. Engine Instruments and Ammeter -- CHECK.
   d. Suction Gage -- CHECK in green arc.
(10) Avionics Power Switch -- ON.
(11) Radios -- SET.
(12) Autopilot (if installed) -- OFF.
(13) Flashing Beacon, Navigation Lights and/or Strobe Lights -- ON as required.
(14) Throttle Friction Lock -- ADJUST.
(15) Parking Brake -- RELEASE.

TAKEOFF

NORMAL TAKEOFF

(1) Wing Flaps -- 0°- 10° (10° preferred).
(2) Power -- FULL THROTTLE and 2850 RPM.
(3) Mixture -- RICH (lean for field elevation per fuel flow placard above 3000 feet).
(4) Elevator Control -- LIFT NOSE WHEEL at 60 to 70 KIAS.
(5) Climb Speed -- 80-90 KIAS.
(6) Brakes -- APPLY momentarily when airborne.
(7) Landing Gear -- RETRACT in climb out.
(8) Wing Flaps -- RETRACT.

SHORT FIELD TAKEOFF

(1) Wing Flaps -- 10°.
(2) Brakes -- APPLY.
(3) Power -- FULL THROTTLE and 2850 RPM.
(4) Mixture -- RICH (lean for field elevation per fuel flow placard above 3000 feet).
(5) Brakes -- RELEASE.
(6) Elevator Control -- SLIGHTLY TAIL-LOW.
(7) Climb Speed -- 72 KIAS until all obstacles are cleared.
(8) Landing Gear -- RETRACT after obstacles are cleared.
(9) Wing Flaps -- RETRACT after reaching 80 KIAS.

NOTE

Do not reduce power until wing flaps and landing gear have been retracted.

STALL SPEEDS

CONDITIONS:
Power Off
Gear Up or Down

NOTES:
1. Maximum altitude loss during a stall recovery may be as much as 300 feet.
2. KIAS values are approximate.

MOST REARWARD CENTER OF GRAVITY

WEIGHT LBS	FLAP DEFLECTION	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
3800	UP	64	65	69	70	76	77	91	92
	10°	64	64	69	69	76	76	91	91
	30°	50	56	54	60	59	67	71	79

MOST FORWARD CENTER OF GRAVITY

WEIGHT LBS	FLAP DEFLECTION	ANGLE OF BANK							
		0°		30°		45°		60°	
		KIAS	KCAS	KIAS	KCAS	KIAS	KCAS	KIAS	KCAS
3800	UP	68	69	73	74	81	82	96	98
	10°	68	68	73	73	81	81	96	96
	30°	55	61	59	66	65	73	78	86

Figure 5-3. Stall Speeds

TAKEOFF DISTANCE

3500 LBS AND 3200 LBS

SHORT FIELD

REFER TO SHEET 1 FOR APPROPRIATE CONDITIONS AND NOTES.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
3500	63	69	S.L.	925	1495	990	1605	1065	1720	1145	1845	1225	1980
			1000	1010	1640	1085	1760	1165	1885	1250	2030	1340	2180
			2000	1105	1800	1185	1930	1275	2080	1370	2235	1470	2410
			3000	1210	1980	1300	2130	1400	2295	1505	2475	1615	2680
			4000	1325	2190	1425	2360	1535	2550	1650	2755	1775	2990
			5000	1460	2430	1570	2625	1690	2845	1820	3090	1960	3365
			6000	1605	2715	1730	2940	1865	3195	2005	3490	2160	3825
			7000	1770	3050	1910	3320	2060	3630	2220	3990	2395	4415
			8000	1960	3460	2115	3790	2280	4175	2460	4640	2655	5215
3200	60	66	S.L.	755	1220	810	1305	865	1395	930	1490	995	1595
			1000	820	1330	880	1425	945	1525	1015	1635	1090	1750
			2000	895	1455	965	1560	1035	1670	1110	1790	1190	1925
			3000	980	1595	1055	1710	1135	1835	1215	1970	1305	2120
			4000	1075	1755	1155	1880	1240	2025	1335	2180	1435	2350
			5000	1180	1935	1270	2080	1365	2240	1470	2415	1580	2610
			6000	1300	2140	1395	2305	1500	2490	1615	2695	1740	2920
			7000	1430	2380	1540	2575	1655	2785	1785	3025	1920	3295
			8000	1575	2665	1700	2885	1830	3140	1970	3425	2125	3755

Figure 5-4. Takeoff Distance (Sheet 2 of 2)

TAKEOFF DISTANCE

MAXIMUM WEIGHT 3800 LBS

SHORT FIELD

CONDITIONS:
Flaps 10°
2850 RPM and Full Throttle Prior to Brake Release
Mixture Set at Placard Fuel Flow
Cowl Flaps Open
Paved, Level, Dry Runway
Zero Wind

MIXTURE SETTING	
PRESS ALT	PPH
S.L.	144
2000	138
4000	132
6000	126
8000	120

NOTES:
1. Short field technique as specified in Section 4.
2. Landing gear extended until takeoff obstacle is cleared.
3. Where distance value has been deleted, climb performance after lift-off is less than 150 fpm. Rate of climb is based on landing gear extended and flaps 10° at takeoff speed.
4. Decrease distances 10% for each 10 knots headwind. For operation with tailwinds up to 10 knots, increase distances by 10% for each 2.5 knots.
5. For operation on a dry, grass runway, increase distances by 15% of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	0°C		10°C		20°C		30°C		40°C	
	LIFT OFF	AT 50 FT		GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS	GRND ROLL	TOTAL TO CLEAR 50 FT OBS
3800	66	72	S.L.	1120	1820	1205	1960	1295	2105	1390	2265	1495	2440
			1000	1225	2005	1320	2155	1420	2320	1525	2505	1640	2705
			2000	1345	2210	1445	2380	1555	2570	1675	2785	1800	3020
			3000	1475	2450	1585	2645	1710	2865	1840	3110	1980	3390
			4000	1620	2725	1745	2955	1880	3210	2025	3505	2180	3840
			5000	1785	3055	1925	3325	2075	3630	2235	3990	2410	4415
			6000	1970	3455	2125	3780	2290	4160	2470	4615	2665	5185
			7000	2180	3950	2350	4365	2540	4860	2740	5485	- - -	- - -
			8000	2415	4595	2610	5155	- - -	- - -	- - -	- - -	- - -	- - -

Figure 5-4. Takeoff Distance (Sheet 1 of 2)

RATE OF CLIMB

MAXIMUM

CONDITIONS:
Flaps Up
Gear Up
2700 RPM
Full Throttle
Mixture Set at Placard Fuel Flow
Cowl Flaps Open

MIXTURE SETTING	
PRESS ALT	PPH
S.L.	138
4000	126
8000	114
12,000	102

WEIGHT LBS	PRESS ALT FT	CLIMB SPEED KIAS	RATE OF CLIMB - FPM			
			-20°C	0°C	20°C	40°C
3800	S.L.	97	1020	930	835	745
	2000	95	895	810	720	635
	4000	94	775	690	610	525
	6000	93	655	575	495	415
	8000	91	535	460	380	300
	10,000	90	420	345	270	- - -
	12,000	89	310	235	160	- - -
3500	S.L.	95	1155	1060	965	865
	2000	94	1025	935	840	750
	4000	93	895	810	720	635
	6000	91	770	685	605	520
	8000	90	645	565	485	405
	10,000	89	520	445	370	- - -
	12,000	87	405	325	250	- - -
3200	S.L.	94	1310	1210	1110	1010
	2000	92	1165	1070	975	880
	4000	91	1030	940	850	760
	6000	90	895	810	725	640
	8000	88	765	685	605	520
	10,000	87	635	555	480	- - -
	12,000	86	510	435	355	- - -

Figure 5-5. Rate of Climb

Air Safety Investigations

ENGINE FIELD INSPECTION REPORT

FINAL

ENGINE MODEL: IO-520L (7)

ENGINE SERIAL: 294831-R

AIRCRAFT MODEL: C210M

SERIAL NUMBER: 210-61648

REGISTRATION: V5-GWH

Examiner	Signature	Date
G. Schmidt		1/24/08

GENERAL INFORMATION			
EXAMINATION		ACCIDENT DATA	
Date	1/17/08 – 1/18/08	Investigator In Charge	Deo Tjihukununa
Facility	Aviation Center Ltd.	NTSB Accredited Representative	Dennis Jones
Address	Eros Airport	Law Enforcement	N/A
City	Windhoek	Coroner/Medical Examiner	N/A
Country	Republic of Namibia, Africa		

ENGINE INFORMATION	
Make	Teledyne Continental Motors
Model	IO-520L (7)
Serial No.	294831-R
Engine Position	Front
Total Time	4255.02
Time SOH	456.7
Build Date	1997
In Service Date	Unknown

AIRCRAFT / ACCIDENT INFORMATION	
Aircraft Make	Cessna Aircraft Company
Aircraft Model	210M
Aircraft Serial No.	210-61648
Registration No.	V5-GWH
Accident Date	1/11/08
Accident Location	Windhoek, Republic of Namibia

Significant logbook information:

The logbooks are in the custody of the Namibia CAA. The logs were allowed to be researched by this writer. The engine was first overhauled on 1/8/01 at 1887.9 total hours. The #2 cylinder was replaced due to a crack on 11/18/02 at 596.0 hours since engine overhaul. The #3 cylinder was overhauled on 10/15/03 at 1189.9 hours since engine overhaul. All 6 cylinders were overhauled on 4/20/04 at 1492.6 hours since engine overhaul. A second major overhaul was performed on the engine due to a "bad oil sample" (according to the engine logbook), 4/28/05 at 1910.6 hours since initial engine overhaul. The engine was overhauled by WestAir in Windhoek, Namibia. On 3/22/07 the engine was re-installed with 00.0 hours since second overhaul. The #5 cylinder was overhauled on 8/24/07 at 256.3 hours since second overhaul. The #3 cylinder was overhauled on 8/28/07 at 256.3 hours since second overhaul. The last observed maintenance entry was dated 11/29/07 with 456.7 hours accrued.

Report Summary: **Search Code:**

The engine inspection occurred in the presence of the Namibia CAA, Investigator in charge. Thumb compression and exhaust was noted on all 6 cylinders. Crankshaft and valve train continuity was established, via multiple rotations. The engine external components were removed and the engine core was disassembled, with the exception of the counterweights from the crankshaft and the valves, rocker arms and valve springs from the cylinders. The fuel drive coupling was retained and a sample of debris from the engine driven fuel pump was retained by the CAA for NTSB metallurgical analysis.

No visual pre-accident anomalies were observed during the engine inspection. Superior Parts engine components were observed within the engine.

Disposition of engine following exam: Remains in the custody of the Namibia CAA, as of this writing.

Inspection Witnesses			
Name	Deo N. Tjihukununa	Name	Theo Shilongo
Address	Private Bag 12042, Windhoek, Namibia	Address	Private Bag 12042, Windhoek, Namibia
Organization	Directorate of Aircraft Accident Investigation	Organization	Directorate of Aircraft Accident Investigation
Phone No	+264-61-208-8406	Phone No	+264-61-208-8408
Name	Henry Soderlund	Name	Greg Schmidt
Address	1780 Airport Road, Wichita, KS 67209	Address	2039 Broad Street, Mobile, AL 36615
Organization	Cessna Aircraft Company	Organization	Teledyne Continental Motors
Phone No	316-946-1802	Phone No	251-436-8520
Name		Name	
Address		Address	
Organization		Organization	
Phone No		Phone No	
Name		Name	
Address		Address	
Organization		Organization	
Phone No		Phone No	

EXTERNAL INSPECTION OF ENGINE: There was thermal damage to the engine and all external components. The inspection occurred at the Aviation Center Ltd. facility. The engine was initially viewed on the ground in a hangar with the firewall and instrument panel section attached. The engine was removed via a forklift and taken to a secure and sterile environment for further inspection and disassembly.









ENGINE TEARDOWN AND COMPONENT EXAMINATION

Exhaust System	The exhaust system remained attached to the engine. The exhaust pipes and exhaust muffler assembly were bent and deformed and exhibited thermal damage. Corrosion was observed at the muffler. Deformation was observed to the exhaust pipe.

Induction System

The induction system remained attached to the engine. The induction tubes were thermally damaged and melted.

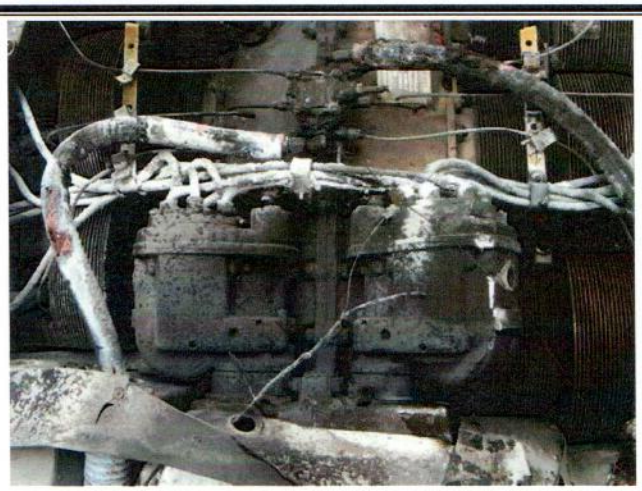
IGNITION SYSTEM:

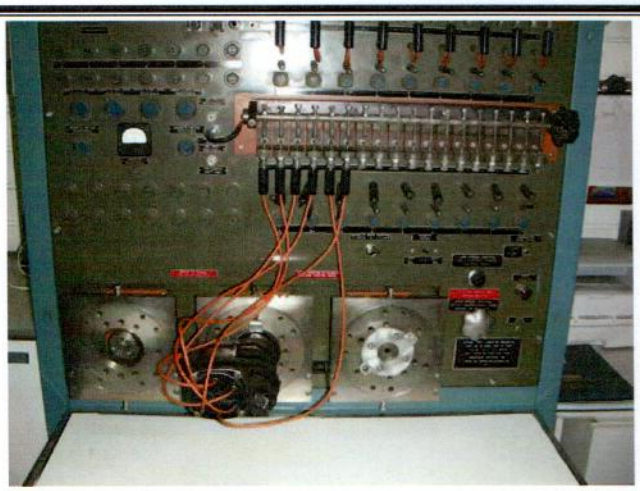
R/H Magneto Manufacturer: Bendix Model/Part Number: S6RN-1225 Serial #: A12337_

Condition: The magneto was intact and remained attached to the engine mounting pad. Internal and external thermal damage was observed. During the bench test, coupling engagement was noted, although spark was not observed. The harness assembly could not be used during the test due to thermal damage.

L/H Magneto Manufacturer: Bendix Model/Part Number: S6RN-1225 Serial #: A123390

Condition: The magneto was intact and remained attached to the engine mounting pad. Internal and external thermal damage was observed. During the bench test, coupling engagement was noted, although spark was not observed. The harness assembly could not be used during the test due to thermal damage.





Ignition Harness Manufacturer: Not Marked Model/Part Number: Not Marked Serial #: Not Marked

Condition: The ignition harness was attached and thermally damaged. No sparks to any lead was observed.

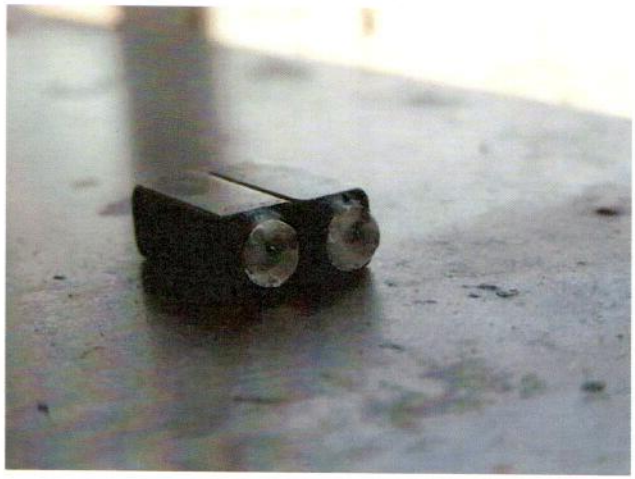
Spark Plugs Manufacturer: Champion Part number: RHB-32E

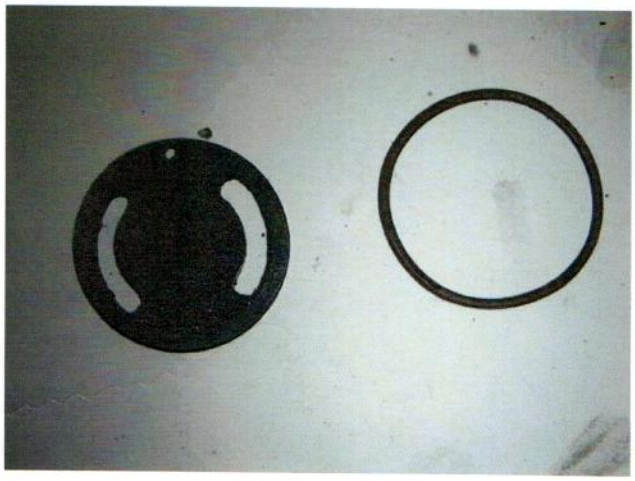
Condition: The spark plugs were intact and secured prior to removal. The top and bottom plugs were inspected and gap checked. They all exhibited thermal damage. The plugs appeared new with the exception of #3 top plug which was worn. All other plugs exhibited normal wear according to the Champion check a plug chart.

FUEL SYSTEM:

Fuel Pump Manufacturer: TCM Part Number: 646212-1 Serial #: HC59715BR

Condition: The fuel pump was intact with thermal damage to the exterior as well as to the interior. The pump drive shaft would not rotate. Air or liquid could be circulated through the pump. The pump disassembly exhibited thermal damage to the vanes. The drive coupling was separated in two sections. The pump exhibited debris that resembled carbon material. The drive coupling and a sample of the debris is to be sent to NTSB for further analysis, according to the CAA-IIC.





Fuel Manifold Valve Manufacturer: TCM Part Number: 631351-17A6 Serial #: H059715LR

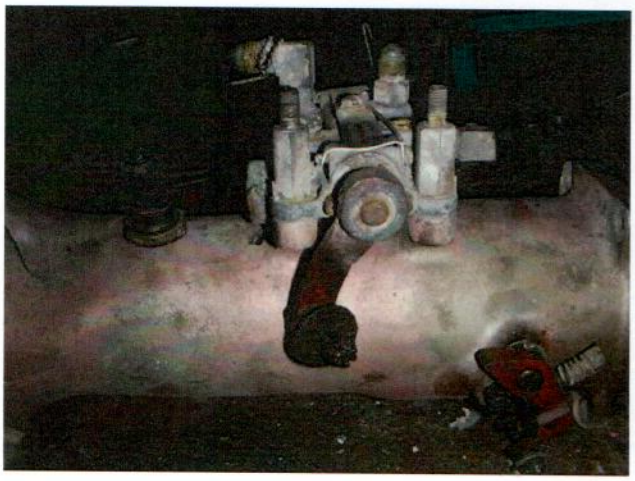
Condition: The manifold assembly was intact. Thermal damage was observed. The TCM lead seal was not observed. The internal gasket, diaphragm and screen was thermally damaged.

Fuel Nozzles and Lines Manufacturer: GAMI Size: 6 each – 1,2: GA173 / 3,4: GA156 / 5,6: GA147

Condition: All injectors are intact. External thermal discoloration was noted. Numbers 2, 3,and 4 were clear of obstruction.

Throttle Body Fuel Control Manufacturer: TCM Part Number: 629703-2 Serial #: H059712HR

Condition: The throttle body fuel control was intact, although, it was cracked. There was also thermal damage observed to the unit. The throttle plate was stuck open ¼ travel. The throttle and mixture controls were bent and could not move. The screen was clear and thermally damaged.



LUBRICATION SYSTEM:

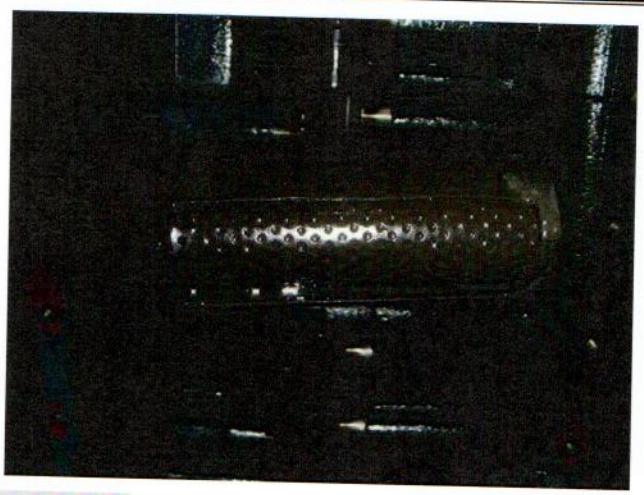
Oil Pump	The oil pump was intact. The pump assembly was disassembled. Oil was observed within the pump assembly. The internal gears rotated and were intact. Rotational scoring signatures were noted to the pump internal housing walls. The relief valve spring was intact. The filter screen was intact and no metal contaminants were observed.

Oil Sump

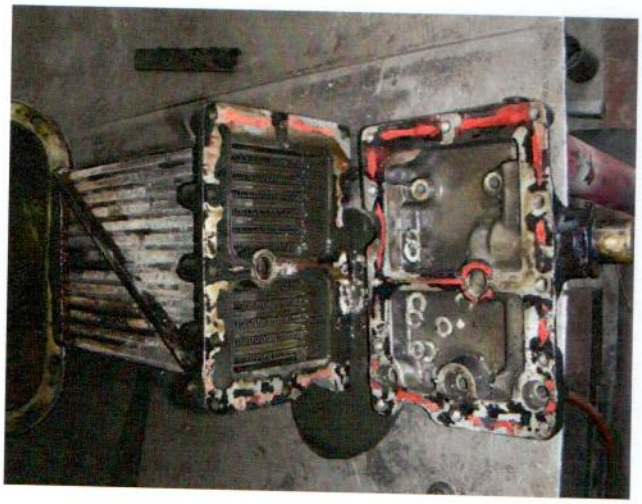
The oil sump remained attached to the engine. The sump assembly was crushed inwards. The sump was breached. There was thermal discoloration to the outside and the inside of the sump assembly. Only residual oil was observed within the sump. No metal contaminants were observed in the sump.

Oil Pick-up Tube & Screen

The pickup tube and screen were intact and secured. The screen and tube assembly was clear of debris and contaminants.



Oil Cooler The oil cooler was thermally damaged. It was intact and secured. There was oil inside the oil cooler.



CYLINDERS:

Cylinder #1 Part Number: 649166P Head Date: 3-96 Barrel Surface: Steel

Work Order Numbers: None

Condition: The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts were loose. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder #2 Part Number: 649166P Head Date: 1-88 Barrel Surface: Steel

Work Order Numbers: None

Condition: The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts were. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder #3 Part Number: 649166P Head Date: 8-91 Barrel Surface: Steel

Work Order Numbers: None

Condition: The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts were. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder #4 Part Number: 649166P Head Date: 11-90 Barrel Surface: Steel

Work Order Numbers: None

Condition: The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts were. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder #5 Part Number: 649166P Head Date: 9-91 Barrel Surface: Steel

Work Order Numbers: None

Condition: The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts were. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Cylinder #6 Part Number: 649166P Head Date: 9-91 Barrel Surface: Steel

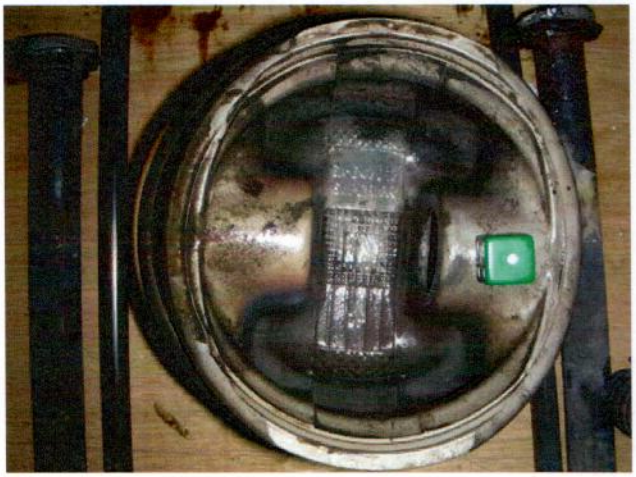
Work Order Numbers: None

Condition: The cylinder was intact and secured to the engine. There was external thermal discoloration to the barrel and head assembly. The cylinder stud nuts were. Torque putty was not observed on any of the cylinder nuts. The combustion chamber was lightly lubricated and contained light brown deposits. The valves were not removed. The valve faces exhibited light combustion deposits.

Rocker Arm and Shaft The rocker arms and shafts were not removed due to lack of tooling in the facility. They were intact and undamaged.

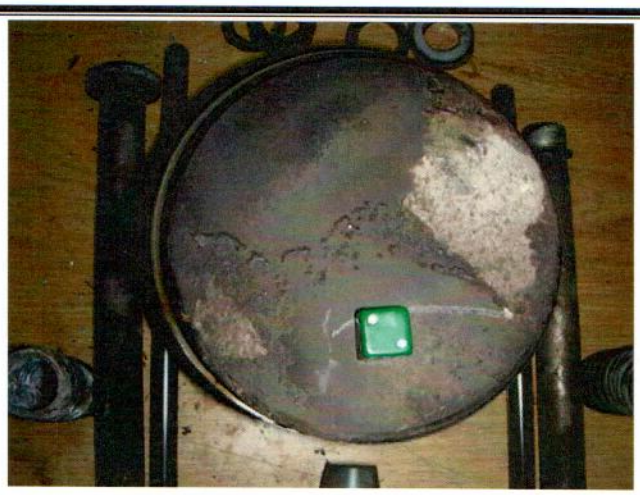
#1 Piston, Rings and Pin Piston Part Number: SA648013 (Ring P/N: SA5209)

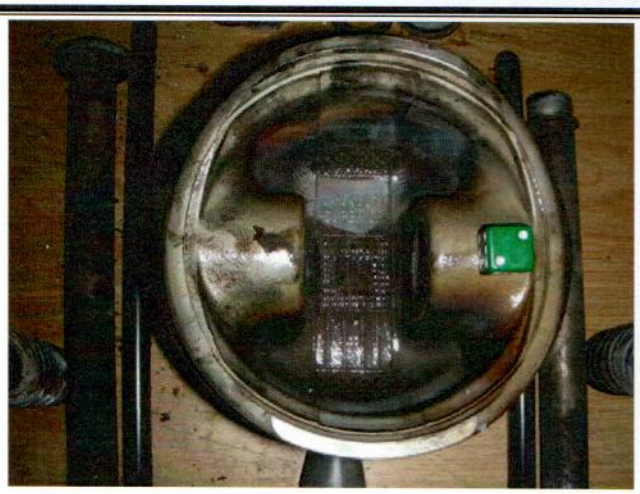
Condition: The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.



#2 Piston, Rings and Pin Piston Part Number: SA648013 (Ring P/N: SA5209)

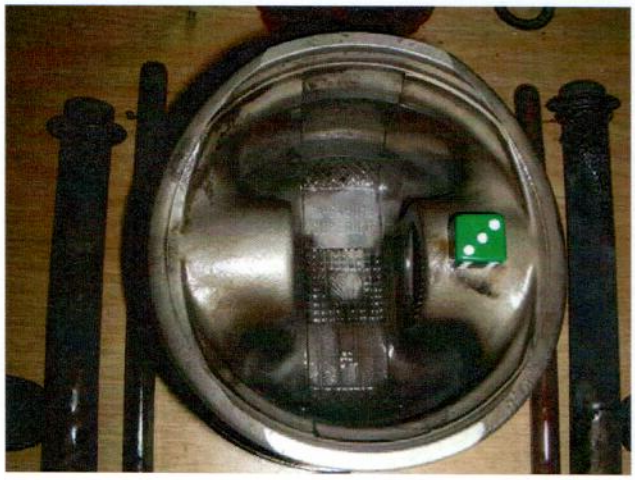
Condition: The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.





#3 Piston, Rings and Pin Piston Part Number: SA648013 (Ring P/N: SA5209)

Condition: The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.



#4 Piston, Rings and Pin Piston Part Number: SA648013 (Ring P/N: SA5209)

Condition: The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

#5 Piston, Rings and Pin Piston Part Number: SA648013 (Ring P/N: SA5209)

Condition: The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

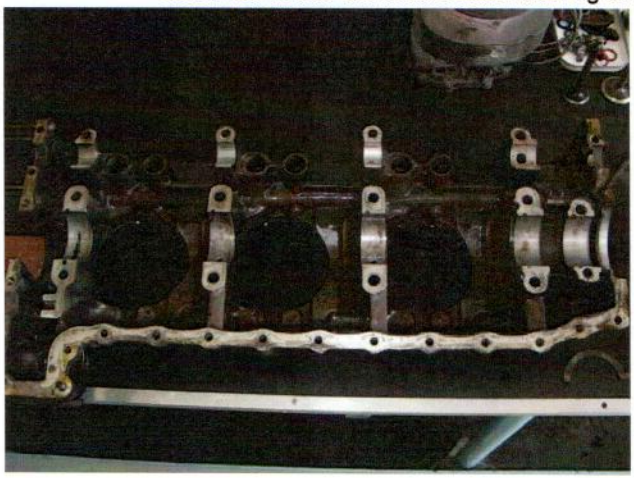
#6 Piston, Rings and Pin Piston Part Number: SA648013 (Ring P/N: SA5209)

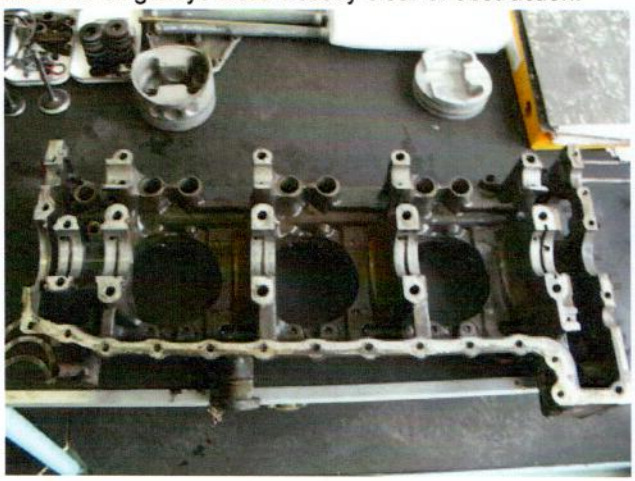
Condition: The piston, pin and rings were intact. The piston exhibited light combustion deposits. The piston skirt visually appeared to have thermal discoloration. The rings were properly offset. The pin was intact and not scored.

CRANKCASE ASSEMBLY:

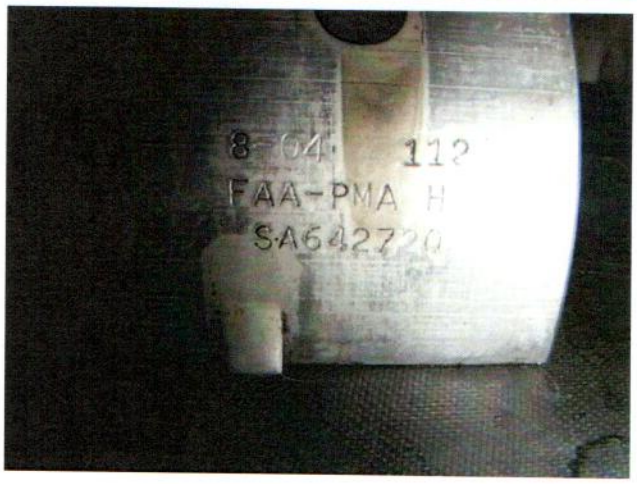
Crankcase Casting Number 1-3-5 Side: 649043 2-4-6 Side: 649042 Serial number: 319712

Condition: The crankcase halves were intact with thermal discoloration to the outside surfaces. Pitting was observed to the crankcase main bearing saddles. The oil galleys were visually clear of obstruction.





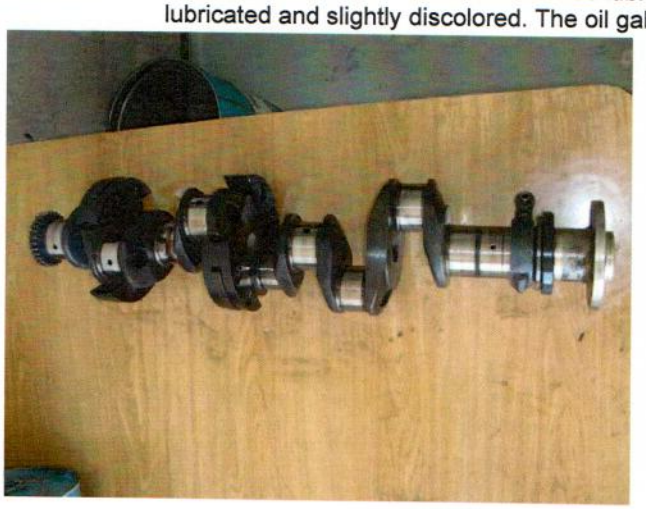
Main Bearing Part Number	Rear	Intermediate	Front
	SA642720	SA642720	SA642720
Condition	DATE CODE: 8-04 The bearings were all intact and light scoring signatures were observed to the bearing surfaces.		

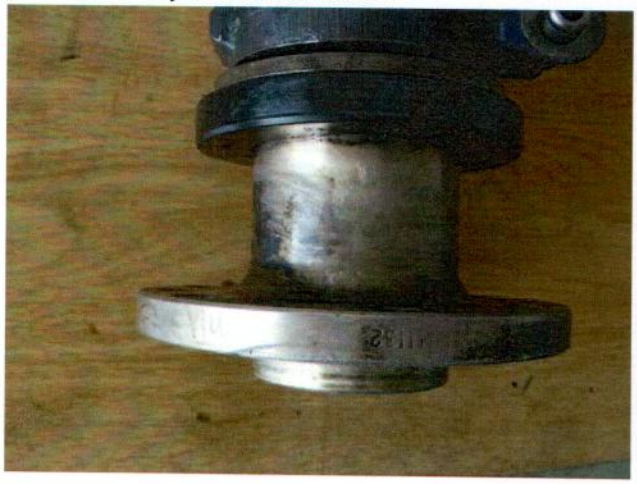


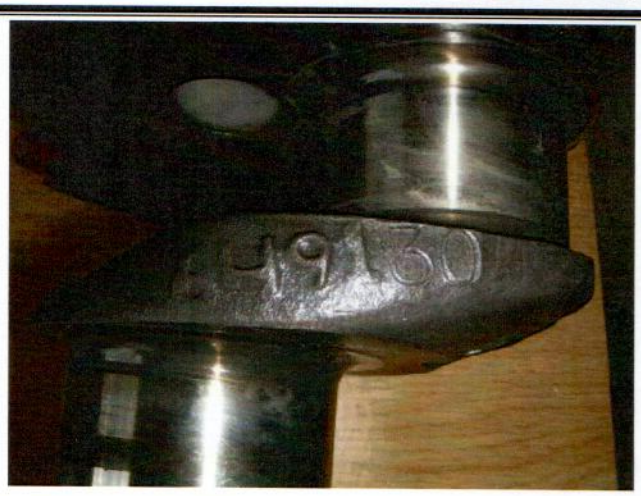
CRANKSHAFT ASSEMBLY:

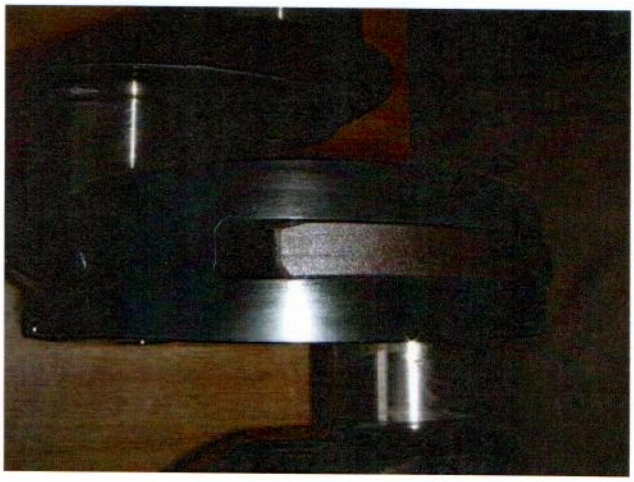
Crankshaft Forging number: H129719N Serial number: 649130 Heat code: XNA

Condition: The crankshaft was intact and exhibited lubrication. The main journals and rod journals were lubricated and slightly discolored. The oil galleys were visually free of obstruction.









Transfer Collar: P/N: 626737

The transfer collar was intact and no binding was observed.

Counter Weights: P/N: 639196 (pair) and 639195 (Pair) The counterweights were intact and the snap rings were correctly installed and intact. Movement of each counter weight was noted over the hangars.

Crankshaft to Camshaft Timing The timing marks were observed in alignment.

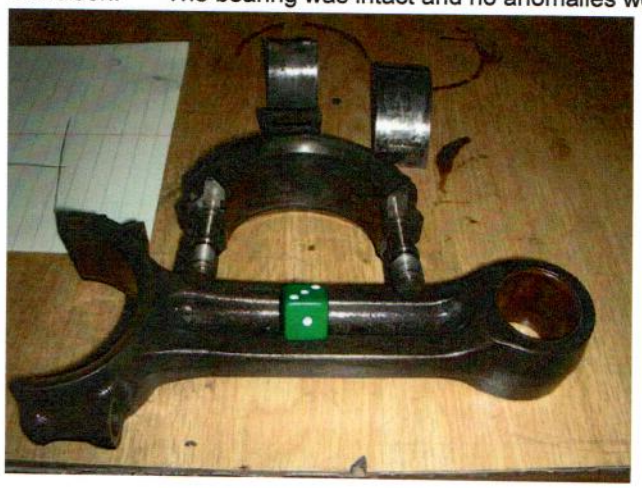
#1 Connecting Rod Part Number: 646126-N Forging number: 11

Condition: The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

#1 Connecting Rod Bearing

Part Number: SA630826 / Date: 10-04

Condition: The bearing was intact and no anomalies were visually observed.



#2 Connecting Rod

Part Number: 646126-N

Forging number: 10

Condition: The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

#2 Connecting Rod Bearing

Part Number: SA630826 / Date: 10-04

Condition: The bearing was intact and no anomalies were visually observed.

#3 Connecting Rod

Part Number: 646126-N

Forging number: 10

Condition: The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

#3 Connecting Rod Bearing

Part Number: SA630826 / Date: 10-04

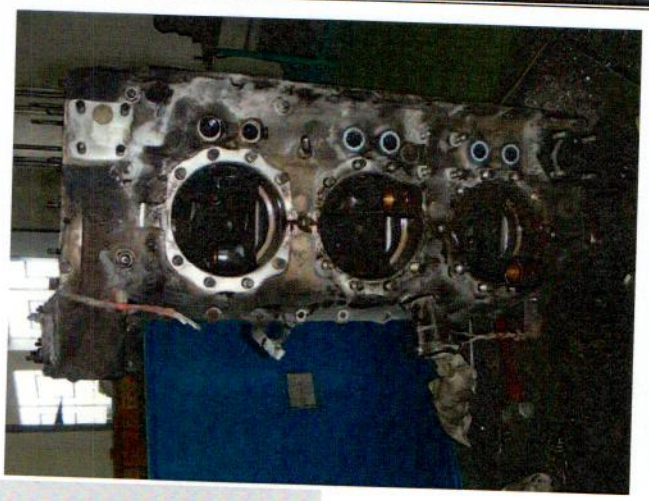
Condition: The bearing was intact and no anomalies were visually observed.

#4 Connecting Rod

Part Number: 646126-N

Forging number: 10

Condition: The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.



#4 Connecting Rod Bearing

Part Number: SA630826 / Date: 10-04

Condition: The bearing was intact and no anomalies were visually observed.

#5 Connecting Rod

Part Number: 646126-N

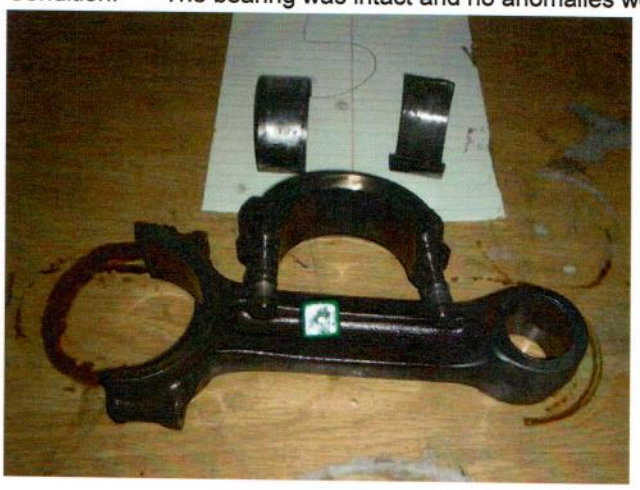
Forging number: 11

Condition: The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.

#5 Connecting Rod Bearing

Part Number: SA630826 / Date: 10-04

Condition: The bearing was intact and no anomalies were visually observed.

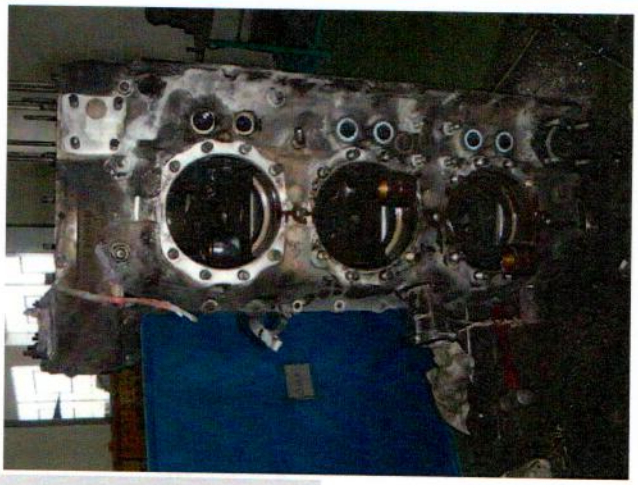


#6 Connecting Rod

Part Number: 646126-N

Forging number: 11

Condition: The connecting rod was intact and secure. The rod was able to move freely on the crankshaft.



#6 Connecting Rod Bearing

Part Number: SA630826 / Date: 10-04

Condition: The bearing was intact and no anomalies were visually observed.

CAMSHAFT:

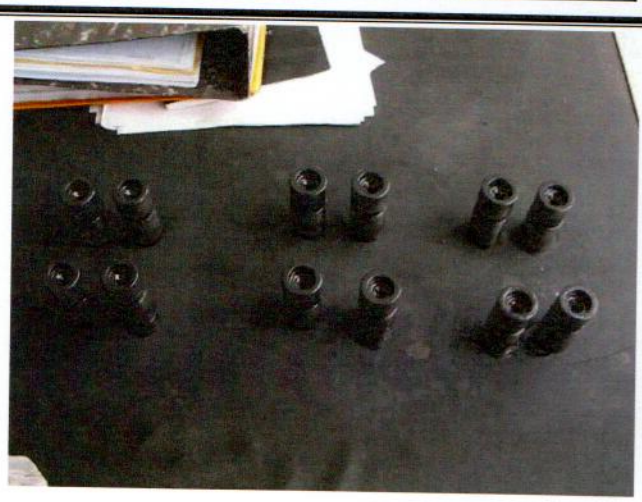
Camshaft	Part number: A535661	Serial Number: 47-3401
Condition	The camshaft was intact and no anomalies were visually observed. The woodruff key was observed in place and intact.	

LIFTERS:

Lifter	#1	#3	#5	#2	#4	#6
Intake	SA-628488	SA-628488	SA-628488	SA-628488	SA-628488	SA-628488
Exhaust	SA-646277	SA-646277	SA-646277	SA-646277	SA-646277	SA-646277

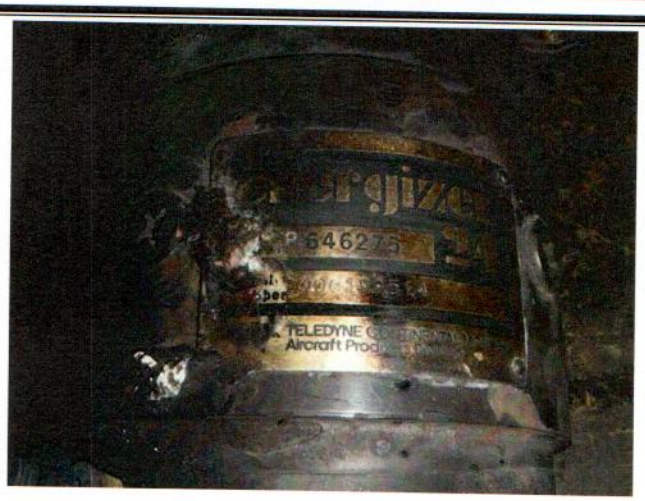
Condition: All the lifters were intact and no visual anomalies were observed. The lifters exhibited lubrication.

The lifter pistons had full travel up and down within the lifter body.



Starter Manufacturer: TCM (24V) Part Number: 646275 Serial #: A06199514

Condition: The starter was intact, although some case damage was observed and exterior thermal damage was observed. The starter shaft rotated without any binding. The wires were melted.



Starter Adapter Part Number: Illegible.

Condition: The adapter was intact. The internal gear and clutch was intact and the shaft rotated. Signatures of lubrication was observed. The pulley was damaged.

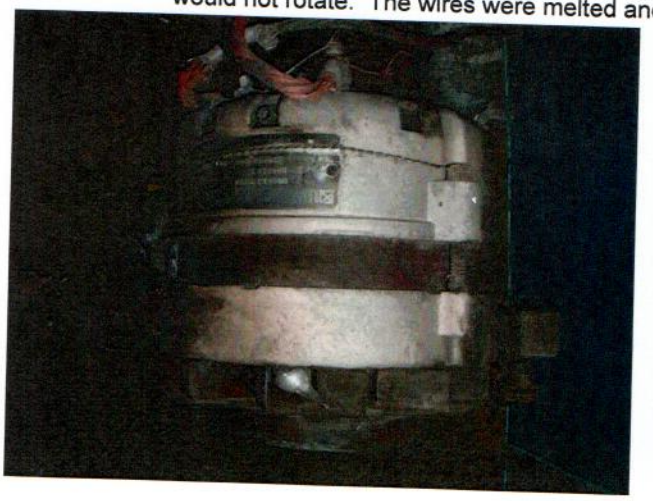
Alternator/Generator

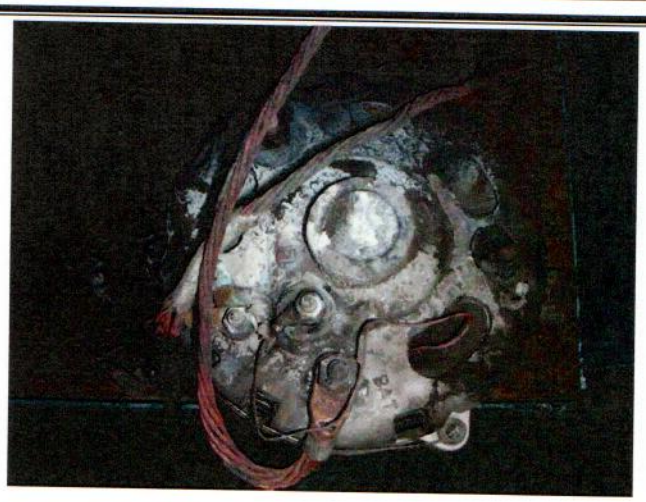
Manufacturer: Kelly Aerospace (28V/60A)

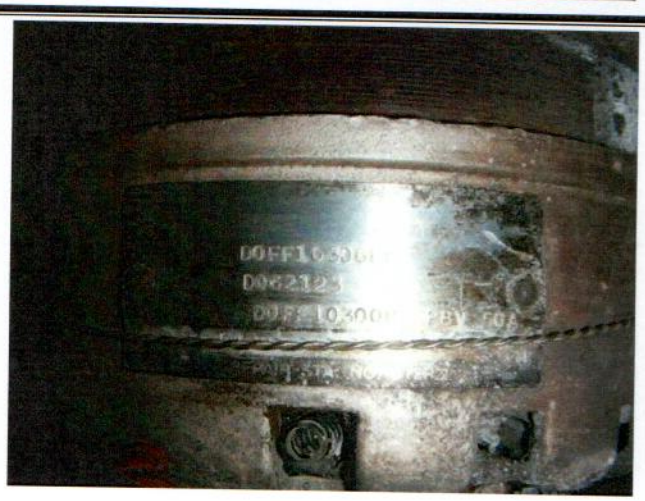
Part Number: DOFF10300BR

Serial #: DO62123

Condition: The alternator was intact. Thermal damage and corrosion was observed to the exterior. The pulley would not rotate. The wires were melted and damaged.







Accessory Gears All accessory gears were observed intact and all gear teeth were observed intact.

Vacuum Pump Part number: Not Legible Serial Number: Not Legible

Condition: The vacuum pump was intact. Thermal damage was observed to the exterior. The coupling was separated and melted.

Propeller Governor Part Number: C290DK/T4 Serial Number: 730208

Condition: The McCauley governor was intact and thermally damaged. The propeller governor cable was damaged. The shaft rotates freely. The gasket and screen were intact and clear of debris.

Propeller: MFG/Model: Hartzell / PHC-J3YF-IRF S/N: F7691 HUB S/N: FP718A

Blade S/N: 1 H99089

Blade S/N: 2 H99087

Blade S/N: 3 H99090

Condition: The propeller remained attached to the crankshaft flange. The hub assembly was crushed aft and twisted around the propeller hub. The propeller exhibited thermal damage. The three blades were attached although loose in the hub. All three blade tips separated. One separated tip section was located ~350-400 meters from the wreckage site, according to the CAA-IIC. The section was curled and exhibited heavy gouging and scoring signatures in a chordwise direction. The three blades exhibited curling, S-bending, twisting and chordwise scoring. There was also forward and aft bending signatures to the blades. The large quantity of sludge was observed inside the crankshaft flange.







SER NO.
FP7184
FP7184