

FINAL INVESTIGATION REPORT



**ACCIDENT OF M/S SHAHEEN AIR FLYING TRAINING
SCHOOL CESSNA-162 AIRCRAFT, REG # AP-ZBQ ON
24TH FEBRUARY, 2017 AT FAISALABAD**

SCOPE

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Synopsis

The accident was reported to Safety Investigation Board (SIB), Pakistan by Airport Manager CAA Faisalabad Airport and General Manager Operations SAFTS. The accident was notified in accordance with ICAO Annex-13. Aviation Division, Government of Pakistan issued memorandum vide letter No. HQCAA/1901/389/SIB/127 dated 1st March, 2017 authorizing SIB, Pakistan to investigate the accident and investigation was conducted by SIB.

1. FACTUAL INFORMATION

- 1.1 **History of the Flight.** On 24th February, 2017 Cessna-162 Reg. No. AP-ZBQ was on a routine training flight at Faisalabad airport. The aircraft had seating capacity of two and carried Instructor on the right seat along with Student Pilot on the left seat. The Instructor Pilot was Chief Flying Instructor, Shaheen Air Flying Training School (SAFTS) whereas student pilot had completed Private Pilot License (PPL) training and was flying PPL initial issue check in the mishap flight. The Instructor Pilot had flown 3 hrs instructional / training flight on the mishap aircraft on the same day prior to accident flight. According to available evidence, the start up, taxi out and line up on runway 03 were normal. The crew obtained takeoff clearance after performing necessary checks and aircraft rolled for takeoff at 0738 UTC. The mishap aircraft climbed to 575 feet above ground level and developed some engine problem leading to loss of power. There was no call exchanged during the event and aircraft was observed turning right for landing back on the runway. During this turn, the aircraft went into a steep dive and impacted ground in a steep nose low attitude. Recorded data indicated that just before the impact, the engine had picked up to full power. Both occupants sustained fatal injuries. There was no damage to property on ground.
- 1.2 **Injuries to Persons.** The instructor and the student pilot, both sustained fatal injuries in the accident.

Injuries	Crew	Passengers	Others
Fatal	2	-	-
Serious	-	-	-
Minor/None	-	-	-

- 1.3 **Damage to Aircraft.** The aircraft was completely destroyed as a result of the accident.
- 1.4 **Other Damages.** No other damage was observed on ground or to any other person as a result of this accident.
- 1.5 **Personnel information.** A total of 02 souls were onboard including 01 Instructor Pilot and 01 Student Pilot. Their details are mentioned below :-

Instructor Pilot

- Date of Birth : 12th April, 1964
- ATPL No. : ATPL-1440 (valid till 30-09-2017)
- Medical Validity Date : 30th April, 2017
- Total Flying Experience : 3970:00 Hrs
- Total In command on Cessna-162 : 46:20 Hrs
- Total in command : 3703:40 Hrs

Student Pilot

- Date of Birth : 21st May, 1997
- SPL No. : SPL - 4481 (valid till 30-09-2018)
- Medical Validity Date : March, 2017
- Total Flying Experience : 39:15 Hrs
- Total On Type Hrs : 39:15 Hrs

1.6 **Aircraft information.** As per operator, the mishap aircraft was being maintained in accordance with the regulations of Pakistan Civil Aviation Authority. Pertinent aircraft, engine and propeller maintenance and life information is as follows :-

1.6.1 Aircraft

Aircraft Make & Model	Cessna-162
Registration Marking	AP-ZBQ
Manufacturer Serial No.	16200235
Year of Manufacture	21 st November, 2013
C of A (S No. , expiry date)	004, 15 th June, 2017 (Special Light Sport)
Certificate of Maint review prior to 24 th February, 2017 (date, hrs, expiry date)	10 th November, 2016, Hrs 883:45 hrs EXP: 09 th May, 2017
Daily inspection prior to 24 th February, 2017 occurrence (date, location)	24 th February, 2017, SAFTS, Faisalabad
Total Aircraft Hours as on 24 th February, 2017 (prior to occurrence)	1051:30
Last Inspection (type, date, hrs, agency performed & location) prior to occurrence	50 hrs / 06 months' inspection at 1043:15 hrs on 21 st February, 2017 at SAFTS, Faisalabad maintenance hanger

ENGINE	
Engine S No.	1003611
Manufacturer	Teledyne Continental Motors Inc. USA
Engine Type	O-200-DIB
Date of Manufacturing	09 th March, 2011
Total Hours Flown till 24 th February, 2017	1051:30
Date of installation on AP-ZBQ	21 st November, 2013
Hours Flown since Installation	1051:30
Time between Overhauls	2000 Hrs / 12 Years

Last Inspection (type, date, hrs, agency performed & location) prior to occurrence	50 hrs / 06 months' inspection at 1043:15 hrs on 21 st February, 2017 at SAFTS, Faisalabad maintenance hanger
PROPELLER	
Propeller S No.	AGB01012
Manufacturer	<u>McCauley Propeller Systems, USA</u>
Propeller Type	1L100LSA6754
Date of Manufacturing	04 th April, 2012
Total Hours Flown till 24 th February, 2017	1051:30
Date of installation on AP-ZBQ	21 st November, 2013
Hours Flown since Installation	1051:30
Time between Overhauls	2000 Hrs / 72 months
Last Inspection (type, date, hrs, agency performed & location) prior to occurrence	50 hrs / 06 months' inspection at 1043:15 hrs on 21 st February, 2017 at SAFTS, Faisalabad maintenance hanger

1.6.2 The aircraft, engine and propeller were assembled in February, 2015 before starting of training operations at SAFTS, Faisalabad. Following documents are mentioned pertaining its manufacturing and induction :-

- (a) Aircraft Engine Test verification Certificate by CMG, USA
- (b) Light Sport Aircraft Statement of compliance by FAA, USA
- (c) Aircraft component Information
- (d) Engine component information
- (e) Propeller Certificate of Conformance by McCauley, USA

1.7 **Meteorological Information.** On 24th August, 2017, at the time of occurrence the weather prevailing at Faisalabad Airport is appended below :-

Outlook	Visibility	Clouds	Wind	Temp	QNH
Haze	7 Km	NSC	NW 06 Kts	25 ⁰ C	1020

1.8 **Aids to Navigation.** Cessna-162 AP-ZBQ aircraft was equipped with serviceable ADF, VOR / DME, ILS and GPS equipment for the conduct of flight operations. All ground equipment installed at Faisalabad airport related to ADF, VOR / DME and ILS was found serviceable at the time of occurrence.

1.9 **Communications.** Cessna-162 AP-ZBQ aircraft was equipped with UHF and VHF sets for radio contact with all concerned / relevant agencies during the conduct of flight. The communication facilities appended below were also available at Faisalabad airport :-

OPFA AD 2.18 ATS COMMUNICATION FACILITIES

Service designation	Call sign	Frequency	Hours of operation	Remarks
1	2	3	4	5
TWR	FAISALABAD Tower	118.625 MHZ 397.425 MHZ 121.5 MHZ	HS	Primary frequency UHF Frequency Emergency Frequency
APRON	FAISALABAD Tower	121.8 MHZ		Ground Frequency

1.10 **Aerodrome Information.** The Faisalabad airport detailed aerodrome data is appended below :-

AIP
PAKISTAN

AD 2. OPFA-5
01 JUL 17

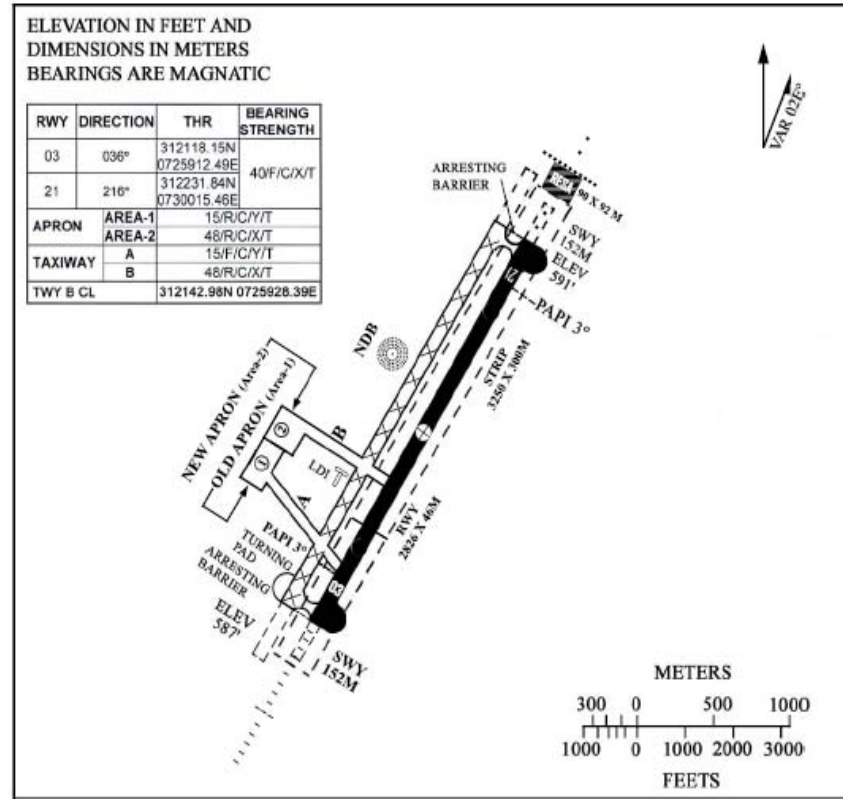
AERODROME/
HELIPORT
CHART-ICAO

312154.99N
0725943.96E

ELEV 591'

TWR 118.625

FAISALABAD/
Faisalabad/Int'l



AD 2.OPFA-4
01 JUL 11

AIP
Pakistan

OPFA AD 2.19 RADIO NAVIGATION AND LANDING AIDS

Type of aid. CAT of ILS (VAR VOR/ILS)	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
NDB	FA	312.15	HS	312212.65N		

OPFA AD 2.12 RUNWAY PHYSICAL CHARACTERISTICS

Designations RWY NR	True Bearing	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY
1	2	3	4	5	6
03	036°	2826x 46	40/F/C/X/T bitumen	312118.15N 0725912.49E	THR 179M / 587 FT
21	216°		40/F/C/X/T	312231.84N 0730015.46E	THR 180M / 591FT

Designations RWY NR	Slope of RWY/SWY	SWY dimension (M)	CWY dimension (M)	Strip dimension (M)	Obstacle Free Zone
7	8	9	10	11	12
03	0.04% Up	152	210 M	3250 x 300	Available
21	0.04% Down	152	210 M		Available

Remarks: RWY-03 RESA 90 X 92 M

OPFA AD 2.13 DECLARED DISTANCES (M)

Designations RWY NR	TORA	ASDA	TODA	LDA	Remarks
1	2	3	4	5	6
03	2826	2978	3036	2826	--
21	2826	2978	3036	2826	--

OPFA AD 2.14 APPROACH AND RUNWAY LIGHTS

Designations RWY NR	APCH LGT type LEN INTST	THRLGT colour WBAR	VASIS (MEH) PAPI	TDZMLGT LEN	RWY Centre line LGT Length, spacing, colour, INTST	RWY EDGE line LGT Length, spacing, colour, INTST	RWY End LGT spacing colour WBAR	SWY LGT LEN (M) colour	Remarks
1	2	3	4	5	6	7	8	9	10
03	PALS CAT-1	GREEN	PAPI	-	-	2826 M,	RED	RED	

- 1.11 **Flight Recorders.** The aircraft was not equipped with Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR). However some flight parameters were recorded on Garmin-100 equipment (Memory Card) installed in the cockpit with PFD / MFD. The memory card was recovered from the wreckage in a slightly de-shaped form which was subsequently sent to NTSB (ACCREP) and successfully downloaded. The downloaded data / information was extensively utilized to re-construct the flight profile along with the engine parameters.
- 1.12 **Medical and Pathological Information.** Not applicable.
- 1.13 **Fire.** The wreckage and surroundings area was thoroughly inspected by the investigation team to look for presence of in-flight / post impact fire. There was no evidence of pre impact / in-flight fire or post impact fire observed.
- 1.14 **Bird Strike.** A thorough examination of wreckage was done in order to look for signs of bird strike to the aircraft prior to crash. There were no signs of bird strike to any part of the engine as well as aircraft. Hence possibility of a bird strike was ruled out.
- 1.15 **ATC Tape Extracts.** ATC Tower Tape Extracts were retrieved and analysed, however they could not reveal any useful information merely because no communication took place during the emergency situation encountered by the crew.
- 1.16 **Crew Resource Management (CRM).** Most likely, at the time of occurrence, the Student Pilot was the Pilot Flying (PF) (as the mishap flight was a training flight) whereas the Captain was Pilot Monitoring (PM) in the capacity of Instructor Pilot.
- 1.17 **Use of Effective Investigation Techniques.** Besides employing various investigation techniques and procedures, data extracted from memory card was extensively utilized for development of flight profile and events leading to the accident and their analyses.

2. ANALYSIS

2.1 Operational Analysis

- 2.1.1 The mishap flight was a routine training flight of Shaheen Air Flying Training School, Faisalabad.
- 2.1.2 The cockpit crew was qualified and medically fit to undertake the mishap flight. The Instructor Pilot had valid ATP license and medical fitness certificate whereas the Student Pilot had valid SP license and medical fitness certificate.
- 2.1.3 Both crew members had adequate rest before flying as per Flight Duty Timing Limitation (FDTL) minimum requirement.
- 2.1.4 The Student Pilot was a young 20 years old male with academic qualification Intermediate FSc (pre-engineering). He was inducted in Shaheen Flying Training School in May, 2016 for Commercial Pilot License (CPL) course. At the time of crash he was undergoing Private Pilot License (PPL) training as a part of CPL course.
- 2.1.5 The Instructor Pilot was an experienced pilot who had flown different general aviation aircraft during his flying career. He was inducted / appointed in Shaheen Flying Training School in March, 2015 as Chief Flying Instructor (CFI).
- 2.1.6 The Instructor Pilot and student had undergone ground training before beginning of flying on Cessna – 162 aircraft. It is pertinent to mention that **detailed training plan of Instructors as well as Student Pilots at induction and refresher training was not available at SAFTS. Mostly the ground schooling during flying phases of student pilots was done at adhoc basis by randomly selecting subjects and without having a comprehensive plan.**
- 2.1.7 The detailed results of Instructor Pilot's recurrent / refresher academic training during his entire stay at SAFTS is appended below :-

Date	System	Grades Obtained (Pass Percentage = 70%) (Emergencies Pass Percentage = 80%)	
		Marks Obtained	Result
04-04-2016	Aircraft General	94 / 100	passed
04-04-2016	Emergencies & Limitations	100 / 100	passed
10-10-2015	Aircraft General	94 / 100	passed
10-10-2015	Emergencies & Limitations	94 / 100	passed
09-04-2015	Aircraft General	100 / 100	passed
09-04-2015	Emergencies & Limitations	96 / 100	passed
24-07-2015	Aircraft General	90 / 100	passed
24-07-2015	Emergencies & Limitations	100 / 100	passed

- 2.1.8 The detailed academic training results of student pilot during his ground schooling before commencement of flying are appended below :-

Date	System	Marks Obtained	Result
01-02-2017	Radio Nav	90 / 100	passed
30-01-2017	Radio Nav	94 / 100	passed
15-08-2016	Air Law	73 / 100	passed
15-08-2016	Air Law	82 / 100	passed
02-08-2016	Air Law	50 / 100	passed
02-08-2016	Air Law	92 / 100	passed
30-06-2016	Instrumentation	76 / 100	passed
29-06-2016	Instrumentation	86 / 100	passed
28-06-2016	Instrumentation	74 / 100	passed
17-06-2016	Metrology	88 / 100	passed
17-06-2016	Metrology	84 / 100	passed
15-06-2016	Air Law	70 / 100	passed
15-06-2016	Air Law	74 / 100	passed
16-06-2016	Instrumentation	68 / 100	passed
14-06-2016	Aircraft General Knowledge	86 / 100	passed
10-06-2016	Principles of Flight	95 / 100	passed
08-06-2016	Metrology	88 / 100	passed

- 2.1.9 The mishap flight was second sortie of the day for aircraft as well as the Instructor Pilot, however it was first flight of the Student Pilot. The Instructor Pilot had flown an earlier 3 hrs duration training navigation flight with another student prior to the mishap flight. In prior flight, the Instructor Pilot took off at 0405 UTC and landed back at 0705 UTC.
- 2.1.10 The aircraft was refuelled and made ready for the next flight. The Instructor Pilot proceeded with Student Pilot for PPL check mission on mishap aircraft.
- 2.1.11 While proceeding for mishap flight, the aircraft started up at 0732 UTC when outside temperature given by ATC was 25 degree centigrade with QNH 1019 HPa. The aircraft requested for taxi instructions at 0734 UTC. ATC asked the mishap flight to taxi for runway 03 through back track from the main link.
- 2.1.12 After line-up and performing take off checks the crew requested for takeoff clearance at 0736 UTC. ATC cleared them, for takeoff while cautioning for light and variable wind besides

presence of birds. The flight was cleared to turn left after departure for subsequent part of the mission.

- 2.1.13 After line up when preparing for takeoff the crew carried out necessary checks, and subsequently opened full power for takeoff roll. The recorded engine parameters at this time are appended below which did not indicate any abnormality against required parameters for takeoff :-

RPM	EGT (°F)	Oil Pressure (PSI)	Oil Temperature (°F)	Carburettor Temperature (°F)	Voltage
2403	803	47	158	77	14.4
All within normal operating limits					

- 2.1.14 The aircraft continued to accelerate to takeoff speed (55 kts IAS) with desired engine performance and travelled approximately 1150 feet on the runway before getting airborne. The aircraft took off at 0738:01 UTC, continued to climb and accelerate to 68 kts IAS before developing first indication of engine abnormality i.e RPM drop. By this time the aircraft had travelled approximately 2500 feet from beginning of runway 03 while flying straight over the runway. At 0738:46 UTC, 45 seconds after getting airborne the first indication of gradual drop in RPM was observed. At this stage the aircraft was flying through following parameters :-

Height Above Ground (Approx)	Speed IAS (kts)	Vertical Speed (feet/minute)	Pitch	Roll (Degree)
555 feet	66.8	1054 ↑	10.94 ↑	3.97 L

- 2.1.15 The associated engine other parameters also indicated a very gradual drop till 0738:52 UTC (6 seconds after onset of abnormality).

- 2.1.16 At 0738:52 UTC when aircraft was at height approximately 607 feet above ground there was a sharp and sudden decrease in engine parameters which indicated some serious problem with the engine. At this time the recorded engine parameters are :-

RPM	EGT (°F)	Oil Pressure (PSI)	Oil Temperature (°F)	Carburettor Temperature (°F)	Voltage
1159	1166	39	160	71	14.4

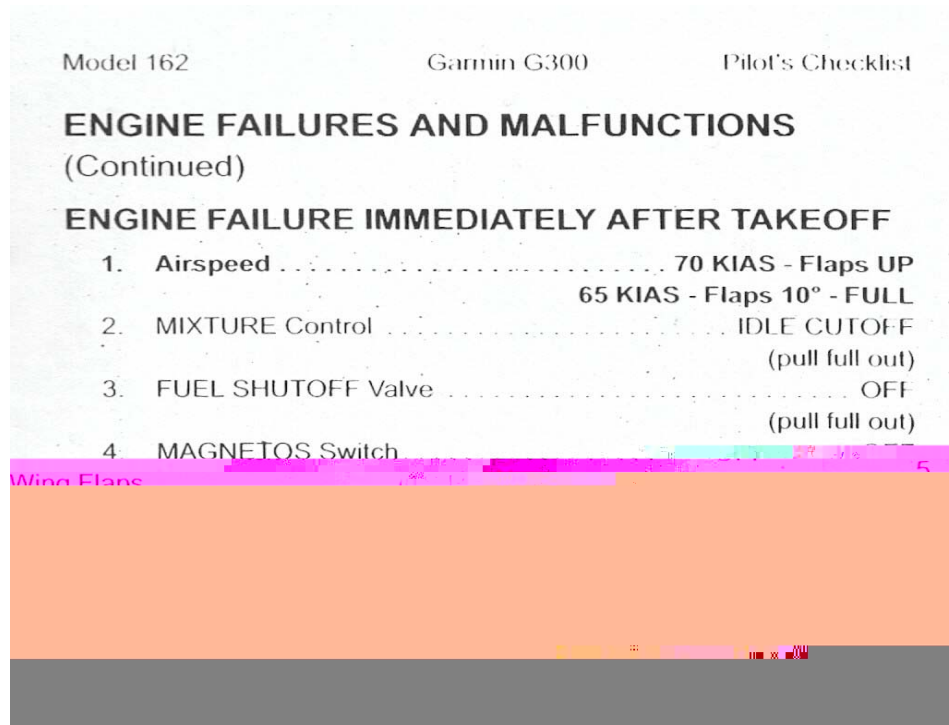
- 2.1.17 The minimum engine parameters recorded during this drop (12 seconds period) which continued till 0739:04 UTC are as follows :-

RPM	EGT (°F)	Oil Pressure (PSI)	Oil Temperature (°F)	Carburettor Temperature (°F) (Rise)
868 (at 0738:56)	819 (at 0739:04)	38 (at 0739:01)	163 (at 0739:00)	100 (at 0739:03)

- 2.1.18 During this abnormal engine behaviour the aircraft was initially observed to gradually pitch down along with a little roll of 3 to 4 degree left. When the engine developed sudden and sharp drop in its parameters, the aircraft was observed to reverse its roll from left to right side all the time increasing to 87 degree and nose pitch down to 43 degree and beyond.

There was no communication between aircraft and ATC during entire this event till aircraft impacted ground.

- 2.1.19 During interaction with other Student Pilots and Senior Instructor Pilots' statements it was ascertained that the Instructor Pilot, being Chief Flight Instructor, was in habit of teaching the aircrew to turn back for the runway in case of engine flameout after takeoff. Also, he demonstrated such procedure to others but never landed through, discontinuing halfway. The Instructor Pilots' of SAFTS, while following the instructions of CFI, were also teaching the same procedure to students. None of the aircrew ever challenged each other for following this non standard / prohibited procedure.
- 2.1.20 The SAFTS pilot checklist emergency procedures page E-5 describes procedure for Engine Failure and Malfunctions of Cessna – 162 aircraft. The procedure for engine failure immediately after takeoff, as the case under discussion, necessitated maintenance of 70 kts IAS and landing straight ahead while carrying out the safety checks (mixture control, fuel shutoff valve, magnetos switch, master switch – all OFF) inside the cockpit. The relevant procedure is also appended below :-

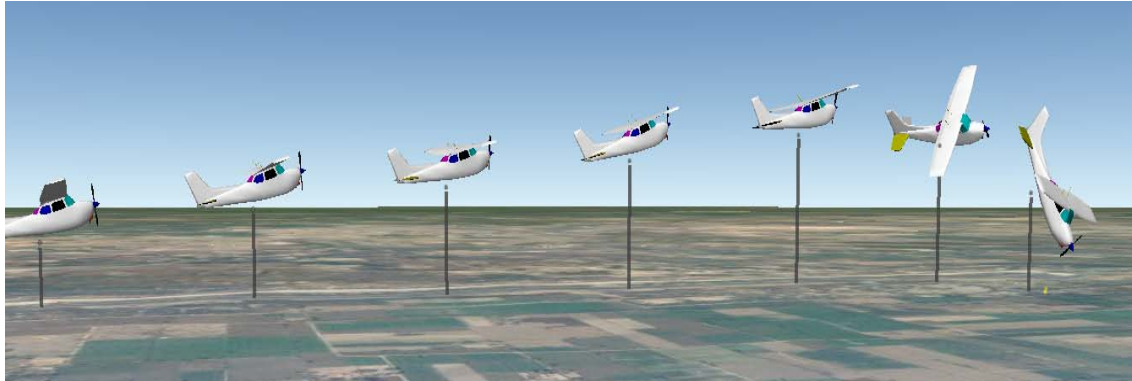


- 2.1.21 The OEM's recommended procedure and related guidelines given in Pilot Operating Handbook and Flight Training Supplement for Cessna – 162 originally issued on 22nd July, 2009 and revised (revision 4) on 21st October, 2011 page 3-27 indicate that in case of engine failures immediately after takeoff seldom sufficient altitude and airspeed would be available to execute the 180 degree gliding turn to return to the runway. Hence in such cases landing should be planned straight ahead with only small changes in the direction to avoid obstructions. The detailed procedure is appended below :-

ENGINE FAILURE

If an engine failure occurs immediately after takeoff, in most cases, the landing should be planned straight ahead with only small changes in direction to avoid obstructions. Altitude and airspeed are seldom sufficient to execute the 180° gliding turn necessary to return to the runway. The checklist procedures assume that adequate time exists to secure the fuel and ignition systems prior to touchdown.

2.1.22 The aircraft attitude / flight path during entire emergency situation is pictorially depicted below :-



2.1.23 Based on the aircraft behaviour from takeoff onwards till impact with ground, as discussed above, there could be two possibilities which lead to crash. These possibilities are discussed below :-

2.1.23.1 **Real Emergency Situation.** The first possibility is that the aircraft developed a real engine related problem after takeoff in which the RPM started to drop and loss of power was experienced leading to unsustainability of climb / level flight. While considering the sequence of events, especially the ATC communication part, there was no evidence found which supported the onset of a real engine problem. The engine behaviour just short of impact with ground depicted that engine RPM and other engine parameters rose to max power indicating no abnormality with the engine. But a situation may have been there in which some engine problem occurred but recovered later on. However, this aspect can be further probed and explored in technical part of the investigation before concluding this aspect. The absence of voice recording of the cockpit crew is a limitation in ascertaining the actual situation during the onset of abnormal situation.

2.1.23.2 The above discussion neither supports the onset of real emergency situation nor rules out it completely.

2.1.23.3 **Simulated Emergency Situation.** Considering the fact that the flight was a PPL check and Instructor Pilot had to assess the proficiency level of the student pilot in handling the aircraft in normal and emergency situations, the Instructor Pilot might have given "Engine Flameout after Take Off" to the student Pilot. It is however ended up into a real uncontrollable situation due to following a non recommended procedure. As the student pilot was seated on left seat while the instructor pilot was on right seat, the turn initiated after simulated emergency was towards right side which in all probabilities ended up in over banking condition leading to either a steep nose drop or stall. The over banking appears to be the more probable event as in order to see the runway the student pilot had to look through right all the way while turning, unintentionally leading to over banking followed by a steep nose drop which was not timely acknowledged / recovered by either of the pilots. Important to note here is that the engine RPM built up to max power setting just before impact with ground supports this supposition.

2.2 Technical Analysis

2.2.1 The sequence of event for the crashed has been covered in detail in the Ops analysis. The technical analysis is mainly aimed at verifying the serviceability of the entire aircraft, its power plant and essentially required onboard equipment.



2.2.2 The course of technical investigation was focused towards following aspects :-

2.2.2.1 Structural Integrity of the Airframe / Flight Controls

2.2.2.2 Serviceability of Engine and Propeller System

2.2.2.3 Testing of the POL serviced to the aircraft prior to crash

2.2.2.4 Flight Data analysis

2.2.3 **Structural Integrity of the Aircraft / Flight Controls.** Entire wreckage of the aircraft was confined to a limited area and all four corners of the aircraft were well accounted. Since, it was a short duration lift off, the entire track of the aircraft was scanned for any lost structure prior to the crash site, however, nothing was found. Moreover, the flight parameters analysis also revealed nothing un-usual that could have been recorded especially due to an in-advertant loss of any lift generating or flight control surfaces etc. Therefore, crash of the aircraft due lost structural integrity has been ruled out. All primary and secondary flight surfaces were intact. Left aileron was detached and lying under the left wing, however, it was due to aircraft impact with the ground. Rest of the left wing and left flap was intact.

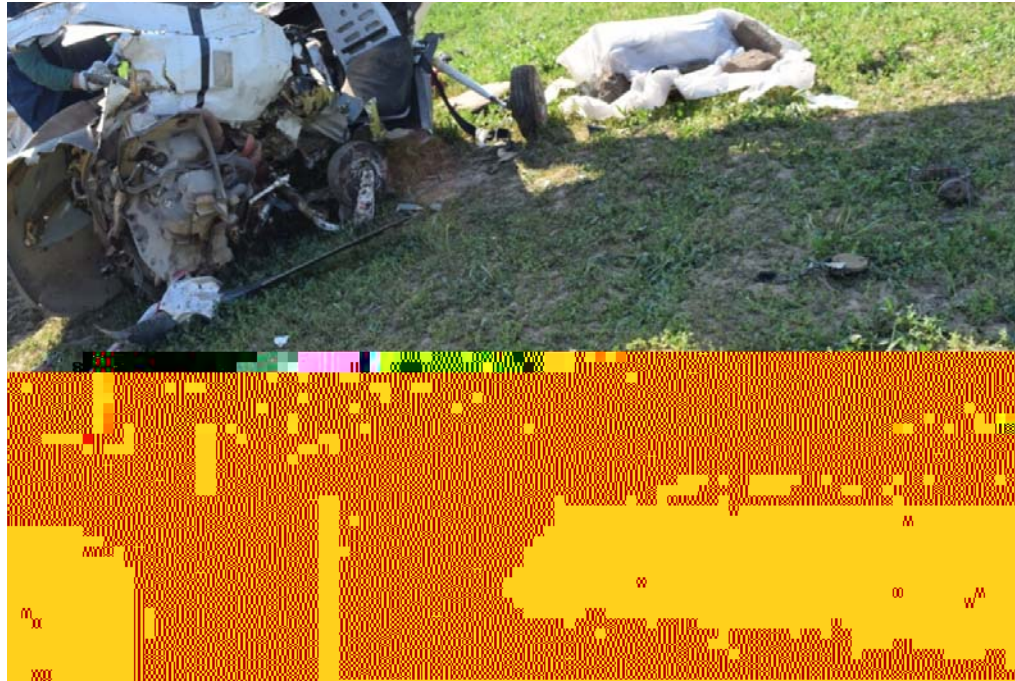


Fig. Detached Left Aileron lying under the Wing

2.2.3.1 Right wing was badly damaged beside aircraft nose as it seems to have hit the ground first. Tail section of the aircraft was in good shape and so were the horizontal stabilizers and the rudder.



Fig. Tail section of the aircraft and badly damaged right wing

2.2.3.2 This aircraft has typical 03 primary flight control surfaces i.e. Ailerons, Horizontal stabilizers and rudder while Flaps are the only secondary flight control surface on this type of aircraft. All primary and secondary flight control surfaces are moved thru steel cables without any hydraulic booster. After the crash, all the steel cables were removed and inspected which revealed no anomaly with any of the flight cable which may have lead to an un-controlled flight. Additionally, the flight parameters recorded during last moments of this misshaped flight from time 07:38:38 till impact at 07:39:07 (Local time) didn't indicate any un-usual parameter which could be referred to a lost flight control surface.

- 2.2.3.2.1 Left and Right Aileron Cables
- 2.2.3.2.2 Aileron interconnection Cable
- 2.2.3.2.3 Left and Right elevator Cables
- 2.2.3.2.4 Left and Right Rudder Cables

Primary Flight Control Cables

- 2.2.3.2.5 Left and Right flap cables

Secondary Flight Control

2.2.4 Engine Teardown Analysis. The engine was removed from the misshaped aircraft and dispatched to its OEM (Teledyne Continental Motors, USA) thru NTSB Accrep in the light of provisions given in ICAO Annex-13. At the OEM premises, a detailed tear down examination was conducted in the presence of representatives from SIB, Pakistan and NTSB, USA during first week of November, 2017. Subsequently, a detailed tear down examination report was submitted by the OEM thru NTSB. The engine tear down examination report has been summarized as :-

"The engine exhibited normal operating signatures with the exception of the impact damage, caused by the accident. All accessories were tested and torn down with no anomalies noted during the inspection."

2.2.5 Testing of Fuel and Lubricating Oil serviced to the Aircraft. The samples of fuel and oil were collected from the misshaped aircraft and subjected to tests in the relevant laboratories. All parameters were found to be within the specified limits.

2.2.6 Analysis of the Flight Parameters. Following are the flight parameters of this short / misshaped flight for last 29 seconds till its impact with the ground :-

Local Time	Altitude	Heading	Airspeed	Vertical Speed	Pitch	Roll	EGT	Oil Temp	Carb Temp	Oil Press	RPM
7:38:38	989	35	66	432	7.88	-0.23	1223	162	67	46	2474
7:38:39	1002	35	66	548	8.09	-4.92	1222	162	67	46	2474
7:38:40	1015	31	69	594	9.78	-2.98	1224	162	67	46	2483
7:38:41	1027	29	71	690	10.24	-0.22	1225	162	67	46	2485
7:38:42	1044	33	73	799	9.88	-3.69	1225	163	67	46	2498
7:38:43	1062	35	68	780	13.7	-3.65	1226	163	67	46	2495
7:38:44	1083	33	68	678	12.88	-3.75	1227	163	67	46	2490
7:38:45	1103	31	70	812	12.34	-2.2	1228	163	67	46	2489
7:38:46	1119	31	69	1054	10.94	-3.97	1228	163	67	46	2486
7:38:47	1132	32	69	1135	10.43	-3.66	1229	163	67	46	2483
7:38:48	1143	32	68	1054	9.86	-3.45	1230	163	67	46	2481
7:38:49	1153	31	68	932	9.39	-3.74	1231	163	67	46	2472
7:38:50	1163	32	68	833	8.96	-3.3	1230	163	66	45	2303
7:38:52	1170	34	67	752	7.17	-4.12	1166	163	71	39	1159
7:38:52	1171	35	65	717	5.85	-4.54	1124	163	75	39	971
7:38:53	1168	33	62	548	5.72	6.3	1068	163	80	39	872
7:38:55	1161	39	61	328	3.29	10.64	1010	163	87	39	872
7:38:55	1155	46	57	196	1.16	10.88	990	163	89	39	874
7:38:56	1148	53	57	-125	3.59	21.1	960	163	92	38	868
7:38:57	1143	63	59	-296	3	25.52	934	163	95	39	882
7:38:58	1138	77	56	-320	0.84	32.15	909	163	96	38	891
7:38:59	1132	90	55	-331	-0.96	36.23	889	163	98	39	885
7:39:00	1124	106	54	-319	0.04	37.21	873	163	99	40	895
7:39:01	1113	119	55	-303	-4.31	37.69	858	163	99	38	889
7:39:02	1096	139	53	-396	-4.31	37.68	842	163	100	39	899
7:39:03	1077	153	56	-555	-10.49	48.01	828	163	100	39	888
7:39:04	1047	180	57	-705	-17.55	44.68	819	163	98	45	1699
7:39:05	1013	204	61	-905	-43.63	87.85	867	163	86	46	2315
7:39:06	977	182	67	-1209	-82.14	-166.78	946	163	77	46	2434
7:39:07	941	115	81	-1887	-60.46	-17.79	1014	164	72	47	2494

12
Sec

12
Sec

- 2.2.6.1 The engine can be seen running at maximum RPM (2474) till time 07:38:52 and all other engine parameters Oil Temp, Carburetor Temp, Oil pressure and EGT are correspondingly showing normal values. After time 07:38:52, the RPM have suddenly reduced to IDLE value and accordingly all other engine parameters have responded. Oil pressure and EGT have reduced while Carburetor temperature has increased which is a normal behavior. After time 07:38:52 till 07:39:03 (12 seconds) the engine has remained at IDLE setting. After time 07:39:03 (04 seconds prior to impact), the engine has once again achieved maximum power parameters. The reduction of power from max to IDLE during these 12 seconds has come up as an area of interest and raises multiple questions about why the power has been reduced during such a critical phase of flight (takeoff). In this regard, following possibilities were thoroughly investigated :-
- 2.2.7 **Power Reduction due to Mechanical / Catastrophic Failure inside the Engine.** In case some internal moving part had fractured, it can lead to power loss from the engine. However, in such a case, the power shall not come to IDLE setting, rather the engine shall be completely shut down and there would be no possibility of achieving the maximum power once again. Whereas in this case, the power has reduced from max to IDLE and later on the engine has successfully achieved the max power indicating that there was no mechanical or catastrophic failure with the structure of the engine. Moreover, during tear down examination of the engine at the OEM premises, no such fracture signs were found and all corners of the engine especially the rotating parts were found in perfect shape.
- 2.2.8 **Partial Power Loss due to some Technical Problem.** The engine can partially lose its power due to some restriction in the in-flow of fuel or air or some electrical malfunction for some time and can once again achieve max power with the elimination of this problem. However, analysis of the engine parameters suggests that there was no such problem and the power reduction parameters were like a normal engine. E.g. in case there is some restriction in the airflow to the carburetor, then all parameters shall drop except the EGT which will shoot up due high air-fuel mixture and vice versa. The engine parameters doesn't depict any of such anomaly. Moreover, the engine tear down examination at the OEM premises confirmed that electrical system (magneto timings etc) were as per specifications given in the Technical Manual as well as there were no signatures of fuel or air blockage that could have been there in the feeding lines or on the cylinder heads.
- 2.2.8.1 The analysis of engine parameters and tear down examination at the OEM premises suggests that the engine was operating normal till last moments of the flight and technically there was nothing un-usual which can attribute towards the crash. The other flight parameters i.e. Pitch, Roll, vertical speed, altitude and air speed doesn't depict any technical anomaly as well.

3. CONCLUSION

3.1 Operational Findings

- 3.1.1 The mishap flight was a routine training flight of Shaheen Air Flying Training School, Faisalabad.
- 3.1.2 The cockpit crew was qualified and medically fit to undertake the mishap flight.
- 3.1.3 The Instructor Pilot had valid ATP license and medical fitness certificate whereas the Student Pilot had valid SP license and medical fitness certificate.
- 3.1.4 Both crew members had adequate rest before flying as per Flight Duty Timing Limitation (FDTL) minimum requirement.
- 3.1.5 The Student Pilot was a young 20 years old male with academic qualification Intermediate FSc (pre-engineering). He was inducted in Shaheen Flying Training School in May, 2016 for Commercial Pilot License (CPL) course. At the time of crash he was undergoing Private Pilot License (PPL) training as a part of CPL course.
- 3.1.6 The Instructor Pilot was an experienced pilot who had flown different general aviation aircraft during his flying career. He was inducted / appointed in Shaheen Flying Training School in March, 2015 as Chief Flying Instructor (CFI).

- 3.1.7 The Instructor Pilot and student had undergone ground training before beginning of flying on Cessna – 162 aircraft. It is pertinent to mention that **detailed training plan of Instructors as well as Student Pilots at induction and refresher training was not available at SAFTS. Mostly the ground schooling during flying phases of student pilots was done at adhoc basis by randomly selecting subjects and without having a comprehensive plan.**
- 3.1.8 The mishap flight was second sortie of the day for aircraft as well as the Instructor Pilot, however it was first flight of the Student Pilot. The Instructor Pilot had flown an earlier 3 hrs duration training navigation flight with another student prior to the mishap flight. In prior flight, the Instructor Pilot took off at 0405 UTC and landed back at 0705 UTC.
- 3.1.9 The aircraft was refuelled and made ready for the next flight. The Instructor Pilot proceeded with Student Pilot for PPL check mission on mishap aircraft.
- 3.1.10 While proceeding for mishap flight, the aircraft started up at 0732 UTC when outside temperature given by ATC was 25 degree centigrade with QNH 1019 HPa. The aircraft requested for taxi instructions at 0734 UTC. ATC asked the mishap flight to taxi for runway 03 through back track from the main link.
- 3.1.11 After line-up and performing take off checks the crew requested for takeoff clearance at 0736 UTC. ATC cleared them, for takeoff while cautioning for light and variable wind besides presence of birds. The flight was cleared to turn left after departure for subsequent part of the mission.
- 3.1.12 After line up when preparing for takeoff the crew carried out necessary checks, and subsequently opened full power for takeoff roll. The recorded engine parameters at this time are appended below which did not indicate any abnormality against required parameters for takeoff :-

RPM	EGT (°F)	Oil Pressure (PSI)	Oil Temperature (°F)	Carburettor Temperature (°F)	Voltage
2403	803	47	158	77	14.4
All within normal operating limits					

- 3.1.13 The aircraft continued to accelerate to takeoff speed (55 kts IAS) with desired engine performance and travelled approximately 1150 feet on the runway before getting airborne. The aircraft took off at 0738:01 UTC, continued to climb and accelerate to 68 kts IAS before developing first indication of engine abnormality i.e. RPM drop. By this time the aircraft had travelled approximately 2500 feet from beginning of runway 03 while flying straight over the runway. At 0738:46 UTC, 45 seconds after getting airborne the first indication of gradual drop in RPM was observed. At this stage the aircraft was flying through following parameters :-

Height Above Ground (Approx)	Speed IAS (kts)	Vertical Speed (feet/minute)	Pitch	Roll (Degree)
555 feet	66.8	1054 ↑	10.94 ↑	3.97 L

- 3.1.14 The associated engine other parameters also indicated a very gradual drop till 0738:52 UTC (6 seconds after onset of abnormality).
- 3.1.15 At 0738:52 UTC when aircraft was at height approximately 607 feet above ground there was a sharp and sudden decrease in engine parameters which indicated some serious problem with the engine. At this time the recorded engine parameters are :-

RPM	EGT (°F)	Oil Pressure (PSI)	Oil Temperature (°F)	Carburettor Temperature (°F)	Voltage
1159	1166	39	160	71	14.4

3.1.16 The minimum engine parameters recorded during this drop (12 seconds period) which continued till 0739:04 UTC are as follows :-

RPM	EGT (°F)	Oil Pressure (PSI)	Oil Temperature (°F)	Carburettor Temperature (°F) (Rise)
868 (at 0738:56)	819 (at 0739:04)	38 (at 0739:01)	163 (at 0739:00)	100 (at 0739:03)

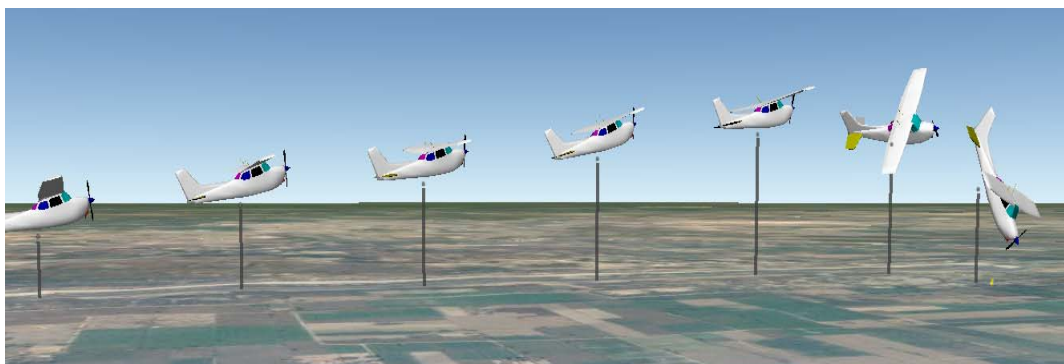
3.1.17 During this abnormal engine behaviour the aircraft was initially observed to gradually pitch down along with a little roll of 3 to 4 degree left. When the engine developed sudden and sharp drop in its parameters, the aircraft was observed to reverse its roll from left to right side all the time increasing to 87 degree and nose pitch down to 43 degree and beyond. There was no communication between aircraft and ATC during entire this event till aircraft impacted ground.

3.1.18 The Instructor Pilot, being Chief Flight Instructor, was in habit of teaching the aircrew to turn back for the runway in case of engine flameout after takeoff. Also, he demonstrated such procedure to others but never landed through, discontinuing halfway. The Instructor Pilots' of SAFTS, while following the instructions of CFI, were also teaching the same procedure to students. None of the aircrew ever challenged each other for following this non standard / prohibited procedure.

3.1.19 The SAFTS pilot checklist emergency procedures page E-5 describes procedure for Engine Failure and Malfunctions of Cessna – 162 aircraft. The procedure for engine failure immediately after takeoff, as the case under discussion, necessitated maintenance of 70 kts IAS and landing straight ahead while carrying out the safety checks (mixture control, fuel shutoff valve, magnetos switch, master switch – all OFF) inside the cockpit. This procedure was not followed.

3.1.20 The OEM's recommended procedure and related guidelines given in Pilot Operating Handbook and Flight Training Supplement for Cessna – 162 originally issued on 22nd July, 2009 and revised (revision 4) on 21st October, 2011 page 3-27 indicate that in case of engine failures immediately after takeoff seldom sufficient altitude and airspeed would be available to execute the 180 degree gliding turn to return to the runway. Hence in such cases landing should be planned straight ahead with only small changes in the direction to avoid obstructions. This procedure was not followed and an attempt was made turn back and land on the runway.

3.1.21 The aircraft attitude / flight path during entire emergency situation is pictorially depicted below :-



- 3.1.22 Based on the aircraft behaviour from takeoff onwards till impact with ground, as discussed above, there could be two possibilities which lead to crash. These possibilities are discussed below :-
- 3.1.22.1 **Real Emergency Situation.** The first possibility is that the aircraft developed a real engine related problem after takeoff in which the RPM started to drop and loss of power was experienced leading to unsustainability of climb / level flight. While considering the sequence of events, especially the ATC communication part, there was no evidence found which supported the onset of a real engine problem. The engine behaviour just short of impact with ground depicted that engine RPM and other engine parameters rose to max power indicating no abnormality with the engine. But a situation may have been there in which some engine problem occurred but recovered later on. However, this aspect can be further probed and explored in technical part of the investigation before concluding this aspect. The absence of voice recording of the cockpit crew is a limitation in ascertaining the actual situation during the onset of abnormal situation.
- 3.1.22.2 The above discussion neither supports the onset of real emergency situation nor rules out it completely.
- 3.1.22.3 **Simulated Emergency Situation.** Considering the fact that the flight was a PPL check and Instructor Pilot had to assess the proficiency level of the student pilot in handling the aircraft in normal and emergency situations, the Instructor Pilot might have given "Engine Flameout after Take Off" to the student Pilot. It is however ended up into a real uncontrollable situation due to following a non recommended procedure. As the student pilot was seated on left seat while the instructor pilot was on right seat, the turn initiated after simulated emergency was towards right side which in all probabilities ended up in over banking condition leading to either a steep nose drop or stall. The over banking appears to be the more probable event as in order to see the runway the student pilot had to look through right (to pick visual with runway) all the way while turning, unintentionally leading to over banking followed by a steep nose drop which was not timely acknowledged / recovered by either of the pilots. Important to note here is that the engine RPM built up to max power setting just before impact with ground supports this supposition.
- 3.2 **Technical Findings.**
- 3.2.1 The aircraft, engine and its propeller were in good condition as all three had just accumulated 1050:30 hrs since new.
- 3.2.2 The past maintenance history depicts that the aircraft, engine and the propeller didn't encounter any technical issue in the past which could have an impact on this accident.
- 3.2.3 The aircraft was adequately serviced prior to the mishap flight and there was no carry forward defect which could contribute to the accident.
- 3.2.4 The aircraft structural integrity didn't depict any signatures which can be considered responsible for the accident.
- 3.2.5 Tear down examination of the engine at the OEM premises confirmed its serviceability prior to the crash.
- 3.2.6 Fuel and Oil serviced to the aircraft prior to the crash were found as per their required specifications.
- 3.2.7 Data analysis of the misshaped flight didn't depict any technical abnormality / in-adequacy with the engine or flight parameters which can contribute towards the accident.

4. OBSERVATIONS

- 4.1 The record of inspections for declaring SAFTS as Flying Training Organization (FTO) was not available with PCAA.
- 4.2 SAFTS was not being effectively supervised by Additional Director, General Aviation (North), PCAA.
- 4.3 None of the instructor pilots or the student pilots ever highlighted at any forum for teaching a prohibited procedure.

5. CONCLUSION

5.1 Cause of Occurrence

- 5.1.1 The occurrence was caused due to non adherence to OEM recommended "Engine Flameout After Takeoff" procedure, in which the crew tried to turn back 180 degrees and land on the runway. This procedure was also being taught in SAFTS by CFI and all instructors, deviating from Pilot Checklist and PCAA approved Basic Flying Training Manual.

6. SAFETY RECOMMENDATIONS

- 6.1 PCAA (Flight Standards Directorate) is to ensure through Additional Directors (General Aviation) that all Flying Clubs follow OEM recommended and PCAA approved procedures in flying as well as ground training.
- 6.2 Supervision of Flying Clubs/ Flying Training Schools by PCAA may be enhanced. A monitoring mechanism of flying training at appropriate intervals during a year may be devised by Flight Standards Directorate and ensure its compliance.
- 6.3 In order to keep proficiency and competence of CFIs under check, Additional Directors General Aviation should mandatorily fly with them at frequency to be decided by PCAA.