AAI Case Reference: 03/2010

AIR ACCIDENT INVESTIGATION SECTOR

FINAL

AIR ACCIDENT INVESTIGATION REPORT

AIRCRAFT CRASH DUE TO ABRUPT MANOEUVRE

Light Sport Aircraft
Aeroprakt A-22
A6-XAP
Al Jazirah Aviation Club
Ras Al Khaimah
The United Arab Emirates
19th March 2010

General Civil Aviation Authority
of
The United Arab Emirates

OBJECTIVE

This investigation is performed in accordance with the UAE Federal Act No 20 of 1991, promulgating the Civil Aviation Law, Chapter VII, Aircraft Accidents, Article 48, and in conformity to ICAO Annex 13 to the Chicago Convention.

The sole objective of this investigation is to prevent aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

AIRCRAFT ACCIDENT BRIEF

GCAA AAI Report No.:	03/2010
Operator:	Al Jazirah Aviation Club
Aircraft Type and Registration:	Aeroprakt A-22, A6-XAP
No. and Type of Engines:	One
Date and Time (UTC):	19th March, 2010, 1300 LT
Location:	150 meters southwest of runway 28
Type of Flight:	General
Persons on Board:	2
Injuries:	2, Serious Injuries
Nature of Damage:	Aircraft destroyed

The Accident, Aeroprakt A-22 Aircraft, registration number A6-XAP, was notified to the General Civil Aviation Authority ("GCAA"), on March 19th 2010 at about 1300 LT.

A team was formed and launched immediately and reached the accident site within minutes after the notification received from Al Jazirah Aviation Club. The team coordinated with all Authorities on site by initiating the accident investigation process according to the already prepared and exercised plans. The Air Accident Investigation Sector ("AAIS") of the GCAA lead the Investigation as the United Arab Emirates ("UAE") is the State of Occurrence.

Notes:

1 The word ("Aircraft") in this Report implies the accident aircraft.

2 The word ("Team") in this report implies the Accident Investigation Team lead by an Investigator-In-Charge assigned by the GCAA of the UAE and encompassed investigators from the GCAA.

3 All times in this Report are LT Coordinated Universal Time ("UTC") (UTC= UAE Local Time -4 hours).

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LIST OF ABBREVIATIONS

AGL	Above Ground Level
AIP	Aeronautical Information Publication
°C	Degrees Celsius (Temperature measurement unit)
C.G	Center of gravity
CHT	Cylinder head temperature, °C
E	East
EGT/MAG	**E**xhaust gas temp, magneto side, °C
EGT/PTO	Exhaust gas temp, propeller side, °C
ft	Feet (British distance measurement unit)
hp	Horsepower
kg	Kilogram (International Standard mass measurement unit)
kts	Knots (Airspeed measurement unit)
Lb	Pounds (British mass unit)
LT	Local Time of the United Arab Emirates (+7 hours UTC)
LSA	Light Sport Aircraft
MAG	Magneto
MTOW	Maximum Takeoff Weight
N	North
NM	Nautical Miles
Psi	pounds per square inch (Pressure measurement unit)
RPM	Revolution Per Minute
RWY	Runway
UTC	Universal Coordinated Time
VFR	Visual Flight Rules

1. FACTUAL INFORMATION

1.1 HISTORY OF FLIGHT

On 19th March 2010, an Aeroprakt 22 ('A-22'), registration mark A6-XAP, took off from runway ('RWY') 28 at approximately 1215 LT with two persons onboard: one pilot and one passenger.

The Accident flight was the second during that day; the first flight was conducted in the early morning with the same pilot and different passenger.

The Aircraft departed the ramp at around 1213 LT to reach runway 28 with no mechanical anomalies.

After takeoff, the engine power was continuously variated by the pilot to manage the in-flight manoeuvrability. The recorded engine parameters showed that the engine power was advanced to maximum takeoff power and kept for 45 seconds; thereafter the power was reduced to 4000 RPM to stay for around 7 minutes and 20 seconds.

The engine power then increased to 4400 RPM and continued for around 2 minutes before reduced to 3820 RPM and stay constant for 1 minute and 50 seconds. During the next 2 minutes, the power was fluctuating between 2350 and 3110 RPM before being increased gradually to 4000 RPM.

The pilot stated that on the final approach to runway 28, the windsock observation suggested favourability of runway 34 and a go-around decision was made at around 300 ft before touchdown to join traffic pattern for landing at runway 34.

The Aircraft banked 30° to the left turn down wind, and while at approximately 150-200 ft Above Ground Level ('AGL'), the Aircraft started to lose altitude until it became ahead of 14 ft elevated sand dune, the pilot advanced the engine power abruptly to 'Maximum' and commanded nose-up elevator.

The Aircraft went into a stall and immediately sank towards the ground until its nose landing gear impacted the dune.

The nose landing gear broke and the Aircraft continued airborne for about 66 ft until it completely stopped with nose heading (37° North), at approximately 500 ft southwest of RWY 28.

The pilot and the passenger were rescued by the local police emergency after they sustained serious injuries.

The Aircraft destroyed with no subsequent fire.

1.2 INJURIES TO PERSONS

Injuries	Flight Crew	Cabin Crew	Passengers	Other	Total
Fatal	-	-	-	-	-
Serious	1	-	1	-	2
Minor	-	-	-	-	-
None	-	-	-	-	-

Total	**1**	**-**	**1**	**-**	**2**

1.3 DAMAGE TO AIRCRAFT

The Aircraft was destroyed due to the significant impact.

1.4 OTHER DAMAGE

None.

1.5 PERSONNEL INFORMATION

The pilot was a member of the Club and possessed a flying permit to practice his flying activity; he received on-type training in the Club before he started to fly.

The pilot used to fly during weekends, his total on-type flying time was 52 hours.

The pilot was not suffering from any fatigue or sickness during the day of the Accident.

1.6 AIRCRAFT INFORMATION

1.6.1 Airframe Information

The A-22, MSN 268, was a non-aerobatic, Light Sport Aircraft ('LSA'), manufactured by Aeroprakt Ltd, Ukraine.

The A-22 was designed for recreational flying and primary training in daytime VFR flight from grass or hard runways. It was a metal air-framed high-wing strut braced monoplane with side-by-side seating and extensive cockpit glazing. The fixed tricycle landing gear had hydraulic brakes and a steerable nose wheel linked to the rudder pedals.

The standard power unit was a 100 hp, Rotax 912ULS, driving a ground adjustable 3-blade composite propeller. Two wing tanks gave a total fuel capacity of 92 liters.

1.6.2 Flight Limitations

The following were the limitations mentioned in the A-22 Operator & Maintenance Manual ('A-22 Manual')[1]:

- Aerobatics, banked turns over 60°, intentional spinning and accelerated stalls are prohibited.

- **V_{ne}** – (Never exceed speed) 108 kts
- **V_{no}** – (Maximum structural speed) 80 kts
- **V_a** – (Maneuvering speed) 70 kts

  Do not make full or abrupt control movements above this speed.

[1] A-22 Manual is similar to the Pilot's Operating Handbook

- V_y – (Best rate of climb, no flap) 57 kts
- V_f – (Flaps extended speed) 59 kts

  Do not exceed V_f with the flaps extended
- **Best L/D -** (best glide speed, flaps up) 52 kts
- V_{s1} – (Stall, no flaps and wing level) 32 kts
- V_{so} – (Stall, with full flaps and wing level) 27 kts

A hint was contained in the A-22 Manual stating: 'Add 4-10 kts to these speeds for stalls in turns'.

1.6.3 Engine Information

The Rotax 912 ULS was a 4-Cylinder with 4-stroke liquid/air-cooled engine with opposed cylinders, two carburettors and dual-electronic ignition.

The engine starts electrically, equipped with propeller speed reduction unit and air intake system.

The engine was a non-certified 'Aviation Product' engine, the time between overhauls was 2,000 hrs.

The following were the specifications of the engine:

- Maximum engine speed: 5800 RPM (maximum 5 minutes)
- Maximum continuous speed: 5500 RPM
- Dual ignition check: 4000 RPM
- Normal idle: 1800-2100 RPM
- Minimum idle: 1400-1800 RPM
- Maximum exhaust gas temperature: 880 °C (normal: 760–800 °C).
- Maximum cylinder head temperature: 130 °C (normal 95–100 °C).
- Minimum oil temperature for takeoff: 50 °C (normal 85–110 °C)
- Maximum oil temperature: 130°.
- Minimum oil pressure: 0.8 bar/12 psi
- Maximum oil pressure: 7.0 bar/95 psi
- Normal oil pressure: 2-5 bar/30-75 psi

Appendix A shows the recorded engine RPM versus time.

1.6.4 Fuel grade

Premium Unleaded octane rating 95 (or better) - normal use

Avgas - acceptable providing mineral engine oil is used and changed more frequently.

1.6.5 Weights' Limitations

The empty weight was 263 kg (580 lb) +/-2%, MTOW 525 kg (1157.5 lb) [450 kg (992 lb) Australia, 472.5 kg (1041.7 lb) with parachute], maximum cockpit load 172 kg (379.2 lb), minimum cockpit load 55 kg (121.25 lb), and maximum luggage bin 25 kg (55.1).

The C of G datum and range:

Datum– Front face of propeller mounting-flange

AOD– 4.72 to 5.71 ft aft of datum, aircraft level with reference to the lower door valances.

1.6.6 Aircraft Maintenance History

Reviewing the Aircraft maintenance records did not reveal any mechanical defects.

1.7 METEOROLOGICAL INFORMATION

There was no significant meteorological condition in the area at the time of the Accident.

1.8 AIDS TO NAVIGATION

The Accident flight was VFR.

1.9 COMMUNICATIONS

Not a factor.

1.10 AERODROME FORMATION

Al Jazirah Aviation Club Airport is a GCAA certificated airport that was built at a desert area located in Ras Al Khaimah, the United Arab Emirates, to serve the club's operations.

The UAE Aeronautical Information Publication ('AIP') contains the Airport's specifications as shown in the below table.

Al Jazirah 'OMRJ'	
Runways	Two crossing 10/28 and 16/34 crossing each other at 253955N 0554627E. RWY 16/34: 1640 x 65.6 ft, tarmac RWY 10/28: 984 x 65.6 ft, compacted sand
Elevation	10 ft
Types of traffic permitted (IFR/VFR)	VFR only
Aerodrome obstacles	- MAST - 1050 ft

	- Day/VFR - 253923.92 N 0554520.68 E - 243° 1.14 NM from ARP
Circuit patterns	- Left hand circuit, 500 ft at RWY 16 - Right hand circuit at 500 ft at RWY 34

1.11 FLIGHT RECORDERS

The engine was equipped with FLYdat display system that monitors the following parameters:

- RPM - engine speed, revolutions per minute
- HOURS - hours of operation, x 0.1 hour
- EGT/PTO - exhaust gas temp, propeller side, °C
- EGT/MAG - exhaust gas temp, magneto side, °C
- CHT - cylinder head temperature, °C
- EGT display - cylinders for EGT
- OIL TEMP - oil temperature, °C
- OIL PRESS - oil pressure x 0.1 bar

The FLYdat was collected by the Investigation and shipped to the engine manufacturer where it was downloaded and the engineering data processed.

1.12 WRECKAGE AND IMPACT INFORMATION

The location of the impact was at approximately 500 ft meters southwest of RWY 28. The Aircraft was in one unit except the nose landing gear which detached and found (65 ft) before the Aircraft final stop.

The nose of the Aircraft was heading to approximately (37°). The airspeed indicator was pointing to approximately 35 km/hr (18.9 kts), the vertical speed and altitude indicators were pointing to zero,

Figure 1 illustrates the distribution of the main wreckage pieces at the Accident site.

Figure 1- Wreckage distribution diagram

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

No psychoactive material was found in the blood of the pilot.

1.14 FIRE

There was no pre- or post-impact fire.

1.15 SURVIVAL ASPECTS

The pilot and passenger were evacuated by the local police ambulance to a nearby hospital.

1.16 TESTS AND RESEARCH

None.

1.17 ORGANISATIONAL AND MANAGEMENT INFORMATION

Al Jazirah Aviation Club was certificated by the GCAA under Part IV, Section D- *Ultralight and Microlight Operations*, of the Civil Aviation Regulations.

The Club was being managed by a GCAA's accepted organisation structure depicted in the Club's Operations Manual.

The Club was authorised to operate micrloight and ultralight aircraft within certificated vicinity, and facilitated with maintenance hangar and training classes.

The operation was approved under VFR/Daytime only; operational control and authority to release flights were under the Club's 'Chief Flying Instructor'.

According to the Club's Manual, each flight plan shall include information of date and time, route, aircraft type and registration, colour and identifying marks, radio, if installed, and pilot in command.

1.18 ADDITIONAL INFORMATION

The pilot stated that when he joined the Club, someone from the Club had briefed him on the Club's procedure while the Club manual was not provided to him, he was only provided with a copy of the A-22 Operator & Maintenance Manual. The pilot added that he used to see the 'circuit pattern RWY 28' chart at the wall, when the pilot was asked of why he didn't follow that applicable pattern when landing on RWY 34, he answered that he was not doing 'overshoot' on RWY 28 when he decided to change the landing to RWY 34.

According to the Club's Operations Manual, circuit pattern flight for RWY 34 should be initiated to the right while it should be to the left for RWY 16. Traffic pattern altitude should be 800 ft AGL. Aircraft joining the circuit should join on the downwind side of the circuit only after passing overhead centre field at not less than 1000 ft and not more than 1400 ft AGL. Vertical limitations were to be strictly followed, which was not more than 1400 ft AGL and not less than 500 ft AGL. (Appendix B).

According to the A-22 Manual, the missed approach and go-around could be performed in two methods:

- Method One. From "clean" flaps up approach, increase power smoothly to full power whilst gradually raising the nose. The aircraft will accelerate quite rapidly in this situation so be careful with ground and obstacle clearance. Establish a 60 kts climb attitude and trim for stick "neutral".
- Method Two. From a short-field full flap approach, increase power smoothly and sufficiently to establish a climb whilst keeping the stick in the same pitch position. Do not exceed V_f (the flap limiting speed of 59 kts).

The A-22 Manual also dictated to apply a forward pressure to maintain the same pitch position when increasing power for a go-round and to adjust the trim accordingly. Raising flaps before climbing to 200 ft with positive climb was prohibited by the A-22 Manual. When positive climb is ensured, 'half flap' position could be selected with increase to full power. The A-22 Manual allowed for flying a small circuit in this configuration.

A 'Warning' in the A-22 Manual prohibited pilots to raise the flaps suddenly at low level, either on the approach or climb-out, because the aircraft will sink noticeably as the flaps retract. The position of the cockpits flaps' handle showed that the flaps were set at position 1 (out of three positions- 0, 1 and 2, see figure 2), that position was not covered in any of the 'missed approach and go-around' two methods mentioned above.

Figure 2- Flaps' handle

1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES

None.

2. ANALYSIS

The wreckage investigation revealed no Aircraft performance anomalies or mechanical malfunctions: the flight controls were moved freely, no pre-impact damage marks were observed. When moving the cockpit handles and pedals by the investigators, the flight control cables, rods and motions converters exhibited normal power transfer to the ailerons, elevator and rudder.

The free movement of the control surfaces and the Aircraft integrity prior to the impact excluded the probability of controllability loss due to failure of any primary or secondary flight control surface, or any of power transfer means.

The field examination of the engine revealed that the engine was functioning normally: the induction, fuel, ignition, cooling and lubrication systems were intact with no indication of in-flight deficiency or signs of malfunction. The engine reader's downloaded data confirmed that there was a consistent response of the engine within the different phases of the flight.

The flight was normal until the time when the pilot decided to change the landing runway from RWY 28 to RWY 34 and the associated go-around decision. When the pilot made that decision, he immediately commanded the Aircraft for a left turn to catch RWY 34 while he was at low altitude.

According to the Club's Operations Manual, and according to the published AIP, approaching RWY 34 should be from the right side, i.e after the go-around from RWY 28, the Aircraft should continue climbing, follow the RWY 34 circuit pattern before the final approach to RWY 34 (blue line in Appendix C).

The location of the crash site, its distance from RWY 34, the airspeed indicator's reading, and the short period of power increase, would introduce to the Investigation a clue that the turn was started immediately after the go-around was initiated.

In general, an increase in bank angle requires increasing the lift to maintain the aircraft in level flight during its climb, the increase in lift depends on the bank angle: the more bank angle the more lift is required to compensate for the lost lift component due to bank.

When the Aircraft bank angle was increased during the left turn to RWY 34, and in order to maintain altitude while turning in steady coordinated, constant altitude and constant speed turn, the required lift should have been the result of the weight divided by the cosine of the bank angle.[2]

In order to increase the lift to the required amount of maintaining steady coordinated turn, the pilot should have commanded nose-up elevator input to compensate for the nose down pitch moment.

The more lift required to compensate for the bank angle results in an increase in the induced drag which should be overcome by more thrust.

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[2] In a steady state turn:

Σ Vertical forces= $W - L\cos\phi = 0 \rightarrow L = W/\cos\phi \rightarrow L/W = 1/\cos\phi = G$, Where L= the required lift for steady state turn, W=weight, ϕ= Bank angle, G= load factor.....*Equation (1)*

Σ Horizontal forces= $L\sin\phi = m \times a_r = m \times (V^2/r) = (W/g) \times (V^2/r)$, where m= aircraft mass, a_r= radial acceleration of the aircraft, V= speed, r= horizontal turn radius, g= acceleration due to gravity.....*Equation (2)*

Dividing equation (2) by equation (1):

$(L\sin\phi / L\cos\phi) = (W/g)(V^2/r)(1/W)$

i.e. $\tan\phi = V^2/gr$; $r = V^2/g\tan\phi$; or $\phi = \tan^{-1}(V^2/gr)$

The left turn performed by the pilot was initiated at low level which did not avail an opportunity to maintain the altitude and/or take any recovery reaction. The Aircraft continued in losing altitude, while the pilot had no proper input by elevator and throttle commands, until the sudden appearance of the dune to the pilot.

At that moment, the pilot tried to avoid the impact by sudden nose-up elevator and maximum throttle, the Aircraft did not efficiently respond and went into a stall where aerodynamic control was not sufficient to recover.

The Club's Manual did not contain adequate procedure to change the originally planned landing runway. In addition to that, the Manual did not contain procedure for maintaining records pertinent to the takeoff load sheets and weights of the persons boarding the flight, that deprived the Investigation from determining whether the takeoff mass or C.G position were contributing to the Accident or not.

3. CONCLUSIONS

3.1 GENERAL

From the evidence available, the following findings, causes and contributing factors were made with respect to this Accident, these findings and contributing factors shall not be read as apportioning blame or liability to any particular organisation or individual.

The following sections were included in the 'Conclusions' heading to serve the objective of this Investigation.

3.2 FINDINGS

(a) The pilot possessed a properly issued 'flying permit'.

(b) The Aircraft was properly registered and issued a 'flight permit'.

(c) The Aircraft did not suffer from any mechanical defects that might have contributed to the Accident.

(d) The Aircraft engine was functioning normally.

(e) There was no evidence of psychoactive influence that might have adversely affected the pilot performance during the flight.

(f) There was no significant whether in the vicinity of the flying area at the time of the Accident.

3.3 CAUSES

The Air Accident Investigation Sector determines that the causes of the Accident were:

The pilot decision to perform a go-around from RWY 28 and to change the landing to RWY 34 by, improperly, making a left turn associated with bank, at low altitude without taking the necessary actions to maintain coordinated turn, resulting in losing altitude followed by improper impact avoidance reaction causing the Aircraft to enter into a stall, to sink and impact the ground.

3.4 CONTRIBUTING FACTORS TO THE ACCIDENT

(a) The pilot did not follow the standard practice procedures for establishing safe approach and landing when he decided to change the landing runway by following improper joining pattern to the new landing runway.

(b) The pilot's situational awareness did not qualify him to realise that the Aircraft was losing altitude while turning.

(c) The pilot did not take the proper training in the Club's landing and takeoff procedures on RWY 34 or RWY 28.

(d) The Club's Operations a Manual did not contain adequate procedure pertinent to changing a landing runway in case of any unforeseen weather or other conditions.

3.5 OTHER FINDINGS

(a) The Club's Operations Manual did not contain procedure pertinent to recording the weights of the pilot and passenger and insert that into a properly maintained load sheet.

4. SAFETY RECOMMENDATIONS

4.1 GENERAL

The 'Safety Recommendations' listed in this Report are proposed according to paragraph 6.8 of Annex 13 to the Chicago Convention, and are based on the 'Findings', 'Contributing Factors' and 'Other Findings' listed in Section 3 of this Report, the GCAA expects that all safety issues, identified by the Investigation in Section 3, are addressed by the receiving organizations.

4.2 RECOMMENDATIONS TO AL JAZIRAH CLUB

SR 20/2012
To revise the Operations Manual to include procedures for:

(a) Changing the landing runway.

(b) Weighing the pilots and passengers in the beginning of each flying day and maintain record for the generated load sheet.

SR 21/2012
To conduct official training on the Operations Manual and the related Aircraft Manuals before flying any aircraft type.

SR 22/2012
To establish a system for pilots' performance monitoring and assessment.

SR 23/2012
To enhance information communication system, especially those related to 'critical information', to pilots.

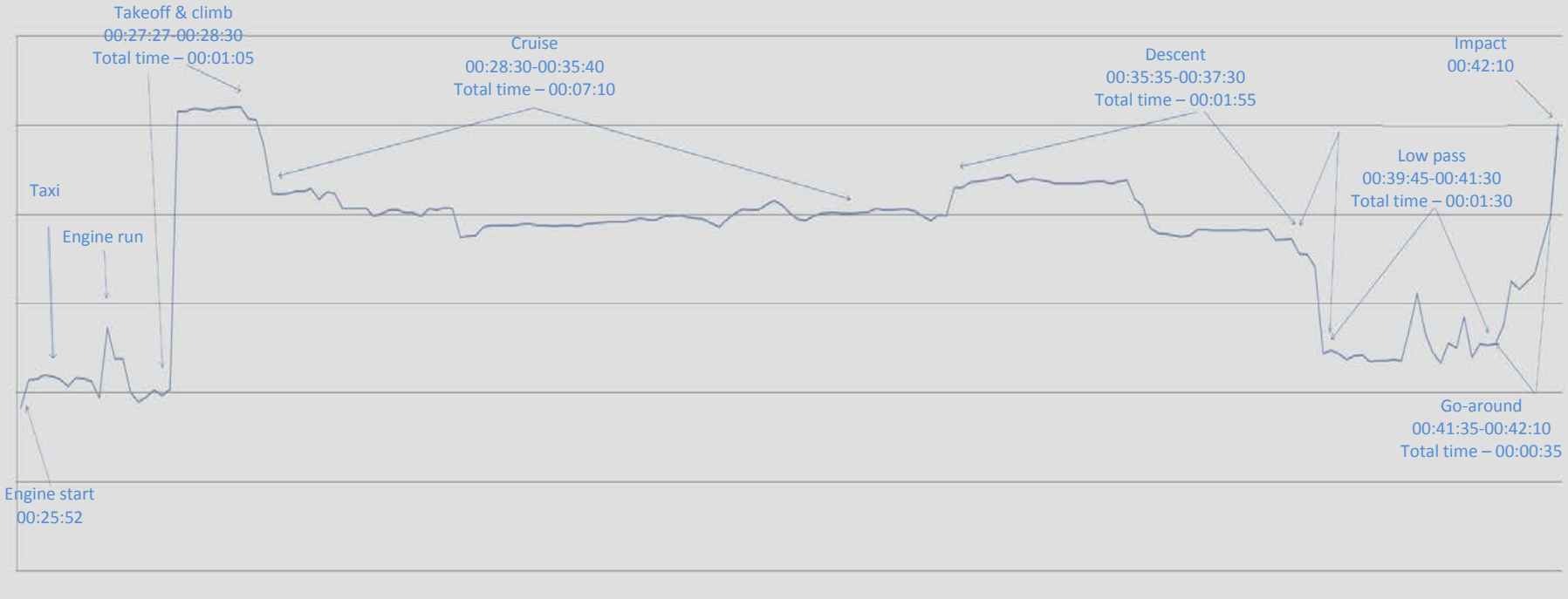
SR 24/2012
To enhance the quality management system in order to ensure that all the necessary safety issues are considered and communicated within the Club's organisation and amongst the pilots.

4.2 RECOMMENDATIONS TO THE GCAA

SR 25/2012
To improve the Civil Aviation Regulations related to Light Sport Aircraft and operations.

Air Accident Investigation Sector
General Civil Aviation Authority
The United Arab Emirates

APPENDIX A- ENGINE POWER SETTING CHART

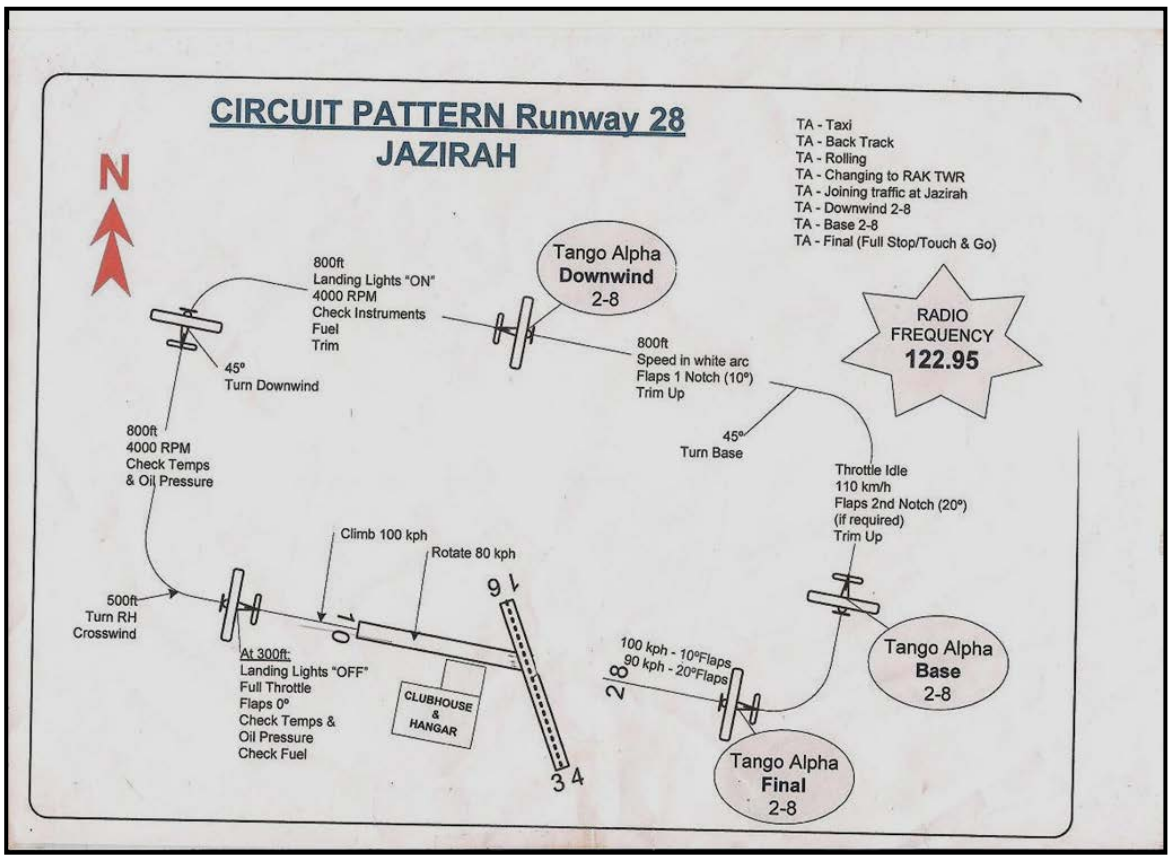


NOTES:

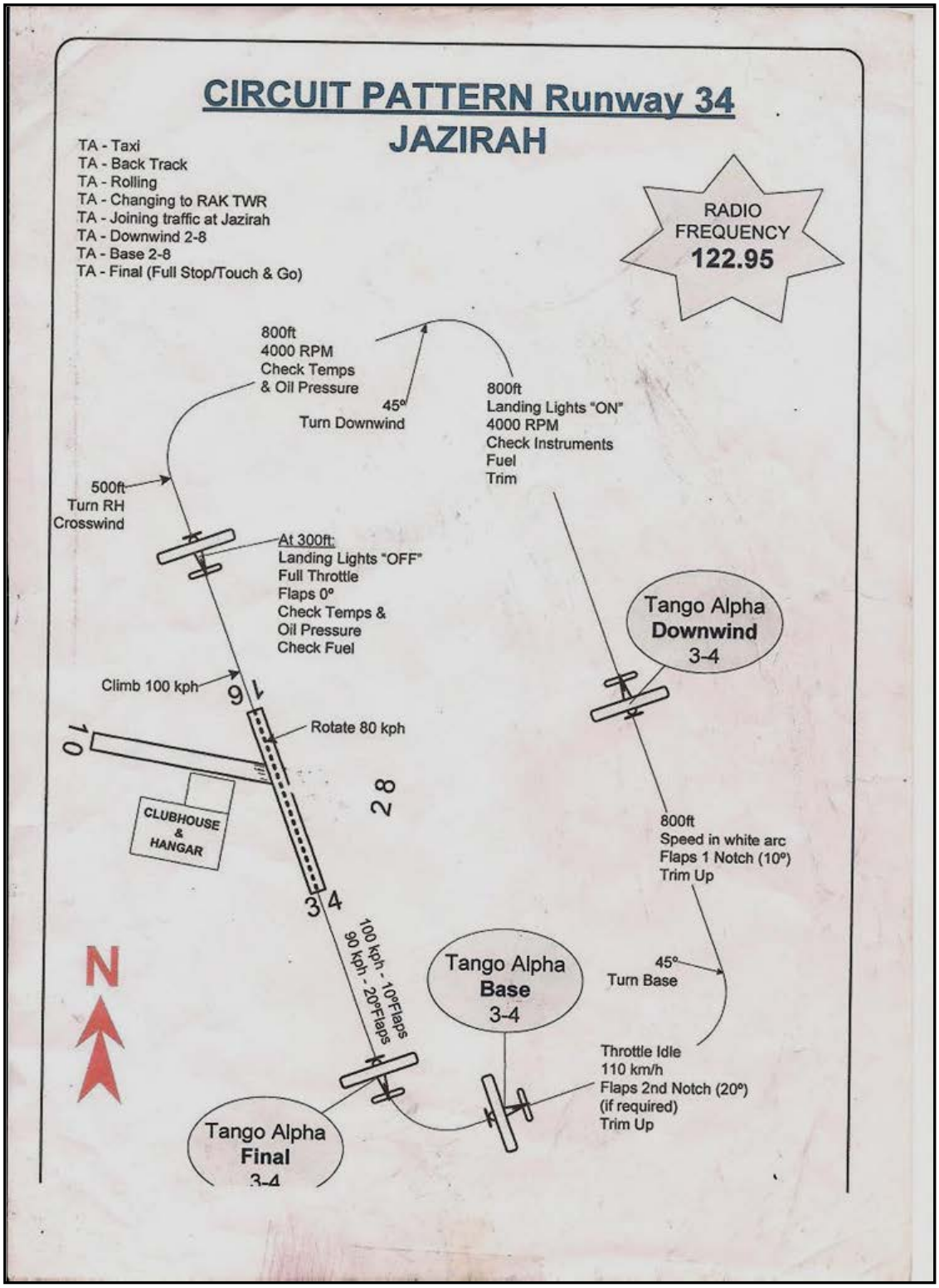
- Hours counter in the above chart was re-set to '00' for clarity.
- The events depicted in the above chart were extracted from the engine power settings, no other evidence could support them.

APPENDIX B- CIRCUIT PATTERNS AS CONTAINED IN THE CLUB'S MANUAL

RWY 28



RWY 34


CIRCUIT PATTERN Runway 34
JAZIRAH
TA - Taxi
TA - Back Track
TA - Rolling
TA - Changing to RAK TWR
TA - Joining traffic at Jazirah
TA - Downwind 2-8
TA - Base 2-8
TA - Final (Full Stop/Touch & Go)
RADIO FREQUENCY 122.95
800ft
4000 RPM
Check Temps
& Oil Pressure
45°
Turn Downwind
800ft
Landing Lights "ON"
4000 RPM
Check Instruments
Fuel
Trim
500ft
Turn RH
Crosswind
At 300ft:
Landing Lights "OFF"
Full Throttle
Flaps 0°
Check Temps &
Oil Pressure
Check Fuel
Tango Alpha
Downwind
3-4
Climb 100 kph
Rotate 80 kph
CLUBHOUSE & HANGAR
800ft
Speed in white arc
Flaps 1 Notch (10°)
Trim Up
100 kph - 10°Flaps
90 kph - 20°Flaps
Tango Alpha
Base
3-4
45°
Turn Base
Throttle Idle
110 km/h
Flaps 2nd Notch (20°)
(if required)
Trim Up
Tango Alpha
Final
3-4
N

APPENDIX C- CIRCUITS PATTERNS OF BOTH RUNWAYS