

Safety Investigation Report - Final

Serious Incident File No. 25-23

Engine failure and belly landing

Date	8.9.2023
Aircraft	TEXAN Top Class 2 RG
Registration	4X-HYT
Location of event	Near Hatzor Air Force Base

For Safety Purposes Only

The law regarding the safety investigation and its results

(Aviation Law, 2011 and ICAO Annex 13)

Safety investigation - An investigation of a safety incident to this chapter is a procedure that includes gathering information and analyzing it, drawing conclusions, including determining the causes of the safety incident or the factors that contributed to its occurrence, and providing recommendations related to the matter for the purpose of improving aviation safety, as far as the Aircraft safety Investigation Authority Israel (AIAI) deems it necessary. (section 104 of the law).

Purpose of a safety investigation - The sole purpose of a safety investigation is the prevention of safety incidents, and its purpose is not to attribute civil, criminal or disciplinary liability to such incidents. (section 105 of the law).

Duties of the AIAI - The IIC will be in charge of conducting safety investigations according to the provisions of this chapter. In fulfilling his duties, the IIC will act in accordance with the provisions of ICAO Annex 13, insofar as they are applicable in Israel, with the exception of such provisions for which the CAAII informed ICAO, according to the provisions of Section 4(b) of the Civil Aviation Authority Law, that Israel operates in a different manner. (section 108 of the law).

Independence - in carrying out a safety investigation according to this chapter, there is no prejudice against the AIAI manager and his deputy, other than the justice; The provisions of this section shall also apply to an investigator authorized under section 115, subject to the provisions of subsection (c) of said section. (section 109 of the law).

Publication of the Final Report - The AIAI will publish the final report on its and will also make the report available for public inspection, free of charge, at the Ministry of Transportation and Road Safety, provided that it will not publish the report or part of it and will not make it available for public inspection as stated, if there is any contradiction with the country's security or its foreign relations. (section 119 of the law).

The recommendations of the AIAI - the CAAII and anyone for whom the AIAI included recommendations in the final report will examine the aforementioned recommendations concerning him, will decide as to their implementation and will notify the AIAI of his reasoned decision in writing; The CAAII will forward his reasoned decision to the minister as well. (section 122 of the law).

Inadmissibility of the final report - The final report will not be accepted as evidence in a trial, except in an appeal according to section 39, in an administrative petition or in an administrative appeal against decisions according to this law, according to the Law of Courts for Administrative Matters, 2000, and will not be used in a procedure taken by an employer against his employee, and regarding a procedure against a pilot employee according to section 38 - will not be used unless the circumstances stated in section 138(b) are met (section 124 of the law).

Confidentiality and inadmissibility of safety investigation material - Safety investigation material will not be given and will not be accepted as evidence in a trial and will not be used in a disciplinary procedure, in an administrative procedure or in a procedure taken by an employer against his employee. (section 123 of the law).

Safety Investigation Report - Final

Serious Incident File No. 25-23

On Friday, September 8, 2023, at 15:30, a solo pilot (hereinafter: "the pilot") took off in a light sport aircraft (LSA), a Texan with

national markings and registration 4X-HYT (hereinafter: "the aircraft"/"the airplane"), which had a retractable landing gear, from the Rishon Lezion airstrip for a commercial aerial photography flight of agricultural areas in the southern part of the country. The pilot planned to climb to an altitude of 7,000 feet.

Note: Throughout the report, all altitudes are above sea level (ASL) unless specifically stated as above ground level (AGL).

While crossing 4,800 feet, engine "stutters" began in the aircraft. The pilot stopped the climb, performed several maneuvers to help the fuel pumps transfer fuel to the engine, and simultaneously started preparing for a landing at the Hatzor military airstrip.

At an altitude of about 2,400 feet, the engine failed. The pilot attempted to restart the engine nine times, but without success.

At 400 feet, approximately 250 feet AGL, the pilot (according to his statement) lowered the landing gear, and subsequently lowered the flaps. After the flaps were fully lowered, he realized the landing gear had not deployed, and performed a belly landing with the engine off on runway 05 at Hatzor. No injuries were reported.

Minimal damage occurred to the aircraft following the landing – the front wheel was worn (the wheel protrudes outward in the raised position), the wingtip flaps and belly of the aircraft were slightly scraped.

The pilot reported the incident to the Aircraft Safety Investigation Authority (AIAI), which subsequently initiated an investigation into the incident.



Figure 1 - The aircraft subject to the investigation

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Acron ym	Meaning
M b	Millibar
L S A	Light Sport Aircraft
A I P	Aeronautical Information Publication
A I A I	Aviation safety Investigation Autl of Israel
A I A I	Civil Aviation Authority
C A AI	Mean Sea Level (MSL)
M S L	Above Ground Level (AGL)
A G L	Certificate of Airworthiness
C of A	Type Certificate
T C	Light Aircraft Association (UK)
L A A	Vapor Lock (The terms are used interchangeably in the report)
Va po r L o c k	Ceiling and Visibility OK
CAVO K	British Civil Airworthiness Req Section S (Refers to light and sm certification requirements)
BC AR section S	

1. Factual information

1.1 Flight History

1.1.1 Background

The aircraft involved in the incident, a Texan Top Class 2 RG light aircraft with national markings and registration 4X-HYT, is a light aircraft with a retractable landing gear, operated for agricultural aerial photography missions under commercial use by a company operating under Chapter 9 of the Air Regulations (Aircraft Operation and Flight Rules), 1981. The aircraft is equipped with a dedicated camera installation. The aerial photography flights are typically conducted at an average altitude of approximately 3,000 feet. The incident flight was the third flight of the day.

The first flight took place around 08:00 in the morning, on a route from the Rishon LeZion airstrip to the Nesharim Junction and back (altitudes 800/1,200 feet) with the purpose of checking the functionality of the camera equipment. The flight lasted approximately 30 minutes and concluded without any unusual events.

The second flight was an aerial photography mission conducted at an altitude of 7,000 feet, between 10:00 and 14:15. Both the climb and descent at the end of the mission were carried out using aviation fuel 100LL from the right wing. The cruise during the photography mission was conducted using automobile fuel, MOGAS 95 octane, from the left wing. No unusual occurrences were reported during this flight.

1.1.2 Data and Preliminary Actions Prior to the Incident Flight

The temperature measured by the meteorological service at the Meteorological Service station in Beit Dagan (the closest measurement point to the Rishon Lezion airstrip) shortly before the takeoff time (15:30) for the incident flight was 40.4°C. The atmospheric pressure measured was 1,002 Mb.

Note: There are discrepancies in the data depending on the measurement source and its location. The GARMIN navigation computer displayed 41°C, while the METAR at Ben Gurion Airport (according to the pilot's statement) recorded 36°C.

State of Israel
Ministry of Transport and Road Safety
Aircraft Safety Investigation Authority Israel (AIAI)
Prior to the flight, the pilot decided not to use the aviation fuel
100LL located in the right wing (26 liters – 7 USG) in order to
reserve it for scheduled aerial photography flights the following day in the
southern part of the country.

Note: There is no aviation fuel 100LL available at the Rishon LeZion airstrip. Such fuel can be purchased at Sde Teiman airstrip, close to the planned photography area for the following day, but for commercial reasons, the pilot chose to avoid this.

Aware of the phenomenon of VAPOR LOCK (hereinafter: "Vapor Lock") during the incident flight, the pilot took preventive actions as follows:

- Parked the aircraft in the shade, inside a hangar, for approximately one hour and fifteen minutes.
- Refueled the left wing with 95-octane automobile fuel, assuming that the temperature of the fuel in the underground tank at the airstrip was significantly lower than the outside temperature at the time of takeoff.

1.1.3 The Incident Flight

(See flight profile diagrams – Images 2, 3, 4)

- The takeoff for the incident flight occurred around 15:30. The takeoff and climb were conducted using 95-octane automobile fuel.
- As directed by the air traffic controller, the airplane climbed from Nitzan to Hodaya (waypoints on the map) to an altitude of 7,000 feet (Image 2).
- At an altitude of approximately 4,800 feet, engine "stutters" began. The pilot stopped the climb, lowered the aircraft's nose, and the engine stutters ceased briefly. The pilot turned left (north) toward the Hatzor airfield, notifying the air traffic control unit of the malfunction and his intention to land at Hatzor if necessary. During the descent, the pilot established communication with the control tower at the Hatzor military airfield, which immediately provided general approval for a potential landing. The pilot began conducting a series of checks using the throttle. Increasing power caused the engine to sputter. Pulling back the throttle briefly stabilized the RPM, but the engine stutters continued.

Note: Data extracted from the aircraft's engine computer after the flight indicates that the fuel pressure during the climb, which was approximately 42 PSI, dropped to 6.4 PSI within 45 seconds. The pilot

- According to the pilot, he lowered the aircraft's nose to an angle that, in his estimation, would position the fuel pump below the fuel level in the tank. In this configuration, he continued descending, losing approximately 2,000 feet. At 2,800 feet, he switched to the optimal glide speed, making a 20-degree right turn for approximately 20 seconds, again with the intention of ensuring that the fuel outlet on the wing, located at the root of the wing, was higher than the pump's fuel inlet.
- According to the pilot, he later switched the fuel selector to the right wing, which contained 100LL fuel, but he reported no change in engine response to the throttle movements.

Note: *The aircraft's computers do not have the capability to track the fuel valve's status. After landing, it was found that the fuel selector was on the left wing, which contained automobile fuel.*

- According to the navigation computer data, the engine shut down at 2,487 feet. The pilot coordinated with the controller and later with the Hatzor control tower for an emergency landing via a direct approach.
- The pilot made nine attempts to restart the engine using the starter (the total duration of the starter activation was 55 seconds).

Note: *The aircraft's manual instructs the pilot to attempt a restart, but no limit is specified for the number of attempts.*

- At an altitude of 400 feet (approximately 250 feet AGL), the pilot lowered the landing gear lever (a two-position lever) and began extension the flaps (a spring-loaded switch that requires continuous pressure during the extension process). Upon completing the flaps extension (a process that took about 36 seconds), the pilot noticed that the landing gear failed to unlock from the up position. A subsequent attempt to raise and lower the switch did not change the landing gear's position. At this stage, there was insufficient time to attempt an emergency Landing gear extension.

The pilot adjusted the propeller to a horizontal position (using a brief starter activation) and executed a belly landing without engine power on runway 05 at Hatzor.

Notes:

a. *The aircraft manual does not provide instructions regarding the sequence or method for extension drag devices – wheels and flaps.*

The pilot's procedure is to lower the landing gear (two-position lever), lower the flaps (spring-loaded switch requiring constant pressure during extension), and upon completing the extension, verify "three greens" to ensure the landing gear is locked down. In general, the extension of drag devices is done simultaneously (wheels and flaps).

b. *In the absence of electrical power from the alternator due to the engine shutdown, as occurred in this case, only the battery provides power to both of these devices operating simultaneously.*

- The aircraft touched down on runway 05 approximately 1,300 meters from the beginning and came to a stop after about 50 meters near the intersection of runway 05 with runway 29/11 South.
- The pilot did not complete Section 3.6.3 of the emergency checklist regarding forced landings (FORCED LANDING). The pilot did not close the fuel valve nor stop the fuel pumps before landing.
- The pilot exited the aircraft unharmed. Following the belly landing, the aircraft sustained minor damage to the front wheel tire and slight abrasions on the tips of the flaps.
- Investigators from the AIAI who arrived at the scene found the fuel selector on the left wing, the fuel pumps in the "ON" position, and the landing gear switch in the "DOWN" position.
 - During the initial field inspection after the incident, the aircraft was lifted using a crane, and an attempt was made to operate the landing gear. The landing gear extended, but during the lifting attempt, it stopped mid-motion. The propeller tips were slightly damaged during the lifting of the aircraft.



Figure 2 - Flight Path



Hatzor



First starting attempt

Maneuver to create a fuel tank to pump head differential, followed by transition to best glide.

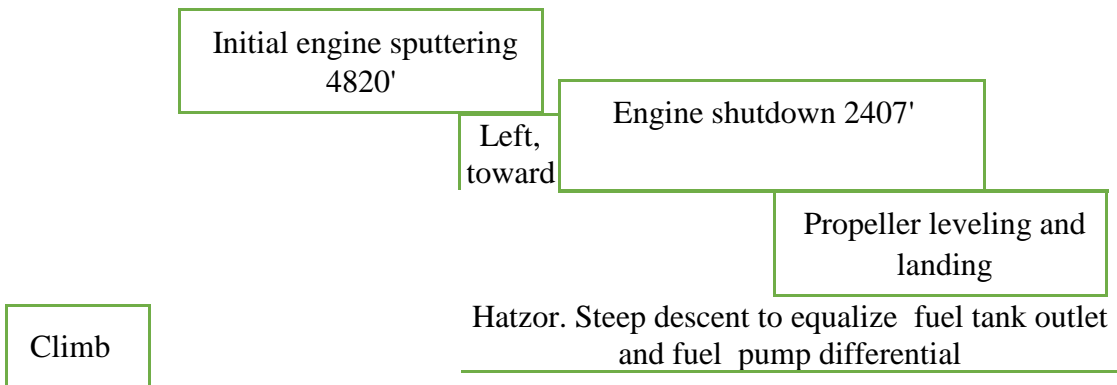


Figure 3 - Flight Path Towards Landing



Figure 4 - Flight Profile and Start Attempts Characterized by Loss of GARMIN Data (Electrical) During Use of Starter



Gear down

Fuel pumps ON

Fuel selector on left tank

Figure 5 - Fuel Valve and Pumps, Landing Gear Operation Switch - After Landing

1.2 Injury to Occupants

Injuries	Pilot+Crew	Passengers	Other
Fatal	0		
Serious	0		
Minor	0		
None	1		

1.3 Aircraft Damage

Front tire torn. Light abrasion on the wing tips. Light abrasion on the fuselage and exhaust tip.



Figure 6 - Damaged Front Wheel

1.4 Other Damage - No other damage.

1.5 Information on Aircrew and Other Involved Parties 1.5.1

Commercial Pilot License for Light Aircraft – Valid.

1.5.2 Valid Medical Certificate - Until 26.2.2024.

1.5.3 Total Flight Hours as Pilot-in-Command - 1,388.

1.5.4 Total Flight Hours on Aircraft Involved in the Incident - 1,088.

1.6 Aircraft Information

1.6.1 Category - Light Sport Aircraft (LSA)

- Aircraft Model: Texan TOP CLASS 2 RG
- Manufacturer: FLY SYNTHESIS
- Serial Number: F2EH1741202F
- Year of Manufacture: 2018
- Nationality and Registration Mark: 4X-HYT
- Airworthiness Certificate Validity: 15.10.2023
- Type Certificate for Aircraft No. IA-180 in Israel
- Aircraft is privately owned and operated under Chapter 9 of the Civil Aviation Regulations by a commercial company

Total Aircraft Hours since Manufacture: 1,089 hours

- Weight and Balance: Special installations and aircraft weighing before certification in Israel were performed during production and certification by the manufacturer. After the incident, the aircraft was weighed (empty) and found to be 50 kg above the weight specified in the certification.

1.6.2 Engine

- Engine Manufacturer: ROTAX 912IS
- Serial Number: 7704347
- Total Engine Hours: 1,089 hours.

1.6.3 Propeller

- Two-blade, variable pitch, GT2VEB
- Manufacturer: GT.

1.6.4 Fuel

- Approved Fuel Types: MOGAS 95 RON, 100LL
- Two tanks with a total capacity of 134 liters, divided between both wings
- Fuel found after landing: Left fuel tank: approx. 65 liters MOGAS 95 octane (automobile fuel). Right tank: approx. 26 liters 100LL (aviation fuel).

Notes:

- *The aircraft does not have a fuel temperature measurement system in the tanks.*
- *The aircraft manual does not prohibit mixing approved fuel types or fueling the aircraft such that each wing's tank contains different types of fuel.*

1.6.5 Battery - Aircraft battery specification: 12 Volts, 18 AH, Sealed Lead Acid Battery **The aircraft manual does not specify whether the battery is a "starter battery" or another type (backup/deep discharge).** The battery

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installed in the aircraft after the incident was a **12V-25AH deep-discharge gel battery**, which is not a "starter battery" but rather a backup deepdischarge battery. The battery in this aircraft serves primarily for starting and as a backup power source in case of electrical failure.

- Warranty duration: 1 year. The battery's date stamp shows 11/2020. According to the aircraft owner, this date refers to the previous battery replaced under warranty (which was reportedly replaced in January 2022). No documentation was found regarding maintenance related to the battery replacement, its type, or capacity.

Note: Battery replacement was done when the aircraft was registered under an airline performing all maintenance operations through an approved maintenance organization.

- Inspections and maintenance are conducted by a maintenance organization licensed and supervised by the Civil Aviation Authority. As the aircraft operates commercially, routine inspections are documented on the operator's forms.
- The 100-hour inspection does not require checking the battery condition.
- The 200-hour inspection (Appendix 7) includes checking the battery (sealing check): charging, general condition, cleaning from liquids, corrosion, and evidence of possible electrolyte discharge.

There is no specific procedure for checking the cranking current for starter batteries when there is doubt regarding their technical condition (a simple, common test in car service centers).

No specific procedure for checking the battery's discharge rate or impedance, which pertains to the battery's chemical performance. Leakage in a battery (fluid discharge through designated vents) indicates an electrical issue in the charging system or the battery itself. Gel batteries do not leak.

According to the maintenance organization, the battery check during the 200-hour inspection is only a **visual inspection**.

- The "maintenance" of the battery is defined by the maintenance organization as "failure maintenance" — replaced when the battery fails.

Note: Battery inspection is done similarly in other aircraft maintained by the same maintenance organization.

- After the incident, the battery was tested at the manufacturer's facility, and it was found to have low capacity - fully discharged within about 4-5 minutes.



Figure 7 - The battery found in the aircraft

1.6.6 Accessories/Parts in the Aircraft

The aircraft is equipped with a dedicated camera that consumes a significant amount of electricity. The camera was not operated during the flight and did not consume electricity during the incident.

1.6.7 Overall Serviceability

The aircraft departed for the flight without any malfunctions or open permits.

1.6.8 After the Incident

The aircraft was inspected at the landing site before being released from the investigation. The electrical system functions, including the operation of the landing gear and flaps, engine (run-up), and supporting systems, were checked. No findings indicated a technical failure or mechanical obstruction

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to the landing gear movement. No technical findings indicated an engine malfunction.

The aircraft was returned by flight to the Rishon LeZion airstrip after three months of parking at the Hatzor Airfield. No technical issues were found during this flight.

A 200-hour inspection of the airframe and a 100-hour inspection of the engine, conducted following the aircraft's return to the airstrip, revealed no findings.

1.6.9 Description and Operation of the Electrical System

- The aircraft's electrical system is used to operate the landing gear (retraction/deployment), flaps, fuel pumps, navigation computer, engine computer, autopilot, lights, and engine start.
- The aircraft's engine start is performed using the battery. After the engine is started, power is supplied to the aircraft's systems by an alternator.
- A charging indicator light is supposed to illuminate when the alternator is not supplying current to charge the battery due to a technical failure.
- No findings indicated a technical failure. The pilot did not report any warning lights indicating a fault in the electrical system.
- 9 start attempts (demand for current) were recorded in the engine computer. Only 8 were displayed in the Garmin computer, showing a real starter rotation, meaning there was insufficient current to complete one of the start attempts.
- During the event flight (as in all flights), Landing gear extension was done simultaneously with flap deployment. The landing gear did not deploy. The flap deployment took about 30 seconds (instead of around 6 seconds, as measured after a battery replacement).

After landing, the extension and retraction of the landing gear on the ground (using only the battery): the landing gear deployed fully. The retraction process stopped midway.

Note: The landing gear functionality check after landing was performed without deploying the flaps.

- The battery was tested by the manufacturer and found to be "unserviceable."

1.6.10 Description and Function of the Fuel System

- The aircraft has a low-wing design. The fuel tanks are located in the wings. Two fuel pumps (which can be operated independently of each other) are located adjacent to the engine, approximately one meter from the fuel tank openings.

The fuel supply pipe from the tanks to the pumps is about half a meter in excess, coiled around itself.

- The fuel pump openings are higher than the tank exit openings.
- The fuel valve is located inside the cockpit and is positioned higher than the tank exit openings in the wing and the fuel intake openings for the pumps.
- The pumps **draw** fuel from the aircraft's tanks.
- A schematic diagram (Figure 8) of the fuel system routing to the engine. The fold in the upper part of the pipe near the fuel valve (reverse siphon) and the excess pipe above the fuel pump intake openings create an "air trap" when such exists in the system.
- When the fuel boils, fuel vapor bubbles are created, causing engine stuttering. If the bubbles accumulate, a blockage can form in the fuel system, which may lead to engine failure (see Figure 8).

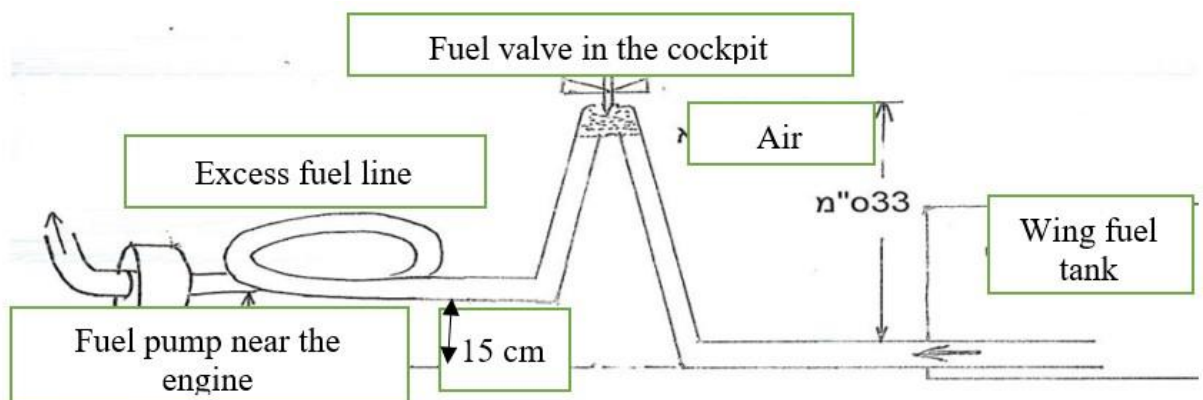


Figure 8 - Schematic Diagram of the Fuel Flow Pattern

1.7 Weather

1.7.1 Lighting Conditions – Daytime.

1.7.2 Cloudiness and Visibility – CAVOK (clear skies, good visibility).

1.7.3 Temperatures as measured at the Beit Dagan weather station (the closest measurement unit to the Rishon Lezion airstrip), at Hatzor, and at Ben Gurion Airport (regarding which the pilot Noted that he checked the weather via this station):

Station	15:00	16:00
Beit Dagan	40.4°C, 1002.7Mb	38.2°C
Hatzor (Air Force Base)	41°C, 1002.6Mb	38.6°C
Ben Gurion (METAR)	36°C, 1006Mb	34°C, 1006Mb

1.7.4 Wind – North-eastern, approximately 14 knots.

1.7.5 According to the GARMIN data and the engine computer, an inversion layer was present. The ambient temperature **increased** by approximately 2 degrees Celsius during the climb, until engine misfires began.

1.7.6 Aeronautical Information Publication (AIP) - Includes updated and published aviation information. The Rishon Lezion airstrip has a meteorological station, which, according to the AIP, **is not approved**.

1.7.7 According to the pilot, he used the forecast obtained from the Ben Gurion station.

1.8 Radio Navigation Aids – Not relevant.

1.9 Communication – The aircraft was in two-way communication with South Control and later with Hatzor Tower.

1.10 Information on Airstrips

1.10.1 Hatzor Air Force Base

- Field elevation above sea level: 148 feet.
- 2 asphalt runways: ○ 05/23 ○ 29/11, North/South
- The aircraft landed on runway 05 and came to a stop at the intersection with 29 South.

1.10.2 Rishon Lezion Airstrip

- The aircraft was refueled at Rishon Lezion Airstrip.
- The airstrip has a fueling station with a tank capacity of 8,000 liters (7,000 liters of which are usable). The fuel supplied at the station is 95 octane automotive gasoline (MOGAS).
- Currently, there is no aviation fuel 100LL available at the airstrip.
- A meteorological measurement station operates at the airstrip, which is listed in the AIP but is neither recognized nor approved by the meteorological service.

1.11 Flight Recording Data

Flight data analysis was performed based on the GARMIN recordings and the aircraft engine computer.

1.12 Information on Wreckage and Damage at the Incident Site

No damage was caused to the runway following the belly landing.

1.13 Medical and Pathological Information No findings.

1.14 Fire

No evidence of fire was found (either in the air or after the impact with the ground).

1.15 Survival Elements

The pilot exited the aircraft on his own.

1.16 Tests and Studies

1.16.1 Information from 12 investigation reports/incidents in Israel between 2017 and 2023, with similar characteristics and defined as "fuel vapor blockage" was examined and analyzed (see Appendix 6).

1.16.2 The analysis revisited the emphasis previously placed on the "winter/summer" fuel blends versus the fuel temperature as a measurable factor influencing vapor blockage.

1.16.3 Articles, guidelines, and restrictions published in the general and light aviation sectors in various countries regarding the risk of "fuel vapor blockage" due to the use of automotive fuel in light aircraft were reviewed.

1.16.4 The process of defining flight envelope boundaries in relation to "fuel vapor blockage" by foreign light aircraft manufacturers was examined.

1.16.5 The engine manufacturer's guidelines regarding the mandatory "hot fuel" test as a condition for mounting the engine on the aircraft were reviewed.

1.16.6 The regulator's (Civil Aviation Authority - CAAI) actions in implementing and preventing previously investigated and analyzed "fuel vapor blockage" incidents were reviewed.

1.16.7 The implementation of recommendations from previous investigation files defined under "fuel vapor blockage" was assessed.

1.16.8 Discussions and meetings were held with battery experts to examine the manufacturer's definitions regarding the battery type specified for the aircraft and the periodic inspection procedures accordingly.

1.17 Information on Organizations and the Regulator

1.17.1 The Air Operator

- The aircraft owner is a private individual. The aircraft is operated by an airline company that operates under Chapter Nine of the Israeli Flight Regulations (Operation of Aircraft and Flight Rules), 1981.
- The technical maintenance of the aircraft is on the responsibility of the airline and is performed at a maintenance facility.
- The aircraft conducts unique agricultural photography in Israel for the Ministry of Agriculture and private farmers.
- The aircraft was grounded for about two months due to a shortage of parts required for the 1,000-hour maintenance. According to the pilot, the photographic flight on the day of the incident was of economic importance due to the prolonged grounding of the aircraft.

1.17.2 Aircraft Manufacturer

The aircraft is manufactured by FLY SYNTHESIS, a company registered in Italy.

Towards the end of the investigation, the investigation team was updated by CAAI officials that the manufacturer ceased operations. As a result, the CAAI revoked the aircraft's Type Certificate (TC) in Israel. Airworthiness certificates were issued after approval of an exemption and related conditions by the Director of CAAI. CAAI officials informed the investigation team that a change of ownership process is underway with the aircraft manufacturer.

1.17.3 Civil Aviation Authority (CAAI) - Regulation and Licensing

- Light aircraft in Israel are licensed and inspected by the Civil Aviation Authority (CAAI).
- Most light aircrafts in Israel do not have a Type Certificate (TC). Historically, the Texan aircraft was certified with an approved Type Certificate issued by CAAI in Israel in 2001.

- The Type Certificate for the aircraft was issued based on the British BCAR CAP 482 Section S standard and ASTM F2245, an international standard adopted by the FAA for the certification of light aircraft (see Appendix 2).
- In section 951C of the BCAR CAP 482 Section S update (dated 31.08.1999, prior to the issuance of the Type Certificate in Israel), vapor blockage was addressed:

"c) The fuel system design and vapor blockage events that occurred".
- In recent years, despite recurring safety incidents and accidents related to fuel vapor blockage in light aircraft fuel systems, the investigation team found no evidence of the regulator's involvement or response to this safety issue.

Note: There are other light aircraft models with TC in Israel, featuring a low-wing, identical engine, and a suction-type fuel system. The investigation team did not examine their licensing or compliance with BCAR Section S. This issue falls under the responsibility of CAAI.
- Although certification in Israel is based on BCAR definitions, there is no hindrance from the Israeli regulator to tighten regulations as deemed necessary (for example, defining a specific type of battery or restricting the use of automotive fuel in certain weather conditions, based on recommendations from previous accident investigations in Israel).
- Following the incident described in this report, at the beginning of 2024, CAAI revoked the aircraft's Type Certificate (TC). The three-year C of A for all Texan aircraft in Israel was revoked and replaced with a temporary C of A valid for one year, provided a new owner/manufacture is found for the company.
- Inspections: CAAI conducts an annual inspection of airline companies, a biennial inspection of maintenance facilities, and a triennial inspection of light aircraft for the issuance of C of A. The inspections primarily focus on compliance with maintenance and licensing procedures as defined by law, regulations, and the

- technical manuals of the aircraft. It is almost impossible to identify non-standard components or deviations in light aircraft during these inspections.

1.17.4 Maintenance Facilities

- As of the time of writing this report, there are about 170 light Sport aircraft (LSA) in Israel. The majority of them are technically maintained by one approved maintenance organization (AMO) located at the Rishon Lezion airstrip. A small number of light aircraft, about 4-6, are maintained at a facility located at Megiddo airstrip.
- The aircraft involved in the incident was maintained at the Rishon Lezion facility in accordance with the maintenance program defined by the airline.

1.17.5 Sporting Aviation Association

- The Sporting Aviation Association in Israel includes about 530 active members who hold flight licenses for aircraft of light aviation and general aviation fields.
- Approximately 170 light aircraft (maximum takeoff weight of 600 kg or less) are present and flying in Israel.
- The association reports around 25,000 flight hours conducted by its members in 2022.
- The closure of Sde Dov Airport increased the load on remaining airstrips, which are mainly used for domestic flights. At the same time, there has been significant technological development in light aircraft, such as Glass Cockpits, GPS, and more. These developments form the basis for a significant change in the nature of light aviation in Israel.
- In 2010, the percentage of light aircraft (with speeds above 90 knots) was about 26% of the total number of "light" aircraft (up to 7,500 kg) in Israel. By 2020, this percentage had increased to about 57%.

- About 50% of private pilot license holders now also hold an LSA license, with this trend on the rise.
- Bureaucratic licensing restrictions, flight restrictions on specific routes, lack of airstrips, lack of suitable airstrips, operational costs, along with significant advancements in the capabilities of light aircraft, contribute to the increased use of light aircraft at the expense of other private aviation types in Israel.
- The association acts as a "knowledge center" for its members, contributing to safety through articles, notifications, and real-time alerts (such as weather alerts) sent to members via various online platforms.

Note: Their publications have no legal validity.

1.18 Additional Relevant Information

1.18.1 Fuel Used in Light Aircraft

- The engines of Texan aircraft are designed for use with automotive fuel - 95 octane MOGAS and aviation fuel 100LL.
- At the Rishon Lezion airstrip, there is a fuel tank with a capacity of 8,000 liters, of which about 7,000 liters are available for use.
- The fuel supplied at Rishon Lezion is 95 octane automotive MOGAS. Currently, there is no refueling station allowing users to refuel with 100LL aviation fuel at this airstrip.
- Except for a few cases, the fuel used in light aircraft is automotive fuel. Some users refuel at the local station at the airstrip, while others purchase fuel at external stations due to economic reasons.
- The Ministry of Energy regulations, TSI 90 Part 2, stipulate the use of winter and summer fuel mixtures for automobiles, distinguishing them by internal vapor pressures. These vapor pressures are controlled by additives in the fuel. The regulations define the transition periods between these fuel mixtures.
- The reason for defining different fuel mixtures such as "winter" and "summer" is to reduce air pollution and increase fuel efficiency in vehicles. These mixtures are not derived from aviation-related concerns.

•
The "initial boiling point" (IBP) of a fuel is the lowest temperature at which vapor bubbles will begin to form in the liquid fuel, which under certain conditions may lead to vapor lock. Internal vapor pressures have a certain impact on the initial boiling point of the fuel. In Israel, "vapor lock" incidents have been investigated, occurring with both winter and summer fuels.

1.19 Investigation Techniques and Methods

- 1.19.1 The pilot was interviewed immediately after landing at the Hatzor Air Force Base.
- 1.19.2 Relevant data was collected from the aircraft's navigation and engine computers for analysis of systems, electricity, and fuel during the flight and incident.
- 1.19.3 In-depth examination of the technical aspects related to the incident was conducted.
- 1.19.4 Past accidents, incidents, investigation reports, and pilot reports related to vapor lock were reviewed, including the emphasis given to "winter/summer" fuel mixtures.
- 1.19.5 The regulation, literature, and manufacturer's responsibility for the design and airworthiness of the aircraft were examined.
- 1.19.6 The licensing process, issuance of permits, and airworthiness monitoring of Light Sport Aircraft in Israel were examined, particularly regarding the requirement to perform a "hot fuel" test before installing the engine on the aircraft model involved in the incident.
- 1.19.7 Previous recommendations and their implementation in accidents caused by vapor lock were reviewed (see Appendix 8).
- 1.19.8 International regulations regarding how aircraft manufacturers equipped with ROTAX engines worldwide address vapor lock were examined.
- 1.19.9 Extensive technical information was gathered through meetings with component manufacturers and remote discussions with relevant experts and stakeholders related to the areas of investigation.

2. Analysis

2.1 General

The analysis chapter mainly deals with examining potential causes for the engine shutdown and the failure of the landing gear to deploy during the incident. The analysis also delves into the phenomenon of vapor lock that caused fuel starvation and the verification of the fuel type used in the aircraft's fuel system.

2.2 Failure of Landing gear extension

An investigation into the functioning of the landing gear folding and extending system found no mechanical failure. It is highly likely that the electrical power supply during the emergency (the battery) was insufficient to operate the system.

2.3 Engine Shutdown

Two potential causes were analyzed:

- A technical malfunction.
- A problem with fuel supply or fuel quality.

2.4 Technical Cause

2.4.1 Engine Failure

Analysis of the engine and Garmin flight data downloaded immediately after the incident, as well as an engine run conducted later, found no evidence of a technical malfunction in the engine.

Note: The engine performed normally in the two flights prior to the incident, in a run conducted a few days after the incident, and in a subsequent flight several weeks later to Rishon Lezion Airstrip.

2.4.2 Electrical Malfunction

- No abnormal data was recorded in the electrical system (alternator and other electrical components) prior to the engine shutdown. The warning light intended to alert the pilot to a charging problem did not light up during the flight until the engine shut down. Neither the Garmin data nor the engine computer indicated any electrical failure.
- The camera mounted in a special installation on the aircraft did not operate during the incident and did not draw any electrical current.

2.4.3 Aircraft Battery

- In addition to starting the engine, the battery serves as the only electrical backup system during power supply failure (or engine shutdown). All systems of the aircraft, except for the controls (and the engine), are electrically powered. **Therefore, the battery's condition is crucial, with clear, measurable parameters for determining its technical state during inspections.**
- The Texan engine is similar to a car or motorcycle engine in terms of size and power. The batteries installed in vehicles are typically "starter batteries" that have measurable parameters such as cranking current, which can be checked periodically to ensure their operability. Backup batteries, on the other hand, have a different internal structure and are used to supply power but cannot easily be checked for condition during regular inspections.
- According to BCAR Section S, which forms the basis for licensing in Israel, there are no specific requirements for battery types, nor is there guidance on how to check their condition during priodoc inspections.
- The manufacturer does not impose strict minimum requirements and allows any battery that meets voltage and capacity requirements to be installed. The battery installed on the aircraft was a "deep discharge" gel backup battery.
- There are three primary tests to assess battery condition:
 - a) **Electrolyte test** - checks the chemical state of the electrolyte, but not the overall condition of the battery.
 - b) **Capacity test** - involves a controlled discharge of the battery to check its capacity against predefined standards.
 - c) **Cranking current test** - provides the most reliable indication of battery health by testing the minimum cranking current the battery can deliver.
 - Visual inspection does not provide reliable indicators of the battery's condition.
- Gel batteries prevent leakage, but this can have implications in the event of an electrical fault that may cause electrolyte buildup inside the battery.
- **For the battery installed on this aircraft, which met the manufacturer's requirements, no technical definitions or monitoring methods (like cranking current) exist for reliable assessment during inspections.**

- The reference to battery power supply requirements is found in the maintenance manual:

"The battery will supply electrical power without the alternator for short periods, e.g. use of landing lights (when installed) and for system connected devices e.g. radio while the engine is stopped".
- "In Israel, the Texan aircraft has two versions, with the main difference being the landing gear (retractable or fixed). There are approximately 40 Texan TOP CLASS 570 ISR aircraft with fixed landing gear and 5 Texan TOP CLASS 2 RG aircraft with retractable landing gear. The manufacturer does not specify different battery requirements despite the difference between the aircraft. The electrical backup time is defined identically for both aircraft models (Flight Manual - Electrical Wiring Failure - 3.5): "A fully charged and functional battery should permit the operation of trim, flap, and auxiliary electrical fuel pump for about 20 minutes."

There is no reference to the increased current draw from the battery in the retractable landing gear model, should such a need exist.
- Nine start attempts (one of which documented an electrical demand, but the starter did not engage), combined with the continuous operation of all electrically powered systems, depleted the battery, leaving insufficient electrical current to extend the landing gear (while simultaneously operating the flaps).
- "The 200-hour inspection (which requires battery condition check), performed by visual inspection only, was found to be superficial and insufficient in relation to the significant role of the battery in the aircraft."
- There is no documentation on when the battery was replaced or by whom.

According to the manufacturer, who inspected the battery after the incident, it was found to be very weak.

2.4.4 Fuel System

- The engine manufacturer, ROTAX, allows two types of fuel for the aircraft: 95 MOGAS and 100LL AVGAS.
- The aircraft manufacturer indicates in the aircraft's operating manual that the aircraft can be operated using automotive fuel (95 octane MOGAS), but

it refers to the engine manufacturer's guidelines regarding fuel characteristics:

Fuel specification: Premium automotive unleaded fuel with a minimum of 95RON.

For complete fuel specifications, refer to the engine manufacturer's manual.

- The fuel pumps in the aircraft are electric. A power supply issue to the pumps can cause fuel starvation and subsequent engine shutdown. The pumps were replaced with other electric pumps on July 20, 2023, as part of the manufacturer's instructions during a 1,000-hour service. Inspection of the aircraft's computer did not indicate any electrical fault in the power supply to the pumps. The aircraft performed 17 flights without fuel system issues after the 1,000-hour service.
- Both the coarse and fine fuel filters were replaced as part of the 1,000-hour service on February 20, 2023. After the incident, the coarse fuel filter in the fuel intake line was inspected, and no abnormalities were found. Additionally, no leaks or loose connections were detected in the fuel system.
- The examination of the technical state of the fuel system leads to an in-depth analysis of the design of the fuel system leading to the engine.
- As shown in image 7 of Chapter 1, the location of the fuel pumps is distant and high from the fuel tank outlet, requiring fuel transfer via suction. This, combined with a convoluted fuel line, creates a favorable environment for vapor lock formation.
- "In accordance with the requirements of BCAR Section S, under which the aircraft is registered, the design and structure of the fuel system must prevent the formation of vapor lock. The investigation team believes that in order to prevent vapor lock, a redesign of the fuel system is required."

2.4.5 Fuel Starvation Due to Vapor Lock: The Impact of the Fuel System Design

- Vapor lock (or air) does not occur due to an external air ingress into the system because of a technical failure. It can form due to fuel boiling. This phenomenon is known among aircraft manufacturers that permit automotive fuel in their engines.
- Vapor in fuel can lead to fuel starvation, causing engine malfunction or shutdown. The fuel type (and its additives), the design of the fuel system,

atmospheric conditions, and the flight profile are critical factors that affect the fuel's boiling point temperature and thus vapor lock formation and its severity.

- The main contributing factors to vapor lock formation include:
 - a) Fuel type: Automotive fuel, due to the additives, has a significant impact on the sensitivity to vapor lock formation.
 - b) Fuel temperature.
 - c) Vapor pressure of the fuel (affected by the fuel type and additives).
 - d) Atmospheric pressure: Low pressure lowers the boiling point temperature.
- The incident occurred on a hot day (around 40°C), with inversion at altitude, low atmospheric pressure (1,002 mb), and full power climbing. At around 5,000 feet, with the aircraft using automotive fuel (95 octane MOGAS), engine sputtering began. It is highly **probable that vapor lock occurred under these conditions.**
- The suction-based fuel delivery method in the described system allows air to accumulate in the line, which can be drawn in by the pumps in certain circumstances.
- *Note:* In contrast, aircraft with a top-wing configuration (fuel tanks above the engine) and gravity-fed fuel lines do not report vapor lock issues.
- The configuration of the fuel system, including differences in fuel line placement and bends, facilitates the accumulation of air, which, if present in the line, can be drawn into the pumps. Vapor formation, induced by the fuel boiling due to environmental conditions, can lead to the formation of air within the system.
- The fuel system design has a direct impact on fuel temperature rise. The fuel line runs near the oil heat exchanger, and in fuel-injected engines, only about 20% of the fuel undergoes combustion; 80% is returned to the tank after being heated in the engine and the fuel line.

Note: Previous investigations in Israel have Noted vapor lock events in aircraft with carburetors, whose fuel systems are similar in design to those with fuel injection.
- **All the investigated incidents involved the use of 95 octane automotive fuel (MOGAS), whose boiling point is relatively low. The investigation**

team is not aware of any vapor lock incidents occurring in Israel when using aviation fuel (100LL).

2.5 Engine Manufacturer's Instructions


2.5.1 The engine manufacturer defines its installation on the aircraft with reference to the design of a fuel delivery system that prevents the possibility of vapor lock or hot fuel temperature check in order to identify such a blockage and address its prevention.

Key manufacturer guidance:

- Fuel supply system design must consider the fuel type and environmental conditions regarding vapor lock.
- A "hot fuel check" should be performed.
- Based on the results, measures should be taken to cool the fuel in the fuel system.

BRP-Rotax
INSTALLATION MANUAL

REQUIREMENTS OF THE FUEL SYSTEM

Operating limits  See Operating Manual 912 i Series Chapter 2 section Operating limits.

ATTENTION

The design and layout of the entire fuel system must ensure engine operation within the specified operating limits.

In case of deviations in fuel pressure:

⚠ WARNING

Non-compliance can result in serious injuries or death!
The furnishing of proof in accordance to the latest FAR and EASA, has to be conducted by the aircraft manufacturer.

FUEL TEMPERATURE

The fuel system must be designed considering vapor lock depending on the ambient conditions (e.g. pressure and temperature) and the used fuel types (vapor pressure class). Vapor lock may result in engine stoppage. Depending on the building regulations on aircraft level e.g. the "Hot Fuel Test" has to be passed. Should problems occur during the test period, the affected components, e.g. the supply line to the fuel pumps, must be cooled.

2.5.2 The manufacturer does not define the inspection system and the associated parameters; However, it is implied that the result of such an inspection should reflect a flight envelope relating to the type of fuel used.

2.5.3 In the United States, the FAA defined the method for conducting the test through an Advisory Circular as described in Chapter 2, Section

2.7, with specific reference to automotive fuel in this test.

Appendix 3 presents the practical section of FAA AC 23.1521-1B, 'Hot Fuel Check in the USA'. *Note: Although the AC does not refer to Light Sport Aircraft (LSA), it can be used as a guideline for conducting a hot fuel check (as performed by the American company VAN'S).*"

2.5.4 Manufacturer Guidelines and Global Standards Other manufacturers and interested parties, such as VAN'S AIRCRAFT in the United States and the LAA (Light Aircraft Association) in the UK, define fuel temperature limits and flight altitude limits regarding the use of automotive fuel (MOGAS). It's important to Note that automotive fuels can pose challenges in hot environments or during high-altitude climbs.

2.5.5 Same Engine in Light Aircraft This engine, with similar fuel supply requirements, is installed in other light aircraft models with a similar fuel system, operating in Israel. The investigation team did not examine these aircraft directly, and this issue is left for consideration by the Civil Aviation Authority.

2.6 Manufacturer's Reference to the Engine Manufacturer's Guidelines

2.6.1 As part of the investigation into the Texan accident - Investigation Case 8-22 (crash due to engine failure, most likely caused by vapor lock), the aircraft manufacturer was asked whether they had conducted a "Hot Fuel Temperature" test before installing the engine on the aircraft. Their response on July 15, 2022 (freely translated) was that such a test was performed using what they defined as "European Fuel," which they claimed is "different" from the fuel in Israel, according to the EN14274 2003 standard. The manufacturer's response indicated that the boiling point of the fuel is defined as 100°C (much higher than the initial boiling point).

Note: The referenced standard pertains to fuel quality monitoring (Fuel System Monitoring) and does not directly address the question asked. The manufacturer's response raises doubts regarding the existence of such a test.

2.6.2 The manufacturer did not address any adjustments that might be required for the aircraft depending on the destination country, particularly considering different climates. At the same time, the manufacturer's response implied that the **fuel test performed** is not suitable (in their view) for the State of Israel. **Additionally, the regulator, who grants the aircraft TC (Type Certificate) in Israel, did not address this issue.**

2.7 Regulation: Aircraft Licensing - Vapor Lock Prevention

2.7.1 The aircraft's Type Certificate (TC) in Israel was validated on January 15, 2001 (see Appendix 2). Licensing of light aircraft in Israel is based on the BCAR CAP 482 Section S standard, which allows a Permit to Fly in the country of registration rather than a Type Certificate.

A specific definition that requires the fuel system to be resistant to vapor lock is outlined in the British document (Revised August 31, 1999), Section C 951, in the following statement: c) The fuel system must be arranged so that vapor lock cannot occur.

Note: The Permit to Fly issued for the aircraft under BCAR section S in the UK is based on the manufacturer's declaration, without the need for flight test evidence or design verification. Therefore, a scenario may exist where a design flaw is only identified later, as is presumably the case with this specific aircraft.

- The Israeli regulator relies on the CAP 482 Section S BCAR standard and, presumably, considers the aircraft to be resistant to vapor lock.
- Between 2004 and 2016, twelve modifications were made to the aircraft, both in technical structure and in the flight envelope (such as an increase in takeoff weight).
- According to the regulator, changes to the Type Certificate are made only at the manufacturer's initiative. The regulator evaluates, approves, or rejects them and accordingly mandates changes for aircraft owners.

Note: There is no legal obstacle to the regulator initiating a change to the aircraft.

- In light of the events in Israel, which were most likely caused by vapor lock (approximately 12 cases in recent years), the investigation team believes that the Civil Aviation Authority (CAAI) should examine the issue more closely, regarding the issuance of the Type Certificate or Airworthiness Certificate, depending on design changes. Alternatively, they should consider restricting the use of automotive fuel until a solution is found for the problem.
- The Israeli aircraft licensing process follows the BCAR standards verbatim. In practice, 12 modifications to the Texan's Type Certificate over 8 years suggest a "living Type Certificate." Therefore, there seems to be no regulatory reason preventing the involvement of the Israeli Civil Aviation Authority (CAAI) in the "vapor lock" issue and the adoption of changes to the fuel system or, alternatively, limiting the use of automotive fuel (in fact, the TC was recently revoked by the CAAI).
- In the five years leading up to the incident, 7 accidents/incidents in Israel were investigated, caused by vapor lock, in addition to a similar number of reports of "engine stuttering/engine failure" under similar flight conditions, which did not meet the criteria for a full investigation and were not classified as technical malfunctions by the owners/maintenance organizations. Most of the accidents/incidents involved Texan aircraft. All the events occurred in aircraft with a

- - lowwing and suction-fed fuel system (the list of investigations and reports can be found in Appendix 6).
 - Previous reports documentation mentions conversations with LSA owners/pilots about other cases of engine stuttering, believed to be caused by vapor lock, which were not reported.
 - Note: The investigation team is not aware of any reports related to vapor lock events when **using 100LL aviation fuel.***
 - In Investigation Case 8-22, regarding the Texan accident near the Aliflet village, a correspondence between the investigation team and the aircraft manufacturer is detailed. From this correspondence, questions arise regarding the adequacy of the fuel system in the aircraft to prevent vapor lock.
- Despite the accidents investigated in recent years, which were defined as "vapor lock" incidents, pointing to the fuel system, and despite the clear definition in BCAR Section C 951 regarding vapor lock prevention, the investigation team found no documentation of the regulator's communication with the aircraft manufacturer to address the issue, despite the regulator's responsibility when the aircraft is fully certified via a TC.
- Based on past accidents and incidents and the structure of the fuel system, **the investigation team believes that the aircraft did not meet BCAR's vapor lock prevention requirements.**
- The use of 100LL aviation fuel is considered a temporary solution until the issue is fully examined and regulated.
- The investigation team focused on the Texan, but the findings have implications for **all light aircraft with a low-wing and suction-fed fuel system in Israel, using automotive fuel.**
- At the time of the investigation and report writing, there was no active manufacturer for the aircraft. This fact prevented the investigation team from receiving answers to technical and regulatory questions regarding the aircraft's structure and licensing process. This created a situation where the Israeli regulator is dealing with a difficult situation involving dozens of "manufacturer-less" aircraft in Israel, with all the

consequences that come with it. The lack of spare parts and inspection/licensing issues directly affect flight safety.

The revocation of the Texan's Airworthiness Certificate by the CAAI in early 2024, and the issuance of C of A (Certificate of Airworthiness) for one year only, creates a time window for finding a solution that prevents vapor lock in this aircraft. The defined time window has the advantage of focusing the entire system on finding solutions within a specific time frame.

2.8 The Effect of Fuel Temperature on Fuel Starvation Caused by Vapor Lock Vapor lock occurs when the fuel is in the boiling process, releasing air (transitioning to a gas state) into the fuel delivery system to the engine.

2.8.1 Internal Vapor Pressure

This value depends on the type of fuel and the additives mixed with it. The use of additives allows for control over the internal vapor pressure (volatility) and is intended for environmental purposes and engine efficiency for cars in Israel. The fuel version - winter/summer determines the vapor pressure range accordingly. The investigation team did not find a reliable value that allows for a measured diagnosis as a basis for decision-making regarding flying conditions.

Note: Vapor lock incidents occurred in both winter and summer fuel versions, despite lower vapor pressures in the summer version, which would typically delay the occurrence of the phenomenon.

2.8.2 Atmospheric Pressure

This value changes, among other things, when the flight altitude changes. As the pressure decreases, for example, when climbing in altitude, the boiling point of the fuel decreases, meaning the fuel will boil earlier as the altitude increases. Atmospheric pressure lower than standard (below 1,013 mb) may indicate an increased tendency for early boiling. In hot summer days, atmospheric pressure is generally lower than standard.

2.8.3 Fuel Temperature

Boiling is a gradual process that occurs within a temperature range. When the fuel temperature reaches the initial boiling point, fuel vapor bubbles begin to form along with natural evaporation. This condition results in air being created inside the fuel delivery line.

Fuel temperature is a measurable value that, if available to the pilot, could prevent flying in "dangerous" conditions.

Note: The Texan does not have a fuel temperature gauge.

2.8.4 Initial Boiling Point (IBP) of 95 Octane Automotive Fuel

The initial boiling point of automotive fuel (95 octane) used in Israel (according to the international E228 standard) is not uniformly defined by different fuel suppliers in Israel and around the world.

2.8.5 Through reviewing publications and data, as well as discussions with professionals in the field, a **temperature range** of **20** to about **34** degrees Celsius was found as a basis for defining the initial boiling point temperature. Details regarding temperature limits are provided in Appendix 5.

2.9 Fuel Temperature Measurements in Light Sport Aircraft in Israel

2.9.1 The fuel temperature in aircraft at the time of takeoff is mainly influenced by the external temperature. Other factors that affect the temperature in the fuel tanks include the type of fuel tank (wing tank made of composite materials or metal wing), parking location (sun/shade), and parking duration. If refueling is done close to takeoff time, the fuel temperature in the fueling station, the amount of fuel refueled in relation to the previous amount in the aircraft's tanks, the flight profile, and more, all influence the final temperature.

2.9.2 Fuel temperature measurements in aircraft tanks at the Rishon Lezion airstrip (Investigation Report 42-19) at a temperature of 39°C in the hangar showed the following values:

- Texan (composite wing) - 27°C
- Bristol (metal wing) - 31°C

- Sierra (metal wing) - 33°C

Note: Texan parked outside in the sun reached 36°C.

2.10 Flight Restrictions Relating to Ambient Temperature or Fuel Temperature 2.10.1

The absence of a fuel temperature gauge in the Texan, as in most other light aircraft, causes those pilots who are aware of the "vapor lock" phenomenon to treat the external temperature as the only available value from which fuel temperature can be inferred. This value was found by the investigation team to be unreliable and based on "guesswork" regarding fuel temperature. However, since everyday practice is based on this value, the team examined the distribution of temperature data in the summer and how those involved responded to it.

2.10.2 The distribution of ambient temperature between March and December in the years 2019-2023 was examined in Be'er Sheva and Beit Dagan (see Appendix 4).

Note: Be'er Sheva was chosen as a location where temperatures do not differ greatly from those in Rosh Pina in the north or the Negev in the south. Pilots flying to Eilat typically experience much higher temperatures for longer periods during the summer.

2.10.3 In principle, most days of the "Israeli summer" were found to have temperatures above 30°C in the shade. Aircraft parked in the sun experience much higher temperatures.

2.10.4 The national regulation does not refer to ambient temperature or other climatic restrictions as part of visual flight conditions in Israel. Any such restrictions, if they exist, should be published in the manufacturers' literature as part of the flight envelope regarding the use of automotive fuel.

2.10.5 The Texan's literature does not define a flight envelope for flights using automotive fuel MOGAS 95 octane with regard to ambient temperature or fuel temperature.

- 2.10.6 The lack of a definition from the manufacturer regarding the flight envelope for flights using 95 octane MOGAS fuel, combined with the regulator's lack of reference, leaves operators and pilots in a situation where they must set their own limitations in a complex field where they may not have sufficient tools or professional understanding.
- 2.10.7 Organizations, such as flight schools, have the tools and authority to set restrictions for all the pilots operating under their wing. A flight school operating light aircraft with a bottom wing, equipped with a fuel delivery system, has determined that specific approval from the school director is required for flights when the external temperature exceeds 30°C, and flights are prohibited when the temperature exceeds 35°C. This also has economic implications.
- 2.10.8 The **Sport** Aviation Association, which includes about 530 pilots, does not have the authority to impose flight restrictions on its members. The association sends weather warnings related to ambient temperature from time to time.
- 2.10.9 The operator of the Rishon Lezion airstrip sends temperature alerts to stakeholders by email when a temperature exceeding 32°C is expected. On April 17, 2022, the Rishon Lezion operator sent a warning to pilots about the risk of "vapor lock" due to a high temperature expected the following day, with "winter fuel" available at the fueling station. The recommendation was to avoid flying when the temperature exceeded 30°C due to the fuel mixture.
- On April 24, 2024, the airstrip operator sent a similar warning noting that the fuel in the tanks was winter fuel. The information was sent as a service to pilots. It should be Noted that the airstrip operator has no authority to stop flights due to temperature, nor is it their role.

2.11 Use of Aircraft Fuel 100LL and Automotive Fuel MOGAS – Extension

- 2.11.1 The common characteristic of the vapor lock incidents investigated in Israel is the **use of 95 octane automotive fuel on a "hot" day, during a climb with high engine power and a fuel suction system.**

- 2.11.2 Automotive fuel is available for purchase by all light aircraft pilots at any fueling station in Israel, and it is the fuel available for purchase at the Rishon Lezion airstrip.
- 2.11.3 Aircraft fuel 100LL is supplied only at defined airstrips (and at the Sde Teiman airstrip). Its price is higher than that of automotive fuel.
- 2.11.4 At the Rishon Lezion airstrip, where over 110 aircraft operate, aviation fuel is not available at the time of writing this report.
- 2.11.5 The fact that aviation fuel is more expensive than automotive fuel and the ability to bring automotive fuel "from home" negatively affects the economic feasibility of adding an aviation fuel tank at the Rishon Lezion airstrip or replacing the fuel sold at the airstrip with aviation fuel during the summer months.
- 2.11.6 Based on previous investigation reports and conversations with light aircraft pilots and other relevant parties, the investigation team identifies a misunderstanding regarding the perceived protection provided by the summer fuel mix during hot summer days.
- Many operators/pilots mistakenly believe that "summer fuel" acts as insurance against the vapor lock phenomenon – **but this is not true!** Vapor lock incidents have occurred, been reported, and investigated even when using "summer fuel."
- 2.11.7 The investigation team found no research or data that could serve as a basis for decision-making regarding the effects of automotive fuel versions on vapor lock in light aircraft. It is Noted, as seen in investigations of previous incidents, that there is a direct correlation between the phenomenon's sensitivity and the internal vapor pressures. However, this is only one factor among several, such as fuel temperature, external temperature, altitude density, atmospheric pressure, the material used to build the aircraft wings (which house the fuel tanks), fuel additives, and more.

2.12 Scenarios and Additional Possibilities Investigated and Discarded Regarding Fuel Supply to the Engine

2.12.1 Scenario of fuel shortage in the left fuel tank – The left fuel tank was found at the scene of the incident almost full. The fuel selector was found set to the left fuel tank.

2.12.2 Failure of continuous fuel flow to the fuel pipe inlet in the tank due to the phenomenon of SLOSHING (fuel sloshing) – The tank's structure and the amount of fuel eliminate this possibility.

2.12.3 Fuel contamination – The fuel filter (coarse) at the pump inlet was inspected after the incident, with no findings indicating a clog.

2.12.4 Engine inspection ruled out the possibility of external air entering the fuel line in this incident.

2.12.5 During the period prior to the incident, as well as on the day of the incident and in the following days, dozens of flights were conducted from the Rishon Lezion airstrip using the same fuel without any issue indicating fuel quality or cleanliness.

2.12.6 Fuel injector malfunctions – An engine run was conducted after the incident with no faults found. The aircraft completed two flights before the incident flight, on the same day, with a total time of approximately 7 hours, and no unusual phenomena were recorded during these flights.

2.12.7 Fuel pump malfunction (electric) – The two fuel pumps were replaced as per the manufacturer's instructions in the six months prior to the incident. The aircraft had conducted 19 flights since the replacement, and an engine run was conducted after the incident – in all these, no issues with the fuel pump's functionality were found.

2.12.8 Engine computer malfunction – No malfunction was found in the engine computer.

2.12.9 Returning the aircraft to Rishon Lezion airstrip, without findings, after three months of waiting at Hatzor Airstrip, and the inspections conducted thereafter as part of the aircraft's return to service, also without technical findings, reduces the likelihood of a technical problem that could have caused the engine shutdown.

2.13 Conduct of the Flight

2.13.1 The flight was conducted under "extreme" weather conditions: external temperature around 41°C (according to GARMIN data), planned climb to 7,000 feet (the event began at around 4,800 feet), atmospheric pressure lower than standard (1002.7 MB – as Noted in section 1.7), **and use of MOGAS automotive fuel** – which created a "favorable" condition for fuel boiling, leading to vapor lock.

2.13.2 The **pilot was aware of the vapor lock phenomenon and even prevented it in the previous flight conducted earlier that day, using aviation fuel 100LL in the right tank.**

2.13.3 Filling the left wing with approximately 50 liters of fresh MOGAS automotive fuel (filled to the top) and parking the aircraft in the hangar for an hour and a quarter between the previous flight and the incident flight did not provide enough of a deterrent to vapor lock given the environmental conditions on the day of the incident. At approximately 4,800 feet, fuel pressure dropped, causing a decrease in engine RPM.

2.13.4 Nose-down maneuver (to position the fuel pump below the fuel tank outlet in the wing) temporarily increased RPM but did not resolve the overall issue. This maneuver caused a loss of approximately 2,000 feet, which was missing later when it became clear that the landing gear needed to be extended in an emergency. A right turn of about 20 degrees for about 15 seconds, intended

to create a height difference between the fuel pumps and the fuel pipe inlet in the wing, also did not contribute to resolving the issue.

2.13.5 These two maneuvers were not only ineffective because of the height differences between the fuel tank outlets and the fuel pumps, along with the "reverse siphon" of the fuel line to the engine, but they are also not written or defined in the FLIGHT MANUAL in the section dealing with irregular engine operation and engine shutdown in flight.

2.13.6 The transition to optimal gliding speed, at 2,800 feet, was delayed, according to the investigation team, and did not allow for the subsequent manual operation (which was later found to be required) of the nose gear.

2.13.7 Use of 100LL aviation fuel:

According to the pilot, switching the fuel faucet selector to the right wing (which contained 100LL) did not help. The investigation team found no evidence of this action being performed, nor did they determine when or for how long it lasted, if it was done at all. **Given that the previous flight occurred under similar conditions of altitude and temperature, using aviation fuel 100LL, and proceeded without similar phenomena, it can be assumed that switching immediately to this fuel might have helped prevent the engine shutdown.**

According to the pilot, the fuel amount in the right tank was low and unstable, which led him to immediately switch the selector back to the left fuel tank, which was full with 95-octane fuel. This action was performed according to the checklist (which ignores the possibility of two different fuel types in the aircraft). The fuel selector was found set to the left fuel tank after landing.

Note: The GARMIN data at the onset of the engine surging shows 7 US gallons in the right wing, equivalent to 26.5 liters (approximately half a tank). The minimum fuel amount for each tank is 2 liters/1.925 US gallons.

2.14 Operation of Electrical Consumers

2.14.1 Unlike a regular flight where the aircraft's power supply is from the alternator, during an engine shutdown, only the battery remains. **Nine attempts to start the engine almost completely drained the battery.** The technique for extension the landing gear, as described by the pilot: extension the landing gear switch (a two-position switch), extension the flaps (a spring-loaded switch held throughout the process), and then checking that the landing gear had extended and locked – all while other electrical consumers (GARMIN, flight displays, engine computer, fuel pumps, radio) continued to operate in the background, after nine attempts to start, did not allow the old battery to manage the task. It is worth noting that in Israel, out of approximately 45 Texan aircraft, only five have retractable landing gear. In the section dealing with the electrical system, the FLIGHT MANUAL does not address the electrical requirements and simultaneous operation of the retractable landing gear and flaps when the only power source is the battery.

2.14.2 Flight Manual - Emergency Procedures – Section 3:

EMERGENCY PROCEDURES

Reference to landing gear extension:

- The aircraft has retractable landing gear, unlike the more common model with fixed landing gear. The gliding performance of both aircraft models is similar. However, the manufacturer does not recommend early extension of the landing gear separately from the flaps in this model to allow the pilot to focus on performing a forced landing "without additional surprises" (such as needing to lower the gear in an emergency, as in this incident).
- In the Flight Manual - "LANDING EMERGENCY PROCEDURES," Section 3.6.3 **FORCE LANDING**, Subsection 7 refers to the possibility of Emergency gear extension:
"Consider manual extension, see 3.6.4" (a process that takes time and attention).

The investigation team Notes that early gear extension and focusing on the forced landing, instead of the maneuvers carried out (to improve fuel flow), in contrast to what is defined in the manual, while trying to

deal with the fuel line system structure and losing 2,000 feet, would have led to earlier identification of the landing gear issue, and if necessary, an emergency gear extension could have been performed. This process is done by inserting a handle into a corresponding hole and rotating it until the gear has fully extended and locked into place (Flight Manual 3.11 Retractable Gear System Failure).

Note: According to the pilot, such a extension would have prevented him from reaching the runway due to the drag of the landing gear doors.

The investigation team found no evidence supporting this claim in the aircraft's documentation.

Pilot Actions Before Forced Landing:

- Section 3.6.3 "FORCE LANDING," Subsections 4 and 5: Closing the fuel tank faucet and stopping the electrical fuel pumps during a forced landing.
After landing, the fuel tank faucet was found in the "open" position regarding the left-wing tank, and the fuel pumps were still in the "ON" position.

2.14.3 Summary:

- The early decision to head toward Hatzor Airfield, coordinating via radio with air traffic control at Hatzor, was made correctly and contributed to the success of the landing. The landing itself was executed with minimal damage to the aircraft and no injuries to the crew.
- The aircraft maneuvers that dealt with the height differences in the fuel line system at the expense of overall energy management are not defined in the aircraft's documentation. Performing these maneuvers delayed early landing gear lowering, resulting in a loss of altitude, which later led to the need for emergency gear extension.
- The use of 100LL aviation fuel, i.e., switching immediately to the right tank:

The FLIGHT MANUAL does not address flying with two types of fuel. It is possible that an early switch to the right tank might have prevented the engine shutdown. As mentioned, the flawless execution of the previous flight, under similar conditions, using 100LL aviation fuel, supports this possibility.

Note: The guidance in the FLIGHT MANUAL, in the case of "engine roughness," to switch to the tank with the higher fuel amount ignores the possibility of having two different types of fuel in the aircraft.

- Nine attempts to start, with all electrical consumers (except autopilot) operating in the background, led to a lack of sufficient power for landing gear extension, which occurred simultaneously with the flaps lowering.
- The belly landing and its results point to the pilot's high skill level.

2.15 Human Factors

The aircraft had been grounded for about two months before the incident. There was commercial pressure to fly it as soon as possible. The pilot had 1,388 flight hours, 1,088 of which were on this specific aircraft.

From debriefing and discussions with the pilot, it becomes clear that the pilot was confident and had a good technical understanding of the aircraft and its flight characteristics. **The pilot was determined to complete the mission** and took actions to mitigate the risks he was familiar with. These actions did not include using the 100LL aviation fuel available on the aircraft. It is possible that this determination was the primary cause of the incident.

2.16 Aircraft Manufacturer

At the time of the investigation, there is no active manufacturer for the Texan aircraft model. The investigation team addresses in its findings, conclusions, and recommendations the existence of a manufacturer or another party that will eventually take responsibility for the design and production of this aircraft model.

2.17 Aircraft Flight Manual (FLIGHT MANUAL) - Section 3: EMERGENCY PROCEDURES

2.17.1 Reference to the battery as the sole power source in engine shutdown is found in section 3.5.1:

"A fully charged and functional battery should permit the operation of trim, flaps, and auxiliary electric fuel pumps for about 20 minutes." **This same reference exists in the FLIGHT MANUAL of the earlier model with fixed landing gear (TOP CLASS 570 ISR) and the same battery.**

2.17.2 There is no reference in the FLIGHT MANUAL to the presence of electrically operated retractable landing gear, which is a significant electrical consumer.

2.17.3 There are no instructions in the FLIGHT MANUAL to separate, as much as possible, the operation of the landing gear and flaps simultaneously during flight without a generator, using only the battery.

2.17.4 There is no definition in the FLIGHT MANUAL of what constitutes "nonessential electrical consumers" (though there is an instruction to turn them off in section 3.5.1, Subsection 2).

2.17.5 **Vapor Lock There is no reference in the FLIGHT MANUAL to fuel starvation caused by vapor lock due to high ambient (and fuel) temperature.**

The lack of reference to this phenomenon is considered by the investigation team to be a serious issue, especially given the climate conditions in Israel. On the other hand, engine icing is mentioned in section 3.8 **OTHER EMERGENCY.**

Notes:

*a. For comparison, in the POH of the V12 aircraft, **with a suction fuel system** and the option to use automotive fuel, manufactured by Aircraft Vans in the U.S., **there is a detailed reference to Vapor Lock.***

b. In a previous investigation (Case File 8-22), with similar environmental conditions, the manufacturer categorically denied the possibility of vapor lock in this type of aircraft, presenting arguments that, in the opinion of the investigation team, do not address the real situation on the field.

2.17.6 Fuel System Operation

- Use of two types of fuel in flight: Filling one wing with automotive fuel and the other with aviation fuel turned out to be a **common practice among light sport aircraft pilots** in Israel. There is no reference to this issue in the aircraft's literature.
- In section 3.4 "**DURING FLIGHT EMERGENCY PROCEDURES,**" under the instructions for **ENGINE SHUTDOWN**, section 4 specifies:
- "Select tank with maximum fuel - Fuel tank faucet." The instruction to choose the **fuller fuel** tank in an emergency, when the aircraft has **two types of fuel**, with aviation fuel (whose use would have initially prevented the issue) being in the less full tank, leaves the pilot with a dilemma.

2.17.7 Retractable Landing Gear

The FLIGHT MANUAL does not provide instructions on the operation of the landing gear and flaps separately or simultaneously, with an emphasis on operation in an electrical emergency (flying with only the battery). **It can be assumed that the attempt to lower the gear while extension the flaps required more current than the battery, after 9 attempts to start the engine, could provide.**

2.18 Partial Summary of Recommendations from Previous Investigation Reports, Defined Under "VAPOR LOCK"

Accidents and serious incidents whose cause has been strongly attributed to vapor lock have been a concern for a long time. Below is a summary of the recommendations given (for detailed information, see Appendix 8):

- Installation of 100LL aircraft fuel tanks at the Rishon Lezion airstrip – Two recommendations for the operator of the airstrip.
- Installation of a warning label in the cockpit – Three recommendations for the regulator.

- Installation of a fuel temperature gauge in the aircraft – Two recommendations for the manufacturer.
- Updating the aircraft manual regarding vapor lock and its prevention methods – Two recommendations for the manufacturer.

No recommendations were found to have been accepted or implemented. *Note: Recommendations for safety changes in aircraft are directed to the manufacturer; however, the investigation team believes this does not absolve the overall responsibility for the aircraft's licensing in Israel and the involvement of the regulator in improving safety.*

3. Findings and Conclusions

3.1 Findings

- 3.1.1 The engine shutdown most likely occurred due to fuel starvation caused by vapor lock in the aircraft's fuel system.
- 3.1.2 No evidence of technical failure in the aircraft's systems, including the engine, fuel system, and landing gear, was found.
- 3.1.3 No evidence of fuel blockage or contamination in the fuel during the incident flight was found.
- 3.1.4 The use of automotive fuel, the flight profile, and the weather conditions on the day of the incident contributed to the likelihood of vapor formation in the aircraft's fuel system, leading to vapor lock.
- 3.1.5 The design of the aircraft's fuel system is not resistant to the phenomenon of "vapor lock," and this was not addressed in the type certificate or the aircraft's operational guidelines.
- 3.1.6 No record of the manufacturer performing a "hot fuel" test, as required by the engine manufacturer, was found.

3.1.7 The aircraft's manual does not include a flight envelope (in terms of altitude and meteorological conditions) related to the type of fuel used, nor does it address measures to prevent the likelihood of vapor lock.

Note: Even in other small aircraft with a similar fuel system and low-wing configuration, no flight envelope addressing automotive fuel use was found in the aircraft manuals.

3.1.8 The pilot was aware of the risks posed by fuel evaporation and tried to mitigate it by reducing the fuel temperature as much as possible by parking the aircraft in the shade and filling one tank with fresh fuel, thereby foregoing the use of existing onboard aviation fuel."

3.1.9 Maneuvers to change the heights of the fuel lines caused a delay in extension the landing gear, resulting in a situation where the proximity to the ground prevented the emergency gear deployment.

3.1.10 The battery type and parameters in the maintenance manual and flight manual are listed **only by voltage and capacity**, which impairs the ability to rely on measurable parameters (such as starting current) during periodic inspections, making it difficult to identify a battery failure early.

3.1.11 The aircraft was equipped with a battery not according to the manufacturer's specifications.

3.1.12 In the 200-hour service inspection form by the airline (Appendix 7), the battery charging and condition are checked only visually without assessing technical parameters that would indicate its readiness.

3.1.13 The battery inspection during the audit is done similarly in other aircraft maintained by the maintenance facility.

3.1.14 It cannot be ruled out that commercial needs contributed to the flight being conducted under the prevailing conditions (temperature, etc.). However, it is important to Note that there are no restrictions, either from the

manufacturer or from a regulatory perspective, on conducting a flight with the profile and under the conditions that existed during the event.

3.1.15 The aircraft manual lacks essential information, particularly regarding the pilot's actions in emergency situations.

- Electrical management of the aircraft's systems during engine shutdown is insufficient, especially regarding the simultaneous operation of landing gear and flaps, as well as the cessation of non-essential electrical consumers.
- There is no mention of "vapor lock" in the aircraft's manual.

3.1.16 The engine manufacturer allows the use of two types of fuel – 95 MOGAS or 100LL AVGAS, but the aircraft manufacturer only references automotive fuel (MOGAS).

The aircraft manual does not address the possibility of carrying two different types of fuel in the aircraft's tanks simultaneously.

3.2 Conclusions

3.2.1 The fuel starvation was most likely caused by a vapor lock, resulting from the **use of automotive fuel** under climatic conditions and a flight profile that created a conducive environment for fuel boiling in the aircraft with a suctiontype fuel system.

3.2.2 Incidents of fuel starvation, with the probable cause identified as vapor lock, have occurred in the past also in non-Texan Light Sport Aircraft (LSA). The common denominator among all of them is a fuel system with **fuel suction** from a tank located in the lower wing to the engine, **using automotive gasoline**.

3.2.3 The use of automotive gasoline, without the publication of a flight envelope in the manufacturer's literature and without conducting a hot fuel check as

required by the engine manufacturer, constitutes a safety risk in the opinion of the investigation team, especially during hot summer days in Israel.

Note: This issue is also existing in other aircraft with a low-wing design and similar fuel systems.

3.2.4 The failure to lower the landing gear resulted from the use of a depleted battery and incorrect prioritization in the operation of electrical consumers, relying solely on the battery. It is important to Note that the flight manual does not address early deployment of the gear, separate from the operation of flaps, in the specific situation where the aircraft was (only the battery and engine shut down). Since the aircraft's literature does not define essential electrical consumers, this remains an open issue left to the pilot's discretion, based on their familiarity with the aircraft's systems.

3.2.5 All of the aircraft's systems (except for the engine and control surfaces) are powered by electricity. In case of electrical supply failure (or engine shutdown), the battery is the power source. This highlights the importance of reliably monitoring and testing the battery condition during periodic inspections. The lack of a manufacturer's definition of the **battery type** (e.g., "starter battery" with specific "starting current" requirements) and **measurable parameters for assessing its technical condition** allows any battery meeting minimum voltage and capacity requirements to be installed. This means the battery inspection is done visually, based on its external condition, as performed at the maintenance facility (the inspection meets the manufacturer's definitions). A faulty battery would only be discovered later when it fails during an electrical fault or engine shutdown, as occurred in this case.

3.2.6 Flight operations

- Flight maneuvers (such as adjustments) aimed at dealing with the aircraft's fuel system structure without backup in the flight manual, at the expense of energy management, ultimately led to a lack of altitude when it became necessary to perform manual gear deployment.

- An early switch to aviation fuel (100LL) might have prevented the engine shutdown. It is impossible to reconstruct if, when, or for how long this switch was made.
- The radio coordination and subsequent gear-up forced landing were executed correctly

3.2.7 Aircraft Manufacturer

The fact that there is currently no active manufacturer behind the aircraft makes addressing and resolving findings more difficult, but not impossible, especially with the possibility of new ownership in the future. The investigation team stresses the importance of updating the aircraft's certification based on the detailed findings and the recommendations provided later.

3.2.8 Rishon LeZion Airstrip

According to the investigation team, the ability to refuel with 100LL aviation fuel at Rishon LeZion Airstrip, which is home to most of Israel's LSA, is of high importance. It could significantly contribute to flight safety and help prevent vapor lock in aircraft that are "sensitive" to this issue (suction-type fuel systems).

3.2.9 Supervision and Regulation

- The rapid development of sport aviation in Israel in recent years, Instead of general aviation, presents a challenge to the regulator. More attention should be given to this sector.
- This is not the first event (and report) related to vapor lock in Israel (12 previous incidents are listed in this report).

Given the licensing conditions based on BCAR CAP 482 Section S, and considering the information provided by the aircraft manufacturer in previous investigations, the regulator should have proactively addressed this issue with the British regulator and the aircraft manufacturer years ago, making adjustments to the licensing so that the phenomenon could

be prevented. For example, limiting the use of automotive fuel until a flight envelope that addresses the issue could be defined.

- Over approximately 14 years, the manufacturer made 12 technical and other changes (Appendix 2), some initiated by Israel, which required specific certification in Israel. Despite the accumulated number of fuel vapor lock incidents, the regulator did not take steps to address the issue, such as requesting the manufacturer to add a fuel pump at the tank outlet to ensure fuel is supplied by pressure, preventing vapor lock, or advising the use of 100LL fuel and/or other solutions.
- The investigation team sees the cancellation of the "type certification" and the suspension of the C of A for one year by the regulator as an opportunity to address the safety issues presented in this report and previous investigations.
- The weather station at Rishon LeZion Airstrip is listed in the operational manual. However, the station is not certified, is not monitored, and does not meet aviation standards. Its presence in the manual may mislead pilots, who might consider the data provided as reliable and official.

3.2.10 The Sports Aviation Association

- The association serves as a source of knowledge and provides professional and safety information to its members.
- The trend in Israel towards small aircrafts (LSA), which are becoming more advanced, at the expense of general aviation, is steeply rising, increasing the importance of maintaining and strengthening this organization.
- The association holds significant weight and importance, especially in the absence of a professional entity (certified maintenance organizations with overall technical responsibility), serving as an intermediary between the aircraft manufacturer and its owners.
- The association is a crucial entity that the regulator, pilots, and maintenance organizations can consult and rely on.

3.2.1.1 Alternatives considered as recommendations to prevent vapor lock

- The complexity of the vapor lock issue, as analyzed in this and previous investigations, does not allow for "textbook solutions" that can be applied depending on varying situations such as atmospheric conditions, flight profiles, etc.
- The investigation team examined several technical, regulatory, and combined solutions regarding the use of automotive fuel:
 - **Consider fuel temperature as the basis for decisions:** This would require installing gauges in the aircraft. However, no specific temperature threshold for vapor lock was found; only a range within which boiling begins. Therefore, the investigation team does not find sufficient justification for installing such instruments.
 - **Consider ambient temperature as the basis for decisions:** There is a significant gap between ambient temperature and fuel temperature. The difference depends on many variables and cannot be practically quantified. Additionally, without a defined reference temperature for the fuel, relying on ambient temperature is not meaningful.
 - **Define a specific period during the year** (not throughout the year) when the use of automotive fuel would be restricted, such as summer months for automotive fuel use: Based on the two previous points, such a definition would not solve the issue.
 - Install a fuel pump at the tank outlet to ensure the fuel is supplied by pressure rather than suction: Adding a fuel pump would require a manufacturer change, with significant technical implications. The investigation team does not see the need to implement such a change, given the overall consequences.
- Install aviation fuel tanks at Rishon LeZion Airstrip: This issue was raised in previous investigations and was recommended and accepted by the airstrip operator. However, it was not implemented due to various reasons, including installation costs and the simultaneous use of automotive fuel.

3.2.12 The absence of a manufacturer creates both a challenge and an opportunity for the regulator. It is important to address the report's recommendations for the manufacturer during any updates or corrections to the aircraft's certification.

4. Recommendations

Notes:

- a. *Each recommendation for the aircraft manufacturer (which is not active at this stage) is currently directed to the CAAI (Civil Aviation Authority), and will be considered during the process of renewing the manufacturer's certification.*
- b. *The order of the recommendations below is based on the party they are directed to and not by their relative importance.*

4.1 Limit the use of automotive fuel (MOGAS) in all aircraft models with a low-wing configuration and a fuel supply system using fuel suction that have been approved for flight in Israel, based on BCAR CAP 482 Section S, Paragraph 951 C: *"The fuel system must be arranged so that vapor lock cannot occur,"* until compliance with conditions defined by the regulator. **Responsible:** Director of the CAAI
Recommended implementation date: 1.5.2025 (Summer fuel use)

4.2 Install a fuel tank at the Rishon Lezion airstrip that will allow refueling of light aircraft with aviation fuel (100LL).
Responsible: Airstrip operator
Recommended implementation date: 1.5.2025 (Summer fuel use)

4.3 Define a flight envelope that will permit the use of automotive fuel MOGAS 95 octane.

Responsible: Director of the CAAI (Aircraft Manufacturer)

Recommended implementation date: 90 days from the definition of a new manufacturer

- 4.4 Add to the *Flight Manual* for the Texan aircraft a reference to fuel starvation resulting from vapor lock, detailing the conditions under which it occurs, the associated dangers, and preventive measures.

Responsible: Director of the CAAI (Aircraft Manufacturer)

Recommended implementation date: 90 days from the definition of a new manufacturer

- 4.5 Define a battery model with measurable parameters that allow for its periodic inspection.

Responsible: Director of the CAAI (Aircraft Manufacturer)

Recommended implementation date: 90 days from the definition of a new manufacturer

- 4.6 Define in the *Aircraft Flight Manual* the possibility of using two types of fuel (MOGAS, AVGAS) and a flight envelope based on the fuel type.

Responsible: Director of the CAAI (Aircraft Manufacturer)

Recommended implementation date: 90 days from the definition of a new manufacturer

- 4.7 Define in the emergency checklist (ECL) the required actions for engine misfires/failures in flight.

Responsible: Director of the CAAI (Aircraft Manufacturer)

Recommended implementation date: 90 days from the definition of a new manufacturer

- 4.8 update the Flight Manual to specify the non-essential electrical consumers during engine shutdown or total electrical power loss, and add to the emergency procedures section of the checklist, under 'Engine Shutdown', an instruction to discontinue their operation as mentioned.

Responsible: Director of the CAAI (Aircraft Manufacturer)

Recommended implementation date: 90 days from the definition of a new manufacturer

Sincerely,



Gad Regev

Director of Aircraft Safety Investigation Authority Israel

Date: 9.4.2025

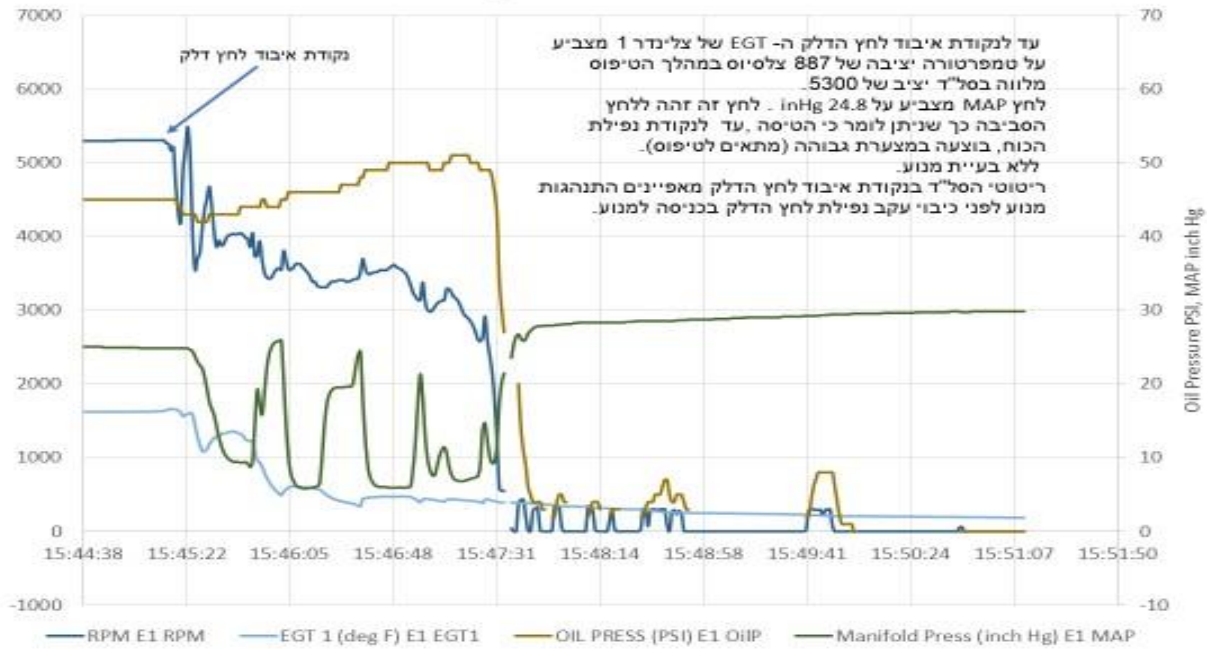
Reference: 4000-0098-2024-0000075

Returning objects seized during a safety investigation

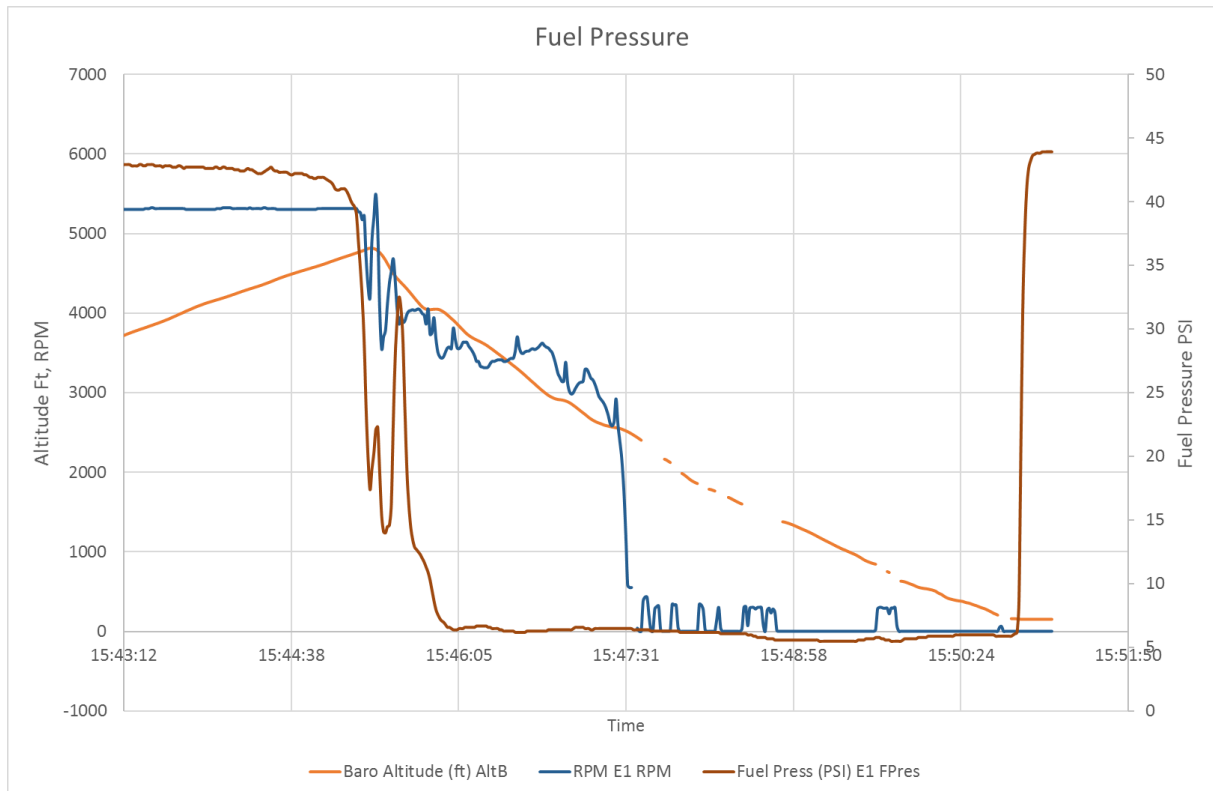
In accordance with Section 114(b)(5) - (7) of the Aviation Law, 2011, the director of the Aviation Safety Investigation Authority will return seized objects, with the exception of aircraft debris, within 45 days from the date of publication of the final investigation report. The objects will be returned to the person from whom the objects were seized, or to their owners. Fragments of an aircraft will not be returned except at the request of the owner of the aircraft and at his expense. A request for their reinstatement must be submitted to the Aviation Safety Investigation Authority, no later than 45 days from the date of publication of the report. A person interested in having seized objects not returned to their owners may submit an appropriate request to the Magistrate's Court, in whose jurisdiction the object was seized.

Appendix 1 Engine Data: Garmin Computer and Engine Computer

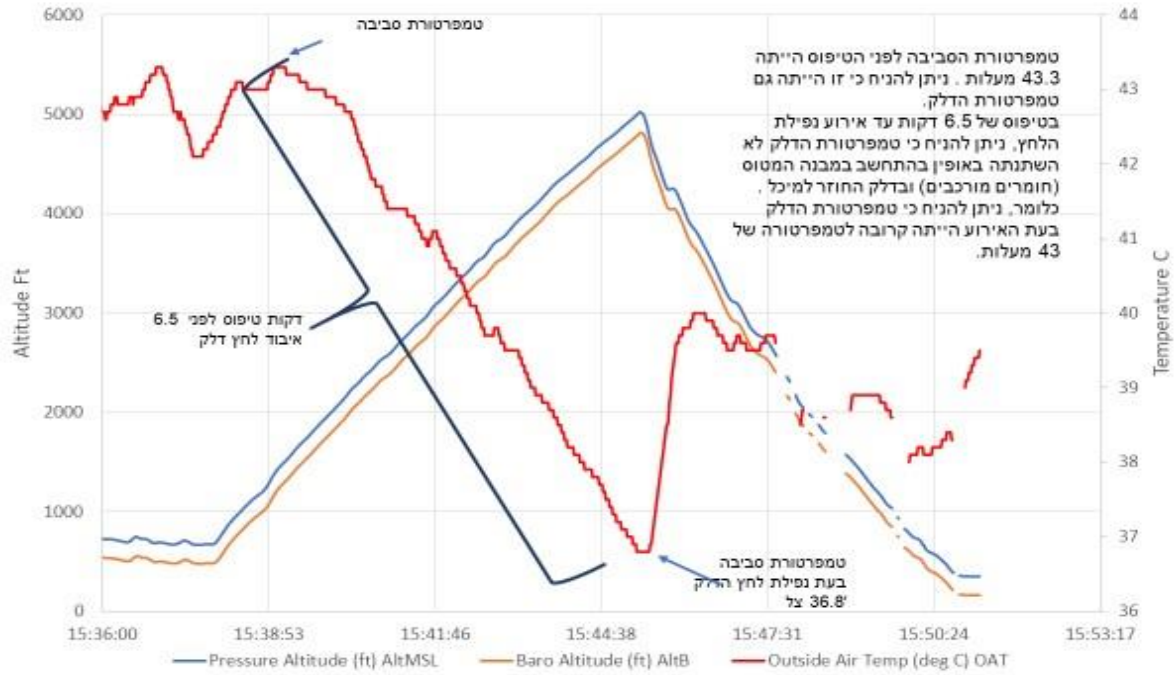
Engine Parameters



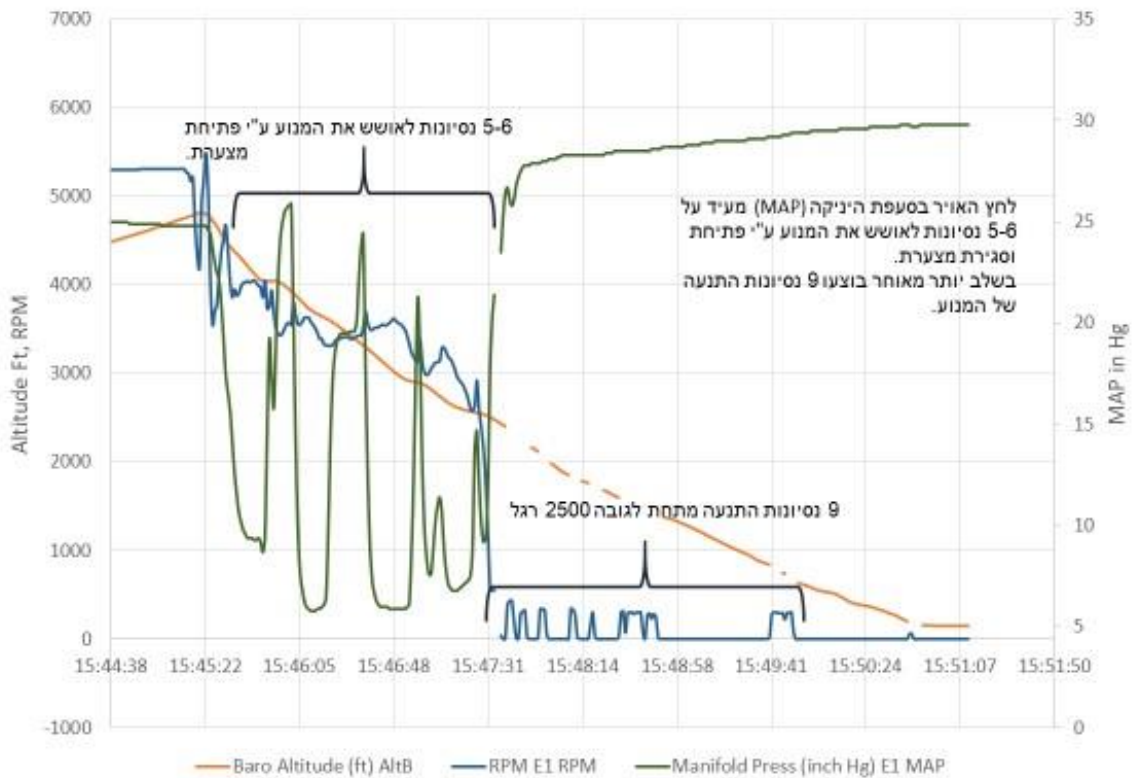
Fuel Pressure



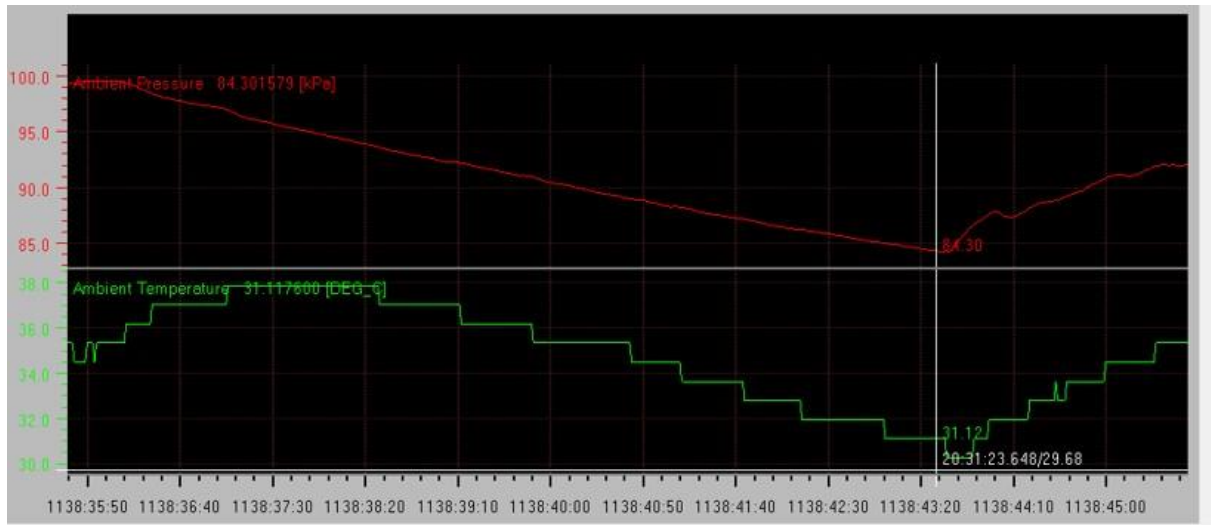
Ambient Condition



Pilot Action



ENGINE COMPUTER

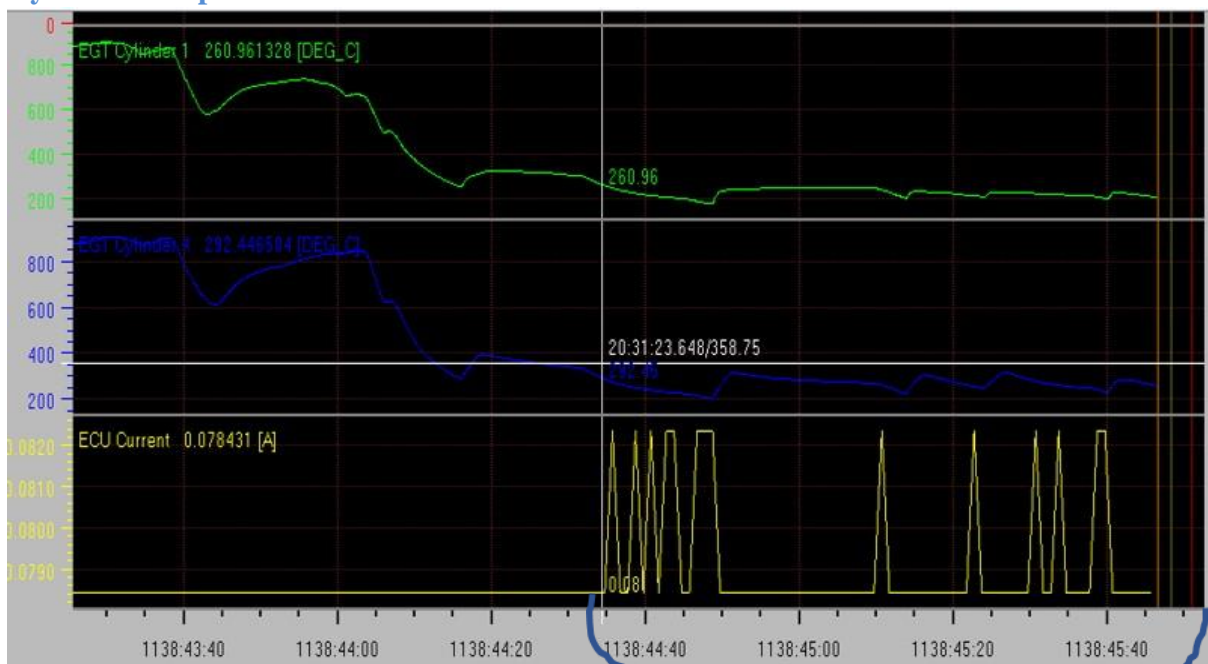


External Pressure (Kpa) decreases with altitude gain until the beginning of the descent. **Ambient Temperature** increases at the beginning of the climb and decreases as the climb continues.

There is a discrepancy between the Garmin data and the engine computer data. This difference is due to the placement of the sensors. However, even the engine computer data indicates a high ambient temperature reaching approximately 38 degrees Celsius during an inversion while climbing.

Cylinder Temperature #1

Cylinder Temperature #4



10 start attempts. The starter receives current (according to the GARMIN, the propeller only spins on the 9th attempt).

Engine Data as Displayed on the GARMIN Computer

Time	Mode	Altitude (ft)	Engine RPM	Fuel Pressure (PSI)	Fuel Flow (Gallons per Hour)	Voltage (Volts)	Current (Amperes)
15:24	Start						
15:30	Takeoff		44	6.7	13.8	3	
15:30- 15:38	Cruise	400-500	4700- 4900	43	4 – 4.5	13.8	1 - 3
15:38	Climb to Photo Altitude	7000	5100- 5300	43.6	5.5 – 5.8	13.8	2
15:39	Climb	1200	5200	43.5	6	13.8	2
15:40		1800	5150	43.3	5.8	13.8	2
15:41		2400	5200	43.0	5.7	13.8	1
15:42		3000	5200	43.2	5.8	13.8	1
15:43		3600	5400	42.8	5.8	13.8	1
15:44		4170	5300	42.7	5.5	13.8	3
15:44:30		4420	5300	42.4	5.5	13.8	2
15:44:45		4540	5300	42.1	5.4	13.8	2
15:45:00		4660	5300	41.3	5.4	13.8	2
15:45:15		4780	5170	32.4	5.4	13.8	2
15:45:30	Descent	4540	4520	16.2	2.4	13.9	2
15:45:45		4100	4030	12.3	0.9	13.9	2
15:46:00		3960	3570	6.6	3.1	13.9	2
15:46:15		3650	3390	6.7	0.4	14	2
15:46:30		3400	3400	6.3	1.9	14	2
15:46:45		3090	3550	6.3	0.4	14	2
15:47:00		2900	3380	6.4	1.7	14	2
15:47:15		2650	3100	6.4	0.4	14	2

Time	Mode	Altitude (ft)	Engine RPM	Fuel Pressure (PSI)	Fuel Flow (Gallons per Hour)	Voltage (Volts)	Current (Amperes)
15:47:30		2530	1780	6.5	0.4	14	2
15:47:38	Engine Shutdown	2420	0	6.4	0.2	12.3	12-
15:47:40	Start Attempt 1	2270		6.4	0.1	11.9	13-
15:47:46	Start Attempt 2	2200		6.3	0.1	11.5	15-
15:47:55	Start Attempt 3	2120		6.3	0.2	11.5	16-
15:48:09	Start Attempt 4	1850		6.2	0.1	11.7	13-
15:48:18	Start Attempt 5	1750		6.2	0	11.6	14-
15:48:32	Start Attempt 6	1600		6.1	0	11.2	13-
15:48:44	Start Attempt 7	1420		5.7	0.1	11.2	12-
15:49:40	Start Attempt 8	850		5.8	0	11.8	12-
15:50:21	Begin Flap Retraction	400		5.9	0	11.8	16-
15:50:44	Propeller Blade Alignment	200		5.9	0	11.7	13-
15:50:48	Landing and Touchdown	160		5.9	0		

Note: The discrepancy between the starter operations as shown on the engine computer and the GARMIN data is due to a low electrical current that was insufficient to turn the starter during one attempt, despite the electrical command being given.

Appendix number 2

Aircraft certification



STATE OF ISRAEL
Ministry of Transport
Civil Aviation Authority (CAAI)

תעודת סוג לכלי טיס
TYPE CERTIFICATE for AIRCRAFT No. IA180

This certificate issued to **FLYSYNTHESIS s.r.l.**
Mortegiano 33050 (UD), Italy תעודה זו ניתנה ל
Strada Prov.n.78, km 12.150

certifies that the Type Design for the following product with the operating limitations and conditions herein as specified in the Air Navigation Regulations (Procedures for Documentation of Aircraft and Aircraft Parts) 1977, and the Type Certificate Data sheet, meets the airworthiness requirements of

מאשרת שתכן הסוג למוצר דלהלן במגבלות ובתנאים המבצעיים בהתאם לתקנות הטיס (נהלי תעוד כלי טיס וחלקיהם) תשל"ז - 1977, וגליון הנתונים של תעודת הסוג, ממלא אחר דרישות כושר אווירי של

**BCAR CAP 482 Section S,
ASTM F2245**

Make **FLYSYNTHESIS** יצרן
Models **TEXAN** דגם
Note: הערה:

1. See CAAI Type Certification Data Sheet (TCDS) No. IA180 Last revision.
2. Rev.1. Texan 3.0 and Texan 3.0 RG added.

This Certificate and the Type Certificate Data Sheet which is a part thereof shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Director General of the Civil Aviation Authority.

תעודה זו וגליון הנתונים של תעודת הסוג המהווה חלק בלתי נפרד ממנה, תהיה בתוקף עד ביטולה, התלייתה, השעייתה, או עד פקיעת תוקפה כפי שנקבע בה על ידי מנהל רשות התעופה האזרחית.

Date of application: May 12, 2000 **תאריך הגשת הבקשה:**
Date of issuance: January 15, 2001 **תאריך הוצאת התעודה:**
Date of amendment, Rev.1: August 01, 2022 **תאריך שינוי התעודה:**

By the direction of the Director
General, Civil Aviation Authority

בהתאם להוראת מנהל רשות התעופה
האזרחית.

Signed by:

TAMIR BARAK AM

חתום:

Title:

Manager, Aircraft Certification
Department

תפקיד:

State of Israel
Ministry of Transport
Civil Aviation Administration

Number:	IA180
Revision:	12
Make:	Flysynthesis, Italy
Model:	TEXAN TOP CLASS TEXAN CLUB TEXAN TOP CLASS 2 TEXAN TOP CLASS 2 RG
September 02, 2019	

TYPE CERTIFICATE DATA SHEET NO. IA180

This Data Sheet which is part of Type Certificate No. IA180 prescribes conditions and limitations under which the aircraft for which the Type Certificate was issued meets the airworthiness requirements of the Aviation Regulations (Certification Procedures for Aircraft and Parts thereof) – 1977 - תקנות הטיס - תשל"ז

Type Certificate Holder:

FLYSYNTHESIS s.r.l. strada provincial n.78, km 12.150 – 33050 Mortegliano (UD), Italy

Revision table:

Rev.	Date	Description of the revision
0	May 2002	First issue
1	October 2004	DUC 3 blades propeller STC SA 144
2	May 2010	Alisport propeller installation fixed pitch
3	December 2010	Alisport propeller with automatic variable pitch controller and MTOW increase
4	December 2012	Parachute, autopilot and smoke machine installation approval
5	June 2013	MTOW increase on Texans SN014 and 019
6	July 2013	Texan Club version and Rotax 912UL (80HP) engine added
7	April 2014	Texan Top Class 2 version and Gt propeller PVV added
8	September 2015	GRS6-600B4 parachute and Rotax912S added to the datasheet
9	September 2015	Table 1 corrected
10	February 2016	Texan Club have been removed, Texan Top Class 2 RG have been added
11	June 2016	Rotax 912iS engine and Garmin G3X avionics have been added
12	September 2019	GT propellers GT2VEB and GT2VEG added

I. Model TEXAN TOP CLASS, Ultra-Light Category, Approved by CAAI June 18, 2002

Engine ROTAX 912ULS (100 HP) per Limitations Section of CAAI approved AFM, POH, TM.

Fuel Gasoline, minimum 95 octane rating per Limitations Section of CAAI approved AFM / POH / TM.

Oil Type SF or SG per API system specification (See also Engine Manual).

Engine limits

Engine speed (RPM)	
- Maximum (Limited for 5 minutes)	5800
- Maximum continuous	5500
Cylinder Head Temperature	
- Maximum	135°C
- Minimum for Flight	60°
Oil Temperature	
- Maximum	130°C
- Minimum for Flight	50°C
Oil Pressure	
- Maximum	5.0 bar (72 PSI)
- Minimum at 3500 RPM and above	2.0 bar (29 PSI)
- Minimum below 3500 RPM	0.8 bar (12 PSI)

Fuel Pressure

Page	1	2	3	4	5	6	7	8	9	10
Rev.	11	5	10	12	12	12	10	12	11	11

Appendix 3

Hot Fuel Testing Procedure FAA AC No. 23.1521-B

Summary



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: TYPE CERTIFICATION OF
AUTOMOBILE GASOLINE IN PART 23
AIRPLANES WITH RECIPROCATING
ENGINES

Date: 3/2/95
Initiated By: ACE-100

AC No: 23.1521-1B
Change:

1. **PURPOSE.** This advisory circular (AC) provides information and guidance concerning an acceptable means, but not the only means, of compliance with part 23 of the Federal Aviation Regulations (FAR), for approval/certification to use automobile gasoline with or without oxygenates (alcohols, ethers, etc.) in part 23 airplanes. These procedures also apply to those airplanes approved/certificated under previous regulations superseded by part 23. Accordingly, this material is neither mandatory nor regulatory in nature and does not constitute a regulation. This AC may be used for certification of automobile gasoline that contains not more than 11 percent by volume of alcohol. Gasoline containing more than 11 percent by volume of alcohol should be certificated using the guidance in AC 23.1521-2.

2. **CANCELLATION.** AC 23.1521-1A, Certification of Non-Oxygenated Automobile Gasoline (Autogas) Instead of Aviation Gasoline (Avgas) in Part 23 Airplanes with Reciprocating Engines, dated January 2, 1991, is canceled.

3. **RELATED FAR SECTIONS.**

- a. Section 23.1521(d) - Fuel grade or designation
- b. Section 23.961 - Fuel system hot weather operation
- c. Section 23.955 - Fuel flow

4. **RELATED READING MATERIAL.** Refer to appendix 1 for related reading material.

3/2/95

AC 23.1521-1B

(ii) Test Procedure II.

(A) Service experience indicates that the following test should be conducted on airplanes proposed for certification on automotive gasoline. Use fuel identified in 6e(3)(i)(A) and (B) above, fuel the airplane with a minimum safe amount of fuel, and heat to 29°C ($85^{\circ}\text{F} \pm 2^{\circ}\text{F}$). Prepare the airplane for takeoff in a manner that will ensure the fuel temperature does not fall below 28°C (83°F).

(B) Refer to AC 23.961-1 for test procedures.

(iii) Test Procedure III. Service experience indicates that the following test should be conducted on airplanes proposed for certification on automotive gasoline when the main fuel tanks are at or below any pump on a suction lift fuel system. Subsequent to completing 6e(3)(ii)(A) and (B) above, park the airplanes on the ramp with ambient air temperature of 80°F or higher. Allow airplane to sit on the ramp a minimum of 15 or a maximum of 30 minutes to heat soak. Without refueling, start engine, taxi, complete normal preflight, takeoff, climb to 3000 feet AGL, return, and land. Ensure that there are no abnormal engine operating characteristics.

(4) Evaluate the inflight restart envelope with the fuel (§ 23.903(f)). Restart procedures should be placed in the flight manual (paragraph 6e(12)).

(5) Engine cooling tests, in accordance with § 23.1041, should be evaluated for compliance with the regulations if the fuel flow rate or fuel net heat of combustion is different.

(6) Evaluate for normal engine operation during all approved aircraft maneuvers; e.g., takeoff and landing, balked landing, etc. Also engine operation when changing from one tank to another, in accordance with § 23.955(e), should be evaluated. The stall test should be conducted first with aviation gasoline to ensure that the test pilot is aware of the normal airplane operation.

(7) Carburetor heat rise test, in accordance with § 23.1093, should be evaluated for compliance with regulations if the fuel freezing point or fuel icing inhibitors are different.

(8) Suction lift fuel systems are more critical than pressure feed systems with respect to vapor formation and should be evaluated for operational problems.

Appendix 4

Number of Days with Temperatures Above 30°C

Between the Years 2019 - 2023 in Be'er Sheva and Beit Dagan

באר חודשים/שבוע	3	4	5	6	7	8	9	10	11	12
2019	0	7	25	28	31	31	30	23	9	0
2020	0	6	17	27	31	31	30	30	0	0
2021	5	12	28	24	31	31	30	17	9	0
2022	0	13	18	28	31	31	30	14	1	0
2023	3	9	18	27	31	31	30	19	11	1

חודשים\בית דגן	3	4	5	6	7	8	9	10	11	12
2019	0	3	12	23	31	31	30	9	7	0
2020	0	4	8	11	31	31	30	20	0	0
2021	3	4	10	13	31	31	30	9	9	0
2022	0	6	8	21	31	31	30	10	1	0
2023	3	6	11	19	31	31	30	21	5	0

Appendix 5

Fuel and Environmental Temperature Data – Operational Guidelines

1. The Bazan Group defines in section 9 of the safety data sheet (Bazan file, safety sheet, classification, packaging, labeling, and marking of packaging – 1998 edition, updated September 2021) the boiling range of automobile fuel as between 28–210°C (meaning that boiling starts at 28°C under certain conditions).
2. As part of the investigation file, discussions were held with aviation fuel suppliers in Israel. It was stated that the boiling point begins between 32–34°C.

3. The British Light Aircraft Association (LAA), which has been in existence for approximately 70 years and has over 8,000 members, defined in a document dated June 19, 2013, and reaffirmed in a document from April 2023 (see Appendix 4), the maximum temperature of MOGAS automobile fuel in the tank at 20°C and a maximum flight altitude of 6,000 feet as operational limits.

The 2013 definitions focus on four types of aircraft with underwing fuel tanks. The Texan is one of them.

4. The NFPA – National Fire Protection Association 921 (USA) defines in Table 26.3.1 the initial boiling point of automobile fuel as between 26–49°C.
5. The FAA defines in ADVISORY CIRCULAR 23.1521-2B the temperature of automobile fuel at 29°C as the baseline for conducting a hot fuel test.

Appendix 3 presents the basic parameters required from the fuel during the test.

6. VAN'S AIRCRAFT, an American manufacturer of sport aircraft equipped with ROTAX engines, defines a temperature of 26°C as one that requires attention to VAPOR LOCK (Appendix 3 – Service Letter 00078 REV 1 April 25, 2023).
7. THE AIRPLANE FACTORY (TAF), a South African aircraft manufacturer, defines in their INFORMATION LETTER 004 dated December 1, 2016, that a temperature of 25°C or higher suggests the recommended use of pure aviation fuel or at least a 50% mixture with MOGAS.

Note: Some of the recommendations and guidelines refer to external temperature, while others refer to fuel temperature. The relevant data is the fuel temperature in the tank, which is affected by the external temperature, environmental conditions, and the aircraft's structure.

8. The CAAI UK (Civil Aviation Authority, UK) – Policy Specialist – Airworthiness, in a document dated January 11, 2024, refers to MOGAS as a fuel with a European standard but with various internal variables that are affected by factors such as ethanol content and/or other additives, environmental influences (storage, ambient temperatures, evaporation), etc., as opposed to AVGAS 100LL aircraft fuel, which is defined as "stable" in the discussed aspects.

Appendix 6

Investigation Reports Indicating Vapor Lock as the Most Likely Cause

1. Accident and Incident Data Caused by Vapor Lock in Israel are detailed in the reports and investigation files:
 - 21-17 – Serious incident of forced landing of a Texan on a road near Susiya due to engine power loss.
 - 27-17 – Engine shutdown incident after rotation and forward landing of a Texan at the Rishon Lezion airstrip.

37-19 – Accident caused by engine shutdown and crash during forced landing of a Texan at Kerozim.

42-19 – Accident of a Bristol aircraft in Haifa caused by engine stutter during takeoff. This investigation focused on the issue of 95-octane fuel.

18-21 – Incident involving a Texan north of the Tzihor junction caused by unstable RPM during climb.

8-22 – Texan accident in Elifelet caused by engine power loss and crash during forced landing.

27-22 – Texan accident east of Beit Sakhur caused by engine shutdown during climb to route and forced landing.

2. Additionally, the following incidents were reported:

Sting – May 9, 2017

Sierra – May 30, 2019

Texan – June 1, 2020

Texan (another incident) – June 1, 2021

Bristol – April 2022 (No official report issued)

Other unreported events in the official reporting system were passed among pilots through word of mouth.

Appendix 7

Battery Condition Fitness Inspection



State of Israel
Ministry of Transport and Road Safety
Aircraft Safety Investigation Authority Israel (AIAI)



מסעיל:

MP: TEXAN TOP CLASS2 RG 4X-HYT

TASKS TO BE PERFORMED	25	100	200	SIG	SIG
Check and if necessary replace all oil hoses and cooling system hoses, check clamps for Security and condition.			X	✓	✓
Check that all connection to terminals is firm and retained well to all electrical system wiring in the engine Compartment.	X	X	X	✓	✓
Check cooling liquid level and add if required.	X	X		✓	RII
Drain and Replace cooling liquid.			X	✓	✓
Check oil level, add if required	X				
Drain and change oil	X	X	X	✓	✓
Check engine for leaks.	X	X	X	✓	✓
Check engine cowling for proper condition & security.	X	X	X	✓	✓
Check all fuel and oil hose connection for security	X	X	X	✓	✓
Check cooling hoses and expansion tank for security	X	X	X	✓	✓
Check all components attached to fire wall for security	X	X	X	✓	✓
Check operation of cockpit ventilation.	X	X	X	✓	✓
Check instrument pick-up attachments to engine for proper condition.	X	X	X	✓	✓
Check all electric harness for proper condition.	X	X	X	✓	✓
Check the sealed battery, for charge and general condition.	X	X	X	✓	✓
Check battery base and securing straps for condition, attachment and cleanliness from battery fluids. Look for evidence of electrolyte leak or corrosion on terminals.	X	X	X	✓	✓
Check battery cables for connection and cable dressing	X	X	X	✓	✓
Visual inspection: the engine shock absorber's spacer must be centred about its seat.	X		X	✓	✓
[see MPM Page 83 (16.9) for engine mount checks]					
i) Disassembly for deep inspection of shock absorbers.			X		
ii) Check the absorber seats: no sign of damage must be present					
iii) The hole of each shock absorber must not be ovalized					
[see MPM Page 83 (16.9) for engine mount checks]					
The engine shock absorbers must be replaced after 300 hours or within 2 years (whichever occurs first).			X		RII
Check the absorbers seats: no sign of damage must be present.					
[see MPM Page 83 (16.9) for engine mount checks]					
Fuel computer sensor maintenance			X		
The fuel computer sensor must be controlled every 100h. See sensor installation manual for additional details.					
Re-install engine cowling.	X	X	X	✓	✓

Appendix 8

Summary of Recommendations from Previous Investigation Reports

1. **Landing Accident (due to Vapor Lock) - Investigation File 42-19, Bristol in Haifa** ○
Provide 100LL fuel at the Rishon LeZion airstrip or advance the fuel tank filling with "summer fuel" to March.
 - Directed to the operator of the Rishon LeZion airstrip – **not implemented.**
2. **Incident File 18-21, RPM Issue during Climb, Texan**
 - Instruct to install a warning label on the instrument panel for aircraft operators using MOGAS fuel, addressing the risk of Vapor Lock.
 - Directed to the Director of the Civil Aviation Authority (CAAI) – **not accepted.**
3. **Accident File 8-22, Texan Crash Near Moshav Aliflet**
 - Instruct to install a warning label on the instrument panel for aircraft operators using MOGAS fuel, addressing the risk of Vapor Lock (repeated recommendation).
 - Directed to the Director of the Civil Aviation Authority (CAAI) – **not accepted.** ○
Add fuel tank temperature indication capability.
 - Directed to the aircraft manufacturer – **no response.** ○ Update the Aircraft's POH (Pilot Operating Handbook) to include operational instructions, limitations, and warnings regarding Vapor Lock.
 - Directed to Fly Synthesis (the manufacturer) – **no response.**
4. **Accident File 27-22, Flight from Masada Airstrip to Rishon LeZion, Texan** ○
Add reference to Vapor Lock in the Flight Manual.
 - Directed to Fly Synthesis (the manufacturer) – **no response.**
 - Consider installing fuel temperature indicators with hazard zone indicators.
 - Directed to Fly Synthesis (the manufacturer) – **no response.** ○ Modify the fuel line system, including the valve position and adding ventilation openings.
 - Directed to Fly Synthesis (the manufacturer) – **no response.**
 - Evaluate the possibility of installing 100LL fuel tanks at the Rishon LeZion airstrip (following the previous recommendation).
 - Directed to the operator of the airstrip – **not accepted.** ○ Instruct to install a warning label on the instrument panel for aircraft operators using MOGAS fuel, addressing the risk of Vapor Lock (repeated recommendation). ○ Directed to the Director of the Civil Aviation Authority (CAAI) – **not accepted.**