Safety Investigation Final Report

Accident File No. 29-24

Agricultural aircraft Accident

Date	5 December, 2024
Aircraft	Turbo Thrush S2R
Registration	4X-AFB
Location of event	Near Kibbutz Shoval

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 CAAI 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 CAAI 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 CAAI 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 Final Report

Accident File No. 29-24

Summary of the Event

On the afternoon of Thursday, 5 December 2024, the agricultural spray pilot (hereinafter: **"the pilot"**) began an agricultural spraying operation over a potato field near Kibbutz Shoval in the Negev. As part of the preparation for the spraying operation, the pilot conducted an initial inspection pass over to assess the terrain and to evaluate wind direction and intensity. It is presumed that during this inspection pass over, the Turbo Thrush S2R agricultural aircraft (hereinafter: **"the aircraft"**) crashed near the intended field for spraying. The pilot sustained serious injuries, and the aircraft was destroyed.

Figure 1 - **The aircraft involved in the accident**

Abbreviations

CAAI	Civil Aviation Authority of Israel
RPM	Revolutions Per Minute
OM	Operations Manual
AMSL	Above Mean Sea Level
C/L	Checklist
AFM	Aircraft Flight Manual
AFMS	Aircraft Flight Manual Supplement
ATO	Approved Training Organization (in accordance with ICAO Annex 1)
S.B.	Service Bulletin
STC	Supplement Type Certificate
TBO	Time Between Overhauls
TC	Type Certificate
TCDS	Type Certificate Data Sheet

1. Factual information

1.1 History of the flight

On Tuesday 3 December 2024, the pilot completed his training as an agricultural spray pilot at Telem Company (hereinafter: "**the company**"). The following day, he conducted his first independent spraying flight, which he completed without any notable events.

In the afternoon of Thursday, 5 December 2024, the pilot arrived at the Beer Sheva Airstrip (LLBS), where he received a briefing from a company manager.

The planned workday included spraying four potato crop fields using the pesticide Manzidan 80, used for disease control. The pesticide leaves a white layer on the plants after application. The aircraft was loaded with the spray material at the Beer Sheva Airstrip, separately for each field. Before departing for the third field and in parallel with loading the spray material, the aircraft was refueled with 140 gallons for the remaining two fields (Flights No. 3 and 4), which is sufficient for approximately two and a half hours of flight time.

After approximately half an hour, upon completing the spraying of the third sortie, the aircraft returned to Beer Sheva Airstrip, refilled with spray material, and departed to spray the fourth and final sortie for that workday.

Weather conditions in the area were fair, with a light northwesterly wind. The spraying direction was planned along the furrows, oriented southwest to northeast. The pilot took off from Beer Sheva Airstrip and flew in a straight line, generally northbound, approximately 16 km, toward the crop field.

<u>Notes:</u>

1. *The flight reconstruction was carried out based on statements from the company's ground personnel and analysis of findings collected thereafter. The pilot, who was seriously injured in the accident, had no recollection of the event and was unable to provide the investigation team with information related to the flight path details and the circumstances of the accident.*
2. *There is no GPS data available for the flight path. The flight path is estimated based on partial radar data obtained from the Air Force.*

At approximately 2:55 PM, as part of the preparation for spraying the field, the pilot performed a pass over the field in a northeast direction and then turned south. According to a witness statement, this maneuver was likely a wind-check pass, utilizing smoke to identify wind direction and velocity. While turning back toward the spraying field, on a northeast heading, the aircraft lost altitude and crashed (see Figure 2). A witness in the area notified the company of the accident.
No evidence of Manzidan (spraying material) was found in the field.

1.2 Injury to Occupants

Injuries	Pilot	Passengers	Others
Fatal			
Serious	**Moderately to Seriously injured**		
Minor / No			
None			

1.3 Damage to aircraft - The aircraft was destroyed

Figure 2 - **The aircraft at the accident site**

1.4 Other damage - No other damage was reported.

1.5 Personnel Information

Pilot in Command (PIC)

1.5.1 Age - 32.

1.5.2 Pilot License - **Commercial Pilot License with Agricultural Rating and aircraft Category - Group D (S2R Turbo Thrush).**

1.5.3 Medical Certificate- Valid.

1.5.4 Pilot Flight Experience - Approximately 750 total flight hours. Of these, approximately 490 flight hours were in helicopters, and approximately 260 flight hours were in fixed-wing aircraft.

1.5.5 Of the fixed-wing flight hours, the pilot had accumulated approximately 18 flight hours on the Turbo Thrush S2R aircraft type.

1.5.6 The pilot completed his initial training at the company two days prior to the accident. The accident flight occurred on his second day of solo operations without an instructor.

1.6 Information about the aircraft

1.6.1 General information

- ✓ Aircraft Manufacturer: Rockwell Int. (Ayres Corp).
- ✓ Model: S2R.
- ✓ Serial Number: 2500R.
- ✓ Year of Manufacture: 1978.
- ✓ Nationality and Registration Marks: 4X-AFB.
- ✓ Special Airworthiness Certificate Issue Date: 15 August 2007.
- ✓ Aircraft Owner and Operator: Telem Aviation Ltd.
- ✓ Airworthiness Certificate Valid Until: 29 January 2025.
- ✓ Aircraft Type Certificate: TCDS IL010 - based on the U.S. FAA Type Certificate TCDS A4SW.

1.6.2 Aircraft History

- ✓ The aircraft was manufactured by Rockwell Int. (Ayres Corp). as an S2R (600 HP) model, equipped with a Pratt & Whitney R-1340 radial engine.
- ✓ The aircraft, while registered as N4006U, was involved in an accident on 12 May 1984, in which it sustained substantial damage but was subsequently repaired and returned to service.
- ✓ According to the aircraft logbook, on 26 June 2007 the engine was converted from a radial engine to a Pratt & Whitney PT6A-34AG turboprop engine, in accordance with STC SA3238WE.
- ✓ Following this conversion, the aircraft was purchased by the company and imported to Israel.
- ✓ Total time since manufacture: 16,173 hours.
- ✓ Time since last inspection: 40 hours.
- ✓ No discrepancies and/or open maintenance items were found in the aircraft logbook.
- ✓ In Israel, a modification was performed under TCDS IL010, increasing the aircraft's Maximum Takeoff Weight from 6,000 lb to 7,860 lb.
- ✓ **As part of the Maximum Takeoff Weight increase, a maximum ambient temperature limitation of 30°C was established for operations at weights above 7,100 lb.**

1.6.3 Engine

- ✓ Engine Manufacturer: Pratt & Whitney Canada
- ✓ Model: PT6A-34AG (turboprop)
- ✓ Serial Number: PCE-56719
- ✓ Time Since Overhaul (TSO): 132 months
- ✓ Total Time: 5,291 hours
- ✓ Time Since Overhaul: 5,291 hours

- ✓ In November 2023, the operator transitioned from the basic 4,000-hour TBO program to the MORE Company extended maintenance program, in accordance with FAA STC SE00002EN, which increases the TBO to 8,000 hours. This program was approved by the Israeli Civil Aviation Authority (CAAI).

  <u>Note</u>: *According to information received from the engine manufacturer, Pratt & Whitney Canada (PWC), this maintenance program* ***is not recognized by the manufacturer****.*
- ✓ The operator performs complex engine maintenance tasks at the Bet Shemesh Engines Ltd.

1.6.4 <u>Propeller</u>

- ✓ Propeller Manufacturer: Hartzell.
- ✓ Model: HC-B3TN-3D.
- ✓ Serial Number: BUA32431.
- ✓ Total Time: 754 hours.
- ✓ Time Since Overhaul: 754 hours.
- ✓ Blade Model: T10282NS+4.
- ✓ Blade Serial Numbers: L29666, L29667, L29668.

1.6.5 <u>Fuel</u>

- ✓ Fuel Type Used: Jet-A1.
- ✓ Fuel Quantity at Last Refueling: 140 gallons, determined by mechanical gauges.
- ✓ Fuel Weight in aircraft Tanks at Last Refueling: approximately 420 kg, stored in two wing tanks, 70 gallons each.

1.6.6 <u>Accessories / aircraft Systems</u>

- ✓ The aircraft was equipped with an agricultural spraying system consisting of a spray tank located forward of the cockpit and a system of pipes and nozzles with attached booms mounted beneath the wing's trailing edge.
- ✓ The spraying system is approved by the manufacturer and by the FAA under the applicable U.S. Type Certificate Data Sheet (TCDS).

1.6.7 Aircraft Weight and Balance (see Appendix 2)

The aircraft was originally manufactured under the S2R model designation with a radial engine and a maximum takeoff weight (MTOW) of 6,000 lb.

Subsequently, the manufacturer defined several sub-models, some of which incorporated weigh upgrade STC, and in connection with these configurations, the maximum takeoff weights were increased.

According to FAA TCDS A4SW, the MTOW was increased for several specified sub-models of the aircraft; however, this approval does not include the current S2R aircraft.

The weight units referenced throughout this report appear as documented in the various certificates: either in kilograms or in pounds. Where applicable, conversions between units are indicated in parentheses.

- ✓ In the type certificates for the S2R model issued by both the FAA and EASA, the maximum takeoff weight (MTOW) is defined as **6,000 lb** (2,722 kg).
- ✓ In the AFM approved by the FAA, the maximum takeoff weight for the S2R model is defined as **6,000 lb** (2,722 kg).
- ✓ The weight limitations specified in the aircraft's airworthiness certificate issued by the Israel Civil Aviation Authority (CAAI) are **3,565 kg** (7,860 lb).
- ✓ At the time of the accident, the estimated weights were as follows:
  - Empty aircraft weight (including pilot): 2,100 kg (4,630 lb)
  - Fuel at the beginning of the spraying operation: 275 kg (606 lb)
  - Spray material: 800 kg (1,764 lb)
  - Total aircraft weight: **3,175 kg** (7,000 lb)

- ✓ A review conducted by the investigation team found one state (New Zealand) that approved an identical maximum takeoff weight increase for the S2R aircraft model, **but only in exceptional cases, meaning not as a routine practice, and under strict operational limitations** (see Appendix 2).

The weight and balance envelope is defined in the documents approved by the CAAI (presented in Appendix 2). Increasing the maximum takeoff weight from 6,000 lb to 7,860 lb reduces the envelope (the distance between the forward and aft center-of-gravity limits) by 65.7% when the aircraft weight is 7,860 lb. At this weight, the distance between the envelope limits is **1.2 inches**.

1.7 Weather - (according to IMS data)

1.7.1 Fair weather, good visibility, ceilings 1-2/8 at 3,200 ft AMSL.

1.7.2 Wind: light northwesterly.

1.7.3 Temperature: 22°C.

1.7.4 The pilot reported that during his flight from the airstrip to the spraying field (approximately 16 km), the wind was unstable northerly, characterized by turbulence and gusts.

1.8 Radio Navigation aids - Not applicable.

1.9 Communication - Not applicable.

1.10 Aerodrome Information

Fueling and loading of the spray material were carried out at the company's facility at the Beer Sheva Airstrip.

1.11 Flight Recording data

The onboard GPS device did not record the field-inspection pass nor the wind-check pass.

Notes:

1. *The pilot acted in accordance with the instructions he received from the instructor/chief pilot recording was to be activated only at the beginning of the spraying run, after completing the field inspection.*
2. *The flight path was obtained from IAF radar; however, the data was incomplete and did not allow for an accurate analysis of turn directions or other details.*

1.12 Aircraft wreckage and information regarding the ground impact

The aircraft impacted the ground at a nose-down angle exceeding 45°.

The field in which the aircraft crashed consists of furrows approximately 0.5 meters deep, with furrow walls angled at roughly 45° to the vertical.

The aircraft came to rest within a single furrow, with both wings aligned parallel to the furrow's direction, indicating that the impact occurred perpendicular to the furrow orientation. No marks were observed on adjacent furrows, indicating there was no horizontal movement during or after ground impact (see Figure 2).

All major aircraft components were located within a confined area adjacent to the main wreckage at the accident site (see Figure 5). The landing gear collapsed, the wings were bent and deformed, the propeller sustained significant damage, and the propeller shaft was severed from the engine.

Two of the three propeller blades were found bent. The third blade had separated from the hub and was located intact and straight nearby (see Figure 3).

The engine detached from the fuselage, disintegrated, and was significantly deformed. The aft section of the fuselage, including the tail assembly, fractured upward and separated at its attachment point to the fuselage. The flaps were found in the "down" position; the right-wing flap cable was torn, while the left-wing flap cable remained intact and connected to the actuation mechanism. The cockpit structure retained its overall integrity.

Both wing fuel tanks were ruptured, and the fuel had been absorbed into the surrounding soil.

1.12.1 Engine Control Levers - Accident Site Positions:

- ✓ The throttle and torque were found in a position consistent with high engine power during flight.
- ✓ The propeller pitch lever was found in the "feather" position (see Figure 4), however, the propeller blades were found in a fine-pitch position consistent with the flight condition in which the aircraft was expected to be (see Appendix 1 for details).

  Note: As a result of the accident, the control cables (throttle, torque, and propeller pitch) were severed; however, when the levers are positioned such that all cable fracture points align on the same plane, it is found that the pitch corresponded to a fine-pitch setting.

1.12.2 The stall-warning circuit breaker was found in the out position (disconnected), while all other circuit breakers were in the in position (see Figure 8).

Figure 3 - **Propeller - pitch mechanism and blades**

Figure 4 – **Engine control lever positions after the accident**

Figure 5 -**Distribution of aircraft debris**

1.13 Medical and Pathological information

As a result of the impact with the ground, the pilot sustained multi-system trauma.

An initial interview was possible only after approximately two weeks, during which the pilot did not recall any details of the accident. In subsequent interviews, conducted about two months after the accident, the pilot recalled only a small portion of the event.

1.14 Fire - No fire erupted as a result of the accident.

1.15 Elements of Survival

The cockpit "cage" structure maintained its integrity, thereby preventing more severe injury to the pilot.

1.16 Tests and Research

1.16.1 Engine Examination

The damage sustained by the engine allowed only a limited inspection of its technical condition at the time of the accident. However, within the collected investigative material, no evidence of an engine malfunction was found.

1.16.2 Propeller Examination

At the accident site, the propeller was found with one blade bent forward, one blade with a damaged tip, and one blade separated without structural deformation. The propeller pitch control lever was found in the feather position. In order to determine the propeller condition at the time of the accident, an examination was carried out in accordance with the manufacturer's instructions.

The findings indicate that at the moment of ground impact, the blades were in a fine-pitch position, consistent with high-RPM flight, **and not in the feather position** (see details in Appendix 1).

1.16.3 Stall Characteristics

The stall sequence in this aircraft begins at the tail unit. At this stage, the pilot experiences vibrations in the control stick, which are transferred directly from the elevator. At this point, an immediate relaxation (a slight forward push) of the stick returns the aircraft to fully controlled flight. Failure to release the stick—meaning continued or even increased aft pressure results in a full tail stall, occurring before the wings reach the full stall that follows. The consequence is a nose-down pitch while entering a full stall.

In the AFM approved by CAAI (see Appendix 3), under Section 4 "PERFORMANCE" the stall altitude loss is defined as: "Loss of altitude during stall exceeds 150 ft".

According to information provided by experienced agricultural pilots familiar with this aircraft type, approximately **800 ft** are required for stall recovery (at an average aircraft weight). Stall training is typically performed at a minimum altitude of approximately **2,000 ft**.

1.16.4 Stall Warning

The aircraft is equipped with a stall-warning system. An angle-of-attack sensor is installed on the left wing (see Figures 6 and 7) and is connected to a unit containing an electrical switch that transmits a warning signal to a horn and an indicator light located on the cockpit instrument panel, which illuminates when a high angle of attack is detected.

The stall-warning horn has a constant intensity and frequency, which do not change as the angle of attack increases prior to the stall.

Figure 6 - **Stall Warning System**

As the angle of attack increases, the airflow lifts the "red tab" (see Figure 7), which closes an electrical circuit and activates the stall warning; that is, it operates in an ON/OFF manner.

In straight and level flight, the system is calibrated to provide a warning approximately 5 MPH prior to the actual stall.

During maneuvering, the "warning margin" between the initial stick pull and the actual onset of the warning varies according to the rate of stick pull and the buildup of angle of attack.

Figure 7 - **Angle of Attack Sensor**

Independently of the warning system, as the aircraft approaches the stall speed, the pilot feels vibrations in the control stick resulting from buffeting of the elevator.

✓ A circuit breaker for the stall warning system is installed in the cockpit.
  This circuit breaker controls the system, which includes the sensor, the horn, and the red indicator light.

✓ The stall-warning proximity circuit breaker (horn and light), which was found in the aircraft at the accident site, **was in the OUT position (disconnected)** (the right push-button in Figure 8).

Figure 8 - **Stall Warning System circuit breaker**

- ✓ Checks performed on the circuit breaker after the accident indicated proper function.

  <u>*Notes*</u>:

  1. *This circuit breaker was the only one found in the "Pull-out" position among all the other circuit breakers on the panel.*
  2. *The pilot could not state what the position of the circuit breaker was during the flight, but noted that he had not changed its position when taking over from the previous pilot (the pilot changeover was carried out while the aircraft's engine was running).*
  3. *Mud marks found on the circuit breaker indicate that it was in the "Pull-out" position at the time of the accident.*

     This means that the stall warning did not operate during the event.

- ✓ The investigation team found that many Turbo Thrush pilots in Israel fly with **the stall-warning circuit breaker in the "out" position (disconnected)** due to what some refer to as "false alarms". Some pilots also indicated that the frequent activation of the warning increases cumulative fatigue during spraying operations (tens or even hundreds of sharp turns per workday). This practice is known and **common primarily** among experienced pilots. According to the pilots, their aircraft handling experience is sufficient for recognizing when approaching stall, whereas the operation of the audible warning hinders them and contributes to cumulative fatigue throughout the workday during spraying flights.

- ✓ Calibration testing of the stall-warning system is performed during test flights following the replacement or repair of certain aircraft components, during scheduled maintenance, or after malfunction report by a pilot. The most recent test of the system on the accident aircraft was carried out after maintenance, on 1 January 2024.

  <u>No malfunction entries for this system were reported by pilots in the aircraft Maintenance Log on any of the company's aircraft in recent years</u>.

- ✓ **Separation of the stall warning horn from the warning light:**

  The investigation team examined the stall warning system in additional agricultural aircraft of models S2R and S2R-T34 operating in Israel.

  <u>*Note*</u>*: The original S2R model and S2R-T34 model was equipped with just a stall warning red light in the cockpit. Later on, following a fatal accident in the USA, the manufacturer added also a horn to the stall warning system.*

  In some aircraft, a separation was found, using a dedicated circuit breaker for the warning horn and another circuit breaker for the warning light. According to senior personnel in the industry, the first aircraft of this type that arrived in Israel (in the late 1970s) were equipped with a warning light only.

  No documentation of this modification was found in the aircraft records, nor was any approval for such a change found in the CAAI (Civil Aviation Authority of Israel) records.

1.17 Information about the regulator, operator and other interested parties

1.17.1 Civil Aviation Authority of Israel (CAAI) - Areas of Responsibility:

- ✓ **<u>Company certification</u>**

  Chapter 11 of the Air Navigation Regulations (ANR) - Operation of aircraft and Flight Rules 1981, deals with the issuance of an operator's license for companies engaged in agricultural aviation.

- ✓ <u>Licensing and certification of pilots in companies engaged in agricultural aviation</u>

  Certification of pilots within an air operator engaged in agricultural aviation includes the following combination:

(a) Holding a pilot license that includes an agricultural rating and a Group D Aeroplan rating on the relevant aircraft type, all in accordance with the Air Navigation Regulations (Licensing of Aviation Personnel), 1981 (hereinafter: **"the Licensing Regulations"**).

(b) Authorization to perform missions within the company shall be carried out in accordance with the Air Navigation Regulations (Operation of aircraft and Rules of Flight), 1981 (hereinafter: **"the Operations Regulations"**).

Regulation 207(a) of the Operations Regulations defines the minimum requirements for the employment of pilots in companies operating under the aforementioned Chapter 11. This regulation stipulates that a pilot must hold a commercial pilot license (or an airline transport pilot license), and that the license must also include an agricultural rating and an appropriate rating for the type of aircraft intended to be used within the air operator.

Most of the pilots recruited to work for an air operator engaged in agricultural aviation do not possess these ratings, and they undergo their training within that operator.

(a) The licensing of new pilots in the company is based on training and conversion programs prepared by the company and, as part of the approval of its Operations Manual (OM), submitted to the regulator for review and approval. The training programs must, at a minimum, comply with the requirements set out in the Air Navigation Regulations.

(b) The CAAI personnel responsible for pilot licensing and for oversight of spraying companies with respect to Chapter 11 of the Air Navigation Regulations do not have a background in agricultural spraying flight. The CAAI does not involve agricultural-spraying pilots/examiners (who are employed by it on an ad-hoc basis) in the process of approving training programs when such approval is required as part of the qualification of new pilots in this field.

(c) **The training program for the addition of the *Turbo Thrush* rating (Group D aircraft), which was approved by the CAAI, does not comply with the requirements of Regulation 180(3) in that it did not include study and practice of stalls.**

(d) OM: The regulator (CAAI) accepted the Operations Manual (OM) from the air operator (the company) and approved the training programs contained in it. The regulator exercises oversight of the air operator's activities.

✓ Addition of a Group D aircraft rating to an Israeli pilot license based on training conducted abroad

In accordance with the Air Navigation Regulations (Licensing of Aviation Personnel), 1981, the addition of a Group D aircraft rating (Turbo Thrush) to an Israeli pilot license is permitted only after receiving training at a **flight training school** (or, alternatively, individual training) in accordance with a training program approved as set out in the above regulations. Upon completion of the training, the applicant for the additional rating must pass a practical test with a CAAI examiner.

According to CAAI procedures (1.3.013, Version 01, December 2023), the process of adding a rating to an Israeli pilot license may be carried out abroad under the conditions specified therein. That is, a person may receive training for the additional rating on the license within a flight training school (Approved Training Organization - ATO) that operates under the oversight of a foreign state, or, alternatively, in accordance with Israeli regulations and subject to the granting of an appropriate exemption, receive individual training not conducted within an approved flight training school.

Regulation 34 of the Air Navigation Regulations (Licensing of Aviation Personnel), 1981, provides that:

"34. No person shall take a practical test unless –

(1) the applicant has passed all the theoretical examinations required under these Regulations for the issue of the license or rating sought;

(2) (a) the applicant has submitted a certificate of completion issued to him by a school approved by the Licensing Authority, at which he studied, signed by the chief training officer of that school; or

(b) the applicant has submitted a confirmation, signed by his personal instructor, stating that he received appropriate instruction, provided that all of the following conditions are met:

1. the personal instructor meets the requirements applicable to a chief flight instructor of a school, as defined in Regulation 1 of the Aviation Services Licensing (Flight Schools) Regulations, 1971, as referred to in Regulation 5 of those Regulations;
2. the aircraft used for the instruction was registered in the name of the personal instructor or in the name of the trainee throughout the entire period of instruction;
3. the instruction was carried out in accordance with a training and supervision program approved by the Licensing Authority;
4. the instruction was not conducted on a commercial flight."

The training abroad for the addition of the Group D Aircraft rating was provided by an American company that is not a flight training school. By approving the training program, the CAAI effectively exempted the pilot from receiving training at a flight school. No structured process for assessing the suitability of the foreign training facility for providing such training was presented to the investigation team. In response to an inquiry from the investigation team, the CAAI informed the investigators that the term "school approved and supervised by the Licensing Authority (ATO)" was intended to refer to a "simulator training center". **This interpretation has no support in Regulation 34.**

No procedure was found at the CAAI that addresses cases in which training for the addition of a rating to a pilot license must be approved, but no suitable flight training school exists in Israel or abroad.

The CAAI approved the addition of the rating (Group D Aircraft on the pilot license) despite the deviations specified below:

(a) 2.34: The aircraft was not registered in the name of either the instructor or the trainee.

(b) 3.34: **The training program that was carried out did not meet the requirements of Regulation 180(3) of the Licensing Regulations, in that it did not include instruction and practice in stalls.**

In addition, the examiner who conducted the practical test was the same flight instructor who implemented the training program.

<u>Notes 1</u>: The situation in which pilots are sent abroad to obtain a rating at a foreign training facility that is not overseen by a foreign (local) aviation authority is contrary to Regulation 34. Under Regulation 329 of the Licensing Regulations, an exemption may be granted based on a structured process. The investigation team was not presented with the benchmarks and criteria on which the company's approval to conduct such training was based.

<u>Note 2</u>: There is no regulation prohibiting a situation where the instructor also conducts the practical test. However, it is standard CAAI practice to maintain a separation between the examiner and the instructor to prevent a conflict of interest, where an examiner might validate their own quality of instruction. In this specific case, a special authorization was granted by the CAA to allow the instructor to serve as the examiner for the pilot.

It should be noted that the training program for the addition of the rating, which included 4 hours in 4 instructional flights plus a practical flight test, was carried out in its **entirety consecutively on a single day**.

The CAAI's response to the investigation team's questions regarding the granting of the rating was that "there was no impediment to carrying out the program as implemented, and all documents were carefully reviewed by the Licensing Department and found to be in order."

On this basis, the rating was added to the pilot's license.

✓ Aircraft certification

The CAAI is the authority responsible for the certification and approval of aircraft registered in Israel.

In 2006, the CAAI issued Type Certificate TC IL010 for the S2R aircraft. The type certificate specified a maximum takeoff weight of 7,860 lb. As noted in Section 1.6.7, **no supporting evidence for this was found in the certification documents of the manufacturer, the FAA, or EASA** (see Appendix 2).

✓ Oversight and supervision

In principle, the CAAI conducts regulatory oversight of the operator once a year.

During these inspections, the following findings were **not identified**:

a) Pilot changeover in an aircraft with the engine running (a standard operating procedure in the company).

b) Flight with the stall-warning push button in the OUT position (according to a senior manager, most pilots fly this way).

c) Missing documentation, AFM supplements, STCs, and other documents - in the aircraft paperwork of the spraying companies.

d) Flight beyond the **external temperature limitation of 30°C** when operating at weights above 7,100 lb (a limitation that appears in Type Certificate TC IL010 but **is not known within the company**). This issue was also found to be unknown during oversight of another company operating this type of aircraft.

Note: In the review of documents relating to similar aircraft in another company, no documentation was found for the modification to the stall-warning system (the addition of a switch separating the horn from the warning light) or for the modification made to the spray-dispersion system (the addition of winglets) on some of its aircraft.

e) As a result of the findings that emerged during the investigation, the CAAI initiated a process of "mapping" the modifications carried out on the aircrafts, with the aim of recording and documenting them for each individual aircraft.

1.17.2 **The Air Operator (the Company)**

The air operator is a crop-spraying company that was established in 2005. The company was granted commercial and air operation licenses by the Civil Aviation Administration (CAA; now the Civil Aviation Authority of Israel - CAAI) and operates under Chapter 11 of the Air Navigation Regulations (Operation of aircraft and Rules of Flight), 1981.

Among the company's primary objectives are the operation and development of flight services for agricultural purposes, and the provision of efficient and safe agricultural flight operations.

The company currently owns four single-seat Turbo Thrush S2R-T34 aircraft. The fifth aircraft, an R2S model, was written off in the accident described above.

The company operates in accordance with the Operations Manual (OM) that was accepted by the CAAI.

Note: The investigation team found gaps and deficiencies in the OM regarding topics that will be detailed below (see Section 1.18.1), and found only partial detail regarding other topics (see Section 2.9).

1.17.3 **Aircraft Maintenance Organization**

The company's aircraft maintenance activities are carried out at Megiddo Airstrip and/or Beer Sheva Airstrip by a maintenance organization based at Herzliya Airport. The maintenance organization is approved and supervised by the regulator. Monitoring of the aircraft's continuing airworthiness is performed by the company's Continuing Airworthiness Manager.

1.17.4 Aircraft Manufacturer

The aircraft was originally manufactured by Collins Aviation, which was later sold to Ayres and subsequently to Thrush Aviation. The current manufacturer, Thrush Aviation, does not possess all of the original design and production documentation for the aircraft, nor a complete list of the modifications made to the aircraft over the years.

1.18 Other relevant information

1.18.1 **Company Operations Manual (OM):** The company's OM is the document in accordance with which the company operates and includes, among other things, descriptions of limitations and guidance for pilots. Several findings requiring attention were identified:

- ✓ From the company's OM, Chapter 3.6, paragraph 10 - a quotation from the Air Navigation Regulations (Operation of aircraft and Rules of Flight), 1981: "No person shall operate an aircraft, in flight or on the ground, negligently or recklessly in a manner likely to endanger life or property."

  Two main issues were found to deviate from this provision:

  - The pilots' helmets are fitted with a Bluetooth device that enables the use of a cell phone during flight. The OM permits the use of the phone in the event of a communication failure and/or loss of communication with the area operator/control unit; however, it does not define any **flight limitations while the phone is in use**.
  - **Flight with the stall-warning circuit breaker disconnected.** The investigation team identified this practice as a commonly accepted norm among many agricultural spray pilots and one that is even known and supported by management.

- ✓ Definition of fields by difficulty with respect to new pilots: The OM does not address difficulty levels of spraying fields or their suitability to the accumulated experience of new pilots.

✓ **Pilot changeover in an aircraft with the engine running:** Following the replacement of piston engines with turboprop engines on agricultural spray aircraft in Israel in the 1980s, a practice became established among spraying companies whereby the engine is not shut down (for cost-saving reasons) when changing pilots during the workday. The operator's OM does not provide a detailed description of such a procedure:

- In Chapter 5, paragraph 3, the pilot is required to perform an external walk-around of the aircraft in accordance with the aircraft checklist.
- Paragraph 4 of this chapter requires checking the cockpit doors, confirming that the hinges are in place, that there are no deformations in the control rods, and that the jettison handles are secured and in position.
- Paragraph 5 instructs the pilot to verify the fuel quantity visually by opening the fuel caps and looking into the tank, ensuring that the amount corresponds to the dispatch sheet.

✓ **In the** aircraft **Flight Manual (AFM), the performance of external inspections of the engine and propeller is specified.**

⑤

27. Engine – CHECK, for oil leaks, loose fittings, cracked exhaust stacks, and excessive dirt or corrosion.
28. Propeller – CHECK, for spinner damage or oil leaks.
29. Propeller – CHECK, the propeller blades for nicks, cracks, or excessive erosion of the leading edge.

FAA APPROVED: Apr. 10, 2007 Revision 3, SECTION II-3

The engine must be inspected for oil leaks, loose seals, cracks in the exhaust, and corrosion. The propeller must be thoroughly inspected, including the blades (for cracks, corrosion, and leading-edge damage), as well as for any oil leakage from the propeller.

These inspections cannot be performed on an aircraft with the engine running.

✓ Section 5.9, which deals with weather issues (crosswind), does not address the maximum temperature limitation for takeoff at weights exceeding 7,100 lb.

- ✓ Trainee **pilot limitations:** In Chapter 3.7, a trainee pilot is defined as being within his first 100 flight hours and until being designated as qualified by the chief pilot. It is further stated that the trainee pilot will be subject to limitations as determined by the chief pilot and the Operational Manual (see details in Paragraph 1.18.2 of this report). **No description of the limitations applicable to a trainee pilot** (Section 3.7) **was found in the OM.**
- ✓ No written procedure was found for conducting a daily briefing for the "trainee" pilot, in order to provide key points and address questions regarding the planned workday.

  In practice, the briefing was sometimes conducted by the chief pilot and sometimes by the regional manager (who is not an agricultural spray pilot). The briefing on the day of the event was conducted by the regional manager. The debriefing (of the first flight), on the day prior to the accident, was conducted by the chief pilot.

1.18.2 Trainee Pilot Limitations

The company imposed additional limitations on trainee pilots, as reported by the chief pilot to the investigation team. **These limitations <u>are not recorded in the OM:</u>**

(a) Maximum load (spray material) of 1,000 kg **<u>(without defining a corresponding maximum takeoff weight limitation</u>).**

(b) Prohibition on operating from airstrips (except Megiddo and Beer Sheva).

(c) No flying underneath wires.

(d) Spraying only simple fields.

1.18.3 Flight Time Recording

In the company, flight hours are recorded manually. The method for recording these hours is defined in the company's briefing manual, in Chapter 3 - "Fuel Management in Flight", as follows:

"Operation of the stopwatches" in the aircraft:

The right-hand stopwatch will be used to measure the total flight time of the aircraft during the workday. The stopwatch must be reset at the beginning of the day, started before each takeoff, and stopped after each landing. The stopwatch must not be reset during the day, and the flight time indicated on this stopwatch will be recorded as the aircraft 's flight time in the aircraft logbook and reported to the company's operations."

1.18.4 **Safety Management and Risk Management**

Flight companies operating under Chapter 11 of the Air Navigation Regulations are not included in the list of organizations required to implement a Safety Management System (SMS). No documentation was found at the operator of risk management activities, particularly with respect to the recruitment and training of new pilots.

1.18.5 **Accidents involving pilots with limited experience in agricultural spraying, and in other tailwheel aircrafts, during the past three years:**

- Between 2022 and 2024, five accidents and incidents in fixed-wing agricultural spray aircraft and other tailwheel aircraft, and one agricultural spray helicopter accident, were reported in Israel. Their causes were non-technical and attributed to pilot operation.
- On 27 April 2022 - Investigation File 9-22: agricultural spraying accident (Turbo Thrush aircraft) near Sderot.
- On 4 April 2023 - Investigation File 8-23: agricultural spraying helicopter accident near Netanya.
- On 22 January 2024 - File 2-24: ground accident involving a Piper Cub aircraft at Megiddo.
- On 19 February 2024 - Investigation File 4-24: ground accident (Turbo Thrush aircraft) at Beer Sheva Airstrip.
- On 19 May 2024 - File 14-24: ground incident involving a Piper Cub at Megiddo.

- On 5 December 2024 - File 29-24: agricultural spraying accident (Turbo Thrush aircraft) near Kibbutz Shoval.
- On 28 May 2025 - a Turbo Thrush aircraft performed a ground loop (with no damage and no injuries) at Megiddo Airstrip. The event involved an agricultural spray pilot who had completed his training during the previous year.

It should be emphasized that a common factor in all of the above events is that they occurred to **pilots with limited experience in agricultural spraying** and/or to **pilots with limited experience on aircraft with a unique configuration (tailwheel)**, of which agricultural spray aircraft are a subset.

1.18.6 Age and Flight Experience

A significant proportion of agricultural spray pilots in Israel have been engaged in spraying operations for decades, and nearly half of them are over the age of 60. In recent years, spraying companies have begun recruiting new, younger pilots as backup and in preparation for the retirement of veteran pilots. The spraying companies face difficulties in finding relatively young pilots who meet the required standards of flying proficiency and maturity as a basis for entering this profession.

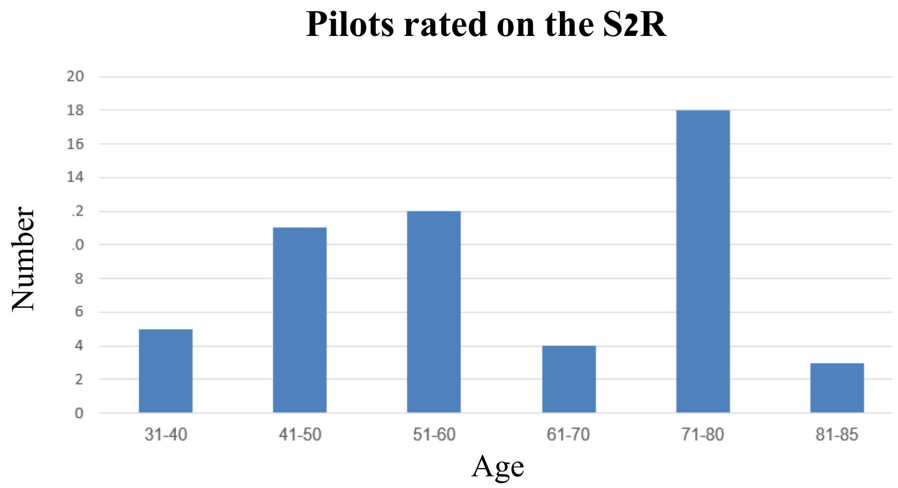


Figure 11 - **Age distribution of Turbo Thrush pilots (license) in Israel**

1.18.7 Regulation and Safety

The CAAI's policy, as presented in discussions and in documents provided to the investigation team, with respect to compliance with the Air Navigation Regulations (Operation of aircraft and Rules of Flight), 1981, Chapter 11 - Operation of aircraft in Agriculture, is one of strict adherence to the regulations and nothing more.

1.18.8 Training Program

The training program for new pilots was written by the company and approved by the CAAI.

Several months prior to the current flight accident, another accident occurred in the company during landing, also involving a new, inexperienced pilot.

Following that first accident, several changes were made to the program; however, in essence it remained similar with respect to the conduct of the flights and the requirement to attend a course in the United States.

The company's initial training program for an agricultural spray pilot is defined in the OM and was approved by the CAAI. The initial flight training includes four stages:

- ✓ Training for the agricultural rating.
- ✓ Training in takeoffs and landings in a tailwheel aircraft.
- ✓ Training for the Group D Aircraft rating (Turbo Thrush model).
- ✓ Training on the Turbo Thrush aircraft for conducting spraying missions.

The training that was carried out included:

Course Stage	Topic	Location	Aircraft	Number of Sorties	Notes
First	**Agricultural Rating**	C-172	**Telem (Israel)**	20+1	**Test conducted by a CAA examiner**
Second	Tailwheel	EAGLE VISTAS LLC	**United States**	Approximately 30 takeoffs and landings	**5 hours on a two-seat aircraft**
Third	Turbo Thrush Tailwheel aircraft **Rating Group D**	S2R-T15	Eagle Vistas LLC, United States	**Approximately 25 takeoffs and landings, including 8 in crosswind conditions**	**4 hours** + **test 1 hour**
Fourth	Spraying Instruction Turbo Thrush – **on the Turbo Thrush aircraft**	S2R-T34	Telem (Israel)	**13 sorties**	**Including a test conducted by a company examiner**

- ✓ The first and fourth stages were carried out in Israel. The second and third stages were unique in that they were planned to be conducted in the **United States**, at a flight school which, according to the response received from the CAAI, "is not required to meet the definition of approval by a foreign CAA as a training organization (ATO)". The training syllabus and the details of the flight tests were written by the company, in English, on forms bearing the company's logo and describing each individual flight.

  Note: The Air Navigation Regulations does not require a detailed training program for a tailwheel aircraft. However, since the program is defined in the OM, it was submitted to the CAAI for approval prior to its implementation.

1.18.9 Training Program and Its Implementation

Phase One - Israel:

Agricultural rating (June 2024, Israel):

In accordance with the company's internal training program, approved by the Israeli Civil Aviation Authority (CAAI), the pilot completed 20 training flights toward obtaining the agricultural rating, conducted on a **Cessna 172** aircraft. Upon completion of the first phase, an application for an examination was submitted to the CAAI, including the following description:

"The pilot completed all twenty flights as defined in the syllabus. He performed all required training content and demonstrated a stable and satisfactory level of performance. In addition, he was trained in checklists and procedures intended to enable safe agricultural flight operations."

The pilot underwent the agricultural rating examination administered by a CAAI examiner and successfully passed the examination.

Phase Two - United States:

Five flight hours, including flight instruction in a tailwheel aircraft

The training program specified in the QM, Phase Two, Tailwheel, refers to a single aircraft type from Group A. The program defines a requirement of 25 takeoffs and landings, of which eight are to be conducted in crosswind conditions. In practice, the training was conducted on three different aircraft types and included solo flight on a fourth aircraft, without reference to crosswind conditions.

The first flight in the syllabus was dedicated to familiarization with the aircraft's flight characteristics (the first of four aircraft), including stall exercises at various power settings. All subsequent flights were devoted solely to tailwheel training and practice, some of which, as noted, were conducted on different aircraft types.

A total of 11 instructional flights were conducted on the 7K-CAB aircraft, all with an instructor and without solo flight.

Subsequently, instruction was conducted on two complex aircrafts: Cessna 305E and Grumman 162A.

Finally, six solo flights were conducted on three different aircraft types: Cessna 305E, Grumman 162A, and Piper 25, with two flights on each aircraft type.

In summary: five hours of flight instruction were conducted on three aircraft types. Solo flights were performed on two aircraft types used during instruction, as well as on an **additional aircraft type that was not included in the instructional phase.**

Phase Three - United States: Addition of Group D Aircraft qualification, conducted on a Turbo Thrush S2R aircraft. **Four hours of flight instruction** (four flights) were completed, including traffic pattern operations and tailwheel training. This was followed by a practical examination **conducted by the instructor, who also served as the examiner,** which the pilot successfully passed.

- ✓ The training program was written in English and documented in the company's Operations Manual (Section 12.5.5, Revision No. 11, April 2024). The first flight was dedicated to demonstrating the aircraft's flight characteristics in various flight conditions, including simulated forced landings, engine fire procedures, and recovery from unusual attitudes. The remaining three flights were dedicated to takeoff and landing practice under various flap and power configurations.
- ✓ In the training program prepared by the company, as well as in the training tracking records, **instruction and practice of stalls were not referenced, contrary to the requirements of Regulation 180(3) of the Flight Licenses Regulations (Air Navigation Regulations - Licenses for Flight Personnel), 1981:**

  "180. An applicant for a Group D aircraft qualification shall receive four hours of flight instruction in the following subjects:

  (3) Control at low and critical airspeeds, recognition of an impending stall, and recovery from a stall, with or without engine power;"

  It should be noted that the term "**recoveries**" is mentioned in the training program; however, **it does not refer to recovery from stall conditions**. The context in which the term appears in the program appears to relate to recovery from emergency situations, such as engine failure and engine fire, rather than to stall recovery.

  Demonstration and preform engine-in and engine-out emergencies at flight level, recoveries, forced landings at flight level, and fire emergencies at flight level

- ✓ The flight documentation (as completed by the instructor) is unclear with regard to the conduct of preflight briefings for each flight. Entries marked with a minus sign (horizontal line) on the forms appear to indicate that a preflight briefing was not conducted.
- ✓ Following severe weather conditions (a storm) that damaged the training center's infrastructure, and in order to avoid returning the trainee to Israel until the training center resumed full operations, the company and the regulator agreed to lease an aircraft and an **instructor who also served as the examiner for <u>one day</u>.** The training and examination were conducted at a site that was not the permanent location of the original training center, for the purpose of conducting and completing the transition training (four instructional flights and a check flight), all of which were conducted on the same day.

<u>Phase Four - Israel</u>:

Agricultural spraying training on a single-seat Turbo Thrush aircraft:

The pilot completed 13 flights in Israel on a single-seat Turbo Thrush aircraft. During these flights, the instructor accompanied the pilot either from a Cessna aircraft flying alongside and/or from the ground. According to the company, two stall exercises were conducted at an altitude of 2,000 ft, while the instructor was not present in the aircraft in which the exercises were <u>performed and observed the trainee externally</u>. The final flight was an internal proficiency check conducted by a company examiner, using an accompanying aircraft. The pilot successfully passed the examination

1.18.10 Aerial Spraying Flight - Influence of Key Factors

- ✓ There are several aerial spraying methods, and multiple factors influence the selection of the spraying method. These factors include, among others, the size and shape of the field, terrain slopes, nearby obstacles, wind direction and intensity, aircraft's weight, weather conditions, and additional environmental factors.

  Field spraying is generally performed along the direction of the crop rows. Flight altitude is primarily determined by the type of chemical used. The manner in which turns are executed is derived from the combined influence of all these factors, with an underlying consideration of operational "efficiency", aimed at accomplishing the task while streamlining the non-spraying steps.

- ✓ A common characteristic of all aerial spraying methods is the need to execute <u>a turn in order to return to the field between successive spray passes</u>. Field spraying is performed in straight, parallel lines, with an approximate spacing of 23 meters between adjacent spray passes.

  Depending on the spraying method selected by the pilot, the turns are defined accordingly- tighter turns when the pilot chooses closely spaced spray passes, or wider turns when a different spraying method is used.

  During a typical workday, a pilot performs dozens, and in some cases hundreds, of turns. <u>The execution of each turn has a significant impact on operational efficiency and on reducing non-productive ("administrative") time</u>.

- ✓ The tighter the turn, the higher the G-forces, a parameter that contributes to cumulative pilot fatigue. During such turns, airspeeds often approach stall speed.

- ✓ The pilot seeks to reduce non-productive ("administrative") time by decreasing the turn radius, thereby enabling a higher and more efficient work output. Reducing the turn radius is typically achieved by reducing airspeed. As pilot proficiency increases, the pilot develops a better "feel" for the aircraft and is able to execute tighter turns near the stall margin. For this purpose, it is common practice to deploy flaps during the turn, thereby reducing airspeed and G-forces. Reducing G-forces has an additional physiological effect on the pilot, resulting in reduced fatigue over the course of the workday.
- ✓ Below is a GPS image of two fields in which aerial spraying was conducted **(general images not related to the current event).** The **purple** area represents the sprayed field, and the flight path is shown by the **yellow** line.

  In the first case **(right side)**, a less experienced pilot executed wide turns. In the second case **(left side)**, a more experienced pilot is shown executing tighter turns.

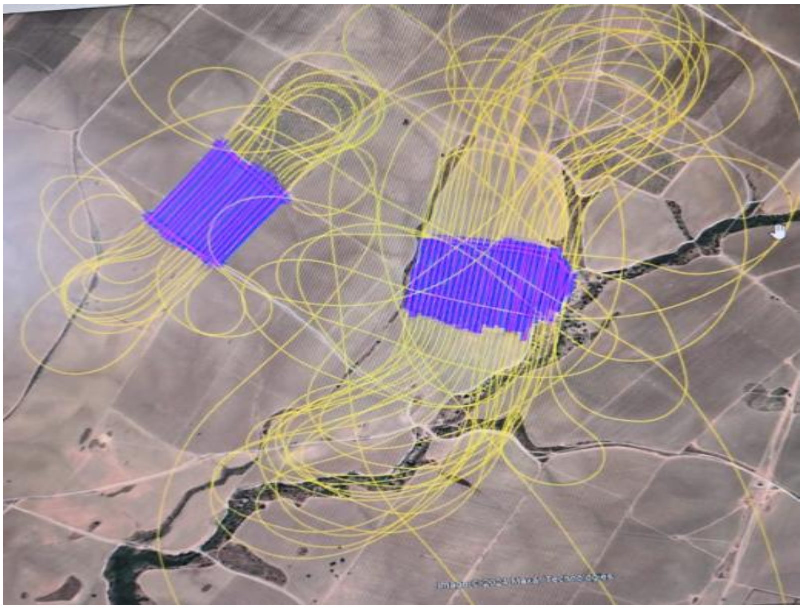


Figure 9 - **Example: Field spraying and the difference between tight and wide turns**

✓ During the accident flight, the GPS system was not activated, in accordance with the chief pilot's instruction that GPS activation is performed only after completion of the field inspection phase. However, during the spraying flight preceding the accident flight, which was conducted by the pilot, tight turns were documented. Such turns are defined by senior professionals in the field as characteristic of pilots with at least three years of operational experience.

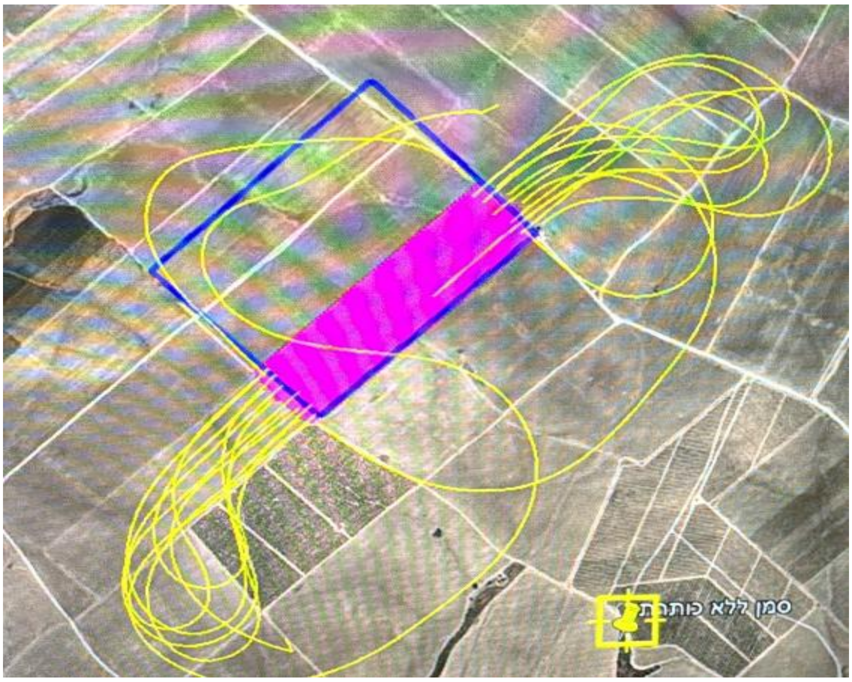


Figure 10 - **Flight profile of the flight preceding the accident flight**

<u>Note</u>: According to senior instructors, this flight profile, which was flown one day prior to the accident by the accident pilot, is indicative of a flight profile characteristic of an experienced pilot.

1.18.11 Spraying field

The field the pilot was scheduled to spray was a potato field, relatively flat, with crop rows (spraying direction) approximately 400 meters in length.

The orientation of the crop rows (potatoes) was northeast–southwest. The field was bordered by an avocado grove along its western and southern edges. The height of the avocado trees was approximately 3 meters.

Spraying is typically performed along the direction of the crop rows, that is, toward the avocado orchard.

A ground-following spray pass in this direction is performed with a slight climb and concludes with a crossing over the avocado grove prior to initiating the return turn (see Figure 11).

Figure 11 - **The Spraying Field**

No traces of the spraying substance were identified (the pesticide typically appears as a white residue on vegetation).

Figure 12 - **Avocado Orchard**

1.19 The technique and methods of investigation

The investigation addressed the following subjects:

- ✓ Collection of evidence at the accident site.
- ✓ Interviews with the pilot and company personnel.
- ✓ Interviews with experienced agricultural pilots (including current and former instructors and examiners).
- ✓ Interviews with personnel from the Israeli Civil Aviation Authority (CAAI).
- ✓ Review of company manuals and documentation.
- ✓ Review of the aircraft weight change certification process.
- ✓ Analysis of GPS data.
- ✓ Disassembly of the propeller for examination of blade condition prior to the accident, conducted at the maintenance facility in accordance with the propeller manufacturer's instructions.

2. Analysis

2.1 General

The investigation team examined the two direct factors that may have led to the accident:

- ✓ Technical malfunction
- ✓ Pilot operational error

From the perspective of indirect factors, the investigation team examined the regulatory and organizational frameworks, including, among other aspects, oversight of the company, the process of pilot induction and training for spraying missions, supervision of a newly qualified pilot, organizational culture, company manuals, and adherence to safety procedures.

2.2 Aircraft Airworthiness and Accident Site Findings

2.2.1 No open discrepancies and/or permits were found in the aircraft records.

2.2.2 The flight control continuity was examined to the extent possible, and no discontinuity in the control system was identified.

2.2.3 The engine was completely destroyed and could not be examined on a test stand. However, no evidence of engine failure was identified, and it is likely that the engine was operating normally and was serviceable prior to ground impact. The presence of fuel absorbed into the soil as a result of ruptured wing fuel tanks rules out the possibility of fuel starvation at the time of the accident.

2.2.4 The stall warning circuit breaker was found in the pulled (Disconnected) position, all other circuit breakers were found in the push position (Connected). A mechanical function check of the circuit breaker (Pull and Pull) indicated normal operation.

2.2.5 Propeller impact marks at the accident site and the condition of the propeller indicate ground impact at high RPM. The blade pitch control system was examined at an approved accessories overhaul facility. A photograph of the "pitch position" piston ring was forwarded to the manufacturer for an opinion regarding blade pitch at the time of ground impact (as presented in Appendix 1). It was determined that the blade pitch was consistent with high engine RPM, as expected at this phase of flight.

2.2.6 These findings indicate, **with a high degree of probability,** that the accident **was not caused by a technical malfunction**.

2.3 Ground Impact Description

The aircraft impacted the ground at a steep angle, with minimal debris distribution (only the engine and propeller separated from the airframe). The flaps were in the down position, and the impact occurred at low energy and high engine RPM.

These findings indicate a high probability of a low-altitude stall occurring during a non-spraying Phase of flight. This issue is addressed in greater detail at the end of the Analysis section (this chapter).

No traces of Manzidan (the spraying chemical) were found in the field designated for spraying, indicating that no actual spraying was carried out.

2.4 Aerial Spraying Flight Characteristics

2.4.1 The primary characteristic of aerial spraying flight is close proximity to the ground and relatively small safety margins. Flights are conducted near obstacles of varying types and in areas with geographic features specific to each field and site. Pilots perform relatively sharp turns at low altitude, incorporating the vertical dimension into these turns. During a single spraying mission, dozens of turns are performed. Spray passes may at times be conducted at an altitude of approximately one to two meters above the surface. **Recovery from a stall at low altitude during spraying operations or during the procedural turn toward the next leg is not possible.**

2.4.2 **Aerial spraying operations require a very high level of pilot skill.** Such skill is an "acquired skill", and the pilot's flight experience in this type of operation carries significant weight in the overall safety assessment. The operation of flaps during turns and during recovery from turns requires a high level of attention and advanced flying proficiency. While flap deployment reduces stall speed, it also significantly increases drag and reduces the margin for recovery in the event of a stall in this configuration. Flap retraction is performed after the turn while entering the spray run at low altitude, during which stall speed simultaneously increases.

2.4.3 Experienced pilots, flight instructors, and examiners indicate that achieving a high level of proficiency requires more than three years of regular operational experience.

It goes without saying that this type of flight presents a professional challenge for newly qualified pilots as well as for those responsible for their training.

2.4.4 **The effect of the S aircraft's weight on its stability:** As shown in the flight envelope graph (Appendix 2), an increase in aircraft weight shifts the center of gravity aft. At the maximum takeoff weight of 7,860 lb, as specified in the license issued in Israel, the distance between the forward and aft limits of the envelope is approximately 1.2 inches (a reduction of 65.7% compared to a takeoff weight of 6,000 lb, as specified in the manufacturer's original documentation). In this condition, the aircraft operates very close to a state of neutral static stability.

This implies a relatively high sensitivity to the rate of increase in the Angle of Attack (AoA), as the aircraft's natural resistance is low, which may lead to frequent stall warning activations during maneuvers. As described above, it was found that many pilots disable the horn (button retracted/out) and rely primarily on elevator buffet (stick shake) prior to a stall. This practice, besides being in violation of regulations and procedures, requires high piloting proficiency and cumulative experience, which are lacking among novice pilots.

2.4.5 **Recovery from Stall:** Examination of this issue with experienced aerial spraying pilots indicates that approximately 800 ft are required to recover from a stall (at an average aircraft weight). The aircraft Flight Manual (AFM) specifies a minimum recovery height greater than 150 ft. It follows that a stall occurring at spraying altitude is not recoverable, which underscores the need for appropriate warning prior to entering such a condition, as well as a high level of training and practice to prevent entry into a stall.

<u>Note</u>: *Proper and professional stall training requires that both the instructor and the trainee be present together in the cockpit. The instructor is "on the controls" and can physically sense the pilot's inputs as well as the aircraft 's responses. This is in complete contrast to stall training conducted while flying in formation with another aircraft.* ***Consequently, it is impossible to monitor the pilot's control inputs and the aircraft's corresponding responses.***

2.5 Characteristics of the Accident Flight

The pilot was "new and with limited experience in agricultural and spraying operations". The accident occurred on the second day of independent flights following completion of training (without an accompanying instructor). The preflight briefing for the flights was conducted by a regional supervisor who was not an agricultural pilot.

The accident occurred during the fourth sortie of that day. In the absence of structured documentation regarding the flight profile of the accident flight, the preceding flight was examined (see Figure 10). That flight demonstrates a flight profile characteristic of an experienced pilot, including tight turns and operation of the aircraft close to its limits. The flaps in the down position and the stall warning switch in the "off" position indicate the execution of a tight turn based solely on the pilot's "feel" of the aircraft. The post-accident condition of the aircraft indicates, **with high probability, a low-altitude stall** followed by near-vertical trajectory.

2.6 Training and Qualification

2.6.1 Agricultural rating and spraying training

- ✓ The training programs for obtaining the agricultural rating and for aerial spraying training were found to be detailed and of good quality.
- ✓ The agricultural rating and spraying training were conducted using a **Cessna 172** aircraft. According to flight instructors and CAAI examiners, the **Cessna 172** is not suitable for this mission, as it does not adequately represent the aircraft used for actual spraying operations, for the following reasons:
  - Slow control responses, which make it difficult to sense the aircraft and to operate it at low altitude.
  - Off-center seating position, resulting in differences between right and left turns.
  - The aircraft is equipped with U-shaped control yokes that provide separate vertical-axis movement (push/pull) and rotational movement about the longitudinal axis for roll control. This represents a fundamental difference from the control stick configuration used in Piper aircraft and the Turbo Thrush.
  - Different external visibility compared to the Turbo Thrush, particularly during low-level flight.
- ✓ Another agriculture spraying company in Israel operates Piper aircraft, which is considered more suitable for this mission by experienced professionals in the field. The operator was unable to lease such an aircraft and therefore used a Cessna 172, as described above, with the CAAI approval.

2.6.2 Tailwheel Training

The training and transition conducted in the United States for tailwheel aircraft operations included five hours of instruction on **three different** aircraft types, with solo flights conducted on an additional aircraft.

Training in landing and takeoff techniques on a tailwheel aircraft within a total of **five flight hours on three different** aircraft types is not sufficient and is inconsistent with the syllabus defined by the company, which allocates the first flight to familiarization with the flight characteristics of "the aircraft" and the remaining flights to tailwheel training. This is a complex flight discipline that requires dedicated training and practice. According to subject-matter experts, it would have been more appropriate to conduct the training on the Turbo Thrush aircraft; however, in the absence of such capability, adherence to the originally defined **training program on a single** aircraft type **would have been more appropriate**.

Note: *Although this accident was not related to tailwheel operation, the investigation team attributes a recurring pattern to the manner in which the training and its oversight were conducted in the United States. This pattern is also relevant to the process of obtaining the Group D aircraft rating and the dedicated transition training to the Turbo Thrush aircraft.*

2.6.3 The number of accidents and incidents in Israel over the past five years attributed to pilots with limited experience in aerial spraying and tailwheel aircraft operations (Chapter 1, Section 1.18.4) raises questions regarding the adequacy of the existing regulations in meeting operational requirements.

2.6.4 <u>Conversion to a Group D aircraft - Turbo Thrush</u>

The four instructional flights and one check flight, **all conducted on the same day and by the same instructor/examiner,** constitute an overall "training envelope" encompassing all relevant subjects, as viewed by the investigation team:

✓ Familiarization with the aircraft's flight characteristics and emergency procedure practice conducted within a single flight:

- In the view of the investigation team, demonstrating the aircraft 's flight characteristics, simulated forced landing, and in-flight fire during the first flight only, without additional practice and repetition of flight conditions characteristic of low-altitude emergencies in subsequent flights, may meet the regulatory requirements; however, in the investigation team's assessment, it does not adequately meet the basic training requirements for the addition of this qualification.
- The training program for obtaining the Group D aircraft rating was defined in Israel (i.e., prescribed to the training center in the United States), taking advantage of the fact that the implementation would be carried out on a Turbo Thrush aircraft on which the pilot would subsequently operate. In the opinion of the investigation team, this program should have focused on the primary and distinctive flight profile planned for the pilot's daily operations. These involve demanding flight conditions close to the ground, tight turns, varying aircraft weights, and all aspects related to the flight characteristics of an agricultural aircraft, as opposed to the emphasis placed primarily on tailwheel operation.

- ✓ In the conversion training documentation prepared by the company and approved by the CAAI, no reference was made to **stalls training**, contrary to the provisions of Regulation 180(3) of the Air Navigation Regulations - Licenses for Flight Personnel, 1981. This indicates a deficiency in the overall licensing process granted to the pilot, including both approval of the training program and subsequent approval of the rating. In addition, the manner in which the training tracking forms were completed (including markings that appear to indicate non-conduct of preflight briefings and the recorded flight hours as documented) raises questions regarding the regulator's <u>oversight</u> at the conclusion of the process, particularly in relation to its claim of having conducted a thorough <u>examination</u> following the conversion, which served as the basis for adding the rating to the pilot's license.
- ✓ In the opinion of the investigation team **(as well as experienced instructors),** the manner in which the transition to the Turbo Thrush was conducted in the United States over the course of **a single day,** although compliant with the regulations, was neither reasonable nor safe. According to experienced professionals, including veteran Turbo Thrush instructors and examiners, conversion training to the Turbo Thrush must be conducted over multiple sessions (not within a single day), allowing for the gradual assimilation of knowledge and experience from flight to flight. **This constitutes a fundamental principle of flight instruction.**
- ✓ The investigation team views positively the regulator's willingness to accommodate the company in light of circumstances requiring flexibility, such as conducting the conversion flights at a location different from the originally planned site. However, such flexibility must not come at the expense of safety. Constraints related to the training center, aircraft availability, the instructor, the examiner, or the operator should not be allowed to influence considerations that may compromise the quality of training or the final proficiency level achieved by the pilot, particularly with regard to safety.

2.6.5 Aerial Spraying Training on a Group D aircraft ("Turbo Thrush") in Israel

The spraying training flights were conducted in Israel using a **single-seat Turbo Thrush** aircraft and included 13 training flights and one company check flight, **totaling 9 hours and 35 minutes**.

- ✓ Aerial spraying instruction in Israel on a single-seat Turbo Thrush aircraft was conducted with external supervision (from a Cessna 172 aircraft), **without the ability to monitor the pilot's actions inside the cockpit, including control inputs, engine power application, visual scanning, responses to stall warnings, and overall aircraft handling behavior.**
  - During the first two aerial spraying flights, stall exercises were conducted at an altitude of 2,000 ft, with the instructor observing from outside the aircraft. In the investigation team's assessment, such training has limited value, as it does not allow monitoring or instruction of control inputs in relevant situations, nor evaluation of pilot responses in relation to aircraft behavior and execution accuracy.
  - There is a distinction between an "approach to stall", during which airframe buffet may be present while the aircraft remains controllable and recovery requires only a release of back pressure on the control stick, resulting in an immediate return to normal flight, and a full stall, recovery from which requires lowering the nose and regaining airspeed, accompanied by a loss of several hundred feet of altitude.
- ✓ The investigation team, which included pilots who previously served as instructors and examiners and consulted with senior Turbo Thrush flight instructors, is of the opinion that conducting training **in this manner significantly degrades its quality.** The investigation team further notes that there is doubt regarding the **validity and quality of a flight test** conducted in this manner, particularly within the specialized domain of aerial spraying operations.

2.6.6 According to those instructors and examiners, the most significant gap in the pilot's training was the conduct of spraying instruction without the use of a **two-seat** aircraft.

- ✓ The training method using an accompanying Cessna aircraft results from a "compromise", due to the fact that the company does not operate a two-seat agricultural spraying aircraft.
- ✓ The investigation team considers this "compromise" to be inappropriate, particularly for spray mission training, which involves flight operations that are demanding, challenging, complex, and hazardous, in addition to the existing difficulties in recruiting, screening, and training new pilots.
- ✓ Following multiple incidents and accidents, another operator acquired a **two-seat Turbo Thrush** spraying aircraft for training in aerial spraying operations. Training for tailwheel aircraft operations and agricultural rating flights is conducted using **Piper** aircraft, which, according to all professional experts consulted, are better suited for this mission.
- ✓ The current operator does not possess Piper aircraft and therefore elected to conduct the training and qualification activities abroad and on a single-seat **Turbo Thrush** aircraft, as described in this report.

2.6.7 <u>Quality of the Training Programs and Regulatory Involvement in Their Approval</u>

- ✓ The training programs were prepared by the company, documented in its Operations Manual, and approved by the Israeli Civil Aviation Authority (CAAI).
- ✓ During the investigation, the question arose as to the criteria under which the training programs conducted in the United States **<u>were approved</u>.** Doubts were raised regarding the **professional quality of these programs and the ability to effectively oversee their <u>actual implementation</u>.** It may be argued that responsibility for the conduct and execution of a training program delivered in the United States rests solely with the operator and the U.S. training center (which, as noted in Section 1.17.1, is not supervised by the FAA). However, given the involvement of the Israeli Civil Aviation Authority (CAAI) in approving the program as incorporated in the company's Operations Manual, a fact viewed positively by the investigation team, the CAAI also bears responsibility for approving the execution of the training in accordance with the definitions it set.

  Given a scenario where the intervention capabilities of both the operator and the **CAAI** (Civil Aviation Authority of Israel) are limited - for example, implementing changes following school feedback (if such feedback is received at all) - a state of **insufficient oversight** is created. This lack of oversight manifests as a decline in training quality and, subsequently, compromises **overall safety**. (e.g., multi-aircraft taildragger conversions or the omission of stall recognition and recovery training).
- ✓ Alongside regulatory requirements, appropriate oversight of their implementation is required.
- ✓ In reviewing the approval processes conducted by the CAAI for the training programs, **it was found that they did not undergo an in-depth review involving CAAI subject-matter experts with knowledge and <u>experience</u> <u>in</u> <u>aerial</u> <u>spraying</u> <u>missions</u>** (experienced agricultural pilots).

- ✓ The CAAI does not have, within its **permanent staffing** structure, professionals who specialize in and are familiar with aerial spraying operations. While the CAAI makes use of external examiners with extensive knowledge and experience to conduct qualification and proficiency checks, it does not consult with them when approving training programs in this field.
- ✓ In the opinion of the investigation team**, it is appropriate to consult experienced professionals prior to approving such a training program, particularly with regard to aerial spraying operations, which may be challenging and potentially hazardous.**
- ✓ During the pilot's stay in the United States, several discussions were held within the CAAI regarding approval of specific matters related to the training program, **with particular emphasis on regulatory compliance**.
  - Training and examination conducted by the same instructor/examiner were approved (there is no regulation prohibiting this; only an internal CAAI practice discourages it, which may be waived by an authorized official).
  - No consideration was identified regarding the conduct of all four instructional flights and the check flight **on the same day**, nor as to whether such an arrangement was reasonable or acceptable (even in the absence of a regulation prohibiting it).
- ✓ According to experienced instructors, as well as the investigation team, conducting the training in this manner resulted in a substantial **<u>degradation of learning, training quality, and safety within the pilot qualification process (for obtaining the Group D Aircraft rating</u>).**

  <u>Note</u>: The investigation team found it appropriate to positively note the involvement of the Israeli Civil Aviation Authority (CAAI) in determining the need to assign additional weight to flight experience in tailwheel aircraft.

2.6.8 **Summary** (Training Program)

In the conduct of the training for obtaining a Group D Aircraft qualification (and conversion to the Turbo Thrush), **a deviation from the Air Navigation Regulations (Licenses for Flight Personnel), 1981, was identified, in that instruction and practice of stalls were not performed, including stall prevention and/or recovery from stall conditions.** In the practical sense, the overall training program that was approved and implemented did not meet the required standards and was, in effect, a form of "compromise" between what was desirable and what was feasible. According to experienced agricultural flight instructors, this compromise resulted in a substantial degradation in the structure and quality of the training, for the following reasons:

- ✓ Training for the addition of the agricultural rating **should be conducted on an aircraft with characteristics similar to those of the aircraft used for actual spraying operations** (such as a Piper aircraft).
- ✓ **Training for tailwheel aircraft operations should be conducted on a single aircraft type,** followed by training on the spraying aircraft (Turbo Thrush).
- ✓ **The Class D Turbo Thrush Type Rating training should be spread over several days,** allowing the pilot to process and internalize the lessons learned between flights.
- ✓ **Spraying training should be conducted on a two-seat Turbo Thrush** (or another Group D Aircraft), allowing the instructor to provide proper and effective instruction.
- ✓ It should be emphasized that stall training conducted in an aircraft **that is not dual-seat has limited value.** This issue is of increased significance given that recovery from a fully developed stall at spraying altitude in the Turbo Thrush aircraft **is not possible.**
- ✓ The sequence of events **involving pilots with limited experience** in aerial spraying, and more broadly also tailwheel pilots (see Section 1.18.4), **underscores the need for a substantial improvement in pilot intake, training, and oversight processes.**

2.7 Stall Warning System

2.7.1 A stall occurring at the low altitude used for aerial spraying, or during the standard turn toward the next leg, **is not recoverable;** therefore, **the stall warning system is of critical importance.**

2.7.2 The stall warning system is a safety system intended to alert the pilot of an impending stall.

2.7.3 The system's operating logic OFF/ON is not pilot-friendly. This contrasts with systems in which the volume, tone, or audio frequency varies according to proximity to an actual stall, thereby enhancing aircraft "feel" and pilot handling.

2.7.4 The manner of flight during aerial spraying characterized by relatively tight turns at comparatively low airspeeds enables higher efficiency, increased productivity, and operation at relatively low G-loads, thereby reducing pilot fatigue over the course of the workday. During the numerous turns performed in a spraying flight, the stall warning system's OFF/ON alert is frequently activated when the aircraft momentarily reaches a high angle of attack. According to experienced pilots, the loud and abrupt nature of the warning tone constitutes a factor that significantly affects their alertness and endurance during a long workday.

2.7.5 Disconnection of the system by a significant portion of pilots constitutes a known (and prohibited) practice, as identified during this investigation.

2.7.6 As a result, the aircraft is operated in very close proximity to the ground, under varying terrain conditions (such as field slope), in an environment containing obstacles with different characteristics (power lines, antennas, trees, and others), and under wind conditions that vary depending on terrain features (during the short climb following a spray pass and the turn-back maneuver, a headwind or crosswind may become a tailwind). These operations involve maneuvering, near the limits of the aircraft's aerodynamic flight envelope, while pilots rely primarily on their personal experience and familiarity with the flight characteristics of each individual aircraft.

2.7.7 The stall warning system calibration is performed in accordance with the instructions specified in the Aircraft Maintenance Manual (AMM) 31-50.01.2.

2.7.8 System calibration is also required to be performed following the reporting of a malfunction by a pilot.

2.7.9 The absence of any fault reports related to the system by pilots on any of the company's aircraft over recent years raises the question of whether the system is indeed highly reliable, or whether it is not being used by the pilots at all.

2.7.10 The investigation team notes that the practice of disabling the stall warning system constitutes a hazardous action and is contrary to regulations (see Section 1.18).

2.7.11 According to the investigation team, the separation of the stall warning horn from the stall warning light, as exists in some aircrafts (see Section 1.16.4), has a negative impact on safety. This configuration allows the pilot to disable the horn while relying solely on the warning light. The location of the warning light on the instrument panel does not allow a pilot flying at low altitude with "eyes outside" to see it unless an aural warning is provided by the horn. In such a configuration, the system is effectively ineffective. Conversely, when the horn is active, the additional safety contribution of the warning light is limited.

2.8 Aircraft Performance (Weight and Balance)

2.8.1 The aircraft is certified in Israel for a maximum takeoff weight of 7,860 lb, **without supporting documentation** for the increase from 6,000 lb found in the manufacturer's, FAA, or EASA documentation.

2.8.2 The operator was not aware of the maximum outside air temperature limitation of 30°C when operating at weights exceeding 7,100 lb.

2.8.3 At higher weights, the reduced distance between the forward and aft center-of-gravity limits, contribute to frequent activation of stall warnings during maneuvering. This situation may, ostensibly, contribute to pilots disabling the warnings (pulling the circuit breaker). Further details are provided in Appendix 2 of this investigation report.

2.8.4 The company limited only the allowable spraying chemical weight for trainee pilots, **without addressing limitations on the aircraft's total MTOW** (spray load plus fuel). **In practice, such a weight limitation has no meaningful effect.**

2.9 Organizational Culture

2.9.1 Company policy emphasizes maximum operational efficiency, safety, and cost savings. Over time, practices have developed within the company that may adversely affect flight safety.

2.9.2 The company operates in accordance with an Operations Manual approved by the Israeli Civil Aviation Authority (CAAI).

2.9.3 It was found that the Operations Manual, which is intended to explicitly define limitations and operating procedures, does not fully address situations involving conflicts between efficiency and safety. Examples of existing practices and the Operations Manual's treatment of some of these issues include:

2.9.4 **Use of mobile phones during flight:** The company supports this practice through the installation of Bluetooth systems on pilot helmets; however, the Operations Manual (or any other company document) **does not define limitations on system use**.

2.9.5 The company has chosen not to implement the use of a tablet (containing maps/aerial imagery) for defining spray patterns, instead relying on a generic GPS unit (installed in the aircraft) that does not contain maps or aerial photographs. While tablet use (with a mapping application) may contribute to pilots, spatial awareness, it may also require head-down time at low altitude, with associated risks. However, the use of a generic GPS mounted on the cockpit sidewall also requires head-down time, albeit less frequently.

2.9.6 The Operations Manual does not define when GPS activation is required, nor does it expand on GPS usage at low altitude (in the investigated accident, the new pilot was instructed not to activate the GPS prior to completion of spray preparation i.e., not before completing the wind-check leg). The investigation team finds no reason to prevent GPS activation during the administrative flight to the spray field, with adjustments made as necessary according to the spraying method.

2.9.7 The GPS displays and records the flight path, highlighting locations where spraying is actually performed.

2.9.8 A new pilot who has completed transition training is required to accumulate 100 "basic" aerial spraying flight hours before being permitted to conduct unrestricted spraying operations. While limitations are to be determined by the chief pilot, **no additional limitations applicable to trainee pilots were identified** in the Operations Manual (see Section 1.18 of this report).

2.9.9 In order to reduce engine starts/minimize engine cycles, pilot changes are sometimes conducted without shutting down the engine. Under such conditions, external inspections cannot be completed, and oil levels and other required preflight items cannot be checked (see Section 1.18). The relieving pilot, who signs the aircrafts journey logbook, is unaware of the aircraft's technical condition (e.g., propeller condition).

<u>Note</u>: In this situation, beyond the possibility that external damage may have occurred during the previous pilot's operation, responsibility for such damage is transferred to the relieving pilot without their knowledge and may be attributed to them following the flight.

2.9.10 Additional practices and procedures with direct and indirect effects on flight safety:

2.9.11 Disconnection of the stall warning system, with pilots relying exclusively on their personal experience and familiarity with the flight characteristics of the various aircraft.

2.9.12 This practice was found by the investigation team to be widespread among many pilots in the sector, primarily experienced pilots. It is known to management and is not attributed to pilots of a specific operator.

2.9.13 Manual flight time recording should be based on a computerized tracking system that enables accurate logging of aircraft flight hours, monitoring of pilot flight time accumulation, and prevention of recording errors. The absence of a computerized system such as a HOBBS meter (see Section 1.18.3) may contribute to errors in recording pilots' flight hours.

2.9.14 **Risk Management:** There is no regulatory requirement, and no documentation was found at the operator, for the implementation of a formal risk management process, particularly with respect to the recruitment and training of new pilots. Operators conducting flight operations under Part 11 of the Air Navigation Regulations are not included among organizations required to implement a Safety Management System (SMS). The investigation team considers the existence of such a system to be of high importance for an operator engaged in aerial spraying. Conducting risk management, with emphasis on the recruitment and training of new pilots, is essential from a flight safety perspective and should be considered an interest of any operator.

2.9.15 The company documentation lacks comprehensive and thorough references to safety-related matters, operational limitations, monitoring and supervision of a "trainee pilot", up to final qualification by the chief pilot.

2.9.16 These practices indicate an organizational culture with the potential to adversely affect flight safety.

2.10 The Regulator (CAAI)

2.10.1 The investigation team is of the opinion that the regulator's (CAAI) involvement and oversight of the operator were inadequate and were carried out in a manner that did not surface the safety issues identified during the investigation (see also Section 1.18.1).

2.10.2 The attempt (which failed) to address the regulatory aspect solely through the lens of "regulatory compliance", demonstrates that this approach is fundamentally flawed. The regulator elects not to utilize the available regulatory tools that enable active involvement in the training program, flight syllabus, and the execution of transition training for the Group D Aircraft qualification (Turbo Thrush) were conducted. In addition, the regulator's acceptance of the manner in which stall recovery training/testing was conducted on a single-seat aircraft (with the instructor/examiner located on the ground or in another aircraft) raises professional concerns regarding its ability to approve such a process as part of the granting of the aforementioned qualification.

Note: The Air Navigation Regulations do not require additional training and/or testing in Israel following the presentation of a Group D Aircraft qualification certificate obtained in the United States. This training was conducted at the company's initiative.

2.10.3 The Operations Manual (OM), as "approved" by the CAAI, does not adequately address essential safety issues such as:

- ✓ Use of mobile phones during aerial spraying operations. In practice, pilots answer phone calls while performing spraying tasks.
- ✓ Use of GPS at low altitude.
- ✓ Pilot changeovers while the engine is running, in contradiction to the written procedures regarding the conduct of pre-flight checks prior to cockpit entry.
- ✓ Deactivation of the stall warning system.
- ✓ Maximum ambient temperature limitation for flight at weights exceeding 7,100 pounds.
- ✓ Limitations applicable to trainee pilots.

2.11 The Relationship Between Regulation and Safety

2.11.1 As the investigation team reviewed the full scope of safety events involving newly qualified pilots in agricultural operations and/or tailwheel aircraft, a recurring pattern of events emerged. One of the central themes identified was insufficient oversight and limited regulatory involvement in training and licensing processes. The repeated reliance on "compliance with regulations" as the sole basis for the issuance of a license or rating, as reflected in the regulator's responses to the investigation team on these matters (see Chapter 1, Section 1.18.6), was found to be a factor that adversely affects flight safety.

2.11.2 During the investigation, CAAI representatives presented the investigation team with an apparently emerging new regulatory policy regarding Chapter 11 and agricultural aircraft, the basis of which is a reduction in regulatory involvement as a means of contributing to safety. The investigation team notes that such a substantive change could, in fact, adversely affect flight safety.

2.11.3 Approximately eight months prior to the present accident, a ground accident occurred within the company, also involving a newly qualified pilot. A certain change made to the training program (an update to the Operations Manual accordingly) was approved by the CAAI; however, unfortunately, it did not prevent the current accident. It is possible that the involvement of experienced agricultural flight instructors (who conduct flight tests under the authority of the CAAI) could have mitigated this safety issue.

2.11.4 The CAAI, whose personnel responsible for and handling this domain do not possess in-depth familiarity with the nature of the activity and the aircraft involved, did not, in this case as well, involve professional stakeholders such as experienced instructors, examiners, or veteran agricultural pilots. These professionals could have provided an objective review of the various training programs and contributed their experience accordingly.

2.11.5 With respect to the current investigated accident, when changes and adjustments to the course were required due to objective circumstances, such as a hurricane that affected the training school, regulatory involvement took place, which is positive in itself. However, the decision was to adhere strictly to regulatory compliance (permitted/prohibited), while professionally disregarding the issue of conducting four instructional flights and a subsequent check flight on the same day. Consultation with experienced flight instructors in general, and veteran agricultural flight instructors in particular, revealed that all, without exception, expressed reservations regarding this method of instruction. This finding underscores the need to involve experienced and objective aviation professionals in the approval of training programs.

2.12 Newly Qualified Agricultural Spray Pilots

The age distribution of aerial spraying pilots in Israel (see Figure 11) presents a situation that will require the recruitment and training of a younger generation in the coming years. Aerial spraying operators are currently in the process of bringing in new spraying pilots with an appropriate operational outlook. The increase in the number of accidents and incidents in recent years involving "new" pilots indicates an issue that requires a solution. Unlike in the past, operators are experiencing difficulty recruiting new pilots. Most younger pilots prefer to join commercial aviation companies, which have recently opened their doors to them. In addition to the challenge of recruiting and training suitable new pilots for the aerial spraying sector, there is also a lack of an up-to-date and practical set of definitions and requirements for training aerial spraying pilots in Israel.

The screening, onboarding, instruction, training, and supervision of new pilots require an in-depth review by operators, in coordination with the regulator, in order to address this significant issue.

2.13 General Summary

2.13.1 The absence of findings indicating a technical malfunction, together with the characteristics of the ground impact - low impact energy, a steep impact angle, and minimal wreckage dispersion- are indicative of a low-altitude stall. The absence of spraying agent residues at the site indicates that the accident occurred prior to the commencement of actual spraying operations. The flaps being found in the down position suggests that the aircraft had completed the administrative transit flight to the spraying field and was in a tight turn, likely in preparation for initiating the spraying run. The aircraft's high weight (near the aft limit of the flight envelope), an Aft center of gravity, and the lack of reliance on the stall warning system led the investigation team to conclude that, **with a high degree of probability, the aircraft entered a stall prior to ground impact.**

2.13.2 The training process developed by the company, fully approved by the regulator and partially conducted in the United States, was found to be suboptimal.

2.13.3 The absence of stall instruction and practice (as documented in the flight training tracking records for the Turbo Thrush transition training), during the phase related to the addition of the Group D Aircraft rating in the United States, which constitutes a substantial deviation from the flight regulations, should have raised early warning signs, particularly at the stage of license approval in Israel. In practice, the pilot, who had limited experience on the aircraft, and whose stall-training experience (beyond the practical test in the United States) was based on the first two flights in Israel in a single-seat aircraft while the instructor observed from outside, may not have performed the training correctly and may not have developed adequate familiarity with stall entry and recovery. There is a genuine concern that non-optimal stall training impaired the pilot's ability to recognize an impending stall.

2.13.4 In the "Swiss Cheese" model, which is part of HFACS (Human Factors Analysis and Classification System), the alleged piloting error is only the direct cause of the accident. The model points to significant underlying factors, which - if properly addressed, each individually, should have prevented the accident in advance:

2.13.5 Latent organizational failure (regulation, company procedures, etc.).

2.13.6 Supervision.

2.13.7 Latent operational failure, apparently (for example, the norm of disabling the stall warning system).

2.13.8 Errors in aircraft handling are part of an ongoing process involving organizational and regulatory factors, including, among other aspects, pilot recruitment, pilot training, training programs, approval procedures for training programs, monitoring of pilot progression, and an overarching organizational culture, as described in this report.

2.13.9 In the opinion of the investigation team, the method of supervising the new pilot may also have contributed to the occurrence of the accident. The sequence of events involving newly qualified pilots (see Section 1.18.4) **underscores the need for an in-depth review by the regulator** of the processes for pilot intake, training, instruction, and supervision of pilot progression.

2.13.10 The approval granted by the New Zealand CAA for an increased maximum takeoff weight (see Appendix 2) is issued only for exceptional cases and under strict limitations. In the approval issued by the Israeli CAA (and in the aircraft documentation), no reference was found to strict limitations, other than a maximum outside air temperature of 30°C for operations at weights exceeding 7,100 lb.

3. Findings and conclusions

3.1 **With a high degree of probability**, the accident was caused by an aircraft stall at low altitude, which led to ground impact.

3.2 With a high degree of probability, the aircraft's altitude at the time of the stall was insufficient to allow for recovery from the stall.

3.3 Flight with the stall warning system deactivated (a practice recognized as common among many pilots) most likely contributed to the occurrence of the accident.

3.4 The pilot underwent conversion training for a Group D Aircraft without having learned or practiced stall maneuvers, with particular emphasis on recovery from the pre-stall condition (approach to stall).

3.5 The training program for the addition of a Group D Aircraft rating (Turbo Thrush) was approved by the CAAI despite not including stall training, contrary to the requirements of Regulation 180(3) of the Air Navigation Regulations (Licensing of Flight Personnel), 1981.

3.6 The manner in which the training program was approved raises questions regarding the level of involvement of the CAAI, which focused on a **"technical" review of regulatory compliance** without addressing the **quality of the program itself** (with the technical review having failed as noted above).

3.7 Training and qualification on the Turbo Thrush aircraft conducted through four instructional flights and a test, <u>all performed on the same day</u>**, resulted in a significant degradation of training quality and of the conversion to a Group D Aircraft.**

3.8 The approval of the flight school in the United States, as part of the approval of the training program for the addition of a Group D Aircraft rating, does not comply with Regulation 34 of the Air Navigation Regulations (Licensing of Flight Personnel), 1981.

3.9 It is likely that the screening and selection process of pilots for agricultural spraying missions was not optimal.

<u>Note</u>: This issue is also mentioned in Report 04-24, which likewise relates to an accident involving a newly hired pilot in the company several months prior to the current accident.

3.10 The training program that was actually conducted for tailwheel instruction did not comply with the approved training syllabus. Training was carried out on three different aircraft types, whereas the practice of the aircraft's specific flight characteristics (in Flight No. 1) was performed on only one aircraft type, and the remaining flights focused on tailwheel operation on aircraft with different flight characteristics. The discrepancy between what was defined in the syllabus and what was actually carried out indicates a deficiency in the supervision and monitoring process of the pilot's progress at the foreign training center and, subsequently, in the granting of final approval of the training in Israel. Training on multiple aircraft types adversely affected the quality of the training itself.

3.11 The company's supervision of the **trainee pilot** in Israel was not optimal. The company was not aware of how the trainee pilot was performing the mission, nor of the extent to which he was reaching maneuvering limits during turns, as indicated by the documentation of the flight preceding the accident flight (see Figure 13).

3.12 The regulator's oversight of the company was found to be deficient. This issue is also expanded upon with respect to another company operating in the spraying sector. Practices such as pilot changeovers with the engine running and flying with the stall-warning pushbutton pulled out are matters occurring in day-to-day operations. In addition, non-compliance with operational limits of weight and temperature (see Section 2.7), the absence of mandatory aircraft documentation (AFMS) within the company, and installations carried out without documentation and certification on aircraft of another company (modifications to the stall-warning system and installation of an Israeli spraying system with aerodynamic air-distribution vanes) **all indicate inadequate monitoring and oversight.**

3.13 The lack within CAAI of a professional authority with expertise in the operational aspects of agricultural/firefighting aircrafts, constitutes a safety concern, given the highly professional and demanding nature of this field.

3.14 **Agricultural rating:** Against the background of this accident on the one hand, and the need to recruit new pilots on the other, there is a clear need for a well-defined, relevant, and detailed agricultural rating regulation. This regulation should also address the type of training aircraft, specify the requirements for agricultural pilots, and detail the associated training processes.

3.15 Conducting a pilot changeover with the engine running precludes the performance of a required pre-flight external walk-around (see Section 1.18.1).

3.16 The organizational culture within the company ostensibly emphasizes safety; however, in practice it was not adapted to the integration of new pilots whose skill level is lower and who are therefore exposed to making errors during the demanding task of aerial spraying. Such errors are typically unforgiving and may result in an accident.

3.17 No documentation was found at the operator indicating the implementation of a formal "risk management" process with respect to the integration of new pilots and all that this entails.

3.18 The company is not familiar with the maximum ambient temperature limitation for flight at weights exceeding 7,100 pounds.

3.19 The method of recording flight hours within the company is not carried out in a manner that prevents recording errors by pilots (manual logging instead of electronic tracking; see Section 2.8.3).

4. Safety Recommendations

4.1 Increase oversight of aerial spraying operators with respect to <u>operational aspects</u> - compliance with AFM and AFMS limitations: maximum takeoff weight 30°C is 7,100 lb; operation with an active stall warning system; and completion of a full ground turnaround during pilot changeovers (engine shutdown).

Responsibility:	**Recommended deadline:**
Manager, CAAI.	28 February, 2026

4.2 Increase oversight of aerial spraying operators in the <u>licensing domain -</u> ensure the existence of appropriate documentation held by the spraying companies for each aircraft, with particular emphasis on AFMS, STC, and any modification performed that is not approved and documented by the manufacturer; alternatively, revoke modifications for which no STC exists.

Responsibility:	**Recommended deadline:**
Manager, CAAI.	28 February, 2026

4.3 Approve training programs based on <u>consultation with subject-matter experts in the relevant flight domain</u>, rather than relying solely on regulatory compliance.

Responsibility:	**Recommended deadline:**
Manager, CAAI.	28 February, 2026

4.4 Mandate that training for aerial spraying missions be conducted within the air operator using a Group D two-seat aircraft.

Responsibility:	**Recommended deadline:**
Manager, CAAI; CEO, Telem Company.	28 February, 2026

4.5 Update the operator's Operations Manual (OM) so that it addresses the issues noted in this report, particularly those specified in Sections 1.18, 2.9, and 2.10.

Responsibility:	**Recommended deadline:**
CEO, Telem Company.	28 February, 2026

4.6 Install a computerized system, such as a HOBBS meter, for recording and monitoring flight hours in the company's aircrafts.

Responsibility: **Recommended deadline:**

CEO, Telem Company. 30 December, 2026

4.7 Establish and implement a Safety Management System (SMS) within the operator's organization, and integrate it across all areas where safety vulnerabilities exist.

Responsibility: **Recommended deadline:**

CEO, Telem Company. 28 February, 2026

Sincerely,

Boas Grossman

Acting Manager

Aircraft safety Investigation Authority of Israel (AIAI)

Date: 7.1.2026 Ref.: 4000-0098-2026-00000000

<u>Returning objects seized during a safety investigation</u>

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

Propeller Hub Examination of its Condition at the time of the accident

General

The inspection of the propeller assembly was conducted in order to determine its condition - whether it was in the feathered position or in the flight position(un-feathered) at the time of the accident, since the propeller pitch control lever in the cockpit was found in the feather position (see Figure 4). The disassembly was carried out in accordance with Hartzell Illustrated Parts List document 61-10-18, Revision dated April 14, 2003. The inspection was performed at an approved accessories overhaul facility by a certified mechanic and in the presence of two AIAI investigators. Full documentation was completed, including stills photographs, measurements, and diagrams. The findings were forwarded to the propeller manufacturer, Hartzell, for validation and confirmation.

Findings

- ✓ During the disassembly process, it was found that the Engine Shaft was sheared as a result of the accident. The Cylinder was deformed due to ground impact, and as a consequence, the Bolts connecting it to the Hub were bent, as were the Rods connected to the Blades that control the blade pitch. The Piston was struck at its rear section, became deformed, and disengaged from the threads connecting it to the Hub. As a result, the Piston was found jammed inside the Cylinder at a distance of 2.4 cm from the rear end.
  Inside the Hub is the rear end of the Spring, to which the Piston is attached. The Piston is pushed forward by engine oil pressure controlled by the Governor unit, thereby setting the blade pitch.
- ✓ The imprint marks found in the system indicate that the propeller was in fine pitch at the time of the accident (as during flight), and rule out a feathered condition.
- ✓ The position of the Propeller Pitch Control Lever is explained by the manner in which it was connected to the Engine, which separated from the aircraft during the crash, causing the lever to be displaced to the Feathered Position.

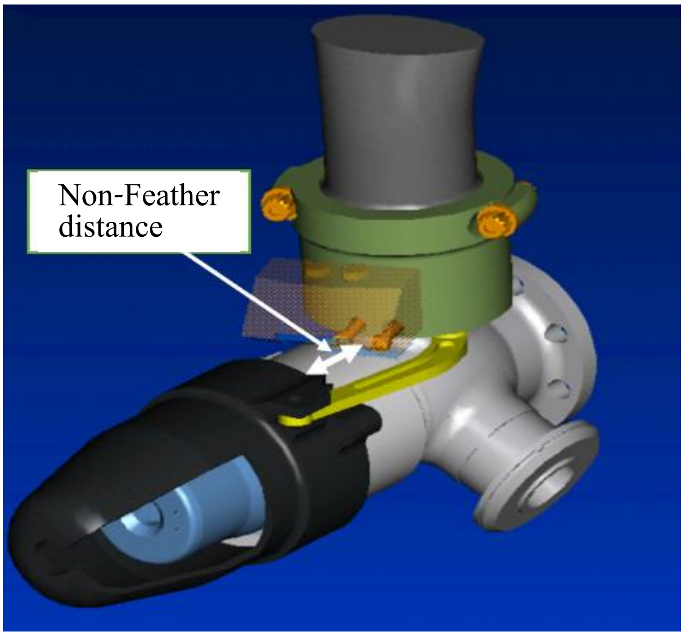


Figure 13 - **Engine Blade Pitch Condition at Power Setting**

Figure 14 - **Feathered propeller pitch condition**

Figure 15 - **Imprint marks on the cylinder**

Figure 16 - **Imprint marks on the piston**

The position of the Propeller Pitch Control Lever, which was found in the Feathered Position, is explained by the manner in which it is connected to the engine. The Lever is connected via a cable to a control mechanism (Governor) that regulates oil flow through the Engine Shaft connected to the Propeller, thereby pushing a Piston that is mechanically linked to the three Blades and moves them to the desired pitch setting. The separation of the engine from the aircraft during the accident caused tension and severing of the cable connecting the engine control mechanism to the Pitch Control Lever. This condition causes the lever to move to the aft position (Feather) and is a consequence of the accident.

Airspeed	2200 RPM		2000 RPM		1800 RPM	
KIAS	Thrust, lbs	HP	Thrust, lbs	HP	Thrust, lbs	HP
140	1419	742	863	435	418	213
130	1650	832	1071	513	607	283
120	1876	917	1275	584	791	346
110	2098	996	1474	649	972	402
100	2313	1072	1669	710	1147	454
90	2521	1145	1859	767	1319	502
80	2719	1216	2042	821	1487	547
70	2925	1296	2215	873	1649	589

Figure 17 - **Propeller Manufacture analysis based on Piston imprint marks**

Appendix 2

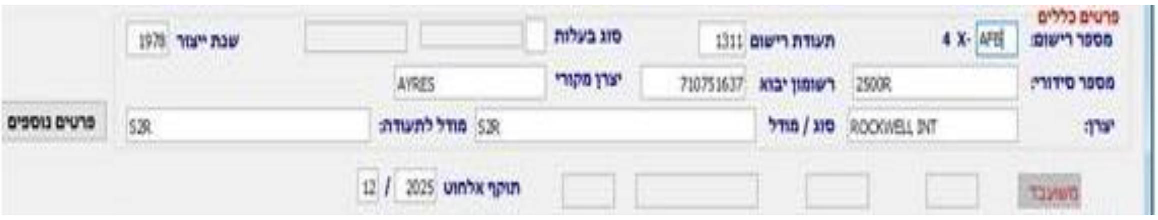
Aircraft Weight

The aircraft was manufactured under the S2R model designation with a Radial Engine and a maximum takeoff weight of 6,000 lb.

Subsequently, the manufacturer defined derivative models, some of which included STC for the replacement of the Radial Engine with a Turboprop Engine, as well as STC for increase of the maximum takeoff weight (MTOW).

No manufacturer documentation was found authorizing an increase of the MTOW above 6,000 lb for the R2S model (the accident aircraft).

- ✓ According to the manufacturer's documentation (AFM), the maximum takeoff weight is **2,722 kg (6,000 lb).**
- ✓ According to FAA TCDS A4SW, the maximum takeoff weight was increased for several sub-models of the aircraft; however, no such approval was found for the **S2R** model.
- ✓ According to EASA TC.IM. A.040, the maximum takeoff weight is **2,722** kg (6,000 lbs).
- ✓ The CAAI issued TCDS IL.010 on 15 November, 2006, specifying a maximum takeoff weight of **7,860 lb**, with reference to FAA TCDS A4SW (revision 28 and above) and the relevant FAA approved AFM. The investigation team **did not find**, in the U.S. regulatory documentation, **substantiation for an increase in the maximum takeoff weight for the aircraft model involved in the accident**.
- ✓ According to the **Certificate of Airworthiness** issued in Israel, **the MTOW is 3,565 kg (7,860 lb).**
- ✓ The operator did not present an AFM Supplement (which should be included in the aircraft documentation) addressing an increase in maximum takeoff weight above 6,000 lb.



STATE OF ISRAEL Ministry of Transport - Civil Aviation Authority SPECIAL AIRWORTHINESS CERTIFICATE No. 2024-15	מדינת ישראל משרד התחבורה - רשות התעופה האזרחית תעודת כושר טיסה מיוחדת מס. 2024-15
Aircraft Serial No המספר הסידורי של כלי הטיס 2500R	Nationality and Registration Marks 4X-AFB סימני הלאומיות והרישום
Manufacturer and Manufacturer's designation of Aircraft AYRES S2R	יצרן כלי הטיס, סוגו ודגמו
Classification RESTRICTED Purpose AGRICULTURAL SPRAYING AND DUSTING	סווג תעודת כושר טיסה מוגבלת שימושים ריסוס ואיבוק חקלאי
Conditions and Limitation [X] 1. See Reverse Side [X] 2. See Attached Operating Limitations	הגבלות ותנאים מיוחדים [X] 1. ראה מעבר לדף [X] 2. ראה דף הגבלות מצורף
Maximum Take Off Weight 3,565 KG	משקל מירבי להמראה
This certificate is issued in accordance with the Air Navigation Regulations (Certification Procedures for Aircraft and Parts thereof)1977 Article 68 and pursuant to other pertinent laws and regulations of Israel. The above mentioned aircraft is authorized for flight when maintained and operated in accordance with the laws and regulations of Israel and the special conditions and operating limitations which are an integral part of this certificate.	תעודה זו ניתנת בזה לכלי הטיס הנ"ל בהתאם לתקנות הטיס (נהלי תיעוד כלי טיס וחלקיהם) תשל"ז- 1977 תקנה 68 ובהתאם לשאר דיני ישראל הישימים. כלי הטיס הנ"ל מורשה לטיסה כל זמן שמטפלים בו ומפעילים אותו בהתאם לתקנות הטיס הישראליות ובהתאם להגבלות תפעוליות ולתנאים המיוחדים המהווים חלק בלתי נפרד מתעודה זו.
Date of Issue תאריך מתן תעודה 30/01/2024 Validity expires on בתוקף עד 29/01/2025	Name & Signature שם וחתימה M. NISSIM מ. ניסים
This certificate must be posted aboard the aircraft	תעודה זו תוצג בכלי הטיס
KA105A (4/2002)	(4/2002) א105-כו

<u>CAAI TCDS IL010</u> <u>(attached on the following page)</u>

In Section C of the attached document, **a maximum takeoff weight of 7,860 lb (3,565 kg) is specified.**

<u>Note 3</u>: states that the aircraft was tested at a maximum takeoff weight of 7,860 lb, an ambient temperature of 30°C, and a paved runway at an elevation of 656 ft (AMSL).

According to the limitations specified in the AFMS approved by the CAAI, there is a maximum ambient temperature limitation of **30°C** for flight at a weight exceeding **7,100 lb**.

State of Israel
Ministry of Transport
Civil Aviation Authority

Number: IL010
Revision: 0
Make: Thrush Aircraft Inc.
Models: S-2R, S2R-T34
15 November 2006

TYPE CERTIFICATE DATA SHEET NO. IL010

This Data Sheet which is part of Type Certificate No. IL010 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:

Thrush Aircraft Inc.
300 Old Pretoria Rd.
P.O.Box 3149
Albany, Georgia 31706-3149

I. Model S2R (Restricted Category only), approved November 15, 2006

1. The FAA TCDS No. A4SW Revision 28 (or later FAA approved Revisions) is incorporated by reference accept the following:

a. Engine: -Pratt & Whitney Wasp R-1340-AN-1
(See TCDS No. A4SW for engine limits and more information)

b. Optional Engines: -Pratt & Whitney (United Aircraft of) Canada PT6A-34AG
- Pratt & Whitney (United Aircraft of) Canada PT6A-27

Note 1: The optional engines are installed per FAA STC No. SA3238WE.For engines limits, see This STC.

c. Maximum Weights: 7100 lbs. with Wasp R-1340-AN-1 Engine (see note 2 below)
7860 lbs. with PT6A-34AG or PT6A-27 Engines (see note 3 below)

Note 2: This Model, equipped with Wasp R-1340-AN-1 Engine, have demonstrated satisfactory Operation in the Restricted Category under the following conditions: TBD

Note 3: This Model, equipped with PT6A-34AG or PT6A-27 Engine, have demonstrated satisfactory Operation in the Restricted Category under the following conditions:
At 7860 lbs. , 30° C, 656 ft altitude and hard runway.

d. C.G. range: Forward Limit at 4000 lbs.= 24.0" aft of datum.
Forward Limit at 7860blbs.= 28.8" aft of datum.
(Straight line variation between 4000 and 7860 lbs.)
Aft Limit (All weights)= 30.0" aft of datum.

e. Airspeed Limits (IAS):
Vne (Never Exceed)= 140 MPH
Vno (Max Structural Cruising)= 120 MPH
Va (Maneuvering)= 120 MPH
Vfe (Flaps Extended)= 120 MPH

f. Maximum Load Factors:
Flaps Up= +2.9g -1.4g
Flaps Down= +1.8g -0.0g

g. Required Documents: CAAI Approved Airplane Flight Manual incorporating CAAI Approved AFM Supplement for operating with increased weight of 7860 lbs (when operating with PT6A-34AG or PT6A-27 Engines) or with increased weight of 7100 lbs.(when operating with Wasp R-1340-AN-1 Engine).

- 1 -

Weight and Balance Envelope

The following chart is based on CAAI documents. It presents the expanded weight and balance envelope of the aircraft.

In the CAAI TCDS IL010 documents and the AFM Supplement issued by CAAI, the center of gravity limits was defined as follows:

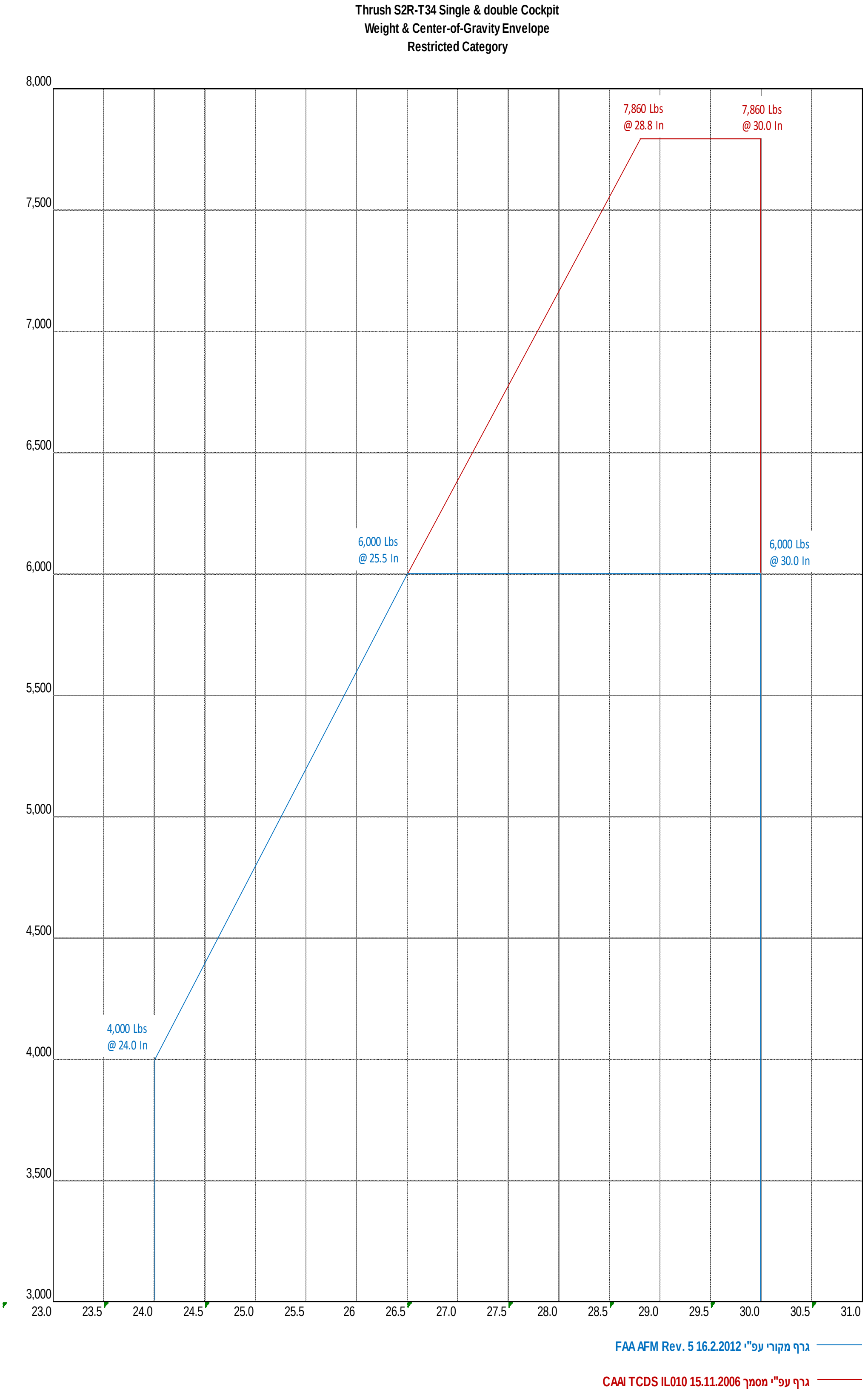
Forward CG

- ✓ At a weight of 4,000 lb: 24.0 inches aft of the datum.
- ✓ At a weight of 7,860 lb: 28.0 inches aft of the datum.
  - ✓ A straight line is defined for the forward CG between weights of 4,000 lb and 7,860 lb.

Aft CG

- ✓ At weights of 4,000 lb and 7,860 lb: 30.0 inches aft of the datum.
- ✓ Maximum takeoff weight according to the aircraft manufacturer **is 6,000 lb.** It follows that at a maximum takeoff weight of 7,860 lb, the weight-and-balance envelope is reduced by 65.7% compared to the manufacturer-defined maximum takeoff weight of 6,000 lb. At this weight, **the distance between the forward and aft envelope limits is 1.2 inches**.

  It cannot be ruled out that the tendency of the stall warning horn to activate frequently during maneuvering **is a result of this condition**, potentially contributing to pilots disconnecting the system.



Weight & Balance Chart according to the AFMS data provided by the CAAI

ISRAEL
OF TRANSPORT
TION AUTHORITY
urion Airport 70100

רשות התעופה האזרחית
Civil Aviation Authority

מדינת ישראל
משרד התחבורה
רשות התעופה האזרחית

ת.ד.8, נמל תעופה בן-גוריון 70100

nent provides detailed operating instructions for the S2R-T34 Model and S2R
PT6A-27 or PT6A-34 Engines when installed per STC SA3238WE.
g instructions covers gross weight in excess of 6000 lb but not more than 7860
ne configurations may includes liquid Spray system or Spreader system, both
ulture purposes or fire fighting.

MITATIONS

itations (IAS): Vne (Never Exceed) = 140 MPH
Vno (Max. Structural Cruising) =120 MPH
Va (Maneuvering) = 120 MPH
Vfe (Flaps Extended) = 120 MPH

enter of Gravity:
imum T/O Weight = 7860 lb
imum Landing Weight = 6000 lb.
. Range- Forward Limit at 7860 lb = 28.8 inches aft of Datum
Forward Limit at 4000 lb = 24.0 inches aft of Datum
(Straight line variation between 4000 and 7860 lb.)
Aft Limit (All weights) = 30.0 inches aft of Datum.

l Factors:
Flaps Up = +2.9g -1.4g
Flaps Down = +1.8g -0.0g

Limitations: At GW above 7100 lb. the maximum OAT is limited to 30°C.

Page 1

Weight and Balance limitations defined in the AFMS, issued by the Civil Aviation Authority at the time (currently CAAI): **the maximum takeoff weight is limited to 7,100 lbs when the ambient temperature exceeds 30°C.**

Following an inquiry conducted with other aviation authorities regarding an increase of the maximum takeoff weight to 7,860 pounds, the investigation team identified only one location worldwide - New Zealand - where operation of S2R aircraft at this weight was permitted, and only under stringent limitations.

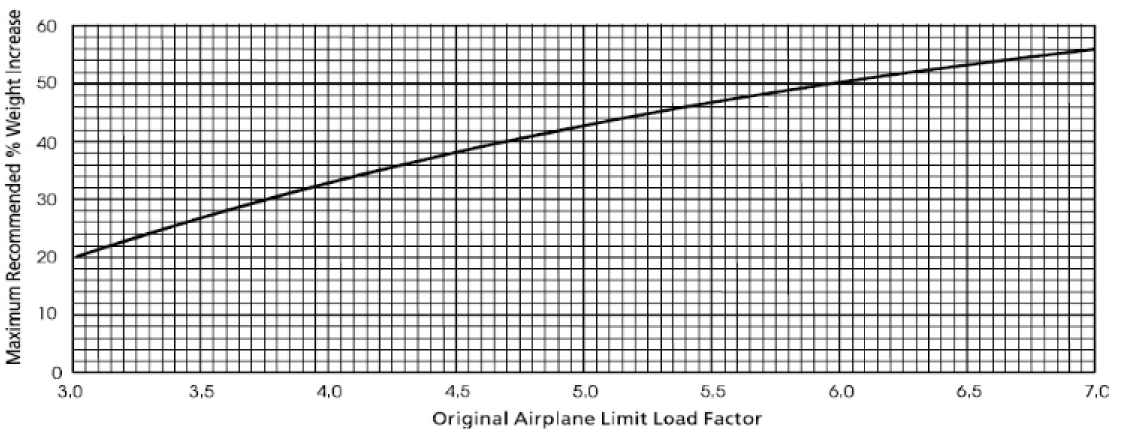
The relevant provisions are specified in the document *Civil Aviation Rules Part 137 - Subparagraph F - Appendix B,* which states as follows:

"(a) The pilot procedures required by rule 137.103(a) consist of -

(1) finding the MCTOW in the aero plane flight manual and the original aero plane limit load factor; and

(2) locating the 'original aero plane limit load factor' on the horizontal axis of figure 2, going vertically up to the reference line and then horizontally to the vertical axis to read the 'maximum recommended percentage weight increase'; and (3) increasing the original category MCTOW by this percentage to find the new maximum take-off weight.

Figure 2



(b) When considering whether to operate up to this new maximum takeoff weight, the pilot must take the following factors into account:

(1) the pressure altitude of the aerodrome;

(2) the ambient temperature at the aerodrome;

(3) the runway surface type and condition;

(4) the runway slope in the direction of take-off;

(5) the headwind or tailwind component in the direction of the takeoff;

(6) any other factors that may affect the performance of the operation."

In other words, when operating the aircraft at a weight exceeding the weight specified in the Type Acceptance Report - Restricted Category, the pilot is required to be aware of the aircraft's **original load factor** and, based on the chart, determine the percentage of allowable increase in maximum takeoff weight.
According to the graph (the source of which is unclear, as well as the methodology by which it was derived), reducing the load factor allows for an increase in takeoff weight. In the case of the S2R, this corresponds to a 31% increase in maximum takeoff weight, effectively **eliminating the original load factor, reducing it to 1 instead of 3.8**.

Routine operation at a load factor of 1 instead of 3.8 imposes excessive loads on the aircraft structure, which may ultimately lead to structural failure.

<u>Note</u>: *It is unclear in which document provided to the air operator the aircraft 's original load factor is specified, as this parameter is information held solely by the aircraft manufacturer and is not included in the documentation made available to the air operator.*

After determining the increased maximum takeoff weight (MTOW), the pilot is required to assess whether operation at this weight is permissible by evaluating the following criteria:

(1) Airport pressure altitude;
(2) Ambient temperature at the airport;
(3) Runway surface type and condition;
(4) Runway slope in the takeoff direction;
(5) Headwind or tailwind component in the takeoff direction;
(6) Any other factor that may affect operational performance.

<u>Note</u>: *The increased takeoff weight approved for use by the New Zealand Civil Aviation Authority* ***is intended for exceptional and special cases only, and not for routine operation. Reducing the aircraft 's load factor increases the likelihood of structural failure as a result of the increased loads.***

The documentation issued by the Israeli Civil Aviation Authority (CAAI) does not include the aforementioned limitations, nor does it specify the considerations that a pilot must evaluate when operating at a takeoff weight exceeding the standard approved weight.

Appendix 3

Altitude Loss During Stall

In the last line of the document, the altitude loss during a stall is defined as exceeding 150 feet.

STATE OF ISRAEL
MINISTRY OF TRANSPORT
CIVIL AVIATION AUTHORITY

רשות התעופה האזרחית
Civil Aviation Authority

מדינת ישראל
משרד התחבורה
רשות התעופה האזרחית

P.B. 8, Ben-Gurion Airport 70100

ת.ד. 8, נמל תעופה בן-גוריון 70100

Models: S2R and S2R-T34

Supplement 01

Section II – NORMAL PROCEDURES

No Change.

Section III – EMERGENCY PRCEDURES

Emergency Damping- Damping time from hopper tank with full load of liquids, may take up to 10 sec.

Caution

Damping at high gross weight and at low speed with high power may cause a strong pitch-up moment.

Section IV – PERFORMANCE

Take-Off Distance to 50' (with 1/3 flaps, sea level, 29°C OAT and no wind):

S2R-T34 or S2R with -34 Engine = 1830 ft. (558 m.)

S2R with -27 Engine = 2300 ft. (700 m.)

Note: Take-off run with -27 engine is 1640' (500 m).

Stall Speeds: At Max. GW of 7860 lb. and Power Off:

(All speeds are CAS)

Bank Angle	Flaps 0° (up)	Flaps 15° (1/2)
0°	79.5 mph	74.4 mph
30°	85.5 mph	79.8 mph
60°	112.5 mph	105.2 mph

Loss of altitude during stall exceeds 150 ft.