Havarikommissionen
Accident Investigation Board Denmark

Bulletin 2022-117

Accident to N745AJ (Cirrus SR22) 3.8 nm south of Ringsted (EKRS) on 20-3-2022.

ISSUED JULY 2023

INTRODUCTION

This bulletin reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of EU Regulation 996/2010, the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the safety investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The safety investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this bulletin for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

CONTENTS

GENERAL

State file number:	2022-117
UTC date:	20-3-2022
UTC time:	16:37
Occurrence class:	Accident
Location:	3.8 nautical miles (nm) south of Ringsted (EKRS)
Injury level:	Serious
Aircraft registration:	N745AJ
Aircraft make/model:	Cirrus SR22
Current flight rules:	Instrument Flight Rules (IFR)
Operation type:	Private
Flight phase:	En route
Aircraft category:	Fixed wing
Last departure point:	Roskilde (EKRK)
Planned destination:	Itzehoe (EDHF)
Aircraft damage:	Destroyed
Engine make/model:	1 x Teledyne Continental Motors (TCM) IO-550-N

SYNOPSIS

Notification

All time references in this report are Coordinated Universal Time (UTC).

The Central and West Zealand Police notified the Aviation Unit of the Danish Accident Investigation Board (AIB) of the accident on 20-3-2022 at 17:10 hours (hrs).

The AIB notified the Danish Civil Aviation and Railway Authority (DCARA), the US National Transportation Safety Board (NTSB), the European Aviation Safety Agency (EASA) and the Directorate General for Mobility and Transport (DG Move) on 20-03-2022 at 23:57 hrs.

The NTSB accredited a non-travelling representative to the AIB safety investigation.

Summary

When leaning during initial climb and cruise, a temporarily high Cylinder Head Temperature (CHT) of cylinder no. 1 most likely induced detonation and an accumulative chain of failures to the engine like:

- severe damages to the piston of cylinder no.1
- engine low oil pressure
- engine disintegration
- smoke
- engine fire
- engine failure.

Non-compliance with emergency procedures probably led to engine fire and a consequential engine failure requiring a forced landing into terrain.

High workload in combination with pilot type training enhanced pilot perception that any forced landing on an unprepared surface required deployment of the Cirrus Aircraft Parachute System (CAPS).

Pilot perception ruled out considerations on attempting a forced landing (non-critical altitude, good weather conditions, full aircraft controllability) into an open area and flat terrain.

CAPS deployment caused an uncontrolled ground impact and consequentially injuries to aircraft occupants and destruction of the aircraft.

The accident occurred in daylight and under Visual Meteorological Conditions (VMC).

FACTUAL INFORMATION

History of flight

The accident flight was a private IFR flight from Roskilde (EKRK) to Itzehoe (EDHF).

Because of expected strong and gusty crosswind on the main runway in EDHF at the planned time of arrival, the pilot delayed the planned departure time from EKRK awaiting an improvement of the wind conditions in EDHF.

At 15:13 hrs, the pilot and the passenger arrived at the aircraft on the apron.

The pilot made a pre-flight inspection of the aircraft and noted that the engine oil level was low and added 0.5 quart. Prior to engine start, the total amount of engine oil was 5.3 quarts.

The pilot and the passenger stayed on board the aircraft.

Upon engine start at 15:55 hrs and taxi to the departure runway in use, the pilot did an engine run up check without remarks.

At 16:07 hrs, the aircraft departed EKRK.

During initial climb, the pilot started engine leaning supported by the Multi Function Display (MFD) engine page.

When passing approximately Flight Level (FL) 007 (approximately 1,500 feet (ft)), the Cylinder Head Temperature (CHT) of cylinder no. 1 exceeded the operator recommended CHT limitation of 380° Fahrenheit (F).

30 seconds later when passing approximately FL 012 (approximately 2,000 ft), the CHT of cylinder no. 1 exceeded the lower limit of the manufacturer CHT caution area (420° - 460° F), while the CHT of cylinders no. 2 to 6 remained stable within the manufacturer CHT normal area (240° - 420° F) and below the operator recommended CHT limitation of 380° F. The MFD engine page presented CHT exceedance caution warnings for cylinder no. 1. The CHT bar and digit for cylinder no. 1 changed colour from green to yellow, and an alert in the bottom right corner of the engine page presented “Check CHT”.

48 seconds later when passing approximately FL 020 (approximately 2,700 ft), the CHT of cylinder no. 1 peaked at a CHT of 454° F.

For a short while, the pilot experienced “a little bit” of abnormal engine vibration. Furthermore, there was some confusion about a radio frequency change. The distractions caused an altitude deviation (approximately 400 ft) from the altitude restriction of 3,000 ft. See appendix 1 position A and appendix 3.

During further climb to cruising level (FL 080) and 1 minute and 30 seconds after the CHT peak of cylinder no. 1, the CHT of cylinder no. 1 decreased below the higher limit of the manufacturer CHT normal area of 420° F.

The CHT of cylinder no. 1 stabilized and levelled with the CHT of cylinders no. 2 to 6.

During initial and continuous climb, the pilot did not note any visual cautions.

At 16:19 hrs, the aircraft reached FL 080 inbound the area waypoint MICOS, and the pilot was in radio contact with Copenhagen Control (121.380 Mega Hertz (MHz)).

The pilot set cruise power (2490 revolutions per minute (rpm) and approximately 21.3 inches Manifold Pressure (MP)) and started engine leaning supported by the MFD engine page.

The CHT of cylinder no 1 started increasing and exceeded the operator recommended CHT limitation of 380° F, while the CHT of cylinders no. 2 to 6 remained stable.

Before decreasing, the CHT of cylinder no. 1 peaked at a CHT of 404° F.

During the above sequence, the engine rpm fluctuated, and the pilot experienced "massive" engine vibration.

Approximately 1 minute after the CHT peak, the pilot took a photo of the MFD engine page presenting the Exhaust Gas Temperature (EGT) and the CHT. See appendix 4.

Overhead the southern coastline of Zealand, the pilot decided to turn around to avoid overflying open sea.

At 16:26 hrs, the pilot reported engine problems to Copenhagen Control. See appendix 1 position B and appendix 3.

Copenhagen Control instructed the pilot to turn to heading 360° and continue the flight directly to the Non Directional Beacon RK (368 Kilo Hertz (KHz)) near EKRK. On request by the pilot, Copenhagen Control instructed the pilot to descend to FL 050.

The pilot initiated a left turn and started a medium power descent. During the descent, the pilot disconnected the autopilot.

Copenhagen Control informed Roskilde Approach about the aircraft returning to EKRK because of engine problems.

The engine oil pressure started decreasing rapidly, and at 16:28 hrs, the pilot reported engine low oil pressure. See appendix 1 position C and appendix 3.

Copenhagen Control informed Roskilde Approach about the situation with engine low oil pressure.

Copenhagen Control instructed the pilot to contact Roskilde Approach (125.525 MHz).

During the medium power descent, the engine oil pressure continuously decreased.

At 16:30 hrs, the pilot unsuccessfully tried to establish radio contact with Roskilde Approach, but reported an emergency because of no engine oil pressure. See appendix 2 position D and appendix 3.

At 16:30 hrs, the pilot re-established radio contact with Copenhagen Control, issued a distress call (MAYDAY) because of no engine oil pressure and requested information about the potentially nearest aerodrome (Kongsted glider airfield (EKKS), approximately10 nm east northeast of the aircraft position). See appendix 2 position E-G and appendix 3.

Passing approximately FL 070, the pilot noted the red oil warning light in the annunciator panel.

The pilot continued the medium power descent.

At 16:31 hrs, the pilot established radio contact with Roskilde Approach and issued a distress call (MAYDAY) including information about no engine oil pressure and the expectation of an engine failure. See appendix 2 position H and appendix 3.

Roskilde Approach encouraged the pilot to continue straight ahead for potentially reaching a grass airfield (Ringsted (EKRS)).

Through the gap between the upper engine cowling and the oil access door, the pilot saw fire, and smoke entered the cabin through the cabin ventilation system.

Because of fear of smoke suffocation, the pilot instructed the passenger to open partially the passenger door, and the pilot partially opened the crew door.

When trying to shut off the engine fuel with the fuel selector handle, the release knob separated from the fuel selector handle.

The pilot started reducing the airspeed below the maximum airspeed for CAPS deployment and squawked 7700. See appendix 2 position I and appendix 3.

Roskilde Approach encouraged the pilot to continue straight ahead for the grass airfield (EKRS).

At 16:32 hrs, the pilot reported onboard fire. See appendix 2 position J and appendix 3.

When passing approximately FL 039 (approximately 4,600 ft), the engine stopped, and the fire and smoke disappeared. The pilot started looking for a suitable area for CAPS deployment near houses and focussed on not exceeding the maximum speed and not descending below the minimum height for CAPS deployment.

At 16:33 hrs, the pilot issued a distress call (MAYDAY), reported the engine failure and the intention of CAPS deployment. See appendix 2 position K and appendix 3.

The pilot briefed the passenger on the intention of deploying CAPS and that the passenger should tighten her seatbelt and not touch anything.

At 16:34 hrs, the pilot reported passing 3,500 ft and the intention of deploying CAPS at 1,000 ft. See appendix 2 position L and appendix 3.

Except for engine related problems and until CAPS deployment, the aircraft was fully controllable, and navigation, communication and autopilot systems were operative.

The pilot switched off the master switch and the ignition.

From 16:35 hrs, Roskilde Approach continuously, but without success, tried to establish radio contact with the pilot.

The pilot deployed CAPS. During the deployment sequence, the parachute harness tore off both the partially opened cabin doors.

At 16:37 hrs, upon full CAPS deployment, the aircraft impacted ground in a field.

Immediately upon ground impact, the pilot initiated an evacuation. The pilot and the passenger quickly evacuated the aircraft over the leading edge of the wings.

Shortly after, witnesses arrived and alerted the fire and rescue services.

The wind caught the aircraft parachute and rotated the aircraft over the propeller and the right hand wing, and the aircraft came to rest upside down.

The pilot could not recall whether or not having consulted the emergency checklists during the sequence of events.

Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal			
Serious		1	
Minor	1		

The pilot suffered from minor head injuries, and the passenger suffered from back injuries.

Damage to aircraft

The ground impact and the consequential damages destroyed the aircraft.

Photo 1. The destroyed aircraft in an upside down position on the accident site.

Photo 2. A drone photo of the accident site.

Personal information

License and medical certificate

The pilot – male, 50 years – was the holder of a valid EASA Private Pilot Licence (PPL (A)) issued by the German Luftfahrt Bundesamt (LBA).

The Single Engine Piston (SEP) land class rating was valid until 30-4-2022.

The SEP land Instrument Rating (IR) was valid until 30-4-2022.

The medical certificate (class 2) was valid until 20-7-2022.

On basis of the German issued PPL (A), the American Federal Aviation Administration (FAA) issued an American PPL (A). The FAA license was only valid when accompanied by a valid German pilot license.

The latest FAA flight review §61.56 was valid until 31-3-2023.

Flying experience

	Last 24 hours	Last 90 days	Total
All types	2:00	9:33	514:32
This type	2:00	9:33	-
Landings this type	1	9	810

Pilot fatigue and stress

Before the flight, the pilot felt at ease and well-rested.

During the sequence of events, the pilot felt significant stress and high workload.

Cirrus SR22 type training

In 2016, the pilot completed his SR22 type training with a Cirrus flight instructor.

With reference to the completed Cirrus SR22 type training and regarding operational motives for deploying the CAPS, it was the perception of the pilot that almost any emergency, including a forced landing on an unprepared surface, required a deployment.

The pilot stated, “The parachute is the only chance to go down alive”.

Aircraft information

General information

Manufacturer:	Cirrus Aircraft
Type:	SR22
Serial number:	0608
Home base of the aircraft;	EDHF
Annual Inspection:	Valid until 1-4-2022 (cf. FAA Parts 43 and 91)
Engine manufacturer:	Teledyne Continental Motors
Engine type:	IO-550-N
Engine serial number:	687449
Engine Time Since New (TSN):	3,078.7*
Engine oil (aircraft manufacturer):	Minimum 6 and maximum 8 quarts of oil Recommended 7 quarts for extended flights

Engine oil (engine manufacturer):	The engine manufacturer informed the AIB that safe engine operation required minimum 5 quarts of oil
Propeller manufacturer:	MT-Propeller
Propeller type:	MTV-14-D/195-30b Constant Speed four blade
Maximum take-off mass (MTOM):	3,400 pounds (lbs)
Center of Gravity (CG) range:	137.2 to 148.2 inches (in) aft of datum
Fuel on board:	230 litres (l)
Aircraft total hours:	3,078.7*
Aircraft date of manufacture:	6-6-2003
Latest maintenance:	10-2-2022

* Hours measured by a Hobbs meter in the aircraft. Recordings began, when the battery (BAT) 1 was ON and either alternator (ALT) 1 or ALT 2 switch was ON.

Maintenance history

On 21-12-2016:	At 1,783 hrs (Hobbs), an engine shock loading inspection took place leading to replacement of the camshaft. No overhaul of the engine.
On 15-1-2020:	At 2,583 hrs (Hobbs), replacement of all spark plugs.
On 19-3-2020:	At 2,612.5 hrs (Hobbs), replacement of CHT probe no. 1 sensor. Cleaning of all fuel nozzles. Replacement of the fuel nozzle to cylinder no. 1.
On 23-12-2020:	At 2,808 hrs (Hobbs), installation of overhauled magnetos.
On 1-4-2021:	At 2,840.8 hrs (Hobbs), replacement of cylinder no. 5.
On 10-2-2022:	At 3,033.9 hrs (Hobbs), change of engine oil.
Fuel selector handle:	The handle had never been replaced.
Engine monitoring:	The operator engine monitoring system consisted of cylinder leak checks, oil consumption, oil filter particle inspection and oil analysis.

Mass and balance

The AIB made a mass and balance calculation based on:

- the onboard mass and balance report issued on 24-2-2017
- available mass and balance data in the onboard Pilot Operating Handbook (POH) (section 2 and 5)
- pilot information about masses of onboard persons and baggage
- pilot information about onboard fuel and TKS ice protection fluid.

See appendix 5.

CAPS

The aircraft was equipped with CAPS designed to bring the aircraft and its occupants to the ground in the event of a life-threatening emergency. The system was intended to save the lives of the occupants, but would most likely destroy the aircraft and might, in adverse circumstances, cause serious injury or death to the occupants.

CAPS consisted of a parachute, a solid-propellant rocket to deploy the parachute, a rocket activation handle, and a harness imbedded within the fuselage structure.

CAPS deployment safety information (valid for this aircraft) – see appendix 14.

CAPS deployment safety information (valid for latest aircraft type generation (G6 SR)) – see appendix 15.

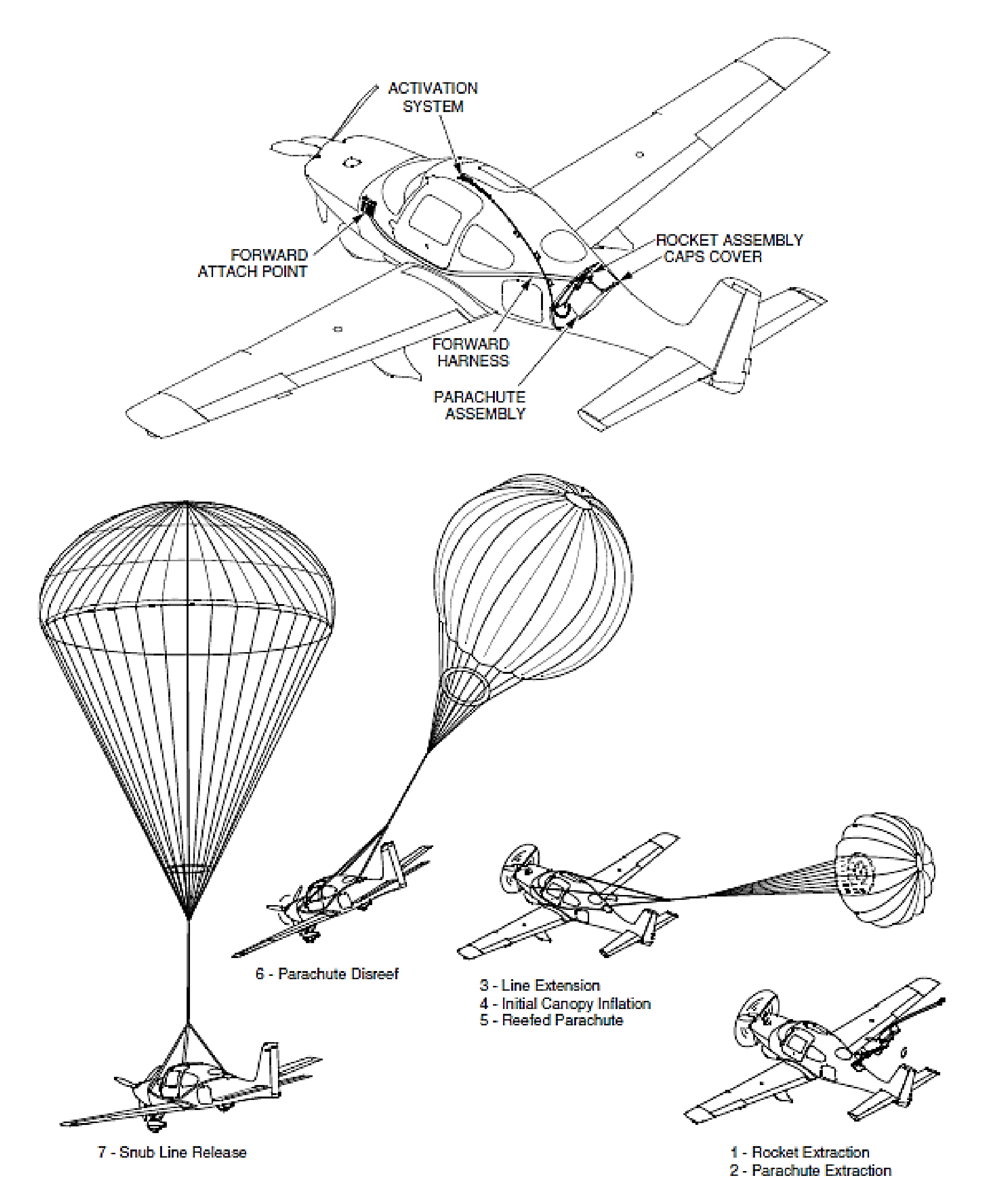


Photo 3. An illustration of CAPS deployment sequence.

Emergency Locator Transmitter (ELT)

Model ME406 – PART NO: 453-6603 REV: E

The below paragraph is an extract of the Component Maintenance Manual (CMM).

"The ME406 is a type AF (automatic fixed) beacon, which transmits on 121.5 and 406 MHz.

Automatic activation (primary G-switch/lateral) occurs at 4.5 ±0.5 ft/sec (2.3 g)."

Pilot Operating Handbook (POH)

On 10-10-2003, the FAA approved the onboard POH. The approved onboard POH contained temporary changes.

For this safety investigation, the AIB extracted relevant POH documentation.

a. Section 2 – Limitations.
Power plant instrumentation – see appendix 6.

b. Section 3 – Emergency Procedures.
1. Memory items.
"Checklist steps emphasized by underlining such as this:
1. Best Glide Speed .... ESTABLISH
should be memorized for accomplishment without reference to the procedure."

2. Maximum Glide

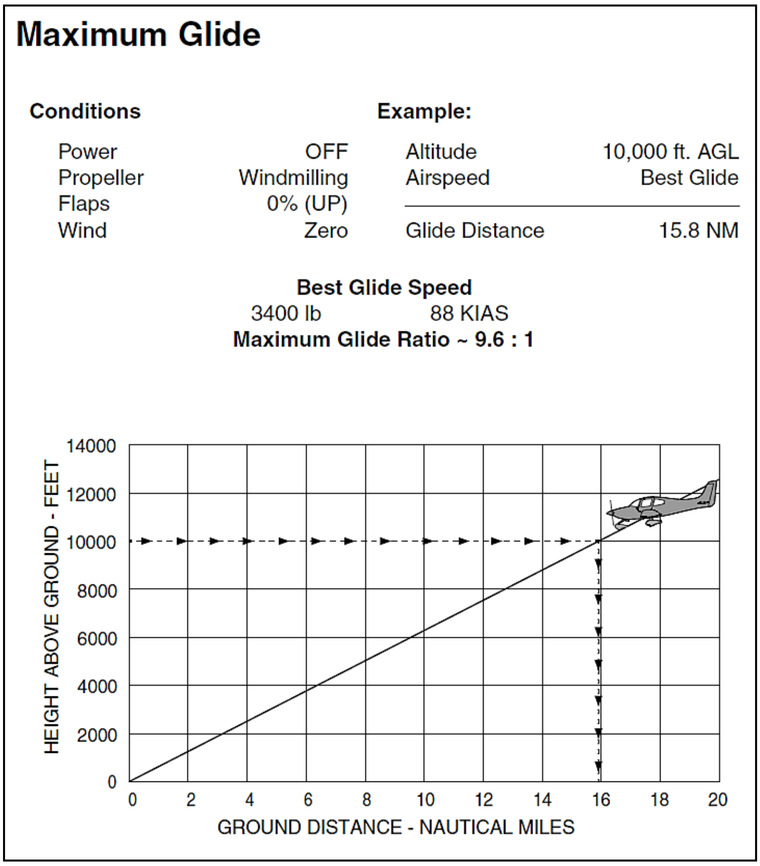


Photo 4. Glide distance versus height above ground.

3. Engine partial power loss – see appendix 7.
4. Low oil pressure – see appendix 8.
5. Smoke and fume elimination – see appendix 9.
6. Engine fire in flight – see appendix 10.
7. Engine failure in flight – see appendix 11.
8. Emergency landing without engine power – see appendix 12.
9. CAPS deployment – see appendix 13.
10. Safety information for CAPS deployment – see appendix 14.

c. Section 4 – Normal procedures.
1. Preflight walk-around (extract) – see appendix 16.
2. Airspeeds for normal operation.

Enroute Climb, Flaps Up:
- Normal .... 110-120 KIAS
- Best Rate of Climb, SL .... 101 KIAS
- Best Rate of Climb, 10,000 .... 95 KIAS
- Best Angle of Climb, SL .... 78 KIAS
- Best Angle of Climb, 10,000 .... 82 KIAS

Photo 5. Enorute climb speeds

3. Maximum power fuel flow – see appendix 17.
4. Climb checklist and procedure – see appendix 18.
5. Cruise checklist, procedure and leaning – see appendix 19.
6. Cruise performance – see appendix 20.

Operator procedures

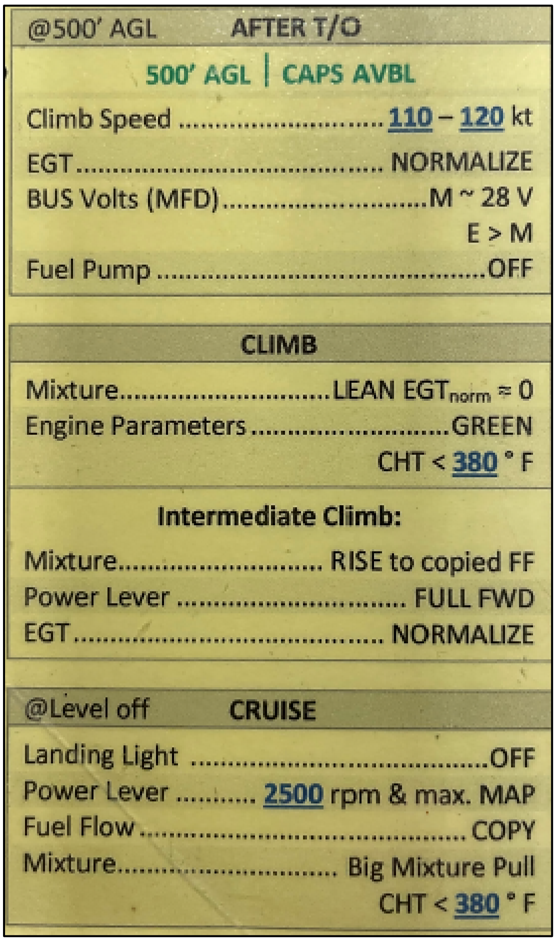
The aircraft owner group developed their own accessible normal and emergency checklists.

a. Normal procedures.
1. Pre-flight inspection (extract).

10. Nose, Left Side
Engine Oil (5.0 - 8 qts) .... DRY / SCRD
Cowling .... SCRD
External Power .... DOOR CLSD
Exhaust Pipe .... SCRD
Vortex Generator .... OK

Photo 6. Checklist for pre-flight inspection (extract).

2. After take-off, climb and cruise.


@500' AGL AFTER T/O

500' AGL | CAPS AVBL

Climb Speed .... 110 – 120 kt
EGT .... NORMALIZE
BUS Volts (MFD) .... M ~ 28 V
E > M
Fuel Pump .... OFF

CLIMB

Mixture .... LEAN $EGT_{norm} \approx 0$
Engine Parameters .... GREEN
CHT < 380 ° F

Intermediate Climb:

Mixture .... RISE to copied FF
Power Lever .... FULL FWD
EGT .... NORMALIZE

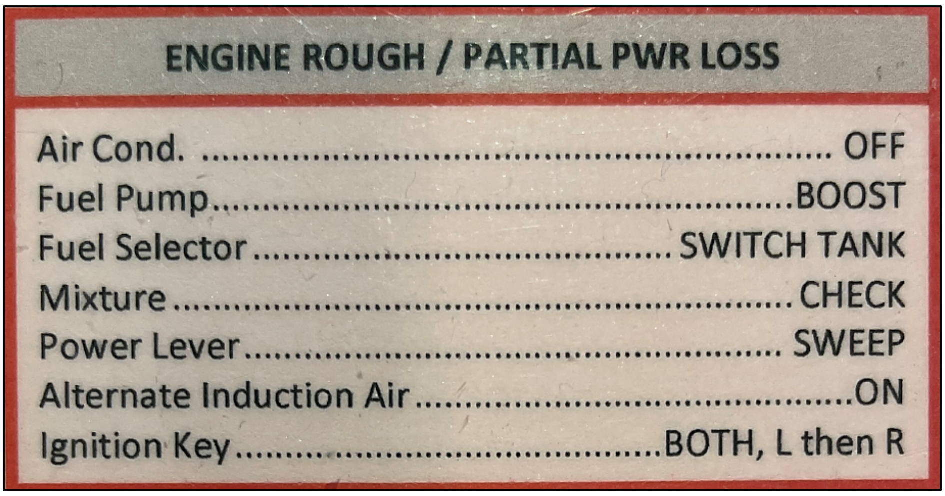
@Level off CRUISE

Landing Light .... OFF
Power Lever .... 2500 rpm & max. MAP
Fuel Flow .... COPY
Mixture .... Big Mixture Pull
CHT < 380 ° F

Photo 7. Checklist for after take-off, climb and cruise.

b. Emergency procedures

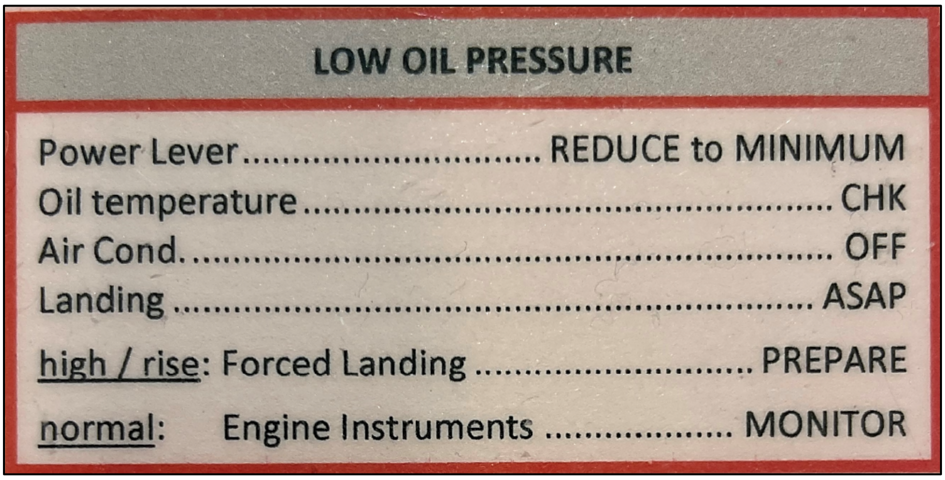
1. Engine rough/partial power loss.


ENGINE ROUGH / PARTIAL PWR LOSS

Air Cond. .... OFF
Fuel Pump .... BOOST
Fuel Selector .... SWITCH TANK
Mixture .... CHECK
Power Lever .... SWEEP
Alternate Induction Air .... ON
Ignition Key .... BOTH, L then R

Photo 8. Checklist for engine rough/partial power loss.

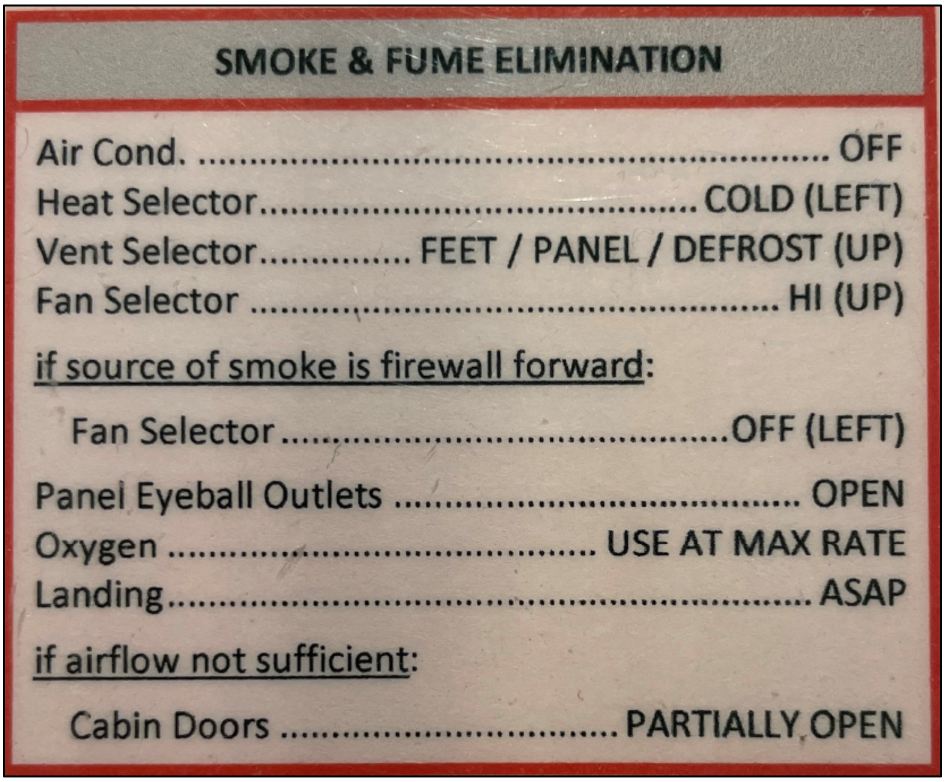
2. Low oil pressure.


LOW OIL PRESSURE

Power Lever .... REDUCE to MINIMUM
Oil temperature .... CHK
Air Cond. .... OFF
Landing .... ASAP
high / rise: Forced Landing .... PREPARE
normal: Engine Instruments .... MONITOR

Photo 9. Checklist for low oil pressure.

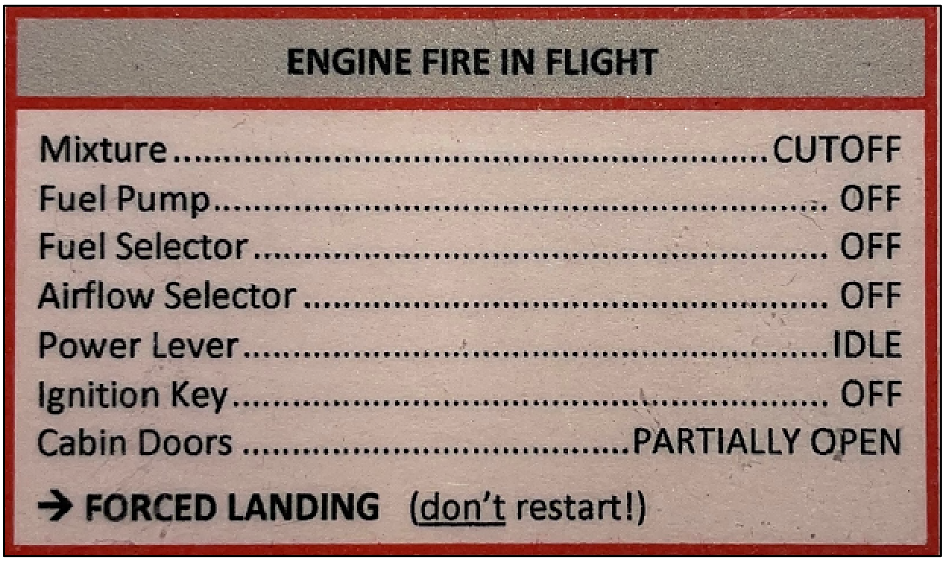
3. Smoke and fume elimination.


SMOKE & FUME ELIMINATION

Air Cond. .... OFF
Heat Selector .... COLD (LEFT)
Vent Selector .... FEET / PANEL / DEFROST (UP)
Fan Selector .... HI (UP)
if source of smoke is firewall forward:
Fan Selector .... OFF (LEFT)
Panel Eyeball Outlets .... OPEN
Oxygen .... USE AT MAX RATE
Landing .... ASAP
if airflow not sufficient:
Cabin Doors .... PARTIALLY OPEN

Photo 10. Checklist for smoke and fume elimination.

4. Engine fire in flight



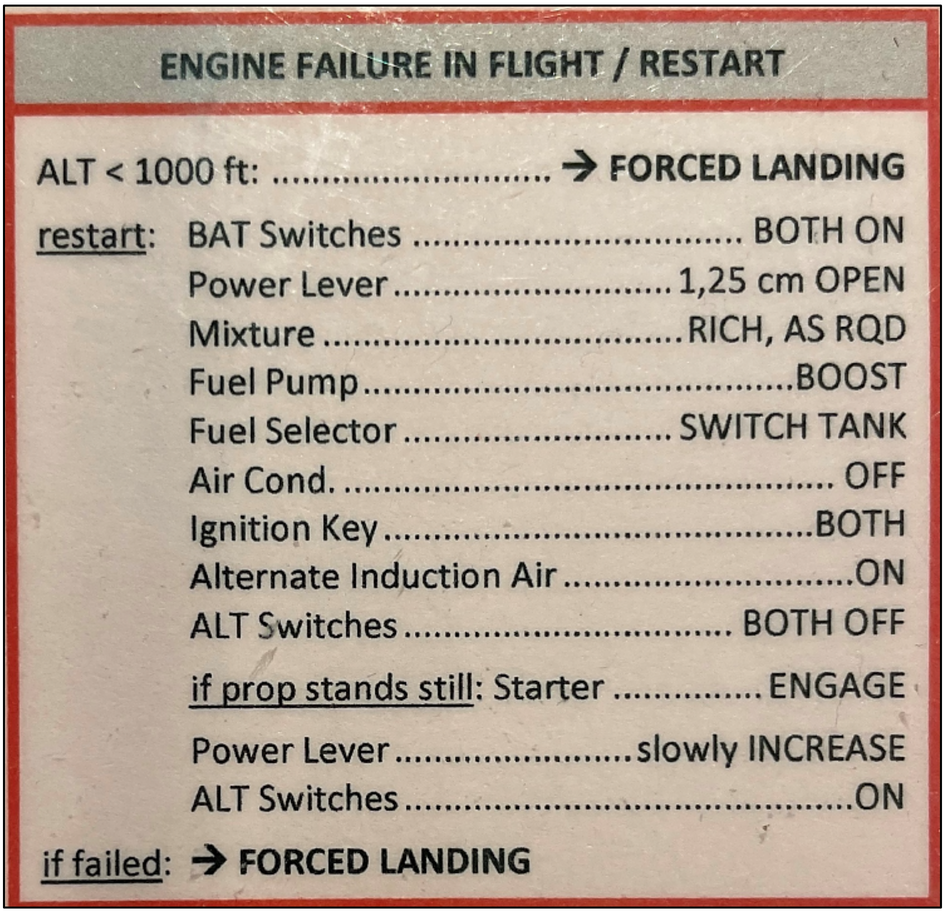
ENGINE FIRE IN FLIGHT

Mixture ....CUTOFF
Fuel Pump .... OFF
Fuel Selector .... OFF
Airflow Selector .... OFF
Power Lever ....IDLE
Ignition Key .... OFF
Cabin Doors ....PARTIALLY OPEN

→ FORCED LANDING (don't restart!)

Photo 11. Checklist for engine fire in flight.

5. Engine failure in flight



ENGINE FAILURE IN FLIGHT / RESTART

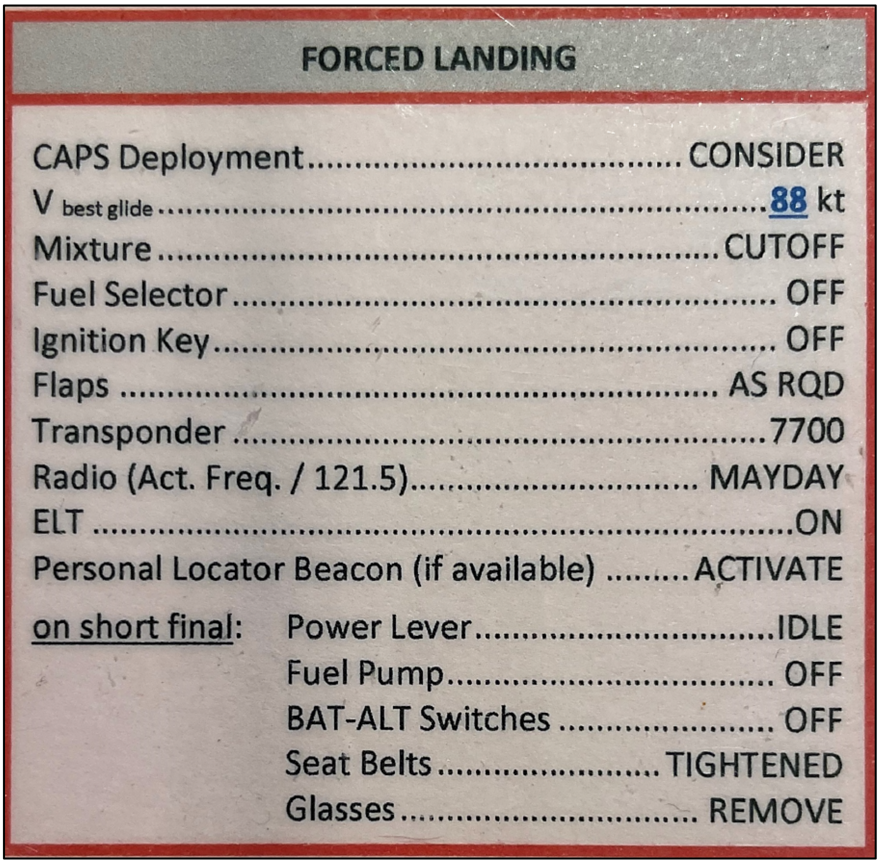
ALT < 1000 ft: .... → FORCED LANDING

restart: BAT Switches .... BOTH ON
Power Lever .... 1,25 cm OPEN
Mixture .... RICH, AS RQD
Fuel Pump ....BOOST
Fuel Selector .... SWITCH TANK
Air Cond. .... OFF
Ignition Key ....BOTH
Alternate Induction Air ....ON
ALT Switches .... BOTH OFF
if prop stands still: Starter .... ENGAGE
Power Lever ....slowly INCREASE
ALT Switches ....ON

if failed: → FORCED LANDING

Photo 12. Checklist for engine failure in flight.

6. Forced landing.



FORCED LANDING

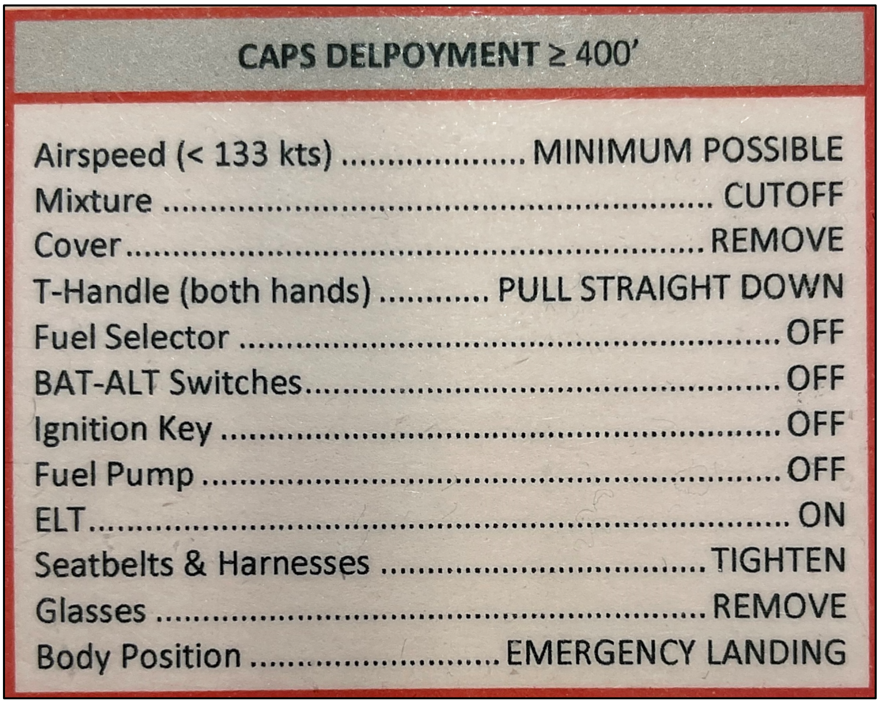
CAPS Deployment	CONSIDER
$V_{best\ glide}$	88 kt
Mixture	CUTOFF
Fuel Selector	OFF
Ignition Key	OFF
Flaps	AS RQD
Transponder	7700
Radio (Act. Freq. / 121.5)	MAYDAY
ELT	ON
Personal Locator Beacon (if available)	ACTIVATE

on short final:

Power Lever	IDLE
Fuel Pump	OFF
BAT-ALT Switches	OFF
Seat Belts	TIGHTENED
Glasses	REMOVE

Photo 13. Checklist for forced landing.

7. CAPS deployment.



CAPS DELPOYMENT ≥ 400'

Airspeed (< 133 kts)	MINIMUM POSSIBLE
Mixture	CUTOFF
Cover	REMOVE
T-Handle (both hands)	PULL STRAIGHT DOWN
Fuel Selector	OFF
BAT-ALT Switches	OFF
Ignition Key	OFF
Fuel Pump	OFF
ELT	ON
Seatbelts & Harnesses	TIGHTEN
Glasses	REMOVE
Body Position	EMERGENCY LANDING

Photo 14. Checklist for CAPS deployment.

Avidyne Entegra EX5000C

a. Electronic checklists.
The EX5000C included complete electronic normal and emergency checklists.

b. The MFD engine page.

For a generic presentation of the MFD engine page – see appendix 21.

c. MFD engine page messages (extract).

Engine Messages & Colors	Meaning	Recommended Pilot Action
Check CHT	EX5000 has detected a cylinder head temperature higher than the normal operating range. Yellow = Caution, Red = Warning.	Acknowledge. Examine CHT indicators on Engine page. Take corrective action as required.

Photo 15. Avidyne Entegra EX5000C engine messages.

By coloring, the CHT bars and digits presented three different scenarios (green=normal, yellow=caution, and red=warning).

Meteorological information

Low Level Forecast

The accident site was within area 51e.

FBDN21 EKCH 201200 changed forecast for the area dk51 (the islands) issued at 12:24 hrs valid on 20-3-2022 between 13:00 hrs and 21:00 hrs.

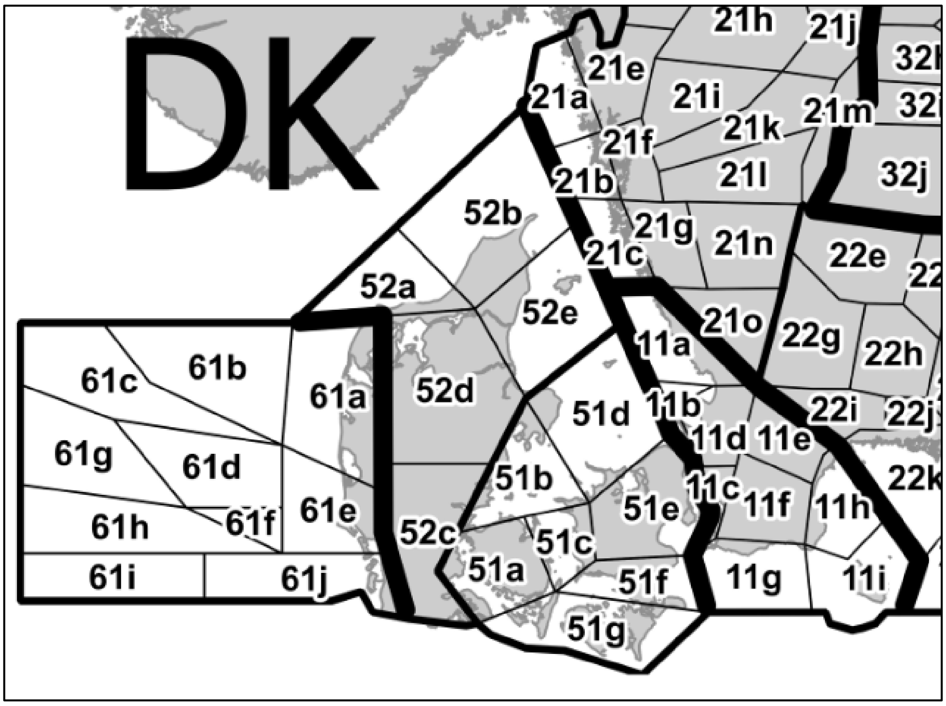


Photo 16. Meteorological regions.

General:	Ridge of high pressure over the area.
Visibility:	More than 8 kilometres (km). Cloudbase > 4000 ft.
Icing:	Not expected.
Surface/altitude wind:	East/southeast 8-22 knots (kt) with gusts up to 30 kt.
Average wind and temperature (2000 ft):	Between 15:00 hrs and 17:00 hrs, 130° and 31 kt, +2° Celcius (C).
Average wind and temperature (FL 050):	Between 15:00 hrs and 17:00 hrs, 150° and 30 kt, +0° C.
Average wind and temperature (FL 100):	Between 15:00 hrs and 17:00 hrs, 160° and 31 kt, -6° C.

Terminal Aerodrome Forecast (TAF)

Roskilde (EKRK) was located approximately 17.9 nm northeast of the accident site.

EKRS was located approximately 3.8 nm north of the accident site.

TAF EKRK	EKRK 201401Z 2015/2024 10012KT CAVOK TEMPO 2015/2018 12018G28KT=
TAF EKRS	NO TAF ISSUED

Aviation Routine Weather Report (METAR)

Hamburg (EDDH) was located approximately 26.0 nm southeast of EDHF.

Hohn (ETNH) was located approximately 20.0 nm north of EDHF.

METAR EKRK	201550Z AUTO 12015KT 9999 NCD 06/M05 Q1040=
METAR EKRK	201620Z AUTO 12014KT 9999 NCD 06/M03 Q1040=
METAR EKRK	201650Z AUTO 11014KT 9999 NCD 06/M03 Q1039=
METAR EKRS	201550Z AUTO VRB15KT 9999 NCD 06/M03 Q1039=
METAR EKRS	201620Z AUTO VRB13KT 9999 NCD 06/M03 Q1039=
METAR EKRS	201650Z AUTO 11015KT 060V180 9999 NCD 06/M02 Q1038=
METAR EDDH	201720Z AUTO 11017KT CAVOK 11/M06 Q1032 TEMPO 11015G25KT=
METAR EDDH	201750Z AUTO 12016KT CAVOK 10/M06 Q1033 TEMPO 11015G25KT
METAR ETNH	201720Z AUTO 10011KT 9999 // ///// 09/M05 Q1032 ///
METAR ETNH	201820Z AUTO 09010KT 9999 // ///// 08/M06 Q11032 ///

Weather archive for EDHF

Time	Code	Weather	Temperature	Ceiling
17:20	V		+9°C	-
18:20	V		+8°C	-

Aftercast valid for the area approximately 4 nm south of Ringsted at 16:40 hrs

General:	Ridge of high over the area.
Visibility:	More than 20-30 km.
Clouds :	Sky clear.
Surface wind:	100-130° with a mean wind of 12-15 kt gusting up to 23-28 kt.
Other information:	No significant weather.

Satellite image over Denmark

Photo 17. Satellite image over Denmark at 12:06 hrs.

Aids to navigation

The primary source for aircraft en route navigation was Global Navigation Satellite System (GNSS).

Communication and radar

The pilot was in radio contact with Roskilde Tower (118.900 MHz), Roskilde Approach (125.525 MHz), Kastrup Departure (124.980 MHz) and Copenhagen Control (121.380 MHz).

The AIB obtained all involved Air Traffic Control (ATC) voice recordings and relevant radar data.

The communication and radar recordings were of good quality and useful to the AIB safety investigation.

Extracted distress radio communication – see appendix 3.

Aerodrome information

General information (EDHF)

Aerodrome Reference Point:	53.59.67N 09.34.71E
Elevation:	82 ft
Runway directions:	02/20, 09/27
Runway dimensions/surface:	02 – 1,040 m x 40 m/30 m (asphalt with turf)
	20 – 1,040 m x 30 m/40 m (asphalt with turf)
	09 – 708 m x 40 m (grass)
	27 – 708 m x 40 m (grass)
Runway lightning:	02/20 – runway edges and ends

Flight recorders

For the accident flight, the onboard MFD, type Avidyne Entegra EX5000C, contained limited engine and positioning data.

The Original Equipment Manufacturer (OEM) assisted the AIB in downloading MFD data.

The data were of good quality and useful to the AIB safety investigation.

Extracted engine data – see appendix 22.

The AIB synchronized downloaded engine data and obtained radar data by comparison of positioning data and time.

For this safety investigation, the AIB accepted a horizontal distance deviation of up to approximately 200-300 m for each time and positioning data marking.

Wreckage and impact information

Wreckage site

Both cabin doors detached the aircraft in flight and ended up approximately 250 m southeast of the accident site.

The aircraft impacted ground on its nose landing gear and then on the main landing gear. The nose landing gear collapsed, and the nose section and the propeller hit the ground.

Photo 18. The aircraft in an upright position shortly after ground impact.

Photo 19. A fully deployed parachute shortly after ground impact.

When witnesses arrived, the parachute still was in the air and attached to the aircraft. Because of strong wind, the parachute drifted from one side to the other.
The wind caught the parachute and rotated the aircraft over the propeller and the right hand wing, and the aircraft came to rest in an upside down position approximately 6 m downwind of the ground impact area.

A minor fuel leakage from the left wing fuel tank caused fuel spill on the ground.

Photo 20. The aircraft in an upside down position without parachute and parachute harness.

Area topography and characteristics

The topography in Central and South Zealand was flat terrain, and the characteristics of the area were farm land, minor woods, cities and villages.

Fire

Engine disintegration in flight caused fire and smoke.

Immediately after the engine stopped in flight, the fire and smoke disappeared.

The ground impact caused no fire.

Survival aspects

General

The pilot and the passenger used lap and shoulder harnesses.

Before CAPS deployment, the pilot instructed the passenger to tighten her seatbelt and not touch anything.

At ground impact, the pilot sat in an upright position. It has not been possible for the AIB to reveal the body position of the passenger at ground impact.

CAPS neither suffered from malfunctioning nor damages.

The ground impact did not overstress the lap and shoulder harnesses, and the lap and shoulder harnesses did not suffer from malfunctioning.

The honeycomb energy absorbing elements of both front seats suffered from deformity but absorbed, in combination with the landing gear and the aircraft structure, some of the impact loads.

The detachment of both cabin doors in flight and the collapse of the nose landing gear facilitated the on ground evacuation of the aircraft. At that point, in an aircraft upright position, there were no hindrances to free movement.

To prevent a sudden gust from dragging the upside down aircraft in a downwind direction towards the pilot and the passenger (the passenger laying in a recovery position), witnesses cut the aircraft parachute harness to secure the accident site.

Search and rescue

Throughout the sequence of events, coordination and cooperation between the Area Control Centre, Copenhagen Control and Roskilde Approach took place.

At 16:29 hrs:	Roskilde Approach alerted the aerodrome fire and rescue services in EKRK.
At 16:33 hrs:	Roskilde Approach made a radar print out for a potential search and rescue mission.
At 16:37 hrs:	The aircraft impacted in a field.
At 16:39 hrs:	Witnesses alerted the emergency dispatch centre, and shortly after Danish Police arrived at the accident site.
At 16:40 hrs:	Roskilde Approach instructed a light twin-engine aircraft in the area to fly towards the expected accident site.
At 16:46 hrs:	A search and rescue helicopter departed EKRK.
At 16:50 hrs:	The local fire and rescue services arrived at the accident site.
At 16:53 hrs:	The pilots of the light twin-engine aircraft located the accident site.
At 16:55 hrs:	The search and rescue helicopter arrived at and landed near the accident site.
At 17:23 hrs:	The search and rescue helicopter with the pilot and the passenger on board departed the accident site. The destination was Copenhagen University Hospital.

ELT

The ELT did not activate the International Satellite System for Search and Rescue Services (COSPAS-SARSAT).

AIB safety investigation

Technical investigation

a. Ownership and operation of an American registered aircraft.
A German aviation group operated the aircraft.
To operate an American registered aircraft in accordance with FAA regulations, the FAA required either an American citizenship or an American ownership.
For non-Americans citizens, the FAA mandated, for 14 Federal Code Regulations (FCR) Part 91 non-commercial operation, that an American trust acted as the formal owner of the aircraft and granted the trustees (in this case the German aviation group) the right to operate the aircraft.
The aircraft had a valid registration approved by the FAA.
The German Civil Aviation Authority, LBA, approved the operation, if the operation met FAA provisions.

b. Engine Time Between Overhaul (TBO).

The engine design holder recommended a TBO of either 2000 hrs or 12 years.

There was no life limits to the engine or its components.

FCR part 91 operations (private and non-commercial) did not require a mandatory overhaul of an aircraft piston engine at TBO.

However, the health monitoring must be acceptable to a certified aviation mechanic (with inspection authorization). The aviation mechanic had to perform and sign the annual inspection/100 hrs inspection and declare the aircraft airworthy.

For FCR Part 91 operations, the FAA did not require any special inspections for engines operating beyond the design approval holder recommended TBO.

c. Onsite investigation.

- The aircraft was in an upside down position.
- Engine oil soaked the underside of the aircraft fuselage from the firewall down to the tail section.
- The ELT switch was in the armed position.
- The master switch was in the OFF position.
- The fuel tank selector handle was in the left hand tank position.
- The mixture control setting was rich.
- The throttle handle was in the idle position.
- The ignition was OFF.
- The release knob on top of the fuel selector handle was missing.
- The fuel boost pump switch was in the OFF position.

Photo 21. Engine oil on the underside of the aircraft fuselage.

Photo 22. The release knob on top of the fuel selector handle was missing.

d. Follow up investigation.

Preliminary engine examination at the AIB facility.

- There was fire damage to the forward area of the engine top cowling and the upper forward area of the engine.
- There was no fire damage to the lower engine cowling, but the lower engine cowling had several cracks and fractures.
- Because of fire in flight, there was fire damage to parts of the engine air induction system i.e. filter and flexible tubes and part of the alternator.
- The engine air cooling baffling installation and seals were intact.
- There were three holes in the upper area of the engine crankcase.
- Removal of the engine with the propeller did not reveal any other abnormalities.

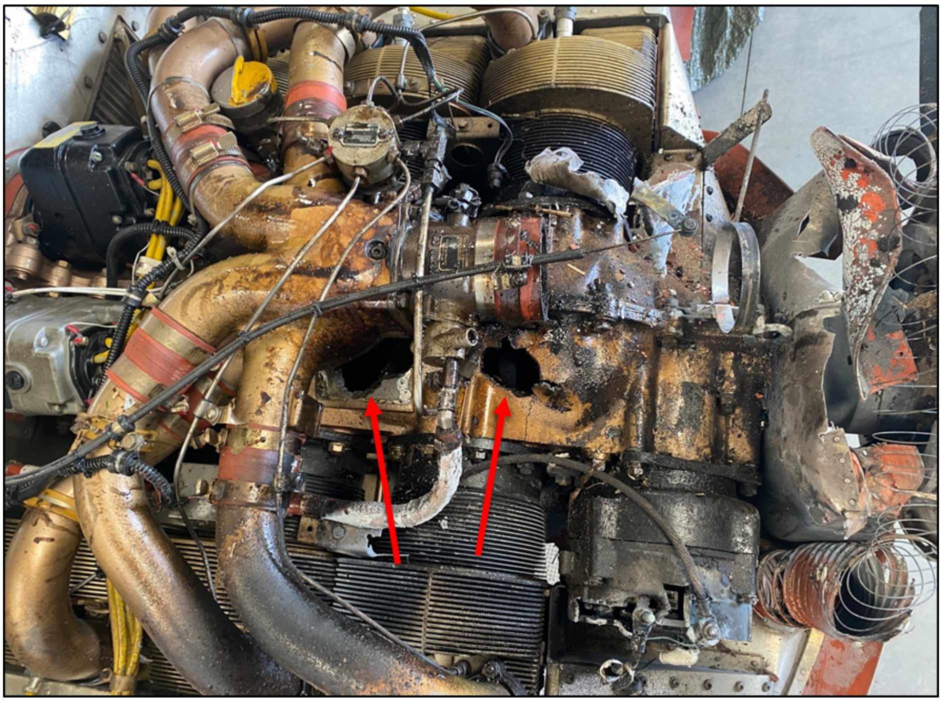


Figure 1. Top view of the engine with two holes in the crankcase and fire damage. Two red arrows mark the crankcase holes.

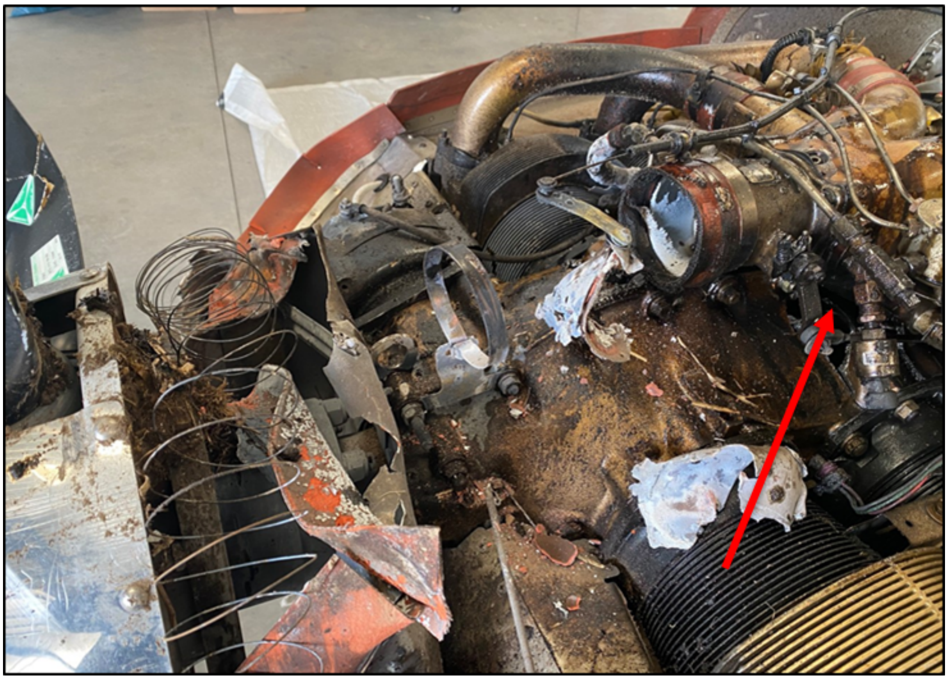


Figure 2. Top view of the engine with a hole in the crankcase under the air throttle body and fire damage. A red arrow mark the crankcase hole.

e. In-depth engine examination at an approved engine and overhaul facility.

Despite engine operation beyond the recommended TBO, the general engine condition was good.

Personnel removed the propeller, the fuel manifold with fuel pipes and fuel nozzles, the air throttle body with induction ducts to each cylinder, the alternator, the starter, the magnetos including ignition leads, the spark plugs, the oil cooler, the oil pump housing and the fuel pump housing.

The removal of the above-mentioned components revealed:

- internal engine parts penetrating the crankcase caused a hole at the lower face of the air throttle body.
- one spark plug in each of the cylinders no. 1 and 2 had parts of the centre electrode insulator loose or missing.

A test, disassembly, and inspection of the following components gave no rise to remarks:

- both magnetos
- fuel nozzles (with synchronous and correct fuel flows)
- fuel pipes
- fuel manifold (except for a tiny crack in a diaphragm, which had no influence on the sequence of events).

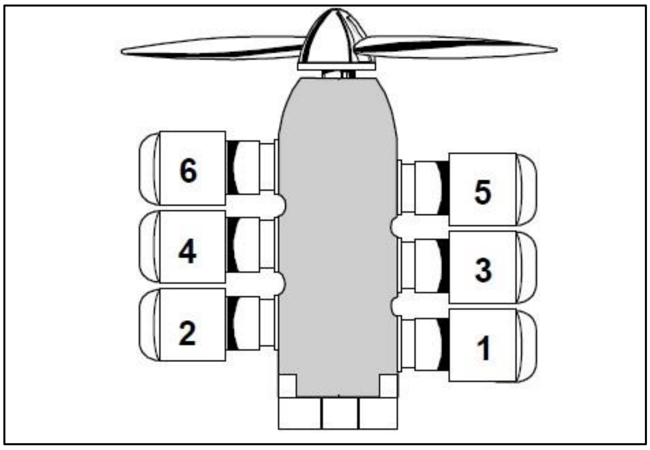


Photo 23. IO-550-N cylinder designation – top view.

The disassembly of the engine revealed the following defects and damages:

- the piston of cylinder no. 1 had severe damages.
  Approximately 30% of the circumference of the piston had severe corner and edge damages with missing material.
  There were damages to the first and second compression ring, the oil control ring and the scraper ring including one end of the piston pin.
  The top surface of the piston had many small damages in form of indentations/pitting marks (detonation characteristics.).

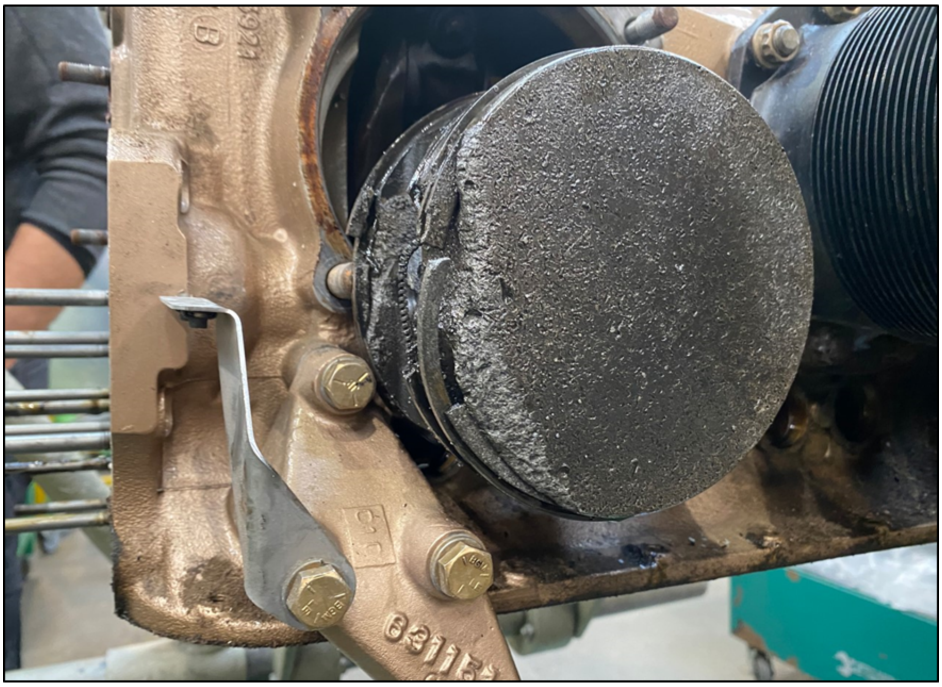


Photo 24. Cylinder no. 1 piston damage with detonation characteristics.

- at cylinders no. 4 and 5, the connecting rods no longer connected to the crankshaft.
  There were severe damages to the connection rods at the crankshaft ends.
- because of lack of lubrication, the crankshaft showed sign of heat damage at the connection rod journals for the connection rods from cylinders no. 4 and 5.
- there were severe damages to the internal part of the crankcase including the holes caused by the "loose" connecting rods.

f. Fuel examination.

The onboard fuel complied with international specifications for AVGAS 100LL.

g. ELT.

The AIB tested the ELT functionalities without remarks.

Operational safety investigation

Human performance.

In a previous AIB safety investigation, an aviation psychologist assisted the AIB in discussing human performance versus stress. The below paragraph on the Yerkes-Dodson Law is an extract.

"The Yerkes-Dodson law describes the empirical relationship between stress and task performance. It proposes that you reach your peak level of performance with an intermediate level of stress or arousal. Too little or too much arousal results in poorer performance.

Human performance increases with physiological or mental arousal, but only up to a certain point. When stress and workload, dependant on task complexity and confidence, get too high, human performance decreases.

Intense stress can lead to a fight, flight, or freeze response, and stress and anxiety are ramping up to an unmanageable level.

Furthermore, time pressure can be a crucial stressor resulting in a high level of arousal and a noticeable deterioration in cognitive processes like attention (e.g. "tunnel vision"), memory and problem-solving."

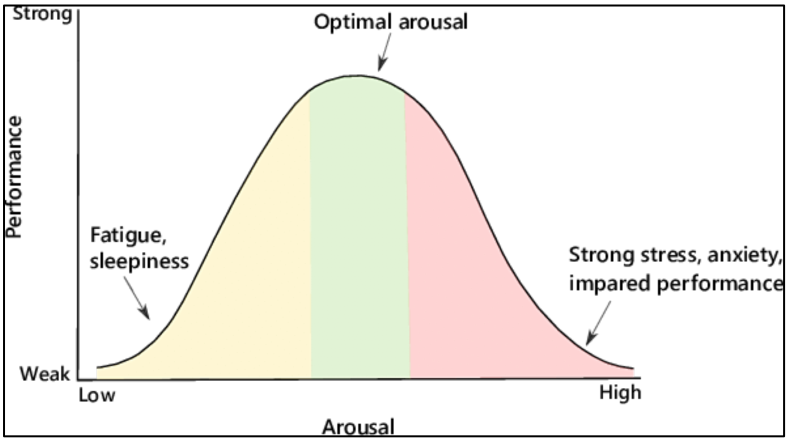


Photo 25. Illustration on the Yerkes-Dodson Law.

Additional information

Engine Detonation

In April 2019, the FAA safety team issued a presentation on pre-ignition and detonation. The below paragraph on engine detonation is an extract.

“Detonation, as the name suggests, is an explosion of the fuel-air mixture inside the cylinder. It occurs after the compression stroke near or after top dead center. During detonation, the fuel/air charge (or pockets within the charge) explodes rather than burning smoothly. Because of this explosion, the charge exerts a much higher force on the piston and cylinder, leading to increased noise, vibration, and cylinder head temperatures. The violence of detonation also causes a reduction in power. Mild detonation may increase engine wear, though some engines can operate with mild detonation. However, severe detonation can cause engine failure in minutes. Because of the noise that it makes, detonation is called "engine knock" or "pinging" in cars.

A combination of high manifold pressure and low rpm creates a very high engine load, and can induce damaging detonation. In order to avoid these situations:

- when increasing power, increase the rpm first and then the manifold pressure.
- when decreasing power, decrease the manifold pressure first and then decrease the rpm.

Other causes of detonation are improper ignition timing, high inlet air temperature, engine overheating, oil in the combustion chamber, or a carbon build up in the combustion chamber.

High heat is detrimental to piston engine operation. Its cumulative effects can lead to piston, ring, and cylinder head failure and place thermal stress on other operating components. Excessive cylinder head temperature can lead to detonation, which in turn can cause catastrophic engine failure. Turbocharged engines are especially heat sensitive.”

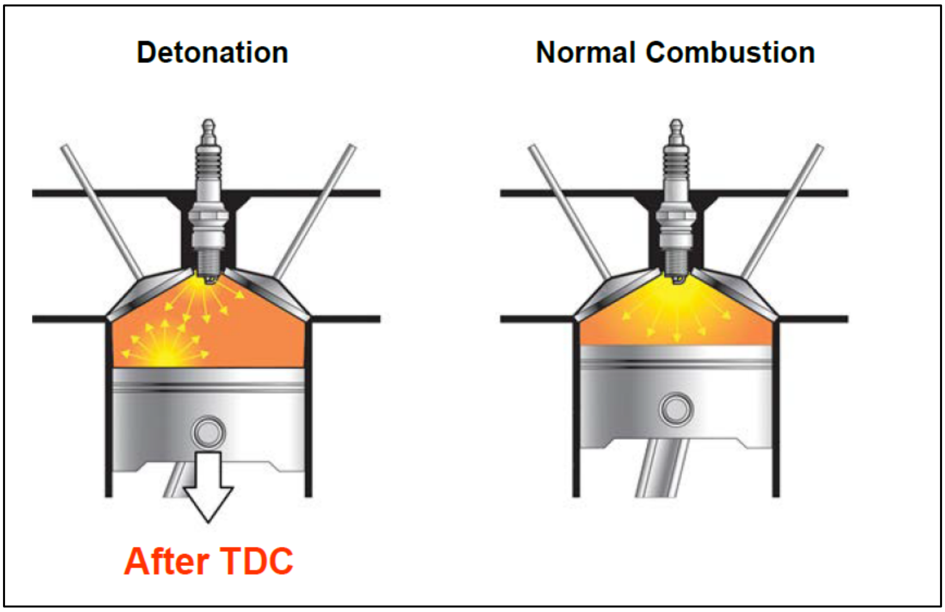


Photo 26. An illustration on engine detonation.

ANALYSIS

General

The pilot was properly licensed.

Before flight, the pilot felt at ease and well-rested.

The operation of an American registered aircraft within Europe with German pilots complied with FAA and LBA requirements.

The aircraft was airworthy.

The actual technical status of the aircraft before flight and the aircraft mass and balance had no influence on the sequence of events.

The forecasted weather conditions for Central and South Zealand were generally consistent with the actual weather.

The actual weather for Central and South Zealand was a clear sky with no restrictions to visibility allowing in due time from FL 080 to pinpoint and select a suitable open area and later a specific spot for a precautionary or a forced landing into flat terrain.

Engine disintegration and failure

The AIB technical safety investigation did not reveal the root cause to the sudden and cautionary high CHT of specific cylinder no. 1.

Taking into consideration the radar recorded Ground Speeds during climb and the forecasted winds aloft; the AIB does not suspect insufficient engine cooling to be contributing to the sequence of events.

Upon landing in EKRK, the engine oil quantity was 4.8 quarts. The engine oil quantity before departure (5.3 quarts) did not comply with the requirement of the aircraft manufacturer (6.0 quarts).

At the time of the accident, the engine time (Hobbs hrs) was 53.9% beyond the recommended TBO of 2,000 hrs.

For private and non-commercial operations, the FAA did not require a mandatory overhaul of an aircraft piston engine at TBO.

However, in general it is the opinion of the AIB that non-compliance with manufacturer requirements and recommendations, for instance lower than required oil quantity or engine time beyond TBO, might induce latent risks to flight safety.

To the AIB, a likely sequential scenario might be:

1. From 16:09:18 hrs until 16:11:30 hrs (2 minutes and 12 seconds during climb), the CHT of cylinder no.1 was above 420° F causing detonation and consequential damages (surface indentations and corner melting) to the piston of cylinder no. 1.
2. At 16:24:18 hrs at cruise level (FL 080), the CHT of cylinder no. 1 reached 398°F and still increased.
3. At 16:24:36 hrs, the CHT of cylinder no. 1 peaked at 404° F. Simultaneously, the EGT of cylinder no. 1 decreased from 1275° F to 975° F, and the engine rpm started fluctuating. Shortly after, the EGT and CHT of cylinder no. 1 started decreasing rapidly. At that point, severe damages occurred to the edge and side of the piston including the compression rings, and the oil control and scraper rings (induced earlier during detonation).

The side damages to the piston of cylinder no. 1, with the engine still running, led to increasing engine crankcase pressure.

4. At 16:27:36 hrs, the engine oil pressure started decreasing rapidly from 42 psi, probably because of a high engine crankcase pressure pressing out the engine oil from the sump through the oil breather tube connected to the oil filler pipe.
5. At 16:30:30 hrs, the engine oil pressure decreased to 10 psi and still decreased (minimum oil pressure required for engine operation).
6. In the period from 16:32:00 hrs to 16:32:12 hrs, the engine oil pressure decreased to 5 psi and simultaneously, the rpm decreased to 2,080 rpm. The MP decreased to 17.4.
   Because of severe heat damages caused by lack of bearing lubrication, the connection rod at cylinder no. 4 disconnected from the crankshaft. The loose connecting rod penetrated the engine crankcase, hit, and penetrated the air throttle body leading to reduced rpm.
   Because of heat damages caused by lack of bearing lubrication, the connection rod at cylinder no. 5 disconnected from the crankshaft. Shortly after, the connection rod of cylinder no. 5 penetrated the engine crankcase as well.
   The engine crankcase holes caused hot engine oil to expel through the holes leading to smoke generation. Parts of the forward air induction tube and filter caught fire.
7. At 16:33:30 hrs, the engine stopped.

As consequence of the engine fire, the pilot tried to shut off the engine fuel with the fuel selector handle, but the release knob separated from the fuel selector handle.

However, if complying with the emergency checklist for engine fire, the use of the mixture control for shutting off engine fuel sequentially was before using the fuel selector handle.

In conclusion, when leaning a temporarily high cylinder head temperature of cylinder no. 1 lead to detonation and and an accumulative chain of failures to the engine like:

- severe damages to the piston of cylinder no.1
- engine low oil pressure
- engine disintegration
- smoke
- engine fire
- engine failure.

Standard operating procedures

In general, every checklist (normal, abnormal and emergency) developed by an aircraft manufacturer are safety barriers.

To the AIB, checklists of an aircraft manufacturer serve four main purposes:

1. Standardization
2. To assist and strengthen the flight crew decision-making processes
3. Mitigation of potentially consequential risks
4. Reduction of flight crew workload.

For that reason, less restrictive operator developed checklists might induce latent risks to a flight operation.

The aviation group in this AIB safety investigation developed their own checklists. The checklists contained deviations from the aircraft manufacturer approved checklists like:

- engine oil check during pre-flight inspection (5.0 quarts versus required 6.0 quarts).

- lack of memory items (emergency procedures like engine fire in flight, emergency landing and CAPS deployment).
- rewriting of the aircraft manufacturer approved checklists (like climb, cruise and engine partial power loss).

The key to successful management of an emergency, and/or preventing a non-normal situation from progressing into a true emergency, is a thorough familiarity with and strict adherence to the procedures developed by an aircraft manufacturer and contained in the approved POH.

The AIB did not succeed in revealing, which leaning procedure was in use during initial climb to and initial cruise at FL 080. However, the aircraft manufacturer climb and cruise checklists did stipulate engine parameter monitoring.

When comparing the prescribed aircraft manufacturer fuel flow (maximum power fuel flow) versus pressure altitude during initial climb, the actual but fluctuating fuel flow in average was below the prescribed fuel flow (too lean air fuel ratio).

The CHT of cylinder no. 1 significantly deviated from the CHT of cylinders no. 2 to 6. The MFD engine page did present CHT exceedance cautions for cylinder no. 1, but the cautions did not trigger corrective pilot actions. Though observing engine vibrations, the pilot decided to continue climbing.

When comparing the prescribed aircraft manufacturer fuel flow at the pre-set power setting versus pressure altitude during initial cruise at FL 080, the actual but fluctuating fuel flow in average was level with the prescribed fuel flow.

However once again, the CHT of cylinder no. 1 significantly deviated from the CHT of cylinders no. 2 to 6. The engine rpm fluctuated, and the pilot experienced “massive” engine vibrations.

The AIB doubts if the pilot, during the emergency sequence, consulted any of the available emergency checklists (engine partial power loss, low oil pressure, smoke and fume elimination, engine fire, engine failure, emergency landing, and CAPS deployment).

It is the opinion of the AIB that use of the emergency checklists would have ensured structure to avoid sporadic pilot actions in a random order.

The AIB fully accepts the premise for time pressure, when one emergency overlaps the next. Nevertheless, the emergency checklists were available tools for the pilot decision-making processes, which might have reduced the risk of engine fire and led to other decisions than CAPS deployment.

Pilot risk considerations might include elements like:

- maintaining altitude versus descending.
- glide distance from FL 080 (at least 15 nm) and upon engine stoppage from altitude 4600 ft (at least 6 nm) in a tailwind condition.
- good weather conditions with a clear sky and no visibility restrictions.
- area topography and characteristics (flat terrain, minor woods, cities and villages).
- a minimum required power descent versus an actual prolonged medium power descent increasing the risk of mechanical failures resulting in potential smoke generation and engine fire.
- controllability of the aircraft. Navigation, communication and autopilot systems were operative, and the aircraft was fully controllable.

- CAPS deployment and an uncontrolled ground impact versus a controlled forced landing into an open area and flat terrain.

To the AIB, none of the aircraft manufacturer criteria (mid-air collision, structural failures, loss of control, landing required in unsafe terrain, and pilot incapacitation) for CAPS deployment were present.

Under the prevailing conditions, neither the operator relevant emergency checklists nor the aircraft manufacturer relevant emergency checklists stipulated CAPS deployment.

However, the wording of the revised safety information on CAPS deployment valid for the latest aircraft type generation was in some parts less directive and largely encouraged to CAPS deployment comparing to the safety information valid for this aircraft.

Pilot type training in combination with the perception and the belief of the pilot that almost any emergency required CAPS deployment most likely ruled out alternative options.

Like the aircraft manufacturer, the AIB strongly encourages the aviation community to discuss CAPS deployment scenarios and not least how and maybe more important when to deploy.

In conclusion, it is the opinion of the AIB that non-compliance with emergency procedures probably led to engine fire and later a decision on deploying CAPS consequentially ruling out considerations on attempting a controlled forced landing into an open area and flat terrain.

Human performance

Accumulative workload and stress caused by a departure time delay in EKRK, a potential desire to return to home base before nighttime, an unauthorized altitude deviation, engine vibrations, an evolving emergency, no use of automation most likely mentally obstructed for alternative decisions to CAPS deployment.

An accumulative stress level above the stress threshold of the pilot induced an impairment of pilot attention and problem-solving.

In the mindset of the pilot and partially supported by ATC radio communication, there were absolutely no alternatives to CAPS deployment (tunnel vision) suggesting a kind of mental freeze response (survival instinct).

Survivability

<u>General</u>

The accident was survivable.

To the AIB, the body position of the passenger at ground impact (though not revealed but the passenger potentially not holding the upper torso erect and against the seat back) might have led the inflicted back injuries.

Furthermore, evacuating in a downwind rather than upwind direction with gusty wind in the impact zone (flat terrain and no obstacles) increased the risk of the aircraft being dragged in the direction of the pilot and the passenger.

The aircraft structure and seat cushions absorbed and reduced impact loads.

<u>Search and rescue mission</u>

The search and rescue mission was effective.

Daylight, good weather conditions and optimal accessibility to the accident site optimized the rescue effort.

ELT

The lateral impact G-forces were below the criteria for an automatic activation of the onboard ELT.

However, compliance with the emergency checklist for CAPS deployment required manual activation of the ELT.

CONCLUSIONS

Summary

When leaning during initial climb and cruise, a temporarily high CHT of cylinder no. 1 most likely induced detonation and an accumulative chain of failures to the engine like:

- severe damages to the piston of cylinder no.1
- engine low oil pressure
- engine disintegration
- smoke
- engine fire
- engine failure.

Non-compliance with emergency procedures probably led to engine fire and a consequential engine failure requiring a forced landing into terrain.

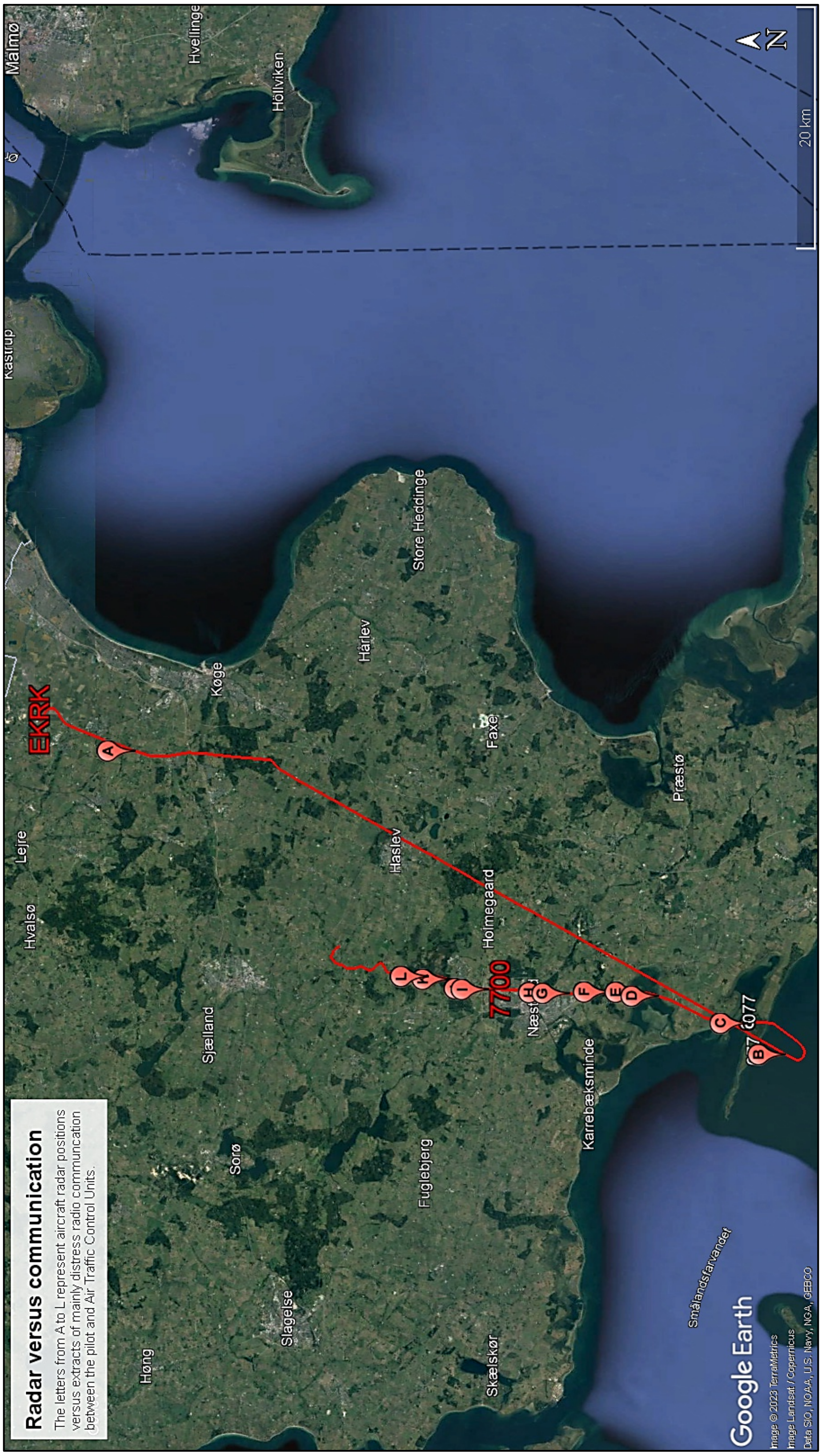
High workload in combination with pilot type training enhanced pilot perception that any forced landing on an unprepared surface required deployment of CAPS.

Pilot perception ruled out considerations on attempting a forced landing (non-critical altitude, good weather conditions, full aircraft controllability) into an open area and flat terrain.

CAPS deployment caused an uncontrolled ground impact and consequentially injuries to aircraft occupants and destruction of the aircraft.

APPENDIX 1

Return to history of flight



APPENDIX 2

[Return to history of flight](#)

APPENDIX 3

Return to history of flight Return to communication and radar

Note to radar data. FL=Flight Level. A=Altitude. N= Ground Speed in kt. Four digits=Squawk code.

Time	Distress radio communication	Radar data
Roskilde Tower 118.980 MHz		
Position **A** 16:10:31 – 16:10:52	Roskilde Tower, N745AJ again. The frequency is 124.890. Is that correct? Yes, 124.980. Maintain 3,000 ft. You are not allowed to climb above. You have airliners above you. DESCEND! N-AJ, 3000 ft and 124.980.	FL 023 (approximately A 030), N102, 0013 - FL 026 (approximately A 034), N101, 0013
Copenhagen Control 121.380 MHz		
Position **B** 16:26:38-16:27:05	N745AJ, we have a problem with our engine. N745AJ, roger. Do you wish to return? Ah yeah, if possible – immediately. N745AJ, roger. Turn left to the heading of 360. 350, N745AJ. Yeah, left turn heading 360. 360.	FL 080, N112, 0013 - FL 080, N097, 0013
Position **C** 16:28:35 – 16:29:01	And N-AJ, when you have the time, could you give further information about the problems you having? N-AJ I read you 1. N5-AJ, roger. N-AJ, we have very low oil pressure. That …*(unreadable)* N5-AJ, I copied low oil pressure. Is that correct? Roger.	FL 077, N174, 0013 - FL 075, N175, 0013

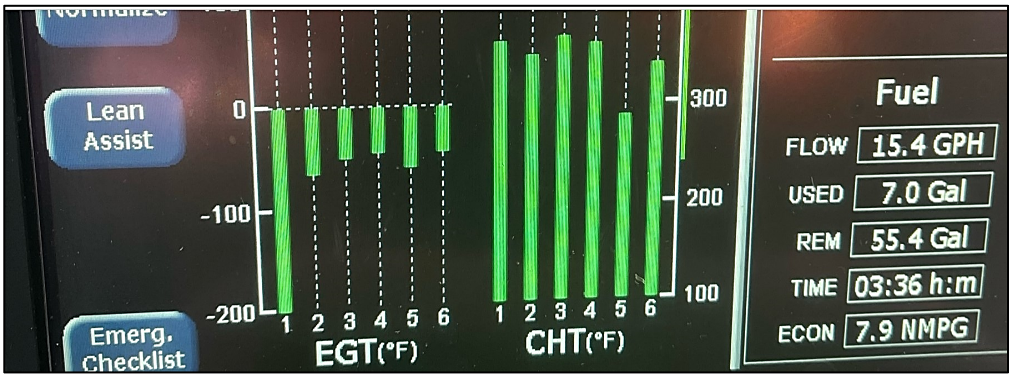
Time	Distress radio communication	Radar data
Roskilde Approach 125.525 MHz		
Position **D** 16:30:00	N745AJ, we have an emergency. There is no oil pressure on board.	FL 070, N176, 0013
Copenhagen Control 121.380 MHz		
Position **E** 16:30:14 – 16:30:34	This is N745AJ again. Go ahead. There is no answer, and we have no oil pressure anymore. What can we do now? Next airport is EKKS? Ja, N5-AJ, standby short. Sorry, I read you 2.	FL 070, N181, 0013 - FL 070, N182, 0013
Position **F** 16:30:42 – 16:31:01	N745AJ, Mayday, Mayday, Mayday. N5-AJ, roger on Mayday. Roger, N-AJ, there is no oil pressure. N5-AJ, I am trying to find information about an airport just ahead of you.	FL 069, N179, 0013 - FL 069, N181, 0013
Position **G** 16:31:18	N-AJ, there is no oil pressure.	FL 066, N182, 0013

Time	Distress radio communication	Radar data
Roskilde Approach 125.525 MHz		
<u>Position **H**</u> 16:31:30 – 16:31:45	N745AJ, (*unreadable*)…… problem. Mayday, Mayday, Mayday. No oil pressure, and the engine is going to stop. How many passengers on board? 2 people on board. 2 people on board – thank you.	FL 066, N179, 0013 - FL 065, N169, 0013
16:32:27	N745AJ squawking 7700 (radar presentation).	FL 060, N128, 7700
<u>Position **I**</u> 16:32:42	I opened the door.	FL 056, N122, 7700
<u>Position **J**</u> 16:32:52 – 16:33: 21	Hello? …… Just continue straight ahead. The VFR airfield is at your 12' o'clock. We have fire on board. Say again, please. We have fire on board. Okay, fuel off please. Fuel off. Hello, we have fire on board. 745AJ, fuel off please. Fuel off. Fuel is on.	FL 054, N117, 7700 - FL 042, N119, 7700

Time	Distress radio communication	Radar data
Position **K** 16:33:35 – 16:33:50	Mayday, Mayday, Mayday. Engine is off. We will pull the parachute. Yes, pull the parachute now. Please fuel off. Fuel off is not possible.	FL 037, N134, 7700 - FL 033, N137, 7700
Position **L** 16:33:59 – 16:34:24	N745AJ. Go ahead, sir. 745AJ, go ahead. We are now at 3,500, and we will do the parachute at 1000. Yes, that is great, and the fire is out – confirm? Ah…..	FL 030 (approximately A 037), N145, 7700 - FL 026 (approximately A 034), N127, 7700
16:34:52 – 16:34:59	745AJ, you have a VFR aerodrome at your 12 o'clock, 12 o-clock.	Only primary radar signal
16:36:09 – 16:36:25	745AJ, if you see Ringsted airfield. Is at your 12 o'clock, and the distance is 2 miles. 2 miles at your 10, 11 o'clock now.	Only primary radar signal
16:36:48	And, N745AJ, do you read?	Only primary radar signal

APPENDIX 4

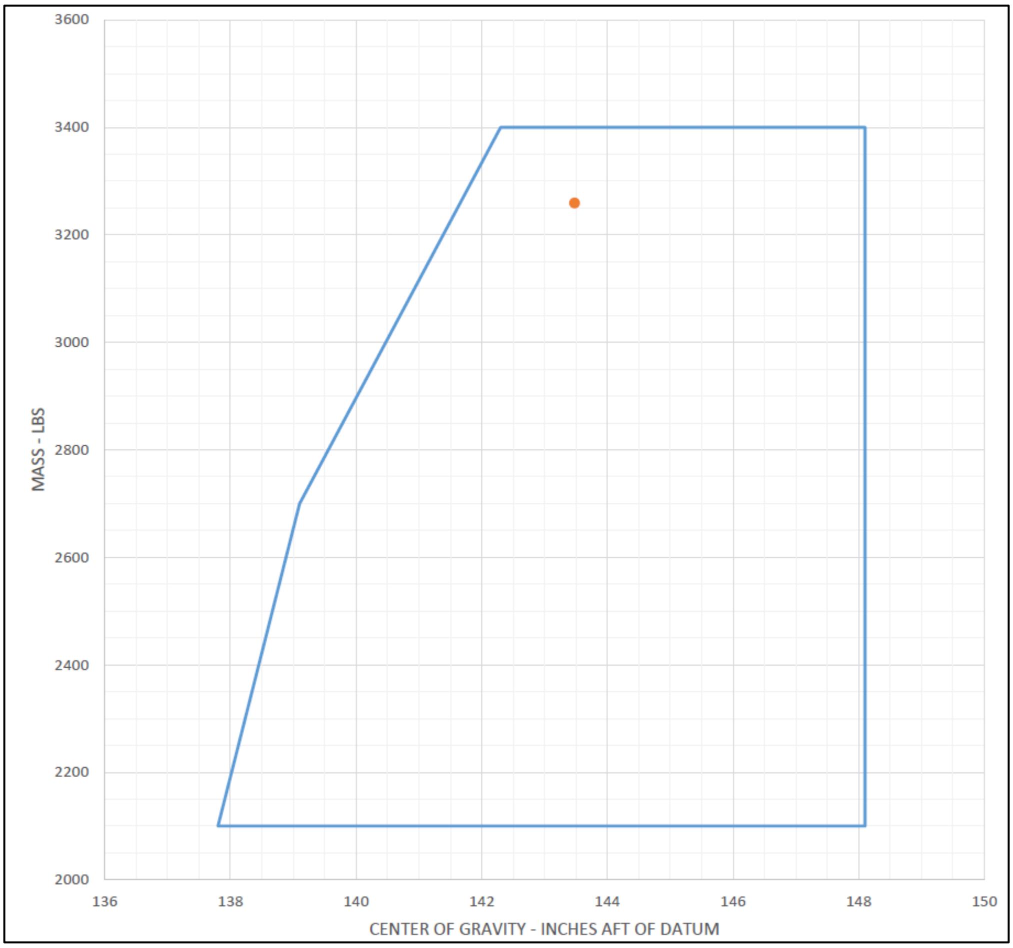
Return to history of flight



APPENDIX 5

Return to mass and balance

Description	Mass (kg) /Vol (l)	Mass (lbs)	Arm (in)	Moment
Empty mass		2,453.50	140,46	344,6235.10
Pilot seat	98	216.05	143,50	31,003.58
Forward passenger seat	70	154.32	143.50	22,145.41
Aft passenger seats	10	22.05	180.00	3,968.32
Baggage	10	22.05	208.00	4,585.61
TKS fluid	12	26.40	181.00	4,778.40
Zero fuel mass		2,894.37	142.04	411,104.41
Fuel on board at take-off	230	365.08	154.90	56,550.79
Take-off mass		3,259.45	143.48	467,655.20



Appendix 6

APPENDIX 6

Return to POH

Section 2
Limitations

Cirrus Design
SR22

Instrument Markings

Instrument (Range)	Red Line Minimum	Green Arc Normal	Yellow Arc Caution	Red Line Maximum
Power Plant Instrumentation				
Tachometer/ Engine Speed (0 - 3500 RPM)	—	500 - 2700	—	2700
Cylinder Head Temperature (200° F - 500° F)	—	240° - 420° F	420° - 460° F	460° F
Exhaust Gas Temp. (1250° - 1650° F)	—	—	—	—
Manifold Pressure (10 – 30 Inches Hg)	—	15 - 29.5 in. Hg	—	—
Fuel Flow (0 – 30 U.S. Gal./ Hr.)	—	10 - 20 GPH	—	—
Oil Temperature (50° - 240° F)	—	100° - 240° F	—	240° F
Oil Pressure (0 - 100 PSI)	10 psi (Idle)	30 - 60 psi	10 - 30 psi 60 - 100 psi	100 psi (Cold)
Fuel Quantity (0 – 90 U.S. Gallon)	0 gal.	—	0 - 14 gal.	—

APPENDIX 7

Return to POH

Engine Partial Power Loss

Indications of a partial power loss include fluctuating RPM, reduced or fluctuating manifold pressure, low oil pressure, high oil temperature, and a rough-sounding or rough-running engine. Mild engine roughness in flight may be caused by one or more spark plugs becoming fouled. A sudden engine roughness or misfiring is usually evidence of a magneto malfunction.

• Note •

Low oil pressure may be indicative of an imminent engine failure – *Refer to Low Oil Pressure* procedure in this section for special procedures with low oil pressure.

• Note •

A damaged (out-of-balance) propeller may cause extremely rough operation. If an out-of-balance propeller is suspected, immediately shut down engine and perform Forced Landing checklist.

If a partial engine failure permits level flight, land at a suitable airfield as soon as conditions permit. If conditions do not permit safe level flight, use partial power as necessary to set up a forced landing pattern over a suitable landing field. Always be prepared for a complete engine failure and consider CAPS deployment if a suitable landing site is not available. *Refer to Section 10, Safety Information*, for CAPS deployment scenarios and landing considerations.

If the power loss is due to a fuel leak in the injector system, fuel sprayed over the engine may be cooled by the slipstream airflow which may prevent a fire at altitude. However, as the Power Lever is reduced during descent and approach to landing the cooling air may not be sufficient to prevent an engine fire.

• WARNING •

If there is a strong smell of fuel in the cockpit, divert to the nearest suitable landing field. Fly a forced landing pattern and shut down the engine fuel supply once a safe landing is assured.

(Continued on following page)

The following procedure provides guidance to isolate and correct some of the conditions contributing to a rough running engine or a partial power loss:

1. Air Conditioner (if installed) .... OFF
2. Fuel Pump .... BOOST

   Selecting BOOST on may clear the problem if vapor in the injection lines is the problem or if the engine-driven fuel pump has partially failed. The electric fuel pump will not provide sufficient fuel pressure to supply the engine if the engine-driven fuel pump completely fails.
3. Fuel Selector .... SWITCH TANKS

   Selecting the opposite fuel tank may resolve the problem if fuel starvation or contamination in one tank was the problem.
4. Mixture .... CHECK appropriate for flight conditions
5. Power Lever .... SWEEP

   Sweep the Power Lever through range as required to obtain smooth operation and required power.
6. Alternate Induction Air .... ON

   A gradual loss of manifold pressure and eventual engine roughness may result from the formation of intake ice. Opening the alternate engine air will provide air for engine operation if the normal source is blocked or the air filter is iced over.
7. Ignition Switch .... BOTH, L, then R

   Cycling the ignition switch momentarily from BOTH to L and then to R may help identify the problem. An obvious power loss in single ignition operation indicates magneto or spark plug trouble. Lean the mixture to the recommended cruise setting. If engine does not smooth out in several minutes, try a richer mixture setting. Return ignition switch to the BOTH position unless extreme roughness dictates the use of a single magneto.
8. Land as soon as practical.

APPENDIX 8

Return to POH

Low Oil Pressure

If low oil pressure is accompanied by a rise in oil temperature, the engine has probably lost a significant amount of its oil and engine failure may be imminent. Immediately reduce engine power to idle and select a suitable forced landing field.

• WARNING •

Prolonged use of high power settings after loss of oil pressure will lead to engine mechanical damage and total engine failure, which could be catastrophic.

• Note •

Full power should only be used following a loss of oil pressure when operating close to the ground and only for the time necessary to climb to an altitude permitting a safe landing or analysis of the low oil pressure indication to confirm oil pressure has actually been lost.

If low oil pressure is accompanied by normal oil temperature, it is possible that the oil pressure sensor, gage, or relief valve is malfunctioning. In any case, land as soon as practical and determine cause.

1. Power Lever .... MINIMUM REQUIRED
2. Land as soon as possible.

APPENDIX 9

Return to POH

Section 3
Emergency Procedures

Cirrus Design
SR22

Smoke and Fume Elimination

If smoke and/or fumes are detected in the cabin, check the engine parameters for any sign of malfunction. If a fuel leak has occurred, actuation of electrical components may cause a fire. If there is a strong smell of fuel in the cockpit, divert to the nearest suitable landing field. Perform a *Forced Landing* and shut down the fuel supply to the engine once a safe landing is assured.

1. Air Conditioner (if installed) .... OFF
2. Temperature Selector .... COLD
3. Vent Selector .... FEET/PANEL/DEFROST POSITION
4. Airflow Selector .... SET AIRFLOW TO MAXIMUM

   If source of smoke and fume is firewall forward:

   a. Airflow Selector .... OFF
5. Panel Eyeball Outlets .... OPEN
6. Prepare to land as soon as possible.

   If airflow is not sufficient to clear smoke or fumes from cabin:

   a. Cabin Doors .... PARTIALLY OPEN

APPENDIX 10

Return to POH

Engine Fire In Flight

If an engine fire occurs during flight, do not attempt to restart the engine.

1. Mixture .... CUTOFF
2. Fuel Pump .... OFF
3. Fuel Selector .... OFF
4. Airflow Selector .... OFF
5. Power Lever .... IDLE
6. Ignition Switch .... OFF
7. Cabin Doors .... PARTIALLY OPEN

   Airspeed may need to be reduced to partially open door in flight.
8. Land as soon as possible.

APPENDIX 11

Return to POH

Engine Failure In Flight

If the engine fails at altitude, pitch as necessary to establish best glide speed. While gliding toward a suitable landing area, attempt to identify the cause of the failure and correct it. If altitude or terrain does not permit a safe landing, CAPS deployment may be required. *Refer to Section 10, Safety Information*, for CAPS deployment scenarios and landing considerations.

• WARNING •

If engine failure is accompanied by fuel fumes in the cockpit, or if internal engine damage is suspected, move Mixture Control to CUTOFF and do not attempt a restart.

1. Best Glide Speed .... ESTABLISH
2. Mixture .... AS REQUIRED
3. Fuel Selector .... SWITCH TANKS
4. Fuel Pump .... BOOST
5. Alternate Induction Air .... ON
6. Air Conditioner (if installed) .... OFF
7. Ignition Switch .... CHECK, BOTH
8. If engine does not start, proceed to *Engine Airstart* or *Forced Landing* checklist, as required.

APPENDIX 12

Return to POH

Landing Emergencies

If all attempts to restart the engine fail and a forced landing is imminent, select a suitable field and prepare for the landing. If flight conditions or terrain does not permit a safe landing, CAPS deployment may be required. *Refer to Section 10, Safety Information*, for CAPS deployment scenarios and landing considerations.

A suitable field should be chosen as early as possible so that maximum time will be available to plan and execute the forced landing. For forced landings on unprepared surfaces, use full flaps if possible. Land on the main gear and hold the nose wheel off the ground as long as possible. If engine power is available, before attempting an "off airport" landing, fly over the landing area at a low but safe altitude to inspect the terrain for obstructions and surface conditions.

• Note •

Use of full (100%) flaps will reduce glide distance. Full flaps should not be selected until landing is assured.

Emergency Landing Without Engine Power

1. Best Glide Speed .... ESTABLISH
2. Radio .... Transmit (121.5 MHz) MAYDAY giving location and intentions
3. Transponder .... SQUAWK 7700
4. If off airport, ELT .... ACTIVATE
5. Power Lever .... IDLE
6. Mixture .... CUTOFF
7. Fuel Selector .... OFF
8. Ignition Switch .... OFF
9. Fuel Pump .... OFF
10. Flaps (when landing is assured) 100%
11. Master Switches .... OFF
12. Seat Belt(s) .... SECURED

APPENDIX 13

Return to POH

CAPS Deployment

The Cirrus Airframe Parachute System (CAPS) should be activated in the event of a life-threatening emergency where CAPS deployment is determined to be safer than continued flight and landing.

• WARNING •

CAPS deployment is expected to result in loss of the airframe and, depending upon adverse external factors such as high deployment speed, low altitude, rough terrain or high wind conditions, may result in severe injury or death to the occupants. Because of this, CAPS should only be activated when any other means of handling the emergency would not protect the occupants from serious injury.

• Caution •

Expected impact in a fully stabilized deployment is equivalent to a drop from approximately 13 feet.

• Note •

Several possible scenarios in which the activation of the CAPS would be appropriate are discussed in Section 10 - Safety Information, of this Handbook. These include:

- Mid-air collision
- Structural failure
- Loss of control
- Landing in inhospitable terrain
- Pilot incapacitation

All pilots should carefully review the information on CAPS activation and deployment in Section 10 before operating the airplane.

Once the decision is made to deploy CAPS, the following actions should be taken:

1. Airspeed.. MINIMUM POSSIBLE

(Continued on following page)

The maximum demonstrated deployment speed is 133 KIAS. Reducing airspeed allows minimum parachute loads and prevents structural overload and possible parachute failure.

2. Mixture (If time and altitude permit) .... CUTOFF

Generally, a distressed airplane will be safer for its occupants if the engine is not running.

3. Activation Handle Cover.. REMOVE

The cover has a handle located at the forward edge. Pull cover down to expose activation T-handle.

4. Activation Handle (Both Hands)............. PULL STRAIGHT DOWN

Pull the activation T-handle from its holder. Clasp both hands around the handle and pull straight down in a strong, steady, and continuous motion. Maintain maximum pull force until the rocket activates. Pull forces up to, or exceeding, 45 pounds may be required. Bending of the handle-housing mount is to be expected.

• WARNING •

Jerking or rapidly pulling the activation T-handle will greatly increase the pull forces required to activate the rocket. Use a firm and steady pulling motion – a “chin-up” type pull enhances successful activation.

After Deployment:

5. Mixture .... CHECK, CUTOFF
6. Fuel Selector .... OFF

Shutting off fuel supply to engine will reduce the chances of fire resulting from impact at touchdown.

7. Bat-Alt Master Switches .... OFF
8. Ignition Switch .... OFF
9. Fuel Pump .... OFF
10. ELT .... ON
11. Seat Belts and Harnesses .... TIGHTEN

(Continued on following page)

All occupants must have seat belts and shoulder harness securely fastened.

12. Loose Items .... SECURE

If time permits, all loose items should be secured to prevent injury from flying objects in the cabin at touchdown.

13. Assume emergency landing body position.

The emergency landing body position is assumed by placing both hands on the lap, clasping one wrist with the opposite hand, and holding the upper torso erect and against the seat backs.

14. After the airplane comes to a complete stop, evacuate quickly and move upwind.

As occupants exit the airplane, the reduced weight may allow winds to drag the airplane further. As a result of landing impact, the doors may jam. If the doors cannot be opened, break out the windows with the egress hammer, located in the console between the front seats, and crawl through the opening.

APPENDIX 14

Return to CAPS Return to POH

P/N 13772-001

Cirrus Airframe Parachute System (CAPS) Deployment

The Cirrus Airframe Parachute System (CAPS) is designed to lower the aircraft and its passengers to the ground in the event of a life-threatening emergency. However, because CAPS deployment is expected to result in damage to the airframe and, depending upon adverse external factors such as high deployment speed, low altitude, rough terrain or high wind conditions, may result in severe injury or death to the aircraft occupants, its use should not be taken lightly. Instead, possible CAPS activation scenarios should be well thought out and mentally practiced by every SR22 pilot.

The following discussion is meant to guide your thinking about CAPS activation. It is intended to be informative, not directive. It is the responsibility of you, the pilot, to determine when and how the CAPS will be used.

Deployment Scenarios

This section describes possible scenarios in which the activation of the CAPS might be appropriate. This list is not intended to be exclusive, but merely illustrative of the type of circumstances when CAPS deployment could be the only means of saving the occupants of the aircraft.

Mid-Air Collision

A mid-air collision may render the airplane unflyable by damaging the control system or primary structure. If a mid-air collision occurs, immediately determine if the airplane is controllable and structurally capable of continued safe flight and landing. If it is not, CAPS activation should be considered.

Structural Failure

Structural failure may result from many situations, such as: encountering severe gusts at speeds above the airplane's structural cruising speed, inadvertent full control movements above the airplane's maneuvering speed, or exceeding the design load factor while maneuvering. If a structural failure occurs, immediately determine if the airplane is controllable and structurally capable of continued safe flight and landing. If it is not, CAPS activation should be considered.

Loss of Control

Loss of control may result from many situations, such as: a control system failure (disconnected or jammed controls); severe wake turbulence, severe turbulence causing upset, severe airframe icing, or sustained pilot disorientation caused by vertigo or panic; or a spiral/ spin. If loss of control occurs, determine if the airplane can be recovered. If control cannot be regained, the CAPS should be activated. This decision should be made prior to your pre-determined decision altitude (2,000' AGL, as discussed below).

Landing Required in Terrain not Permitting a Safe Landing

If a forced landing is required because of engine failure, fuel exhaustion, excessive structural icing, or any other condition CAPS activation is only warranted if a landing cannot be made that ensures little or no risk to the aircraft occupants. However, if the condition occurs over terrain thought not to permit such a landing, such as: over extremely rough or mountainous terrain, over water out of gliding distance to land, over widespread ground fog or at night, CAPS activation should be considered.

Pilot Incapacitation

Pilot incapacitation may be the result of anything from a pilot's medical condition to a bird strike that injures the pilot. If this occurs and the passengers cannot reasonably accomplish a safe landing, CAPS activation by the passengers should be considered. This possibility should be explained to the passengers prior to the flight and all appropriate passengers should be briefed on CAPS operation so they could effectively deploy CAPS if required.

General Deployment Information

Deployment Speed

The maximum speed at which deployment has been demonstrated is 133 KIAS. Deployment at higher speeds could subject the parachute and aircraft to excessive loads that could result in structural failure. Once a decision has been made to deploy the CAPS, make all reasonable efforts to slow to the minimum possible airspeed. However, if time and altitude are critical, and/or ground impact is imminent, the CAPS should be activated regardless of airspeed.

Deployment Altitude

No minimum altitude for deployment has been set. This is because the actual altitude loss during a particular deployment depends upon the airplane's airspeed, altitude and attitude at deployment as well as other environmental factors. In all cases, however, the chances of a successful deployment increase with altitude. As a guideline, the demonstrated altitude loss from entry into a one-turn spin until under a stabilized parachute is 920 feet. Altitude loss from level flight deployments has been demonstrated at less than 400 feet. With these numbers in mind it might be useful to keep 2,000 feet AGL in mind as a cut-off decision altitude. Above 2,000 feet, there would normally be time to systematically assess and address the aircraft emergency. Below 2,000 feet, the decision to activate the CAPS has to come almost immediately in order to maximize the possibility of successful deployment. At any altitude, once the CAPS is determined to be the only alternative available for saving the aircraft occupants, deploy the system without delay.

Deployment Attitude

The CAPS has been tested in all flap configurations at speeds ranging from V_{so} to V_a. Most CAPS testing was accomplished from a level attitude. Deployment from a spin was also tested. From these tests it was found that as long as the parachute was introduced to the free air by the rocket, it would successfully recover the aircraft into its level descent attitude under parachute. However, it can be assumed that to minimize the chances of parachute entanglement and reduce aircraft oscillations under the parachute, the CAPS should be activated from a wings-level, upright attitude if at all possible.

Landing Considerations

After a CAPS deployment, the airplane will descend at less than 1700 feet per minute with a lateral speed equal to the velocity of the surface wind. The CAPS landing touchdown is equivalent to ground impact from a height of approximately 13 feet. While the airframe, seats, and landing gear are designed to accommodate the stress, occupants must be prepared for the landing. The overriding consideration in all CAPS deployed landings is to prepare the occupants for the touchdown in order to protect them from injury as much as possible.

Emergency Landing Body Position

The most important consideration for a touchdown with CAPS deployed is to protect the occupants from injury, especially back injury. Contacting the ground with the back offset attempting to open a door or secure items increases the likelihood of back injury. All occupants must be in the emergency landing body position well before touchdown. After touchdown, all occupants should maintain the emergency landing body position until the airplane comes to a complete stop.

The emergency landing body position is assumed with tightened seat belt and shoulder harness by placing both hands on the lap, clasping one wrist with the opposite hand, and holding the upper torso erect and against the seat backs. The seat cushions contain an aluminum honeycomb core designed to crush under impact to absorb downward loads and help protect the spine from compression injury.

Door Position

For most situations, it is best to leave the doors latched and use the time available to transmit emergency calls, shut down systems, and get into the Emergency Landing Body Position well before impact. The discussion below gives some specific recommendations, however, the pilot's decision will depend upon all factors, including time to impact, altitude, terrain, winds, condition of airplane, etc.

There is the possibility that one or both doors could jam at impact. If this occurs, to exit the airplane, the occupants will have to force open a partially jammed door or break through a door window using the Emergency Exit Hammer located in the lid of the center armrest. This can significantly delay the occupants from exiting the airplane.

If the pilot elects to touchdown with a door opened, there are several additional factors the pilot must consider: loss of door, possibility of head injury, or injury from an object coming through the open door.

- If a door is open prior to touchdown in a CAPS landing, the door will most likely break away from the airplane at impact.
- If the door is open and the airplane contacts the ground in a rolled condition, an occupant could be thrown forward and strike their head on the exposed door pillar. Contacting the ground in a rolled condition could be caused by terrain that is not level, contacting an obstacle such as a tree, or by transient aircraft attitude.
- With a door open, it is possible for an object such as a tree limb or flying debris to come through the opening and strike an occupant.

• WARNING •

If it is decided to unlatch a door, unlatch one door only. Opening only one door will provide for emergency egress as well as reduce risks associated with ground contact. Typically, this would be the copilot's door as this allows the other occupants to exit first after the airplane comes to rest.

CAPS Landing Scenario	Door Position
Empty Copilot Seat	Unlatch Copilot Door
Very Little Time Before Impact	Keep Doors Closed
Fire	Unlatch Copilot Door
Water Landing	Unlatch Copilot Door
Condition Unknown	Keep Doors Closed

Water Landings

The ability of the airplane to float after a water landing has not been tested and is unknown. However, since there is the possibility that one or both doors could jam and use of the emergency egress hammer to break out a window could take some time, the pilot may wish to consider unlatching a door prior to assuming the emergency landing body position in order to provide a ready escape path should the airplane begin to sink.

Post Impact Fire

If there is no fire prior to touchdown and the pilot is able to shut down the engine, fuel, and electrical systems, there is less chance of a post impact fire. If the pilot suspects a fire could result from impact, unlatching a door immediately prior to assuming the emergency landing body position should be considered to assure rapid egress.

Ground Gusts

If it is known or suspected that ground gusts are present in the landing zone, there is a possibility that the parachute could drag the airplane after touchdown, especially if the terrain is flat and without obstacles. In order to assure that the occupants can escape the airplane in the timeliest manner after the airplane comes to rest, the pilot may elect to unlatch the copilot's door for the CAPS landing. Occupants must be in the Emergency Landing Body Position for touchdown. Occupants must not loosen seat belts until the airplane comes to rest. When the airplane comes to rest, the occupants should exit the airplane and immediately move upwind to prevent a sudden gust from dragging the airplane in their direction.

APPENDIX 15

Return to CAPS

P/N 13772-006

Cirrus Airframe Parachute System (CAPS)

The Cirrus Airframe Parachute System (CAPS) is designed to lower the aircraft and its passengers to the ground in the event of a life-threatening emergency. CAPS deployment will likely result in damage to, or loss of, the airframe, and possible injury to the aircraft occupants. Its use should not be taken lightly. Instead, possible CAPS activation scenarios should be well thought out and mentally practiced by every Cirrus pilot. Pilots who regularly conduct CAPS training and think about using CAPS will often have a higher probability of deploying CAPS when necessary.

The following discussion is meant to guide your thinking about CAPS activation. Cirrus also recommends that pilots discuss CAPS deployment scenarios with instructors as well as fellow pilots through forums such as the Cirrus Owners and Pilots Association. In the event of a spin or loss of aircraft control, immediate CAPS activation is required. (See Section 3) In other situations, CAPS activation is at the informed discretion of the pilot in command. The following discussion is intended to be informative, not directive. It is the responsibility of you, the pilot, to determine when and how the CAPS will be used. It is important to understand, however, that numerous fatalities that have occurred in Cirrus aircraft accidents likely could have been avoided if pilots had made the timely decision to deploy CAPS. It is also important to note that CAPS has been activated by pilots at speeds in excess of 180 knots on multiple occasions with successful outcomes. While the best speed to activate CAPS is below 140 knots indicated airspeed, a timely activation is most important for loss of control situations.

Deployment Scenarios

This section describes possible scenarios in which CAPS activation is appropriate. This list is not intended to be exhaustive, but merely illustrative of the type of circumstances when CAPS deployment could be the most appropriate means of saving the aircraft occupants.

Mid-Air Collision

A mid-air collision likely will render the airplane unflyable by damaging the control system or primary structure. If a mid-air collision occurs, immediately evaluate if the airplane is controllable and structurally capable of continued safe flight and landing. Unless it is apparent that structural and control system damage has not occurred, CAPS activation is recommended. If you are not sure of the condition of the aircraft following a mid-air collision, CAPS activation is recommended.

Structural Failure

Structural failure may result from many situations, such as: encountering severe gusts at speeds above the airplane's structural cruising speed, inadvertent full control movements above the airplane's maneuvering speed, or exceeding the design load factor while maneuvering. If a structural failure occurs, CAPS activation is recommended.

Loss of Control

Loss of control may result from many situations, such as: a control system failure (disconnected or jammed controls); severe wake turbulence, severe turbulence causing upset, severe airframe icing, or pilot disorientation caused by vertigo or panic. If loss of control occurs, the CAPS should be activated immediately.

• WARNING •

In the event of a spin, immediate CAPS activation is mandatory. Under no circumstances should the pilot attempt recovery from a spin other than by CAPS activation.

Landing Required in Terrain not Permitting a Safe Landing

If a forced landing on an unprepared surface is required CAPS activation is recommended unless the pilot in command concludes there is a high likelihood that a safe landing can be accomplished. If a condition requiring a forced landing occurs over rough or mountainous terrain, over water out of gliding distance to land, over widespread ground fog or at night, CAPS activation is strongly recommended. Numerous fatalities that have occurred in Cirrus aircraft accidents likely could have been avoided if pilots had made the timely decision to deploy CAPS.

While attempting to glide to an airfield to perform a power off landing, the pilot must be continuously aware of altitude and ability to successfully perform the landing. Pilot must make the determination by 2000' AGL if the landing is assured or if CAPS will be required.

Pilot Incapacitation

Pilot incapacitation may be the result of anything from a pilot's medical condition to a bird strike that injures the pilot. If incapacitation occurs and the passengers are not trained to land the aircraft, CAPS activation by the passengers is highly recommended. This scenario should be discussed with passengers prior to flight and all appropriate passengers should be briefed on CAPS operation so they could effectively deploy CAPS if required.

General Deployment Information

Deployment Speed

The maximum speed at which deployment has been demonstrated is 140 KIAS. Deployment at higher speeds could subject the parachute and aircraft to excessive loads that could result in structural failure. Once a decision has been made to deploy the CAPS, make all reasonable efforts to slow to the minimum possible airspeed. However, if time and altitude are critical, and/or ground impact is imminent, the CAPS should be activated regardless of airspeed.

Deployment Altitude

No minimum altitude for deployment has been set. This is because the actual altitude loss during a particular deployment depends upon the airplane's airspeed, altitude and attitude at deployment as well as other environmental factors. In all cases, however, the chances of a successful deployment increase with altitude. In the event of a spin, immediate CAPS activation is mandatory regardless of altitude. In other situations, the pilot in command may elect to troubleshoot a mechanical problem or attempt to descend out of icing conditions if altitude and flight conditions permit. As a data point, altitude loss from level flight deployments has been demonstrated at less than 400 feet. Deployment at such a low altitude leaves little or no time for the aircraft to stabilize under the canopy or for the cabin to be secured. A low altitude deployment increases the risk of injury or death and should be avoided. If circumstances permit, it is advisable to activate the CAPS at or above 2,000 feet AGL.

While CAPS activation above 2,000 feet is not necessarily safer than activation at 2,000 feet in terms of the altitude needed to deploy the parachute and slow the descent of the aircraft, there are other risks associated with delaying deployment. Distraction, deterioration in flight conditions, aircraft damage, pilot injury or incapacitation all could take place above 2,000 feet and prevent a timely deployment. At any altitude, once the CAPS is determined to be the only alternative available for saving the aircraft occupants, deploy the system without delay.

Deployment Attitude

The CAPS has been tested in all flap configurations at speeds ranging from V_{SO} to V_A. Most CAPS testing was accomplished from a level attitude. Deployment from a spin was also tested. From these tests it was found that as long as the parachute was introduced to the free air by the rocket, it would successfully recover the aircraft into its level descent attitude under parachute. However, it can be assumed that to minimize the chances of parachute entanglement and reduce aircraft oscillations under the parachute, the CAPS should be activated from a wings-level, upright attitude if at all possible.

Landing Considerations

After a CAPS deployment, the airplane will descend at less than 1700 feet per minute with a lateral speed equal to the velocity of the surface wind. The CAPS landing touchdown is equivalent to ground impact from a height of approximately 13 feet. While the airframe, seats, and landing gear are designed to accommodate the stress, occupants must be prepared for the landing. The overriding consideration in all CAPS deployed landings is to prepare the occupants for the touchdown in order to protect them from injury as much as possible.

Emergency Landing Body Position

The most important consideration for a touchdown with CAPS deployed is to protect the occupants from injury, especially back injury. Contacting the ground with the back offset attempting to open a door or secure items increases the likelihood of back injury. All occupants must be in the emergency landing body position well before touchdown. After touchdown, all occupants should maintain the emergency landing body position until the airplane comes to a complete stop.

The emergency landing body position is assumed with tightened seat belt and shoulder harness by placing both hands beside the legs, and holding the upper torso erect and against the seat backs. The seat cushions contain an aluminum honeycomb core designed to crush under impact to absorb downward loads and help protect the spine from compression injury.

Door Position

For most situations, it is best to leave the doors latched and use the time available to transmit emergency calls, shut down systems, and get into the Emergency Landing Body Position well before impact. The discussion below gives some specific recommendations, however, the pilot's decision will depend upon all factors, including time to impact, altitude, terrain, winds, condition of airplane, etc.

There is the possibility that one or both doors could jam at impact. If this occurs, to exit the airplane, the occupants will have to force open a partially jammed door or break through a door window using the Emergency Exit Hammer located in the lid of the center armrest. This can significantly delay the occupants from exiting the airplane.

If the pilot elects to touchdown with a door opened, there are several additional factors the pilot must consider: loss of door, possibility of head injury, or injury from an object coming through the open door.

- If a door is open prior to touchdown in a CAPS landing, the door will most likely break away from the airplane at impact.
- If the door is open and the airplane contacts the ground in a rolled condition, an occupant could be thrown forward and strike their head on the exposed door pillar. Contacting the ground in a rolled condition could be caused by terrain that is not level, contacting an obstacle such as a tree, or by transient aircraft attitude.
- With a door open, it is possible for an object such as a tree limb or flying debris to come through the opening and strike an occupant.

• WARNING •

If it is decided to unlatch a door, unlatch one door only. Opening only one door will provide for emergency egress as well as reduce risks associated with ground contact. Typically, this would be the copilot's door as this allows the other occupants to exit first after the airplane comes to rest.

Water Landings

The ability of the airplane to float after a water landing has not been tested and is unknown. However, since there is the possibility that one or both doors could jam and use of the emergency egress hammer to break out a window could take some time, the pilot may wish to consider unlatching a door prior to assuming the emergency landing body position in order to provide a ready escape path should the airplane begin to sink.

Post-Impact Fire

If there is no fire prior to touchdown and the pilot is able to shut down the engine, fuel, and electrical systems, there is less chance of a post impact fire. If the pilot suspects a fire could result from impact, unlatching a door immediately prior to assuming the emergency landing body position should be considered to assure rapid egress.

Ground Gusts

If it is known or suspected that ground gusts are present in the landing zone, there is a possibility that the parachute could drag the airplane after touchdown, especially if the terrain is flat and without obstacles. In order to ensure that the occupants can escape the airplane in the timeliest manner after the airplane comes to rest, the pilot may elect to unlatch the copilot's door for the CAPS landing. Occupants must be in the Emergency Landing Body Position for touchdown. Occupants must not loosen seat belts until the airplane comes to rest. When the airplane comes to rest, the occupants should exit the airplane and immediately move upwind to prevent a sudden gust from dragging the airplane in their direction.

APPENDIX 16

Return to POH

10. Nose, Left Side
    a. Landing Light..Condition
    b. Engine Oil.........Check 6-8 quarts, Leaks, Cap & Door Secure
    c. Cowling..Attachments Secure
    d. External Power ....Door Secure
    e. Vortex Generator ....Condition
    f. Exhaust Pipe(s) ....Condition, Security, and Clearance

APPENDIX 17

Return to POH

Maximum Power Fuel Flow

Leaning for Takeoff and Maximum Climb is accomplished at full throttle by leaning the mixture from full rich to the target fuel flow for the given pressure altitude. The fuel flow values in the table below were demonstrated to obtain the takeoff and climb performance presented in Section 5.

• Note •

Excessively rich mixture will occur if the Mixture control is set to FULL RICH above 7500 feet pressure altitude.

Pressure Altitude	Target Fuel Flow	Pressure Altitude	Target Fuel Flow	Pressure Altitude	Target Fuel Flow
0	27.1	7000	21.4	14,000	17.5
1000	26.2	8000	20.5	15,000	16.9
2000	25.1	9000	19.9	16,000	16.7
3000	24.3	10,000	19.5	17,000	16.2
4000	23.6	11,000	18.8	17,500	16.1
5000	22.8	12,000	18.4		
6000	22.1	13,000	17.9		

APPENDIX 18

Return to POH

Climb

Normal climbs are performed flaps UP (0%) and full power at speeds 5 to 10 knots higher than best rate-of-climb speeds. These higher speeds give the best combination of performance, visibility and engine cooling.

For maximum rate of climb, use the best rate-of-climb speeds shown in the rate-of-climb chart in Section 5. If an obstruction dictates the use of a steep climb angle, the best angle-of-climb speed should be used. Climbs at speeds lower than the best rate-of-climb speed should be of short duration to avoid engine-cooling problems.

1. Climb Power .... SET
2. Flaps .... Verify UP
3. Mixture .... LEAN as required for altitude
4. Engine Parameters .... CHECK
5. Fuel Pump .... BOOST

• Note •

The fuel pump is used for vapor suppression during climb. It is also recommended that the fuel pump be left on after leveling off for 30 minutes following a climb and anytime fuel flow or EGT anomalies occur.

APPENDIX 19

Return to POH

Cruise

Normal cruising is performed between 55% and 85% power. The engine power setting and corresponding fuel consumption for various altitudes and temperatures can be determined by using the cruise data in Section 5.

The selection of cruise altitude is made based on the most favorable wind conditions and the desired power settings. These significant factors should be considered on every trip to reduce fuel consumption.

• Note •

For engine break-in, cruise at a minimum of 75% power until the engine has been operated for at least 25 hours or until oil consumption has stabilized. Operation at this higher power will ensure proper seating of the rings, is applicable to new engines, and engines in service following cylinder replacement or top overhaul of one or more cylinders.

1. Fuel Pump .... OFF

• Note •

The Fuel Pump may be used for vapor suppression during cruise.

2. Cruise Power.. SET
3. Mixture .... LEAN as required
4. Engine Parameters .... MONITOR

• Note •

Fuel BOOST must be used for switching from one tank to another. Failures to activate the Fuel Pump before transfer could result in delayed restart if the engine should quit due to fuel starvation.

5. Fuel Flow and Balance .... MONITOR

Section 4
Normal Procedures

Cirrus Design
SR22

Cruise Leaning

Exhaust gas temperature (EGT) may be used as an aid for mixture leaning in cruise flight. ***For "Best Power" use 75% power or less. For "Best Economy" use 65% power or less***. To adjust the mixture, lean to establish the peak EGT as a reference point and then adjust the mixture by the desired increment based on the following table:

Mixture Description	Exhaust Gas Temperature
Best Power	75° F Rich Of Peak EGT
Best Economy	50° F Lean Of Peak EGT

Under some conditions, engine roughness may occur while operating at best economy. If this occurs, enrich mixture as required to smooth engine operation. Any change in altitude or Power Lever position will require a recheck of EGT indication.

APPENDIX 20

Return to POH

Cirrus Design
SR22

Section 5
Performance Data

Cruise Performance

Conditions:

- Cruise Weight.. 2900 LB
- Winds .... Zero
- Shaded Cells: Cruise Pwr above 85% not recommended.

• Note •

Subtract 10 KTAS if nose wheel pant and fairing removed. Lower KTAS by 10% if nose and main wheel pants & fairings are removed.

Aircraft with optional Air Conditioning System - Cruise performance is reduced by 2 knots. For maximum performance, the air-conditioner should be off.

Section 5
Performance Data

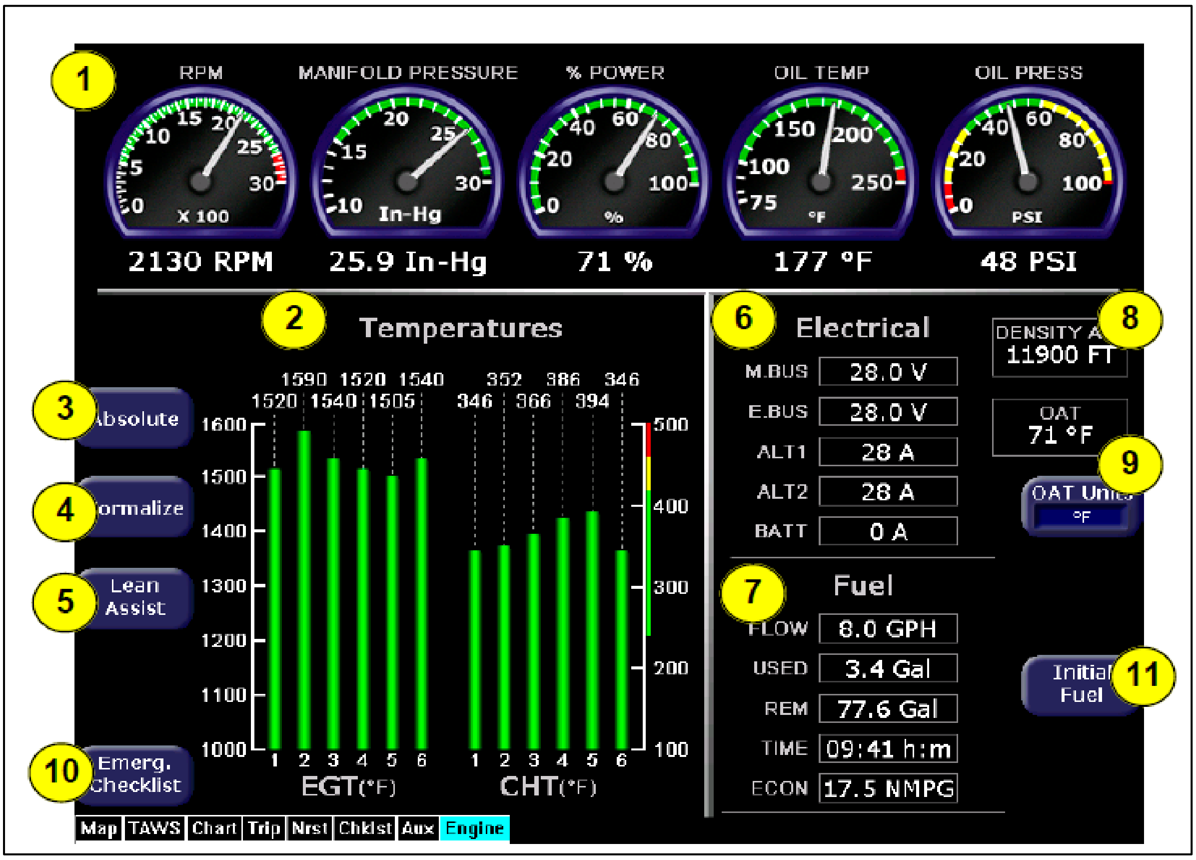
Cirrus Design
SR22

Press Alt			ISA - 30°C			ISA			ISA + 30°C		
	RPM	MAP	PWR	KTAS	GPH	PWR	KTAS	GPH	PWR	KTAS	GPH
8000	2700	21.7	83%	183	19.7	78%	183	18.6	75%	178	17.7
	2600	21.7	79%	180	18.8	75%	180	17.8	71%	175	17.0
	2500	21.7	75%	176	17.7	71%	176	16.8	67%	171	16.0
	2500	20.7	70%	172	16.7	66%	172	15.8	63%	167	15.0
	2500	19.7	66%	168	15.6	62%	168	14.8	59%	163	14.0
	2500	18.7	61%	163	14.5	58%	163	13.8	55%	158	13.1
	2500	17.7	57%	159	13.5	54%	159	12.8	51%	153	12.1

Note. The Outside Air Temperature (OAT) at FL 080 was -4° C.

APPENDIX 21

Return to Avidyne Entegra EX5000C



1. Engine gages presented rpm, manifold pressure, percentage engine power, oil temperature and oil pressure.
2. EGT and CHT temperatures.
3. Absolute mode was the default display mode, which indicated the current exhaust gas temperature for each cylinder.
4. When Normalize was selected, all of the current EGTs were set to zero. The bar graphs then indicated overall changes in EGT rather than displaying the actual temperature values (as in absolute mode).
5. Allowed the pilot to use lean assist mode.
6. Electrical gages: N745AJ did not have ALT1, ALT2 and BATT.
7. Fuel data displayed fuel used, fuel remaining, time remaining, and fuel economy in the fuel flow area of the engines page.
8. Density altitude. N745AJ did not have this indication.
9. Outside air temperature.
10. Opened the initial usable fuel page to allow the pilot to indicate the amount of fuel in the tanks.

APPENDIX 22

Return to flight recorders