



Aviation Investigation Final Report

Location:	Minneapolis, Minnesota	Accident Number:	CEN18LA349
Date & Time:	August 23, 2018, 11:06 Local	Registration:	N215SF
Aircraft:	North American T-28B	Aircraft Damage:	Destroyed
Defining Event:	Sys/Comp malf/fail (non-power)	Injuries:	1 Serious
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

The pilot stated that he received a generator failure annunciation while en route and decided to return to the departure airport. During the approach, the pilot opened the canopy after severe smoke entered in the cockpit. The pilot stated there was a heavy spray of fuel during the downwind leg of the approach that ignited during the base leg of the approach. During the final leg, when the airplane was about 150-200 ft above ground level, he determined that he could not reach the runway due to the severe fire. He pushed the airplane nose down about 20-25°, and the airplane impacted the ground short of the runway. The airplane was destroyed by impact forces and a postcrash fire. Postaccident examination of a fabric sample from the pilot's flight suit revealed stains that were consistent with hydraulic fluid. Postaccident examination of the airplane revealed the engine was separated from the airframe, and the propeller was separated from the engine. The propeller blades displayed features consistent with engine power. Fire consumed most of the cockpit area and underlying systems between the firewall and aft cockpit. Due to the fire damage, the ignition source and the flammable source could not be determined. The pilot did not perform an emergency shut down of the electrical system and/or engine after the generator failure annunciation as indicated in the airplane flight manual. However, the effect of the pilot not performing the airplane emergency procedures for smoke and fire is unknown because the timing in which the procedures would have to be performed, the flammable source location, and the kind of ignition source are unknown.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The fire during approach for reasons that could not be determined based on the available evidence, which resulted in impact with terrain during approach for a precautionary landing.

Findings

Aircraft	(general) - Not specified
Aircraft	Hydraulic fluid - Not specified
Not determined	(general) - Unknown/Not determined
Personnel issues	Lack of action - Pilot

Factual Information

History of Flight

Enroute	Sys/Comp malf/fail (non-power) (Defining event)
Approach	Fire/smoke (non-impact)
Approach	Loss of control in flight
Uncontrolled descent	Collision with terr/obj (non-CFIT)
Post-impact	Fire/smoke (post-impact)

On August 23, 2016, at 1106 central daylight time, a North American T-28B, N215SF, experienced an in-flight fire during approach to runway 18 at Anoka County-Blaine Airport (ANE), Minneapolis, Minnesota. Smoke was seen trailing from the airplane before it descended and impacted the ground near the approach end of runway 18. The pilot sustained serious injuries and the airplane was destroyed by impact forces and a post-crash fire. The airplane was registered to Aviation Specialty LLC and was operated by the pilot under 14 *Code of Federal Regulations* Part 91 as a personal flight that was not operating on a flight plan. Visual meteorological conditions prevailed at the time of the accident. The local flight originated from ANE at 1030.

A witness stated that he was marshaling an aircraft at a fixed base operator located at the north end of the airport when he saw the T-28 coming in. He said the T-28 entered a "hard left turn," which "seemed standard for them." The airplane "seemed normal" as it was flying downwind and then "cut a little soon" than what he was used to seeing. He said the airplane performed S-turns toward the approach end of the runway, performed a slip and then may have stalled; it "seemed like it stalled." The airplane impacted on the north side of the runway, right wing first, and the airplane cartwheeled. The landing gear was in the extended position when the airplane turned onto the base leg. The engine sounded "normal."

The pilot stated while en route, he received a generator failure annunciation and decided to return to ANE. When he entered an overhead approach at ANE, he experienced severe smoke and he then opened the airplane canopy. During the downwind leg, he experienced a heavy spray of fuel. During the base leg, the fuel ignited, and he was engulfed in flames. He entered the final leg and about 150-200 feet above ground level, he determined that he could not attain the runway for landing due to the severe fire. He pushed the airplane nose down about 20-25 degrees and the airplane impacted the ground short of the runway.

The pilot submitted a piece of fabric from his flight suit, which had been sprayed with a fluid when the fire occurred, to the National Transportation Safety Board Material Laboratory. An ultraviolet lamp was used to visualize stains on the fabric; several spots were found. The most stained area was examined using a Fourier Transform Infrared spectrometer with a diamond attenuated total reflectance accessory. The spectrum contained a combination of spectral peaks corresponding to particular functional groups consistent with a phosphate ester. Phosphate esters are commonly found in hydraulic fluid. The presence amide was likely due to an additive to the hydraulic fluid. A spectral library search was performed using

the residue spectrum. There were no exact matches to a hydraulic fluid, however, the unknown spectrum had several similarities to a few lubricating oils which are spectrally similar.

Post-accident examination of the airplane revealed the engine was separated from the airframe, and the propeller was separated from the engine. The propeller blades displayed features consistent with engine power. Fire consumed most the cockpit and the underlying systems between the firewall and aft cockpit. Due to the fire damage, the ignition and flammable sources could not be determined.

The T-28 flight manual Landing Gear System description stated that the landing gear is held up by mechanical locks. All the landing gear uplocks are released by initial movement of the landing gear handle; consequently, in event of hydraulic failure, the gear can be unlocked by the gear handle; the main gear extends by its own weight, and the nose gear is extended fully by a spring bungee.

The emergency checklist for Generator Failure stated that illumination of the generator-off warning light indicates that the generator is inoperative, and the battery is supplying all the power for the electrical system. In case of a generator failure:

1. Nonessential electrical equipment – OFF.

Conserve the battery by immediately turning off all nonessential electrical equipment. If necessary, place dc power switch at OFF and pull circuit breakers.

2. Instrument power – NO. 1 INV.

(Unmodified aircraft – NO. 2 INV.)

3. DC power – BAT ONLY (if radios and instruments are needed).

If flight can be conducted with instruments but without radios, place the dc power switch at BAT & GEN except when radios are required and before landing.

The emergency checklist for Elimination of Smoke or Fuel Fumes was:

1. OXYGEN – 100% (if applicable).

2. Fuel pressure – CHECK.

Warning

If loss of fuel pressure is evident, refer to fuel pressure drop procedures.

1. Airspeed – Reduce immediately.

Reduce airspeed to minimize spreading and to minimize and to prepare for extraction*/bail-out if necessary.

1. Cockpit air – OPEN.
2. Air outlets – OPEN.
3. Windshield and canopy defrost – ON.

Warning

If smoke or fumes enter cockpit from any outlet, turn cockpit air handle to EMER OFF.

1. All nonessential electrical equipment – OFF.
2. Canopy – OPEN.

An open cockpit may aggravate a smoke or fuel fume condition. Open canopy, only a last resort.

3. Land at nearest suitable airfield.

The inflight emergency checklists for fire were: Engine Fire, Fuselage Fire, Wing Fire, and Electrical Fire. The Fuselage Fire checklist stated:

If fuselage fire occurs during flight, proceed as follows:

1. Check cause by shutting off the following, one at a time:
 1. Cockpit heater – OFF.
 2. Cockpit air – EMERG. OFF.
1. If fire continues, shutdown the engine and extract* or bail out.
2. If fire is extinguished, land at nearest suitable airfield.

The emergency checklist for Electrical Fire stated:

Circuit breakers isolate most electrical circuits and automatically interrupt power to prevent a fire when a short circuit occurs. However, if circuit breaker protection does not prevent an electrical fire, and if electrical power is essential (as during instrument flight), try to identify and isolate the defective circuit as follows:

1. Battery and generator – OFF.
2. All electrical equipment (except ignition) – OFF.

3. Battery and generator – Check operation separately.
4. Isolate defective equipment.

Turn on each circuit or piece of equipment individually and check load meter for abnormal reading. Allow sufficient time for the indication or reoccurrence of fire when restoring power to each circuit previously turned off.

5. Defective equipment switches – OFF.
6. Land nearest suitable airfield.

Following the accident, the pilot submitted the story of his accident flight to the North American Trainer Association publication, Skyline, and to Warbirds of America for publication. The story is included in the docket of this report. Several of the pilot's takeaways and suggestions, based on his perspective and experience of a fast onset of a very severe fire in the cockpit, were:

- It is my suggestion that if you have generator failure in flight, or if you have any electrical component fail in flight, or if you sense that anything may be burning in the aircraft, switch all electrical power off immediate and land ASAP. In my case I don't know if the generator failure caused something electrical to short out or if something electrical shorted out and caused the generator to fail. As in my case, you never know what may be smoldering that can turn into a horrible fire. I made the very costly mistake of switching the power from battery/generator to battery only to maintain radio communication and also for landing gear and speed brake operation. Also, while I was only about 15 minutes from my home base, I passed three suitable airports in route. In my 38 years of flying, I have had generator failures many times and continued my flights to a preferred destination instead of landing at the first available airport.
- Always fly high! - It gives one time to deal with emergencies and it also gives one the option to bail out in the event of a catastrophic fire. In my case, what appeared to be a simple generator failure resulted in a ferocious inflight fire in the cockpit. The fire was so intense that in the 20 to 25 seconds it took to fly the second half of the break to land, I was at the end of my human endurance and my burns were severe. Even being in the pattern at 1,000 feet, configured for landing and only 180 degrees of turn to go I could not complete the landing. I know it's very rare and impossible to predict if a generator failure will result in a ferocious fire. Regardless of the reason, if you have an in-flight fire you surely will want to exit the airplane ASAP. If you are cruising along at 180 knots with the airplane configured clean and you have a very fast onset of a ferocious fire you will not survive the time it takes to get the airplane on the ground with the fire burning. I would recommend being prepared ahead of time. First, if you have any suspicion that there may be an impending inflight fire, I recommend climbing to a bail out altitude and turning in the direction of a non-populated landscape. I would also recommend opening the canopy and dropping your speed brake, flaps and landing gear at altitude. When you activate these functions, you pressurize the hydraulic system. Better to find out if you're going to have a hydraulic system fire at altitude than in the pattern. If you do experience a ferocious fire, it is most likely driven by the engine driven fuel pump or the engine driven hydraulic pump. Also, as listed under emergency procedures, cut the engine fuel mixture immediately to stop the engine and stop feeding the blowtorch and also turn the fuel selector and electric fuel pump off.

- Practice getting out of the aircraft with the parachute attached. - I often practiced getting out of my cockpit with my parachute attached in my hanger. Stepping up into the seat bucket with the parachute attached and staying out of the slip stream is harder than one realizes. I attribute my ability to get out of the burning cockpit with severe burns and compromised vision to my previous practice of getting out of the cockpit in the hanger with my parachute attached.

Pilot Information

Certificate:	Private	Age:	65, Male
Airplane Rating(s):	Single-engine land; Single-engine sea; Multi-engine land	Seat Occupied:	Front
Other Aircraft Rating(s):	Helicopter	Restraint Used:	
Instrument Rating(s):	Airplane	Second Pilot Present:	No
Instructor Rating(s):	None	Toxicology Performed:	No
Medical Certification:	Class 2 With waivers/limitations	Last FAA Medical Exam:	July 12, 2018
Occupational Pilot:	No	Last Flight Review or Equivalent:	January 31, 2018
Flight Time:	3500 hours (Total, all aircraft), 320 hours (Total, this make and model), 3500 hours (Pilot In Command, all aircraft), 0 hours (Last 90 days, all aircraft), 0 hours (Last 30 days, all aircraft), 0 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	North American	Registration:	N215SF
Model/Series:	T-28B	Aircraft Category:	Airplane
Year of Manufacture:	1955	Amateur Built:	
Airworthiness Certificate:	Other; Experimental (Special)	Serial Number:	137723
Landing Gear Type:	Retractable -	Seats:	2
Date/Type of Last Inspection:	July 5, 2018 Condition	Certified Max Gross Wt.:	8600 lbs
Time Since Last Inspection:		Engines:	1 Reciprocating
Airframe Total Time:	19426 Hrs as of last inspection	Engine Manufacturer:	Curtis Wright
ELT:	Installed	Engine Model/Series:	R182086B
Registered Owner:		Rated Power:	1425 Horsepower
Operator:		Operating Certificate(s) Held:	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	Condition of Light:	Day
Observation Facility, Elevation:	ANE,912 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	11:08 Local	Direction from Accident Site:	
Lowest Cloud Condition:	Clear	Visibility	10 miles
Lowest Ceiling:	None	Visibility (RVR):	
Wind Speed/Gusts:	10 knots /	Turbulence Type Forecast/Actual:	None / None
Wind Direction:	180°	Turbulence Severity Forecast/Actual:	N/A / N/A
Altimeter Setting:	30.02 inches Hg	Temperature/Dew Point:	25°C / 12°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Blaine, MN (ANE)	Type of Flight Plan Filed:	None
Destination:	Blaine, MN (ANE)	Type of Clearance:	VFR
Departure Time:	10:30 Local	Type of Airspace:	Class D

Airport Information

Airport:	Anoka County-Blaine Airport ANE	Runway Surface Type:	Asphalt
Airport Elevation:	912 ft msl	Runway Surface Condition:	Dry;Vegetation
Runway Used:	18	IFR Approach:	None
Runway Length/Width:	4855 ft / 100 ft	VFR Approach/Landing:	Forced landing;Traffic pattern

Wreckage and Impact Information

Crew Injuries:	1 Serious	Aircraft Damage:	Destroyed
Passenger Injuries:		Aircraft Fire:	Both in-flight and on-ground
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	1 Serious	Latitude, Longitude:	45.145,-93.210281(est)

Administrative Information

Investigator In Charge (IIC):	Gallo, Mitchell
Additional Participating Persons:	Dave Egesdal; Federal Aviation Administration; Minneapolis, MN
Original Publish Date:	June 3, 2020
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.nts.gov/Docket?ProjectID=98148

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