Aviation Investigation Final Report

Location:	Maxwell, California	**Accident Number:**	WPR18LA128
Date & Time:	April 29, 2018, 15:30 Local	**Registration:**	N6674K
Aircraft:	GRUMMAN ACFT ENG COR-SCHWEIZER G 164C	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 None
Flight Conducted Under:	Part 91: General aviation - Other work use		

Analysis

The pilot departed the private agricultural airstrip to the south, orbited over the area just west of the airstrip, then proceeded east. Just east of the airstrip, the pilot turned left heading north then made a 180° left turn back toward the south and onto a right downwind in preparation to land to the north. The pilot stated that about midway down and parallel to the runway, the engine surged about two to three times then completely lost power. The pilot elected to perform a forced landing in a plowed field, but during a short landing roll, the airplane nosed over on its back, which resulted in substantial damage to both upper wing panels, both horizontal stabilizers, the rudder, and the elevator.

Postaccident examination of the engine revealed damage consistent with an engine that was not producing power at the time of impact.

Functional tests of the fuel control unit identified fuel schedules that were out of specification limits, and operation of the engine at low power conditions with the out-of-specification fuel control settings most likely resulted in unstable engine operation below 100% engine speed. The fuel shutoff valve (FSOV), which terminates fuel flow to the engine, was found in the electrically commanded closed position after removal from the airplane. Testing of the valve indicated that it required a higher voltage to open than specified, and had a higher leakage through the output port than was specified, but it passed all other tests and neither condition would cause an uncommanded closing of the valve.

The results of the engine teardown examination coupled with the functional testing of various engine components failed to reveal what precipitated the reported engine surge condition before the subsequent loss of engine power.

Probable Cause and Findings

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

A total loss of engine power due to an uncommanded closing of the fuel shutoff valve, which terminated fuel to the engine. The reason for the fuel shutoff valve's closure could not be determined based on the available information.

Findings

Aircraft	Fuel controlling system - Malfunction
Not determined	(general) - Unknown/Not determined

Factual Information

History of Flight

Maneuvering-low-alt flying	Loss of engine power (total) (Defining event)
Maneuvering-low-alt flying	Fuel starvation
Emergency descent	Off-field or emergency landing
Landing-landing roll	Nose over/nose down

On April 29, 2018, about 1530 Pacific daylight time, a Grumman ACFT ENG COR-SCHWEIZER G-164C, N6674K, was substantially damaged when it was involved in an accident near Maxwell, California. The commercial pilot was not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 personal flight.

The pilot departed the private agricultural airstrip to the south for a short flight, then he orbited over the area just west of the airstrip before proceeding east. Just east of the airstrip, the pilot turned left heading north then made 180° left turn back toward the south and onto a right downwind in preparation to land to the north. According to the pilot, about this time, the engine surged two or three times then completely lost power. He elected to land straight ahead in a field rather than to attempt to turn back toward the runway. The airplane subsequently touched down in a plowed field, which was "very soft and rough," then rolled a short distance before it nosed over and came to rest inverted. The airplane sustained substantial damage to both upper wing panels, both horizontal stabilizers, the rudder, and the elevator.

Pilot Information

Certificate:	Commercial	**Age:**	56,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Single
Other Aircraft Rating(s):	None	**Restraint Used:**	4-point
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 2 Waiver time limited special	**Last FAA Medical Exam:**	November 29, 2017
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	
Flight Time:	7186 hours (Total, all aircraft), 3508 hours (Total, this make and model), 7132 hours (Pilot In Command, all aircraft), 13 hours (Last 90 days, all aircraft), 10 hours (Last 30 days, all aircraft), 8 hours (Last 24 hours, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	GRUMMAN ACFT ENG COR-SCHWEIZER	**Registration:**	N6674K
Model/Series:	G 164C C	**Aircraft Category:**	Airplane
Year of Manufacture:	1978	**Amateur Built:**	
Airworthiness Certificate:	Restricted (Special)	**Serial Number:**	16C
Landing Gear Type:	Tailwheel	**Seats:**	1
Date/Type of Last Inspection:	April 18, 2018 Annual	**Certified Max Gross Wt.:**	6300 lbs
Time Since Last Inspection:	30 Hrs	**Engines:**	1 Turbo prop
Airframe Total Time:	10114 Hrs as of last inspection	**Engine Manufacturer:**	Garrett
ELT:	Not installed	**Engine Model/Series:**	TPE331-10-511M
Registered Owner:		**Rated Power:**	940 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	Agricultural aircraft (137)

The airplane had been in a previous accident on May 26, 2017, due to fuel exhaustion. Shortly thereafter, the engine was overhauled by Ag Air Turbines. Additionally, the fuel control unit was purchased from Turbine Standard by Ag Air Turbines in an overhauled condition. The engine overhaul and test run were completed in February 2018 at an engine total time of 6,983.5 hours, and the engine was certified to be in airworthy condition before American Aviation Inc. installed the engine on the airframe. On April 18, 2018, a commercial pilot performed an engine ground run and flight check, and maintenance records revealed that an annual inspection was performed, and the aircraft was declared airworthy. The operator reported that the airplane had accumulated about 30 hours from the date of the annual inspection to the date of the accident.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	MYV,64 ft msl	**Distance from Accident Site:**	27 Nautical Miles
Observation Time:	15:53 Local	**Direction from Accident Site:**	110°
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	160°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.87 inches Hg	**Temperature/Dew Point:**	25°C / 13°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Maxwell, CA (12CN)	**Type of Flight Plan Filed:**	None
Destination:	Maxwell, CA (12CN)	**Type of Clearance:**	None
Departure Time:	15:25 Local	**Type of Airspace:**	Class G

Airport Information

Airport:	Richter Aviation Airport 12CN	**Runway Surface Type:**	Asphalt
Airport Elevation:	57 ft msl	**Runway Surface Condition:**	Dry;Rough
Runway Used:	34/16	**IFR Approach:**	None
Runway Length/Width:	2856 ft / 40 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:		**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	1 None	**Latitude, Longitude:**	39.26472,-122.11916

Fuel Shutoff Valve

The FSOV can be electrically opened and electrically closed with the arm of the valve in the AUTO position. The valve can also be closed by moving the arm to the MANUAL position. The arm is connected to the speed lever in the cockpit and is positioned in the AUTO position; if the

speed lever is moved to the EMERGENCY STOP position, the valve is moved to MANUAL, which closes the valve and terminates fuel to the engine. Postaccident examination of the arm on the FSOV showed a mark on the shaft to which the valve's arm is connected was positioned vertically relative to the body of the valve, which indicated the valve was in the AUTO position when removed from the airplane. (See Figures 1 and 2)

Computerized tomography scans of the fuel shutoff valve, which were conducted prior to a functional test, revealed that the Belleville washer was in the position that holds the ball against the seat in the valve, which would prevent the flow of fuel through the valve. When the washer was scanned for cracks, none were identified. These results are consistent with a normally operating valve found in the electrically CLOSED position.

Functional tests on the FSOV verified the functionality of the valve, but the valve failed to meet the acceptance criteria of a new part. The valve required a higher voltage to open than specified and had a higher leakage through the output port than was specified but passed all other tests.

Figure 1. Fuel shutoff valve after removal from engine.

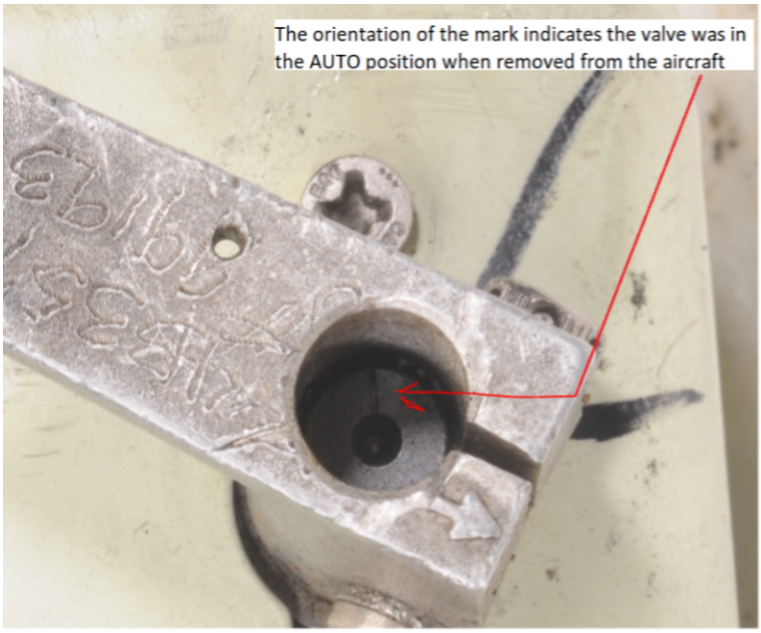

Figure 2 – Close-up of the fuel shutoff valve in AUTO position

Fuel Pump Assembly

Functional testing of the fuel pump assembly revealed that the fuel pump exceeded the flow requirements. The testing also showed the pressure relief valve was set below the maximum pressure limit. A lower setting on the pressure relief valve would affect higher flows with low flowing fuel nozzles. Engine operation at low fuel flows would not be impacted.

Fuel Control Unit

Examination and functional testing of the fuel control unit revealed a missing fuel inlet filter, some minor scratches on the housing, and no other damage. The speed setting lever, power lever, and drive shaft were all intact and rotated freely.

The bypass valve assembly was removed to inspect for contamination. Rust was observed on the shim beneath the bypass valve pilot, but no contamination was observed in the valve. The piston was found to move and rotate smoothly.

A slave inlet filter was installed, and the unit was mounted on the test stand for as-received testing. A patch filter was installed in the discharge line between the fuel control and the nozzle simulator. Several test points of the fuel control unit were found to be slightly out of specification limits on the Accel schedules. The Standard Day Accel schedule had one point low out of limits by less than 1% and three points high out of limits by up to 3.3%. The 15,000 Foot Accel schedule, 35,000 Foot Accel schedule, and Hot Day Accel schedule each had one test point out high by less than 1%. The Cold Day Accel schedule had one point high by 1.4%. The Decel schedule had one test point low out of limits by 3.1%.

The Underspeed Governor 73% Speed schedule showed lean fuel flow at 89 pounds per hour (pph) (limits of 118 +/- 5 pph). To achieve the required fuel flow, the control had to be run at 72.2% speed. The speed setting lever maximum stop was found to be set at 42° (limits of 39° +/- .75°). At this setting, the Underspeed Governor 95.5% Speed schedule had rich fuel flow at 428 pph (limits of 194 +/- 5 pph). To achieve the required fuel flow, the control had to be run at 97.8% speed. It is not known whether the aircraft was rigged with the speed setting lever against the maximum speed stop when the power lever was in the cruise/high speed condition. This setting against the speed lever stop is close to the propeller governor speed setting.

The Overspeed Governor had lean fuel flow of 92 pph (limits of 105 +/- 5 pph) at 106.3% and had to be run at 105.4% speed to achieve the required fuel flow.

Most of the test points on the Power Lever schedules were out of limits with the Max Power setting at 581 pph (limits of 535 +/- 10 pph) and the Flight Idle setting at 171 pph (limits of 214 +/- 5 pph). These are both normal customer adjustments. The Power Lever Angular Travels were also out of limits. The power lever angle at which the unit started to come off the flight idle flat in the decreasing direction was measured to be 32° (limits between 35° and 37°). In the increasing direction, it was measured to be 40° (limits between 43° and 45°). The power lever angle at which the unit started coming off the maximum power flat was measured to be 90° (limits between 93° and 97°). These out-of-tolerance conditions are consistent with a 4° shift in the position of the power lever adaptor plate.

After testing was completed, the patch filter was removed from the discharge flow line and a minimal number of small particles were found. There was no evidence of any contamination that

would have negatively affected the performance of the fuel control unit, and no preaccident malfunctions were observed during testing.

The examination and testing revealed that the propeller governor functioned as required. However, the maximum and minimum control lever stops, which are field adjustable, had been adjusted out of limits.

Fuel Flow Divider Valve

Functional testing of the fuel flow divider valve revealed that a higher total flow was required to achieve the primary flow of 70 pph. During testing, it was discovered that the system orifice simulating the primary nozzles was the incorrect size and the data were corrected. However, the difference in the measured and model primary flower was determined to be insignificant and would not result in engine instability or flame out.

Enrichment Solenoid, Fuel Manifold, and Nozzle Assembly

Functional tests of the fuel enrichment solenoid, fuel manifold, and nozzle assembly revealed no anomalies.

Administrative Information

Investigator In Charge (IIC):	Little, Thomas		
Additional Participating Persons:	Brian Allen; Federal Aviation Administration; Sacramento, CA Dana Metz; Honeywell Aerospace; Phoenix, AZ		
Original Publish Date:	July 15, 2021	**Investigation Class:**	3
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=97129		

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