Havarikommissionen
Accident Investigation Board Denmark

Bulletin 2020-322

Serious incident to OY-BYC (Piper PA-28R-201T) near the village of Lundforlund south of Slagelse on 10-9-2020.

ISSUED SEPTEMBER 2021

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:	2020-322
UTC date:	10-9-2020
UTC time:	10:10
Occurrence class:	Serious incident
Location:	Near the village of Lundforlund, 3.8 nautical miles (nm) southwest of Slagelse
Injury level:	None
Aircraft registration:	OY-BYC
Aircraft make/model:	Piper PA-28R-201T, Turbo Arrow III
Current flight rules:	Visual Flight Rules (VFR)
Operation type:	Private
Flight phase:	Climbing
Aircraft category:	Fixed wing
Last departure point:	Slots Bjergby (private airstrip)
Planned destination:	Omø (private airstrip)
Aircraft damage:	Minor
Engine make/model:	Continental Motors TSIO-360-FB

SYNOPSIS

Notification

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

The Aviation Unit of the Danish Accident Investigation Board (AIB) was notified of the serious incident by the pilot on 10-9-2020 at 10:20 hours (hrs).

On the 10-9-2020 at 15:30 hrs, the AIB notified the National Transportation Safety Board (NTSB), the European Aviation Safety Agency (EASA), the Directorate General for Mobility and Transport (DG Move) and the Danish Transport, Construction and Housing Authority (DTCHA).

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

Summary

The AIB considers it likely that the fuel primer valve, without pilot input, was activated and had a malfunction during flight, or the primer valve, without being activated, had a malfunction during flight, causing reduced fuel flow to the engine followed by reduced engine power and a forced landing in a field.

This serious incident occurred in daylight and under Visual Meteorological Conditions (VMC).

FACTUAL INFORMATION

History of flight

The pilot planned a flight from a private airstrip near the village of Slots Bjergby, 3.0 nm south of Slagelse, to the small island of Omø.

The planned total flying distance was approximately 14 nm.

The aircraft took off from runway 27.

During climb at an altitude of approximately 300 feet above ground level (agl), the engine suddenly went from full take off power down to idle.

Due to power lines ahead of the aircraft, the pilot turned to the left on a southern heading.

While still flying, the pilot performed the emergency procedure "Engine Power loss in flight". The pilot did not manage to re-establish full engine revolutions per minute (rpm).

The pilot chose a harvested rapeseed field for the forced landing and prepared for a landing gear down forced landing.

Upon touchdown the landing gear collapsed, and the lower part of the fuselage, wings and propeller touched the ground.

Before the aircraft came to a complete stop, the aircraft skidded down the field for approximately 50 – 100 meters (m).

The pilot evacuated the aircraft.

The landing site was approximately 0.8 nm to the southwest of the departure airstrip.

Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal			
Serious			
None	1		

Damage to aircraft

The propeller blades were deformed.

The left hand flap had a dent at the lower skin.

On the right hand side of the fuselage, the footstep aft of the wing trailing edge, was partly torn off from its attachment to the fuselage skin and frame.

The nose landing gear retraction actuator piston rod had fractured.

The nose landing gear doors were damaged.

Figure 1: Aircraft in the field after the forced landing.

Other damage

None

Personal information

License and medical certificate

The pilot – male 61 years – was the holder of a valid Private Pilot Licence (PPL/A) issued by the DTCHA on 5-1-2016.

The class rating Single Engine Piston (SEP) Land was valid until 31-8-2022.

The medical certificate (class 2) was valid until 5-3-2021. The medical certificate held the limitation “Correction for defective distant, intermediate and near vision (VML)”.

Flying experience

	Last 24 hours	Last 90 days	Total
All types	-	34:00	1686:30
This type	-	34:00	350:00
Landings this class	-	-	4,025

Aircraft information

General information

Manufacturer:	Piper Aircraft Corporation
Type:	PA-28R-201T, Turbo Arrow III
Serial number:	28R-7803246
Airworthiness Review Certificate:	Valid until 25-6-2021
Engine manufacturer:	Continental Motors
Engine type:	TSIO-360-FB
Time Since New (TSN):	63:05 hrs

Propeller manufacturer:	Hartzell Propeller
Propeller type:	BHC-C2YF-1BF
Maximum take-off mass (MTOM):	1,315 kilograms (kg)/2,900 pounds (lbs)
Maximum landing mass (MLM):	1,315 kg
Fuel on board at landing:	80 litres (l)
Aircraft total flight hours:	3139:15
Latest maintenance:	8-9-2020

Mass and balance

The pilot stated that the actual take-off mass was 980 kg/2,160 lbs and the actual Center of Gravity (CG) was calculated to be 83 inches (in).

According to the Pilot's Operating Handbook (POH), the CG must be between 78 and 90 inches.

Fuel system

The aircraft was equipped with a left wing and a right wing fuel tank. The total wing fuel tank capacity was 77 US gallons (291 l).

By using a fuel selector handle in the cockpit, fuel could be used from either the left wing or the right wing fuel tank.

An engine driven pump or an electrical pump pumped unmetered fuel through pipes and filters from the selected wing fuel tank to the metering unit in the throttle valve. Metered fuel was then pumped through a pipe to the manifold valve and from the manifold valve distributed via six pipes to the six main fuel nozzles – one at each of the six cylinders.

In the metered fuel pipeline between the metering unit in the throttle valve and the manifold valve, a primer valve was installed. When the primer valve was electrically activated, through a primer switch in the cockpit, it would shut off fuel to the six fuel nozzles at the cylinders and only allowed fuel to the two primer fuel nozzles in the air induction pipes after the throttle valve.

When the primer valve was deactivated, the two primer fuel nozzles in the air induction pipes would shut off and the fuel line to the six main nozzles would open.

The function of the primer valve was to make it easier to start a cold engine.

Fuel system schematic - see appendix 1

Primer valve schematic and top view of engine with primer valve - see appendix 2

Primer switch location in cockpit - see appendix 3

Meteorological information

Low Level Forecast (Extract)

The private departure airstrip and the emergency landing site were in area 51c.

The planned private destination airstrip on Omø was in area 51f.

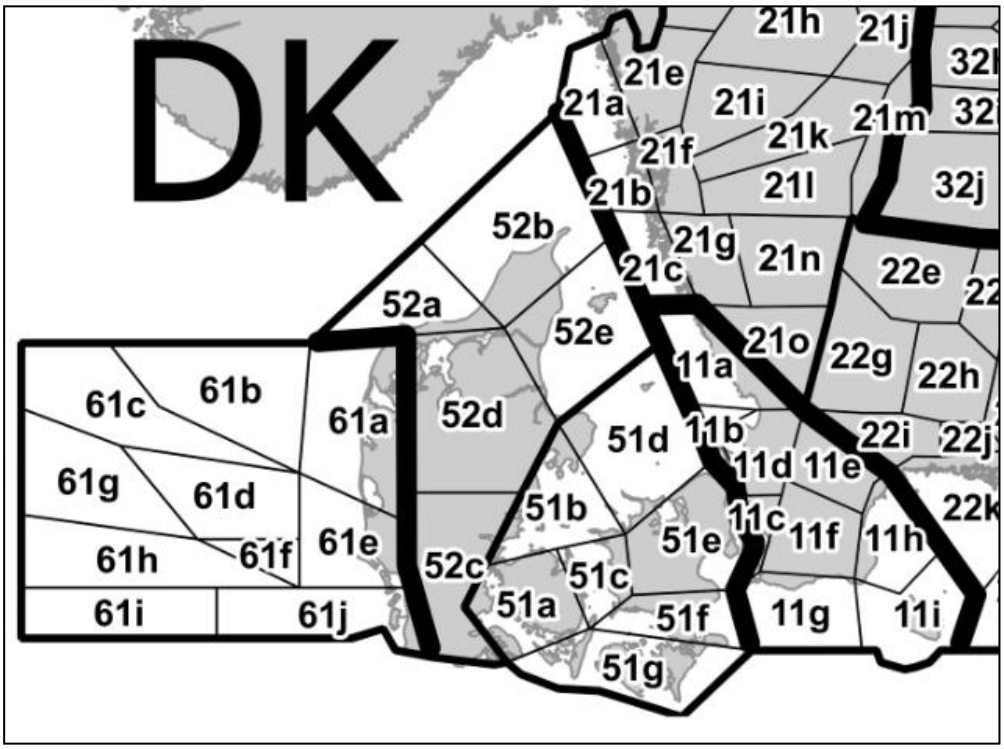


Figure 2: Meteorological regions.

FBDN 21 EKCH 100700 forecast for area dk51 Islands issued at 10:07:46 hrs valid on 10-9-2020 between 08:00 hrs and 16:00 hrs.

General:	North-westerly flow of cold and slightly unstable air. A ridge of high was approaching from the west.
Visibility:	More than 8 kilometres (km). Cloudbase>4000 ft, locally 2000 ft – 4000 ft.
Icing:	Not expected.
Surface/altitude wind:	Northwest 11-22 knots (kt) with gusts up to 30 kt.

Terminal Aerodrome Forecast (TAF)

No TAF was issued at neither the departure nor the destination airstrip.

Roskilde (EKRK) was located 30 nm to the northeast of the departure airstrip.

TAF EKRK 100826Z 1009/1018 29012KT 9999 SCT030 TEMPO 1009/1014 30015G25KT=
TAF EKRK 101125Z 1012/1021 29012KT 9999 SCT035

Aviation Routine Weather Report (METAR)

No METAR was issued at neither the departure nor the destination airstrip.

METAR EKRK 100950Z AUTO 31016KT 9999 SCT031/// 15/07 Q1018=
METAR EKRK 101020z AUTO 31015KT 9999 BKN031/// 15/08 Q1018=

Aftercast valid for the departure airstrip at 10:10 hrs

General:	Northwesterly flow of cold and slightly unstable air with an inversion at around Flight Level (FL) 060. A ridge of high over the North Sea was moving east towards Denmark. No weather phenomena.
Visibility:	Good visibility, more than 10 km, probably 20-40 km.
Clouds and icing:	Over Zealand generally few/scattered stratus cumulus/cumulus, locally broken, with base approximately 3000 ft. At the departure airstrip probably few/scattered.
Surface wind:	280-310° 10-15 kt with periodically minor wind gusts of 18-22 kt, maybe 25 kt.
Other information:	Temperature +15-16 °C. Dew point temperature +8-9 °C.
Turbulence	Light, locally maybe bordering on moderate, thermal/mechanical turbulence.

Communication

Neither the departure airstrip nor the destination airstrip had allocated radio frequencies.

There was no radio communication between the aircraft and Air Traffic Service Units.

The pilot did not transmit a MAYDAY call.

Aerodrome information

General information

Departure airstrip location:	55 21 35N 11 18 36E
Runway directions:	09/27
Runway dimensions	550 m x 20 m
Runway surface:	Grass

Flight recorders

The aircraft was equipped with a JPI EDM-900 Engine Data Monitoring Display in the cockpit, which indicated and logged rpm, manifold pressure, fuel tank quantity, fuel flow, fuel pressure, engine oil temperature and pressure.

Fire

There was no fire.

Survival aspects

The pilot wore lap and shoulder harnesses, and they were intact after the sequence of events.

The cockpit and cabin were intact after the sequence of events.

The selected emergency landing field was large and had a hard surface with no obstacles.

Technical safety investigation

Onsite investigation

Shortly after the serious incident, the AIB arrived at the landing site.

- The left wing and the right wing fuel tanks contained approximately an equal amount of fuel.
- Fuel selector valve was on LH wing fuel tank.
- Total fuel on board was 21.2 US gallons.
- An examination of the throttle and mixture connections from the cockpit to the engine gave no rise to remarks.
- The electrical pump in Low and High setting delivered fuel to the fuel manifold.
- Taken fuel samples from the fuel bowl at the engine firewall did not contain water or other contaminations.

Follow up investigation

The AIB arranged transport of the aircraft from the landing site to the private departure airstrip.

- An examination of the engine air induction system including air filter did not give rise to remarks.
- A visual inspection of the fuel system, from the wing fuel tanks to the cylinders including fuel filters did not give rise to remarks.
- Both wing fuel tanks were drained.
- An examination of the wing fuel tanks and filters in the wing fuel tanks did not give rise to remarks.
- Taken fuel samples from the wing fuel tanks complied with the 100LL specification.
- A visual inspection of the ignition system from the magnetos to the spark plugs including spark plugs did not give rise to remarks.

The damaged propeller was replaced with a serviceable propeller and the engine was started.

- The engine started at once and without hesitation.
- The engine was operated at different rpm including full power for more than 10 minutes which gave no rise to remarks.
- The primer valve was activated at low rpm via the primer switch in the cockpit. The engine rpm decreased. The primer switch was released, deactivating the primer valve, but the engine rpm did not increase back to its initial rpm prior to the activation. It was hereafter not possible to control the engine rpm with the throttle. The engine was shut down.

A second engine test was carried out, when the engine was cold.

- Before starting the cold engine, the primer valve was activated via the primer switch. The engine started but ran very rough. It was not possible to increase the rpm with the throttle lever. If the electrical pump was activated the rpm could be increased to 2000 rpm. It was not possible to increase rpm to 2570 rpm (take off rpm).

A functionally test of the primer valve was carried out with the primer valve installed on the engine.

- The main fuel nozzles at the cylinders and the two primer fuel nozzles in the air induction pipes after the throttle valve were disconnected. The primer valve was activated and fuel only came out through the two primer fuel nozzles at the air induction pipes after the throttle valve. The primer valve was deactivated and fuel only came out through the main fuel nozzles at the cylinders. The primer valve functioned as designed.

A third engine test was carried out with another serviceable primer valve and cold engine.

- The engine was primed with the primer valve before start. Engine was started and it ran smoothly. The rpm could be increased to 2570 rpm. At low rpm the primer valve was activated – the engine rpm went down, but as soon at the primer valve was deactivated the rpm increased back to the initial rpm prior to activation.
- Engine ran smoothly at all rpm.

A fourth engine test was carried out in an approved workshop test cell. The engine test was carried out upon completion of a shock loading inspection, but without the primer valve installed.

- Engine was tested at many different rpm without remarks.

The primer valve installed on the engine during the serious incident was disassembled and inspected according to the assembly drawing.

- The primer valve was assembled according to the drawing and no internal damages were found.

The mechanical fuel pump, the throttle valve and the fuel manifold of the involved engine had only been in operation for approximately 40 hours, since it had been inspected and tested by an approved workshop.

During engine tests with the installed primer valve, the EDM recorded the fuel pressure and the fuel flow. At take-off power, - 2570 rpm, - the measured fuel flow and fuel pressure were higher than the specified values of the Continental engine fuel system specification. However, the engine still ran smoothly.

Several times during engine runs, the magneto switch in the cockpit was activated without any findings.

The pilot did not remember, whether or not the primer switch had been activated before the engine start prior to the serious incident flight.

The primer switch in the aircraft was activated several times without remarks. No further inspections were made to the primer switch.

Service Bulletin issued by the aircraft manufacturer

In April 1989, Piper Aircraft Corporation issued Service Bulletin No. 905 concerning replacement of the primer valve switch at the next regularly maintenance event not to exceed 100 hours of time in service, which Piper Aircraft Corporation considered mandatory.

The Service Bulletin described that an internal failure of the switch could allow uncontrolled activation of the primer valve, which could cause the engine to run rough and possibly stop.

At the time of the serious incident, the primer valve switch installed in OY-BYC had not been replaced, although OY-BYC had flown more than 100 hrs and had many regular maintenance events carried out since the issue date of the Service Bulletin.

Extract from Piper Service Bulletin No. 905 - see appendix 4

Service Bulletin issued by the engine manufacturer

In February 2019, Continental issued a Critical Service Bulletin CBS19-01 and Piper a cover Vendor Service Bulletin no. 267, to complete remove the primer valve in the fuel

system within the next 25 hours of engine operation or at the next scheduled inspection or engine service, whichever occurred first.

The Service Bulletin described that a malfunction of the primer valve could result in a partial or complete loss of engine power.

The Service Bulletin had not been carried out on OY-BYC, although OY-BYC had flown more than 25 hrs and had an engine check carried out since the issue date of the Critical Service Bulletin.

Extract from Continental Service Bulletin CBS19-01 - see appendix 5

Extract from Piper Service Publication No. 267 - see appendix 6

ANALYSIS

General

The pilot was properly licensed.

The aircraft Airworthiness Review Certificate was valid.

The take-off mass and CG were within the allowable limits.

On board fuel was sufficient to complete the planned flight.

The fuel complied with the 100LL specification.

The onsite and follow up technical investigation did not reveal any faults except for faults related to the fuel primer valve.

Although the Service Bulletin from Piper was considered mandatory, and the Service Bulletin from Continental was considered critical, these Service Bulletins were not carried out on OY-BYC.

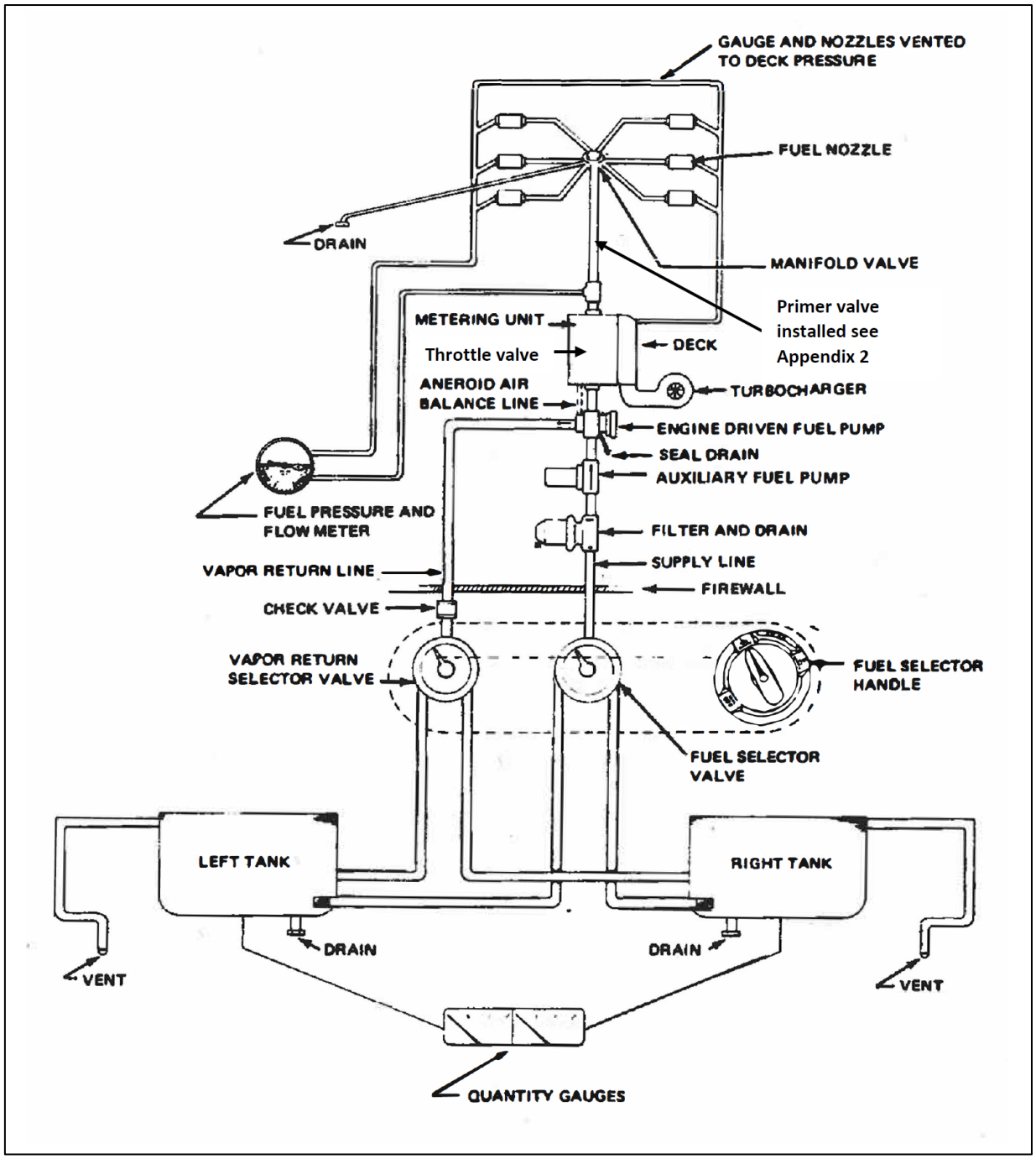
Taking into consideration the results of the technical investigation and the provided Service Bulletins from the aircraft and the engine manufacturer, the AIB considers it likely, that the fuel primer valve, without pilot input, was activated and had a malfunction during flight, or the primer valve, without being activated, had a malfunction during flight.

CONCLUSIONS

The AIB considers it likely that the fuel primer valve, without pilot input, was activated and had a malfunction during flight, or the primer valve, without being activated, had a malfunction during flight, causing reduced fuel flow to the engine followed by reduced engine power and a forced landing in a field.

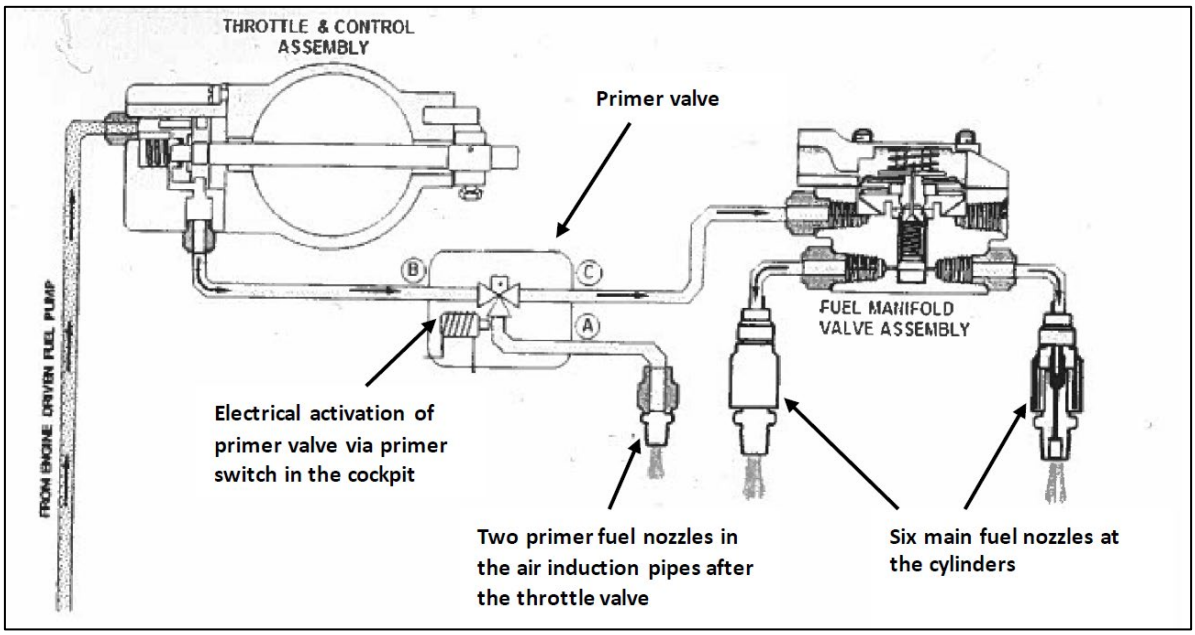
APPENDIX 1

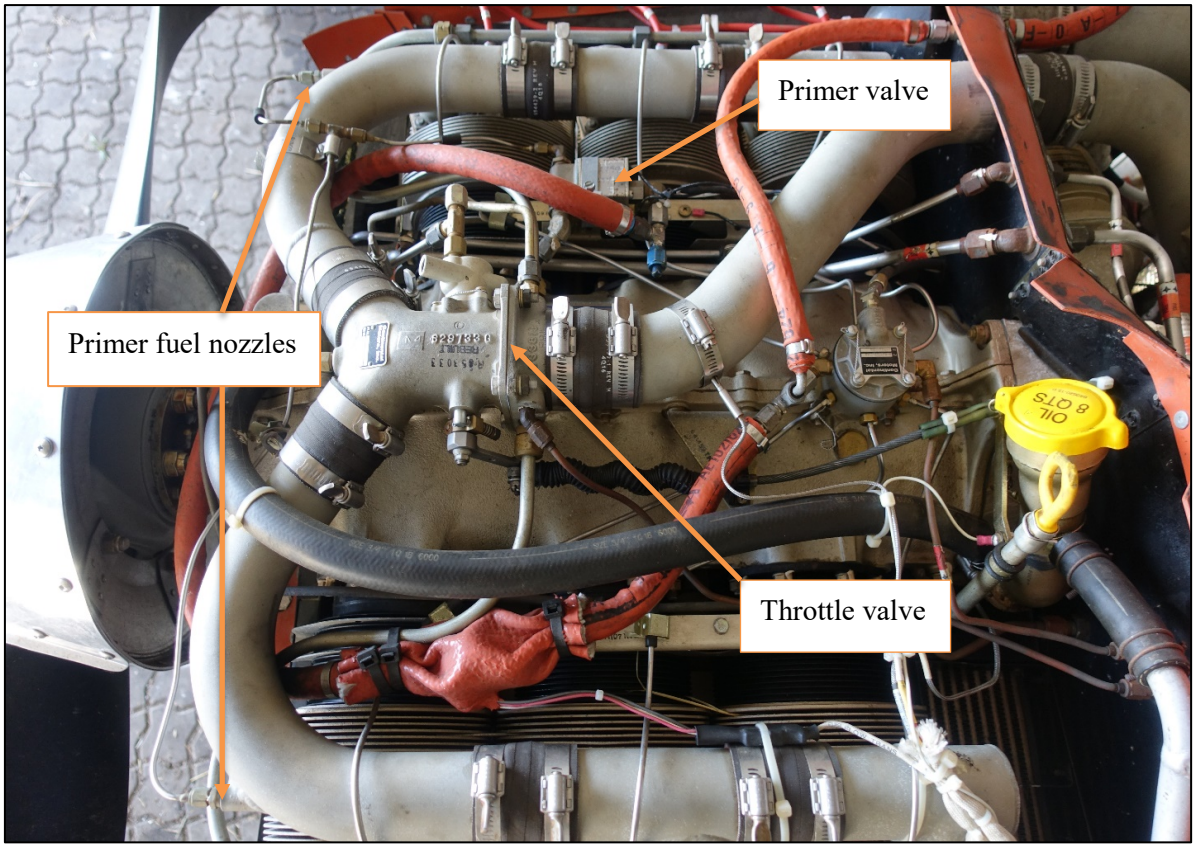
Return to Fuel system



APPENDIX 2

Return to Fuel system



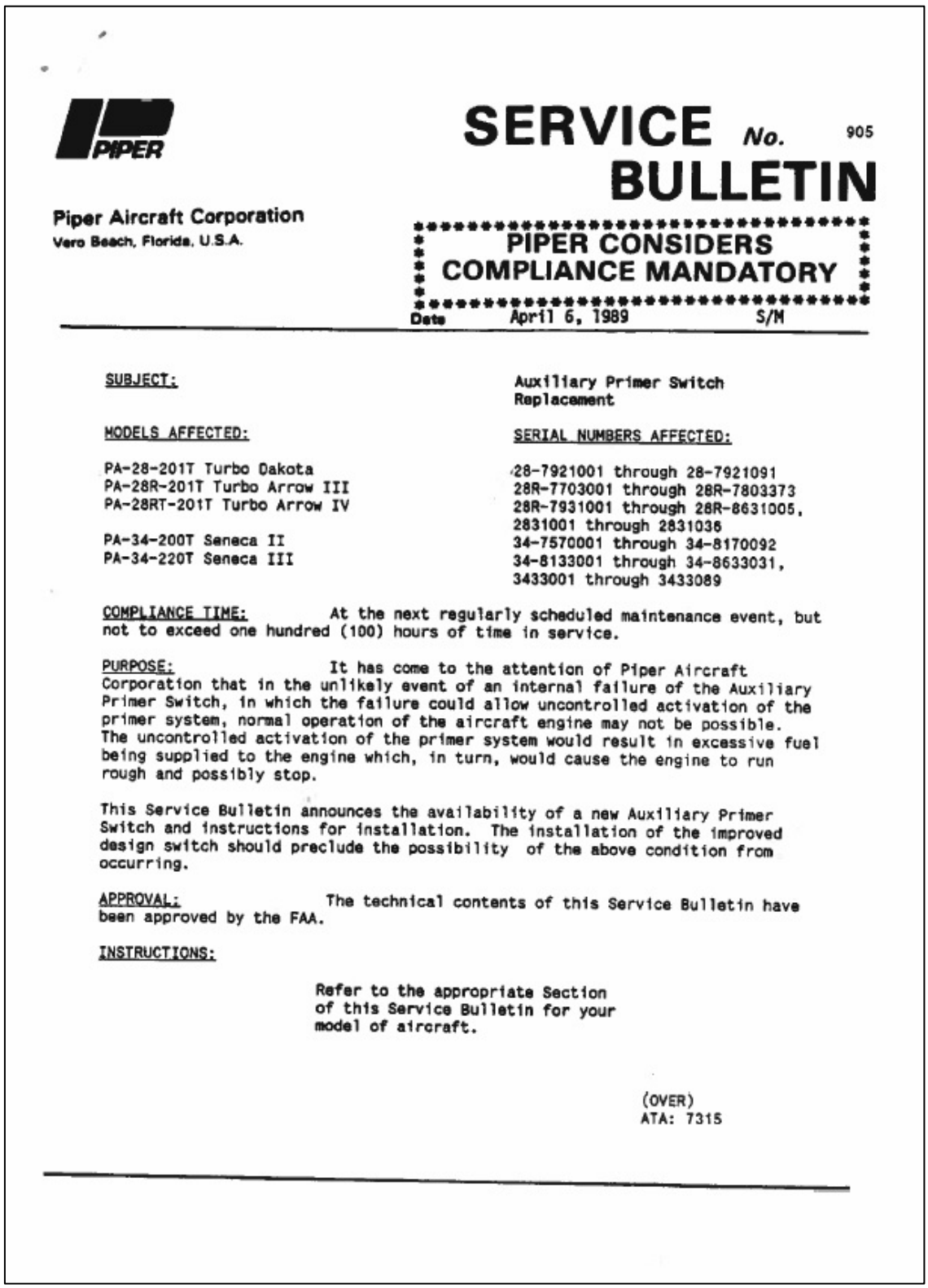


APPENDIX 3

Return to Fuel system

APPENDIX 4

Return to Technical safety investigation



PIPER

SERVICE BULLETIN No. 905

Piper Aircraft Corporation
Vero Beach, Florida, U.S.A.

PIPER CONSIDERS COMPLIANCE MANDATORY

Date April 6, 1989 S/M

SUBJECT: Auxiliary Primer Switch Replacement

MODELS AFFECTED:	SERIAL NUMBERS AFFECTED:
PA-28-201T Turbo Dakota	28-7921001 through 28-7921091
PA-28R-201T Turbo Arrow III	28R-7703001 through 28R-7803373
PA-28RT-201T Turbo Arrow IV	28R-7931001 through 28R-8631005, 2831001 through 2831036
PA-34-200T Seneca II	34-7570001 through 34-8170092
PA-34-220T Seneca III	34-8133001 through 34-8633031, 3433001 through 3433089

COMPLIANCE TIME: At the next regularly scheduled maintenance event, but not to exceed one hundred (100) hours of time in service.

PURPOSE: It has come to the attention of Piper Aircraft Corporation that in the unlikely event of an internal failure of the Auxiliary Primer Switch, in which the failure could allow uncontrolled activation of the primer system, normal operation of the aircraft engine may not be possible. The uncontrolled activation of the primer system would result in excessive fuel being supplied to the engine which, in turn, would cause the engine to run rough and possibly stop.

This Service Bulletin announces the availability of a new Auxiliary Primer Switch and instructions for installation. The installation of the improved design switch should preclude the possibility of the above condition from occurring.

APPROVAL: The technical contents of this Service Bulletin have been approved by the FAA.

INSTRUCTIONS:

Refer to the appropriate Section of this Service Bulletin for your model of aircraft.

(OVER)
ATA: 7315

APPENDIX 5

Return to Technical safety investigation

CONTINENTAL MOTORS® AIRCRAFT ENGINE

CRITICAL SERVICE BULLETIN

COMPLIANCE NECESSARY TO MAINTAIN SAFETY

CATEGORY 2

CSB19-01

TECHNICAL PORTIONS FAA APPROVED

SUBJECT: Fuel (Primer) Diverter Valve Assembly

PURPOSE: To assist Owners, Operators, and Maintenance Facilities with instructions to remove the fuel diverter valve assembly and provide available options to the fuel injection system for continued service.

COMPLIANCE: Within the next 25 hours of engine operation or the next scheduled inspection or engine servicing, whichever occurs first.

MODELS AFFECTED: New and rebuilt Continental Motors (CMI) IO-360-ES; LTSIO-360-E, EB & KB; TSIO-360-E, EB, F, FB, G, GB, KB, LB, MB & SB; TSIO-520-BE and TSIO-550-A, B, C & E aviation gasoline (AvGas) engines

I. GENERAL INFORMATION

Continental Motors has received reports of fuel (primer) diverter valve malfunction that can result in a partial or complete loss of power.

The fuel diverter valve assembly allows a small quantity of fuel to accumulate in each induction manifold for engine priming and to improve starting efficiency. The panel-mounted PRIME switch commands the airframe boost pump, delivering fuel flow through the priming nozzles for current design pre-start priming.

Introduction of the cylinder drain connector serves the same priming function and allows the removal of the fuel diverter valve assembly from current production model specifications.

CAUTION: Over-priming can lead to cylinder/piston hydrostatic lock. Reference the AFM/POH (Airplane Flight Manual/Pilot's Operating Handbook) for fuel mixture settings, priming times, proper engine ground starting and inflight restarting techniques to prevent inadvertent over-priming.

II. SCOPE

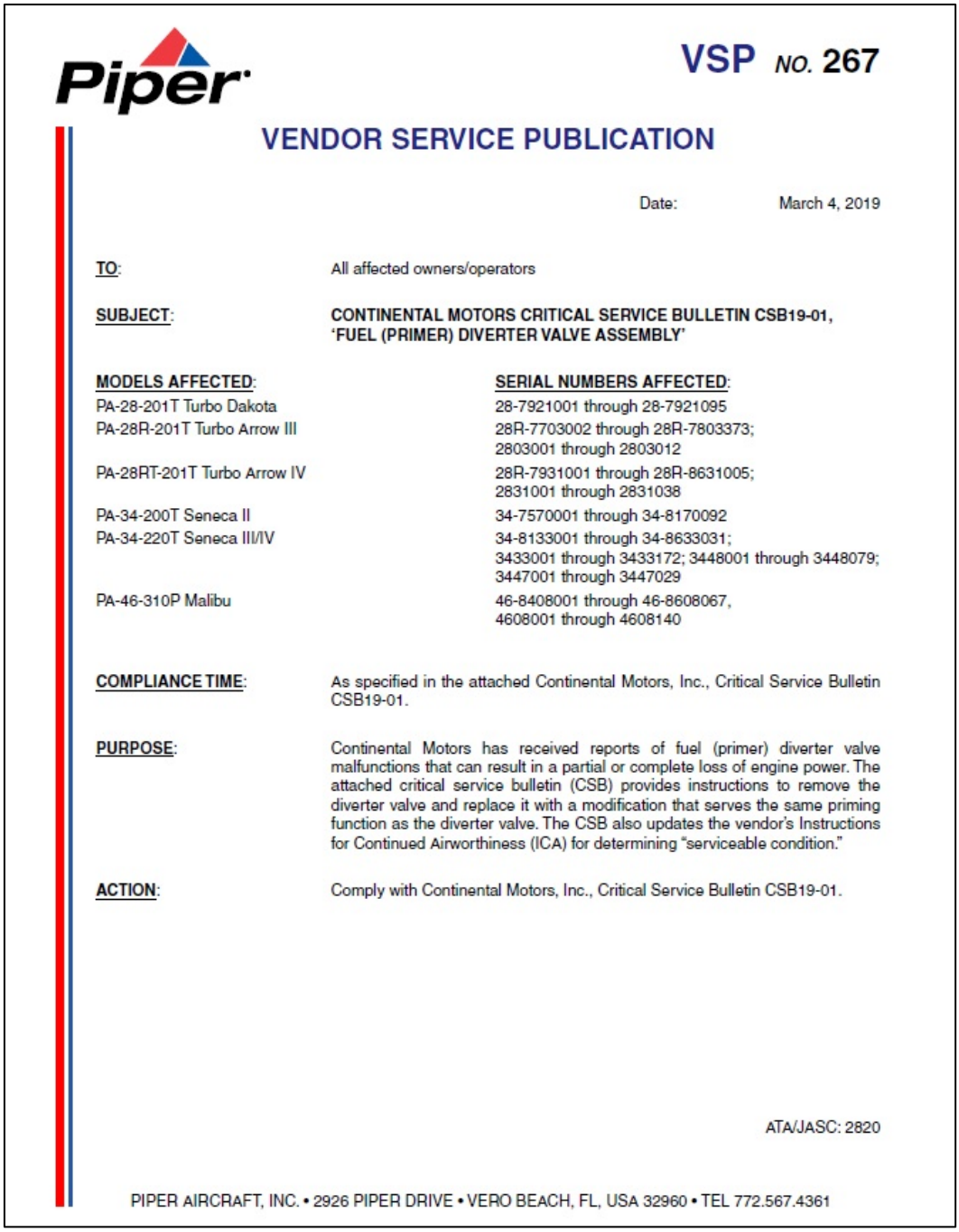
This Service Document provides instructions to reroute fuel flow from the mixture control outlet directly to the fuel manifold valve assembly. This procedure will remove (bypass) the fuel diverter valve assembly from the fuel injection system and terminate electrical connections servicing the fuel diverter valve assembly.

This Service Document updates the manufacturer's Instructions for Continued Airworthiness (ICA) for determining "serviceable condition". This procedure should be added to the "Engine Fuel System Inspection Checklist" and a copy of this bulletin must be inserted into the most current version of the applicable Maintenance and Overhaul manuals (as listed in the "Models Affected") until the data is incorporated into the manual, by revision, or the service document is retired.

ISSUED	REVISED		PAGE NO	DOC NO	REVISION
2019/02/07		P.O. Box 90 Mobile, AL 251-436-8299	1 of 10	CSB19-01	

APPENDIX 6

Return to Technical safety investigation



Piper

VSP NO. 267

VENDOR SERVICE PUBLICATION

Date: March 4, 2019

TO: All affected owners/operators

SUBJECT: **CONTINENTAL MOTORS CRITICAL SERVICE BULLETIN CSB19-01, 'FUEL (PRIMER) DIVERTER VALVE ASSEMBLY'**

MODELS AFFECTED:	**SERIAL NUMBERS AFFECTED**:
PA-28-201T Turbo Dakota	28-7921001 through 28-7921095
PA-28R-201T Turbo Arrow III	28R-7703002 through 28R-7803373; 2803001 through 2803012
PA-28RT-201T Turbo Arrow IV	28R-7931001 through 28R-8631005; 2831001 through 2831038
PA-34-200T Seneca II	34-7570001 through 34-8170092
PA-34-220T Seneca III/IV	34-8133001 through 34-8633031; 3433001 through 3433172; 3448001 through 3448079; 3447001 through 3447029
PA-46-310P Malibu	46-8408001 through 46-8608067, 4608001 through 4608140

COMPLIANCE TIME: As specified in the attached Continental Motors, Inc., Critical Service Bulletin CSB19-01.

PURPOSE: Continental Motors has received reports of fuel (primer) diverter valve malfunctions that can result in a partial or complete loss of engine power. The attached critical service bulletin (CSB) provides instructions to remove the diverter valve and replace it with a modification that serves the same priming function as the diverter valve. The CSB also updates the vendor's Instructions for Continued Airworthiness (ICA) for determining "serviceable condition."

ACTION: Comply with Continental Motors, Inc., Critical Service Bulletin CSB19-01.

ATA/JASC: 2820

PIPER AIRCRAFT, INC. • 2926 PIPER DRIVE • VERO BEACH, FL, USA 32960 • TEL 772.567.4361