MINISTRY FOR
INNOVATION AND TECHNOLOGY
TRANSPORTATION SAFETY BUREAU

FINAL REPORT

2017-371-4

Accident

Dunaújváros Airfield (LHDV)

04 August 2017

Bellanca 8GCBC

HA-KYL

The sole objective of the technical investigation is to reveal the causes and circumstances of aviation accidents, and aviation incidents, to initiate the necessary technical measures and make recommendations in order to prevent similar cases in the future. It is not the purpose of this activity to apportion blame or liability.

This document is the translation of the Hungarian version of the Final Report. Although efforts have been made to translate it as accurately as possible, discrepancies may occur. In this case, the Hungarian is the authentic, official version.

General information

This investigation was carried out by Transportation Safety Bureau on the basis of

- Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC,
- Act XCVII on air transport,
- Annex 13 identified in the Appendix of Act XLVI. of 2007 on the declaration of the annexes of the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents (hereinafter referred to as Kbvt.),
- Decree № 70/2015 (XII.1) of the Ministry of National Development on the technical investigation of aviation accidents and incidents, as well as on the detailed investigation for operators, and,
- In absence of other relevant regulation in the Kbvt., in accordance with Act CXL of 2004 on the general rules of administrative authority procedure and service.

The competence of the Transportation Safety Bureau of Hungary is based on Government Decree 278/2006 (XII. 23.) and as from 01 September 2016, on Government Decree № 230/2016. (VII.29.) 23) on the assignment of a transportation safety body and on the dissolution of Transportation Safety Bureau.

Under the aforementioned regulations,

- The Transportation Safety Bureau of Hungary shall investigate aviation accidents and serious aviation incidents.
- Transportation Safety Bureau Hungary may investigate aviation accidents and incidents which – in its judgement – could have led to more accidents with more serious consequences in other circumstances.
- The Transportation Safety Bureau of Hungary is independent of any person or entity which may have interests conflicting with the tasks of the investigating organisation.
- In addition to the aforementioned laws, the ICAO Doc 9756 and the ICAO DOC 6920 Manual of Aircraft Accident Investigation are also applicable.
- This Final Report shall not be binding, nor shall an appeal be lodged against it.
- The original of this Report was made in the Hungarian Language.

Incompatibility did not stand against the members of the IC. The persons participating in the technical investigation did not act as experts in other procedures concerning the same case and shall not do so in the future.

The IC shall safe keep the data having come to their knowledge in the course of the technical investigation. Furthermore, the IC shall not be obliged to make the data – regarding which the owner of the data could have refused its disclosure pursuant to the relevant act – available for other authorities.

This Final Report was based on the Draft Report which prepared by the IC and sent to all affected parties (as stipulated by the relevant regulation) for comments.

Table of Contents

Definitions and Abbreviations

°C	*Celsius centigrade (temperature unit)*
°F	*Fahrenheit degree (temperature unit)*
AD	*Airworthiness Directive*
ARP	*Airport Reference Point*
CB	*Circuit Breaker*
EASA	*European Aviation Safety Agency*
FAA	*Federal Aviation Administration*
IC	*Investigating Committee*
ICAO	*International Civil Aviation Organization*
Kbvt.	*Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents and other transportation occurrences*
LT	*Local Time*
MIT	*Ministry for Innovation and Technology*
MTOW	*Maximum Take Off Weight*
MND	*Ministry of National Development*
NTA AA	*National Transport Authority, Aviation Authority (Hungary) (till 31 December 2016)*
NTSB	*National Transportation Safety Board*
SAIB	*Special Airworthiness Information Bulletin*
SEP (land)	*Single Engine Piston Airplane (land)*
SL	*Service Letter*
TSB	*Transportation Safety Bureau of Hungary*
UTC	*Coordinated Universal Time*

Introduction

Event category		Accident
Aircraft	Manufacturer	Bellanca Aircraft Corporation, USA
	Type	Bellanca 8GCBC
	Registration	HA-KYL
	Operator	Malév Aero Club
Event	Date and time	04 August 2017 16:10
	Location	Dunaújváros Airfield (Figure 1)
Fatalities / severe injuries related to the accident:		0 / 0
Extent of damage to the aircraft involved:		Destroyed

Each time indicated in this Report is local time. At the time of the accident: LT= UTC+ 2 hours.

Figure 1: Location of the occurrence in Hungary

Report and notifications

The occurrence was reported to the duty service of TSB on 04 August 2017, at 17:10.

MND TSB notified:

- civil aviation authority of Hungary, on 04 August 2017.
- European Aviation Safety Agency (EASA), on 08 August 2017.
- National Transportation Safety Board (NTSB-t) as the investigating organisation of the State of the manufacturer, on 08 August 2017.

The following notified foreign organizations assigned and authorised representatives for the investigation:

- European Aviation Safety Agency (EASA)
- The investigating organisation of the State of the manufacturer (NTSB)

NTSB named contact persons from the following organisations:

- Manufacturer of the aircraft (American Champion Aircraft Corporation)
- Federal Aviation Administration (FAA), after the issue of the safety Recommendation.

Investigating Committee

The following investigating committee (hereinafter: the "IC") was assigned to investigate into the occurrence:

Investigator-in-Charge	**Mr Ferenc Kamasz**	Accident Investigator
Member	**Mr Gábor Erdősi**	Accident Investigator

Overview of the investigation

- The IC investigated the scene of the occurrence, took photos of the wreck of the aircraft, the documents of the pilot and the aircraft, and made interviews with the pilot and the eyewitnesses about the accident.
- The IC notified NTSB and EASA of the occurrence.
- The IC contacted (through NTSB) the manufacturer of the aircraft who then sent the IC the Service Letter 418 (SL418) relating to the electrical system of the aircraft.
- The IC studied the SL418 document, and inspected the wreck again to find out whether the electrical system of the aircraft was the original or a modified construction according to the SL418. The IC took further photos of the wreck.
- The inspection clearly showed that the electrical system of the aircraft did not contain the firewall fitting specified in the SL418 but reflected the original factory design. The IC found marks of electrical discharge at the passage of the high power cable through the plane of the firewall. On the basis of that, the IC determined that the fire had started at that point.
- On 18 October 2017, the IC issued a safety recommendation under Number BA2017-371-4-1A to FAA requesting them to consider the possibility of issuing the modification Number SL418 relating to the electrical system of the aircraft in the form of an AD.
- On 22 January 2018, FAA informed the IC that they would consider issuing an AD, but needed further discussion with the aircraft manufacturer before a final decision.
- In a letter of 08 June 2018, FAA informed the IC that, they analysed all known information within their monitor safety analysis database associated with the electrical system for all American Champion (Aeronca, Bellanca, and Champion) seven and eight series airplanes, and in accordance with the agency's small airplane risk analysis handbook.
- MIT TSB sent the Draft Report on the investigation to the NTSB, the EASA, the civil aviation authority of Hungary, the owner of the airplane and the pilot-in-command on 18 October 2018.
- The organisations and persons answered they had no proposal for modification to the Draft Report.

Synopsis

On 04 August 2017, at about 16:10, the pilot boarded the aircraft, performed pre-flight checks, and then tried to start the engine. After he pushed the start button, fire started in the engine compartment of the aircraft. Then the pilot closed the fuel shut off valve, switched the primary electrical system off, and left the aircraft.

When the pilot got out of the plane, the engine compartment and the hood were in flames already. The people staying around the aircraft attempted to extinguish the fire by portable fire extinguishers, but they were unsuccessful. Then they drew the burning aircraft away from the vicinity of other aircraft with the help of a rope attached to the tail of the aircraft in order to prevent propagation of the fire.

The aircraft burnt out in the occurrence, but no one was injured.

The investigation revealed that the fire in the aircraft started at the passage of the high power cable through the firewall. The fire occurred due to a short circuit.

The IC found that similar occurrences can be prevented by modifying the electrical system of the aircraft as specified in the Service Letter Number 418.

For the sake of preventing similar occurrences, the IC elaborated a safety recommendation for FAA to consider the possibility to issue the Service Letter Number 418 in the form of an AD.

1. Factual Information

1.1. History of the flight

On 4 August 2017 at Dunaújváros Airfield, sailplanes were launched by aerotow. Takeoffs were performed on a continuous basis from Runway 14, three airplanes provided aerotow. Flights took place in daytime circumstances, in good conditions of visibility. When the aircraft with registration mark HA-KYL performed its sixteenth landing, there were fewer sailplanes waiting for aerotow already, so the pilot of the towing airplane taxied to the assigned holding point, and shut the engine off.

After ca. 15 to 20 minutes, the pilot boarded, performed the pre-flight checks, and attempted to start the engine. After he pushed the start button, the people around the aircraft indicated to him, shouting loudly, that there was fire in the engine compartment. The pilot found that the engine did not start and that the fire was spreading very fast. According to his report, he then closed the fuel shut off valve, switched the primary electrical system off, and left the aircraft.

When the pilot got out of the plane, the engine compartment and the hood were in flames already. The people staying nearby attempted to extinguish the fire by portable fire extinguishers, but they were unsuccessful. Then they drew the burning aircraft away from the vicinity of other aircraft with the help of a rope attached to the tail of the aircraft in order to prevent propagation of the fire.

1.2. Injuries to persons

No one was injured during the occurrence.

1.3. Damage to aircraft

The aircraft burnt out and was destroyed as a consequence of the fire.

1.4. Other damage

The IC had got no information on other damage by the completion of the investigation.

1.5. Crew data

1.5.1. Data of the pilot-in-command

Age, citizenship, gender		53 years, Hungarian, male
License data	Type	PPL(A),
	Professional validity until	31 May 2019
	Ratings	SEP (land), TMG, Towing
	Qualification	Pilot in command (since 13 October 1992)
Medical certificate valid until		12 April 2018
Flight Hours/ Flight Cycles	On the day of the occurrence	1 hour and 45 minutes / 16 take-offs

Further details of the pilot's experience are irrelevant to the occurrence.

1.6. Aircraft data

1.6.1. General data

Class	Fixed wing aircraft (MTOW<5700kg)
Manufacturer	Bellanca Aircraft Corporation, USA
Type	Bellanca 8GCBC
Year of manufacturing	1976
Serial number	199-76
Registration mark	HA-KYL
State of registration	Hungary
Date of registration	05 July 2011
Owner	Private person
Operator	Malév Aero Club

	Flight Hours	Cycles
Since manufacturing	3250 hours	No data
Since last 50-hour maintenance (06 May 2017)	42 hours 15 minutes	No data

1.6.2. Findings relating to airworthiness

Airworthiness Certificate	Number	FD/LA/NS/B/286/2/2011
	Date of issue	05 June 2011
	Valid until	Withdrawal
	Restrictions	None

Airworthiness Review Certificate	Number	LFH/24812-1/2017-NFM
	Date of issue	30 April 2017
	Valid until	30 April 2018
	Date of last review	30 April 2017

1.6.3. Aircraft engine data

Sort	Piston, 4 cylinders, air-cooled boxer engine
Manufacturer	Lycoming
Type	O-360-C2E
Serial number	L-21192-36A
Operation time = time on ground + flight time	
Since manufacturing	3562 hours
Since last overhaul	50.74 hours
Since last periodical maintenance (5-hour oil change after overhaul)	45.74 hours

1.6.4. Aircraft loading data

Aircraft loading data had no effect on the occurrence therefore it needs no detailed discussion.

1.6.5. Malfunctioned system information

Marks of electrical discharge at the passage of the high power cable through the firewall (the area indicated by the red arrow in Figure 2).

Figure 3 shows the cable led through the firewall (cable Nr.99 in Figure 10); the cable melted in the plane of the firewall (see detailed description of the electricity system of the aircraft in Chapter 1.18.1).

Figure 2: Location of the cable passage in the firewall

Figure 3: The cable which melted at the passage

This cable is always energised when the master switch of the aircraft is on.

1.7. Meteorological information

The event occurred at daytime, in good visibility conditions.
The weather was sunny in the whole country until the second half of the afternoon on 4 August 2017, a few cumulus clouds were formed only in the northern counties. Peak temperatures varied between 34°C (93°F) and 41°C (106°F) in the country, with 41°C (106°F) as the highest value, which made the day the hottest summer day in that year.

1.8. Navigation equipment

The navigation aids had no effect on the course of events therefore they need no detailed discussion.

1.9. Communications

The communication equipment had no effect on the course of events therefore it needs no detailed discussion.

1.10. Airport data

Earlier takeoffs and landings on that day took place at Dunaújváros Airfield, as well as the engine start which evoked the occurrence.

The airfield involved in the occurrence had valid operating licence.

Name	Dunaújváros Airfield
ICAO Code	LHDV
Operator	Dunaferr Aero Club
Coordinates of the (ARP)	N 46°53’42”; E 18°54’37”
Altitude above sea level	123 metres
Runway direction	140°, 320°
Runway dimensions	950 x 60 metres
Runway surface	grass
State of the runways at the time of the occurrence	Hard, dry

1.11. Data recorders

The aircraft had no flight data recorder which is not required for the aircraft type involved in the occurrence.

1.12. Wreckage and impact information

Figure 4: The aircraft with registration mark HA-KYL after the accident

During the accident, the fire started in the engine compartment of the aircraft and simultaneously in the cockpit as well, and then it spread to the fuel system of the aircraft (see Chapter 1.14 for detailed description).

Due to the burning of fuel, the aircraft burnt out within very short time, ca. 2 to 3 minutes (Figure 4).

1.13. Medical and pathological information

No forensic medical investigation was performed relating to the event.

1.14. Fire

The people staying at the scene made photos taken of the burning aircraft available to the IC.

Figure 5: Spread of the fire along the fuel pipe in the direction of the wing tank

Figure 5 shows the engine compartment on fire, and also the spread of the flames along the fuel pipe running along the windshield frame to the wing tank.

In figure 6, the fire had already reached the tank, melted its front section, then fuel flowed along the bottom surface of the wing and spread the flames wide under the wing.

Figure 6: The front section of fuel tank melted, and fuel spread along the bottom surface of the tank

Figure 7 shows that more and more fuel spilt from the fuel tank, it could not hold and burn on the lower surface of the wing but flowed down to the ground and spread there. The burning fuel led the flames to the ground, and the spreading fire set the rest of the aircraft on fire as well.

Figure 7: The fuel spilt from the fuel tank to the ground where it spread out

The photos in Figures 5, 6 and 7 were taken using the same digital camera. The time of their taking shows that Photos 5 and 6 were taken in the same minute, while a minute lapsed between Photo 5 and 7 was 1 minute. Based on time data of the photos available, the IC concluded that the time between the ignition of the fuel system and the full burnout of the airplane seen in Figure 4 was very short, ca. 2 to 3 minutes.

1.15. Survival aspects

No one was injured during the occurrence.

1.16. Tests and research

On 23 August 2017, the IC held an additional survey of the wreck of the aircraft, and also viewed a serviceable type Bellanca 7GCBC aircraft. The piston engines of the models 7GCBC and 8GCBC are different, but the firewall designs are very similar.

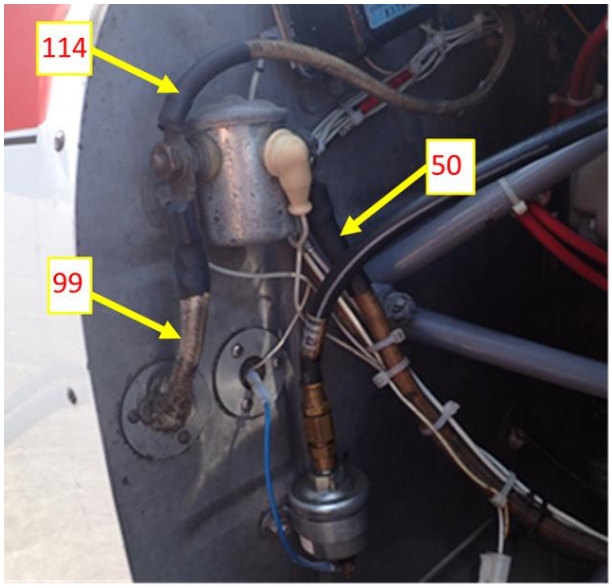

Figure 8: Firewall of the Bellanca 7GCBC airplane

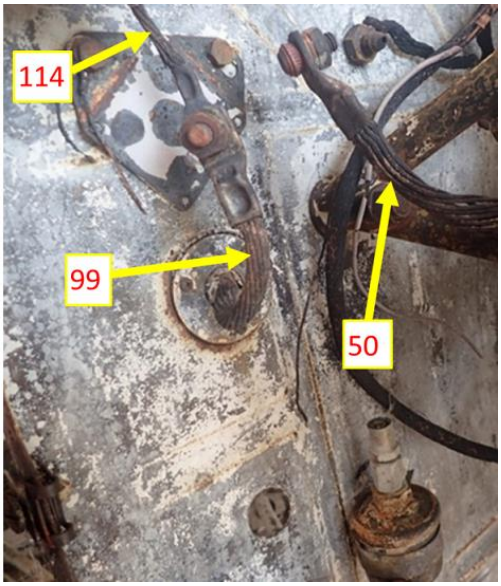

Figure 9: Firewall of the HA-KYL airplane

On the basis of the Starter Solenoid position of the type 7GCBC airplane, the IC placed the melted piece of the cable (Figure 3) of the airplane with registration mark HA-KYL on the firewall, positioning it at the place of the Starter Solenoid (Figure 9, the cable indicated as Nr.99). The experiment showed that the high voltage cable melted in the plane of the firewall.

1.17. Organisational and management information

The activities of the organisations affected had no effect on the course of events therefore they need no detailed discussion.

1.18. Additional information

1.18.1. Factory design of the primary electrical system of the airplane

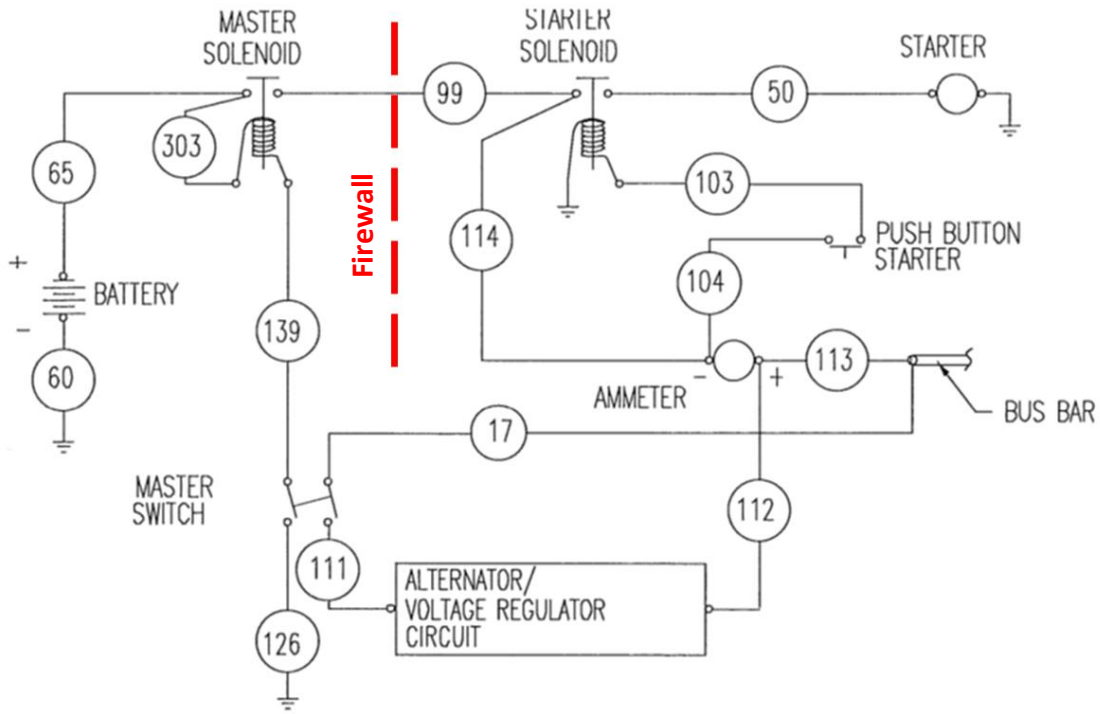

Figure 10 (Source: SL 418)

According to the factory design seen in Figure 10, the battery and the Master Solenoid are installed behind the cockpit, in the tail of the airplane. A high power cable (Nr.99 in Figure 10) runs from the Master Solenoid to the Starter Solenoid which is situated in the engine compartment of the airplane. The Starter Solenoid and the Starter are also connected by a high power cable (Nr.50 in Figure 10). The plane of the firewall is indicated by a red dashed line in Figures 10 and 11.

The molten piece of the high power cable (Figure 3) of the airplane with registration mark HA-KYL is that section of the cable (Nr.99 in Figure 10) which is between the Starter Solenoid and the firewall.

Due to large current consumption of the starter, the circuits of the cables Nr.65, Nr.99 and Nr.50 cannot be protected with fuses, for the sake of reliable operation of the starter. Accordingly, in the case of a possible short circuit to the frame, the two poles of the battery are shorted through the high power cable, and the amperage of the current flowing through the cables will be the maximum amperage of the battery. The high power cables will heat, glow, and melt due to high amperage of the current flowing through them. The melting temperature of copper cable is 1085°C (1985°F).

1.18.2. Design of the primary electrical system of the airplane after modification pursuant to the Service Letter Number 418

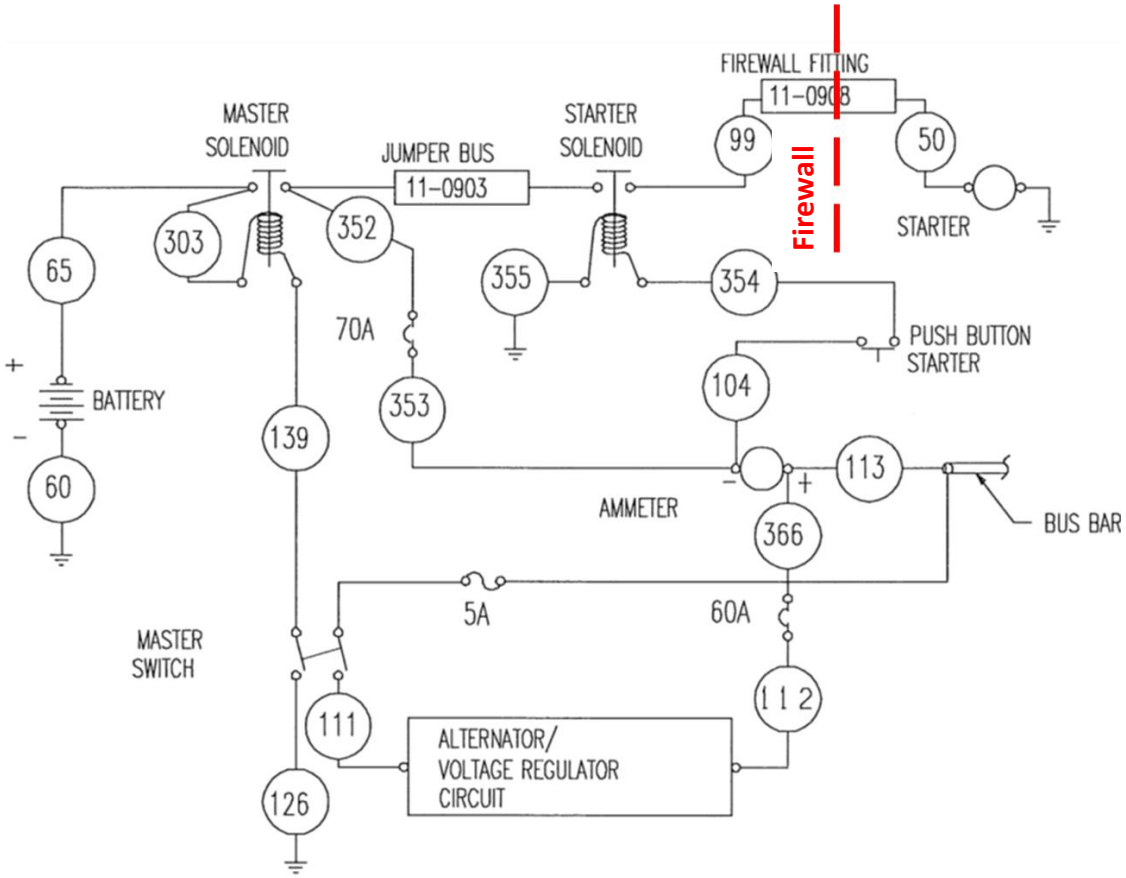

Figure 11 (Source: SL Nr. 418)

Figure 11 shows the electrical system (modified according to the Service Letter Number 418) of the airplane type Bellanca 8GCBC.

An important change compared to the earlier layout is that the Starter Solenoid was repositioned from the engine side of the firewall to the cockpit side, and thus, the cables Nr.99 and Nr.50 are powered only during the period of engine start. Another modification is that a new connecting piece (Firewall Fitting, see Figure 12) has been installed instead of leading the high power cable through the firewall, and the cables Nr.99 and Nr.50 are linked by that fitting. Another important change is that a 5-Ampere fuse has been installed in the exciter circuit of the alternator, a 60-Ampere circuit breaker in its main circuit, and a 70-Ampere circuit breaker in the circuit of the ammeter. By implementing these modifications, electrical fire may be prevented in the case of a possible sudden overcurrent.

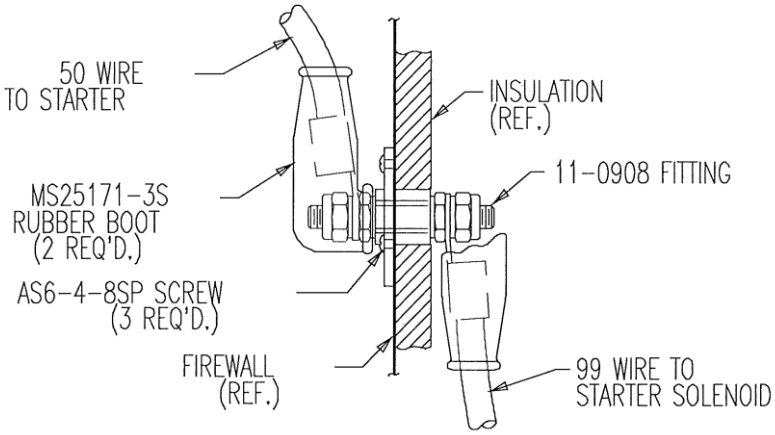

Figure 12: Firewall connection (Source: SL Nr. 418)

1.18.3. Design of the fuel system of the airplane

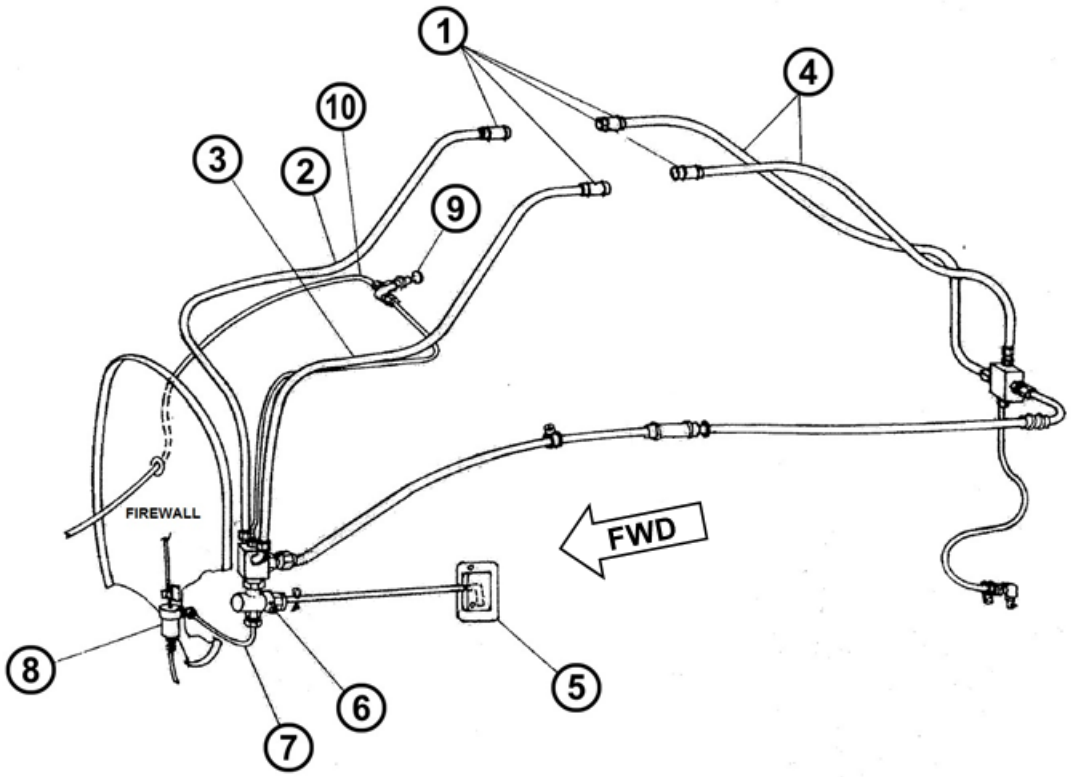

Figure 13: The airframe fuel system of the airplane
(Source: after Champion Service Manual)

Figure 13 shows the positions of the parts of the fuel system of the type Bellanca 8GCBC as situated in the airframe. The fuel system of the airframe is linked with the wing tanks through the connections Nr.①. Due to gravitation, the fuel flows to the frontal junction through the pipes Nr.② and Nr.③ and to the rear junction through the pipes Nr.④, respectively. When the pilot (using the lever Nr.⑤) opens the fire valve Nr.⑥, the fuel flows through the pipe Nr.⑦ to the fuel filter Nr.⑧ and then, through a flexible hose, to the carburettor. The fuel filter is located at the engine compartment side of the firewall. When cold-starting the engine, one may use the manual injector Nr.⑨ to inject extra fuel into the carburettor through the pipe Nr.⑩ in order to make start simpler.

1.19. Useful or effective investigation methods

The investigation did not require techniques differing from the conventional approach.

2. Analysis

2.1. Investigation of the aircraft fire:

The IC found the aircraft in burnt-out state when arriving to investigate the scene of the accident (Figures 4 and 14).

Figure 14: The wreck of the aircraft with reg. mark HA-KYL at the time of the investigation of the scene

The IC viewed the photographs (see Figures 5, 6, and 7 in Chapter 1.14) taken by witnesses. The fire in the engine compartment can be seen in Figure 5, as well as the way how the fuel pipe running along the windshield frame (pipe Nr.3 in Figure 13) leads the flame of the fire to the fuel tank installed in the wing. Due to gravitation, the wing tank provided the fire with fuel supply through the molten aluminium pipe, as a result of which the fire quickly spread to the fuel tank and melted it. Flowing through the molten opening of the fuel tank, the fuel ran along the bottom surface of the wing, and spread the flames beneath the wing (Figure 6).

Figure 15: The molten fuel tank

As an effect of the fire, the openings in the fuel tanks became larger and larger (see locations indicated by yellow arrows in Figure 15), letting more and more fuel spill from the tanks. The spilt fuel could not stick to the bottom surface of the wings any more but flowed down to the ground where it spread, guiding the flames all along, and set the rest of the aircraft on fire (Figure 7).

2.2. Identifying the starting point of the fire:

According to information from witnesses, fire (smoke) was first seen at the engine compartment, after which they warned the pilot who shut off electricity in the aircraft, shut the fire valve of the fuel system, and got out of the aircraft.

The IC viewed the burn marks in the engine compartment of the aircraft, and determined the process of spread of the fire in the engine compartment.

The IC viewed the high power cable (Nr.50 in Figure 10) at the starter and at the firewall (Figures 16 and 17). The insulation was molten on the wire at the end of the cable which is at the starter, while the insulation was fully burnt off the wire and the wire was discoloured at the other end which is at the firewall.

Figure 16: end of cable Nr.50 at the starter

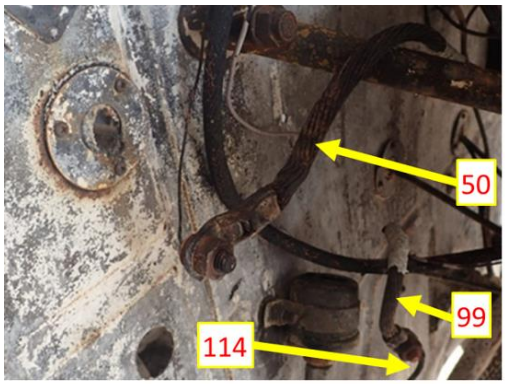

Figure 17: end of cable Nr.50 at the firewall

This suggests that the starter end of the cable Nr.50 was exposed to much lower temperatures than its firewall end, i.e. the melting of the cable was not due to engine fire.

The IC inspected the passage of the high power cable through the firewall where marks of electrical discharge can be seen (Figure 2), and a mark of melting can be seen on this cable in the plane of the firewall (Figure 3). This cable (Nr.99 in Figure 10) is powered when the main switch of the aircraft is ON, i.e. this discharge must have been generated before the pilot shut off the electrical system of the aircraft, using the main switch, through the Master Solenoid (Figure 10).

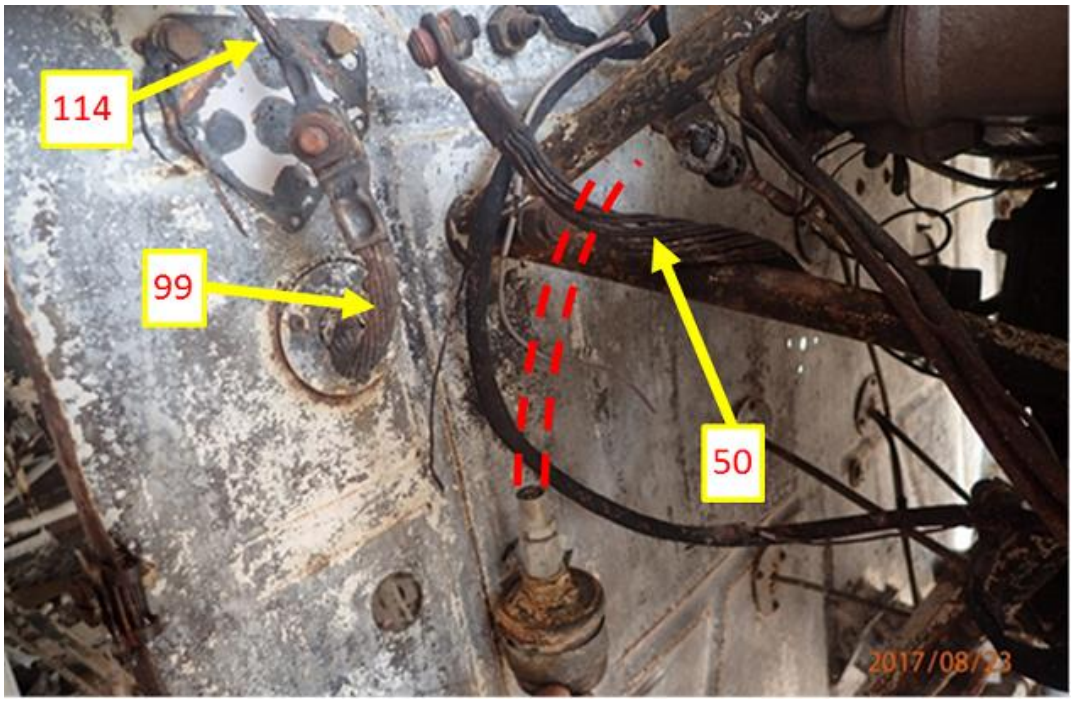

Figure 18: The firewall seen the engine compartment (with the cables Nr.99 and Nr.50 in place)

The melting temperature of copper is 1085°C (1985°F); the cable Nr.99 reached that temperature at the passage through the firewall. Thermal conductivity of copper is very good, so it began to glow quickly in both directions from the passage: toward the engine compartment as well as the cabin.

2.3. Development of fire in the engine compartment:

The position of the IC is that the cable Nr.50 was heated up through the Starter Solenoid by the heated and melted cable Nr.99. The insulation of the glowing hot cable Nr.99 burnt (Figure 18), and then, after the aluminium housing of the Starter Solenoid melted, the cable moved downward due to gravity. Hanging on the cable Nr.114 attached to it, the cable Nr.99 moved in the direction of the engine (Figure 17). The moving cable Nr.99 hit the flexible rubber hose of the oil pressure transmitter (red dashed line in Figure 18), melted it, and the oil spraying from the rubber hose caught fire by self-ignition when contacting the hot exhaust system. The flames arising at the exhaust throat melted the cylinder head oil return pipe (the pipe highlighted with a yellow circle in Figure 19) at the right front cylinder of the boxer engine, and the leaking oil also supplied the fire.

Figure 19: The right-hand side cylinders and exhaust system of the boxer engine

The composite engine housing caught fire and burnt as a consequence of the burning of the lubricating oil.

Figure 18 also shows that the firewall did not burn through, the fire did not penetrate it, but two fires started independently: on at the engine compartment side, and the other at the cockpit side of the firewall.

2.4. Development of fire in the cockpit:

According to the position of the IC, the fire in the cockpit started due to the glowing cable end which was part of the cable Nr.99 which had melted in the plane of the firewall. This part of the cable remained energised until the pilot shut the electricity off using the main switch. The energised cable continued to glow when contacting the aluminium structure of the airframe, and ignited every combustible material it contacted.

The IC could not determine exactly the path of the spread of the fire in the cockpit, because large quantities of fuel spilt into this area from the fuel pipes due to gravity, which made it the core of the fire, so very few parts were left in this area after the fire. Figure 20 shows the cabin of a type Bellanca 7GCBC which is very similar to that of the Bellanca 8GCBC. Major items

made of combustible materials in the cockpit environment: the side cover panels, the carpet, the insulation of electric cables behind the dashboard, and the linen cladding of the airframe.

Figure 20: Illustration: cockpit of a type Bellanca 7GCBC aircraft

As soon as the fire reached the pipe of the right-hand side fuel tank (pipe Nr.② in Figure 13) crossing the dashboard horizontally, the pipe melted.

As the pipes of the fuel tanks of both sides (pipes Nr.② and Nr.③ in Figure 13) were upstream of the fire valve, the fuel was able to flow freely from the tanks through them despite the closed position of the fire valve when they were damaged.

The fuel spilling from the pipe due to gravity continued to nourish the fire and guided the flames very fast to the left and right fuel tanks where the fire soon spread over the entire airplane.

2.5. Primary Electrical System of the airplane:

The IC was informed by the manufacturer that the electrical cable had caused fire at its passage through the firewall on Bellanca aircraft in at least 8 cases before. On 19 January 2001, the manufacturer issued its Service Letter № SL418 which contains a modification (i.e. update) of the electrical system of the aircraft. The IC deals with the factory design of the electrical system of the aircraft in detail in Chapter 1.18.1, and with the electrical system modified according to the SL Nr. 418 in Chapter 1.18.2.

The IC concluded through the investigation that similar occurrences can be prevented by modification of the of the electrical system of the aircraft according to the Service Letter Number 418, so the IC formulated a safety recommendation for the FAA (see in detail in Chapter 4.2) on 18 October 2017.

3. Conclusions

3.1. Factual findings

The pilot had appropriate licence and rating at the time of the occurrence, and significant experience for the given flight task. He performed the flight in compliance with the requirements in effect.

The aircraft was airworthy. It had a valid Airworthiness Certificate as well as a valid Airworthiness Review Certificate. According to its documents, it was equipped and maintained in compliance with the legal requirements in effect as well as with accepted procedures.

The aircraft had been filled with sufficient fuel for the flight.

The flight started according to schedule, in good visibility conditions by daytime, but, due to the fire, it ended before engine start.

No information was found relating to the activity of the ground personnel or to properties of the airfield which could be related to the occurrence.

3.2. Causes of the occurrence

The IC concluded through the investigation that the immediate cause of the occurrence was as follows:

- as a consequence of a short circuit, the high power cable began to glow and split up in such manner that its falling pieces were able to ignite combustible materials both in the engine compartment and in the cockpit.

The root cause behind the immediate cause:

- A short circuit occurred at the passage of the high power cable through the firewall.

Contributing factor:

- the maximum ambient temperature was unusually high, 41°C (106°F) on the day of the occurrence, which was favourable for the development and rapid spread of the fire in the airplane.

4. Safety recommendations

4.1. Actions taken by the organisations involved in operation and by the competent authorities during the investigation

The IC has no information on any extraordinary action taken by the affected organisations or authorities relating to the occurrence during the investigation.

4.2. Safety recommendation issued during the investigation

TSB issued the following safety recommendation during the investigation on 18 October 2017:

BA2017-371-4-1A: *In the course of its investigation, the Investigating Committee of Transportation Safety Bureau of Hungary found that the fire probable started at the passage of the high power cable through the firewall. Proofs of this are the signs of the electrical discharge at the passage, and melting of the electric cable in the plane of the firewall.*
The manufacturer of the aircraft (American Champion Aircraft Corporation) made a modification (Service Letter 418) relating to the electrical system of the aircraft type Bellanca in 2001.
According to information received from the manufacturer during the investigation, there have been 8 aviation incidents before in which an airplane fire was caused by short circuit between an aged cable and the firewall. For this reason,

> **Transportation Safety Bureau of Hungary recommends Federal Aviation Administration to consider the possibility to issue an Airworthiness Directive in accordance with Service Letter 418 Rev.A made by American Champion Aircraft Corporation.**

By acceptance and expected implementation of the safety recommendation, the risk of similar engine compartment fire can be reduced in the future.

On 22 January 2018, FAA informed the IC that they considered issuing an AD on the basis of the Safety Recommendation Number BA2017-371-4-1A, but they needed further consultation with the manufacturer of the aircraft before a final decision.

In a letter of 08 June 2018, FAA informed the IC that they analysed all known information within their monitor safety analysis database associated with the electrical system for all American Champion (Aeronca, Bellanca, and Champion) seven and eight series airplanes, and in accordance with the agency's small airplane risk analysis handbook. The result of their analysis indicated that the risk for this issue is well below the risk threshold for an AD action.

FAA informed the IC in a letter of 10 October 2018 that FAA had published Special Airworthiness Information Bulletin CE-18-20 (See Annex 2) on 12 July 2018. This SAIB recommends airplane owners and operators to comply with the American Champion Service Letter Number 418, Revision A. The FAA also sent a copy of this SAIB to the European Aviation Safety Agency.

4.3. Safety recommendation issued after the investigation

The Investigating Committee of TSB identified no circumstance which wold require issuance of further safety recommendation following the Safety Recommendation Nr. **BA2017-371-4-1A** issued during the investigation.

Budapest, 09 January 2019

Ferenc Kamasz
Investigator-in-Charge

Gábor Erdősi
IC Member

ANNEXES

Annex 1: Service Letter Number 418

American Champion Aircraft Corp.
Rochester, WI 53167

Service Letter: 418 (page 1 of 5) Revision A

Date: January 19, 2001

Title: Electrical System Update

Applicable Models:
All Model 7FC, 7GC, 7HC, 7GCA, 7JC, 7GCB, 7KC, 7GCBA, 7KCAB, and 7ACA
All other early model 7's (7AC, 7BCM, 7CCM, 7DC, 7EC, and S7EC) with electrical systems
All Model 7ECA, serial numbers 1 through 1381-2000
All Model 7GCAA, serial numbers 1 through 438-2000
All Model 7GCBC, serial numbers 1 through 1288-2000
All Model 8KCAB, serial numbers 1-70 through 859-2000
All Model 8GCBC, serial numbers 1-74 through 412-2000

Description: There have been reports of electrical system related problems including grounded wires causing fires and grounded wires melting through the insulation of adjacent wires, grounding them as well. Several causes can lead to these conditions including aged wires and insulation, improper installation, and insufficient inspection. To help prevent further instances of failures, the electrical system should be modified as described in this service letter.

Note: It is important to understand that there is a wide variety of installations spread across many aircraft models and encompassing many years of production. Not all specific instructions can apply to every airplane. It is suggested that the principals of the changes be applied as closely as possible.

Compliance: American Champion Aircraft recommends that the system be inspected within the next 30 hours of flight time. It is recommended that the modifications described herein take place during the next annual inspection. Required parts can be found in Service Kit 418A (for firewall mounted batteries) or Service Kit 418B (for aft mounted batteries).

The inspection procedures described herein are not intended to be a substitute for a properly performed 100 hour / annual inspection. Refer to Advisory Circular (AC) 43.13: Acceptable Methods, Techniques, and Practices; Aircraft Inspection and Repair.

Inspection: Inspect the electrical system for general condition (wear, connections, resistance, etc.). If an electromechanical voltage regulator and over-voltage relay are installed, check them for proper operation.

Concept: The primary electrical system on most rear mounted battery models looks similar to the schematic in figure 1. The diagram has been simplified to show only the affected areas. Upon inspection, it can be seen that there is no circuit protection for the voltage regulator circuit before the voltage regulator. This wire is in a bundle with other critical wires and is a source of concern. Also, the circuit from the battery to the bus bar is not protected. This was due to the 'sharing' of a line to the starter. To accommodate circuit protection for these two circuits, the electrical system must be modified to look similar to figure 2.

American Champion Aircraft Corp.
Rochester, WI 53167

Service Letter: 418 (page 2 of 5) Revision A

Date: January 19, 2001

Title: Electrical System Update

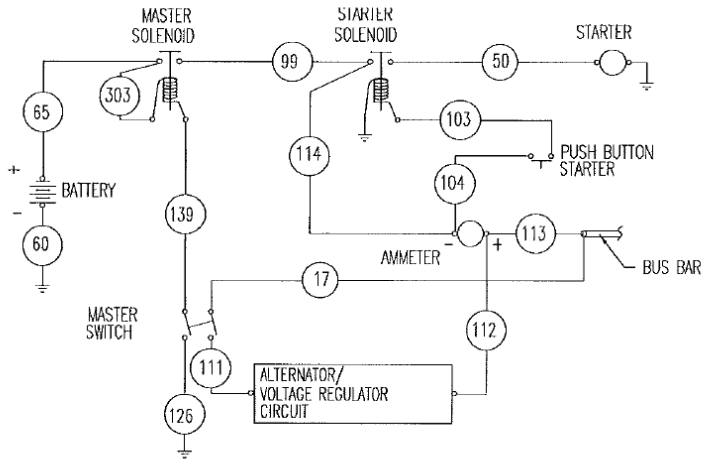

Figure 1 Schematic of Primary Electrical System (Aft Mounted Battery) Before Modification

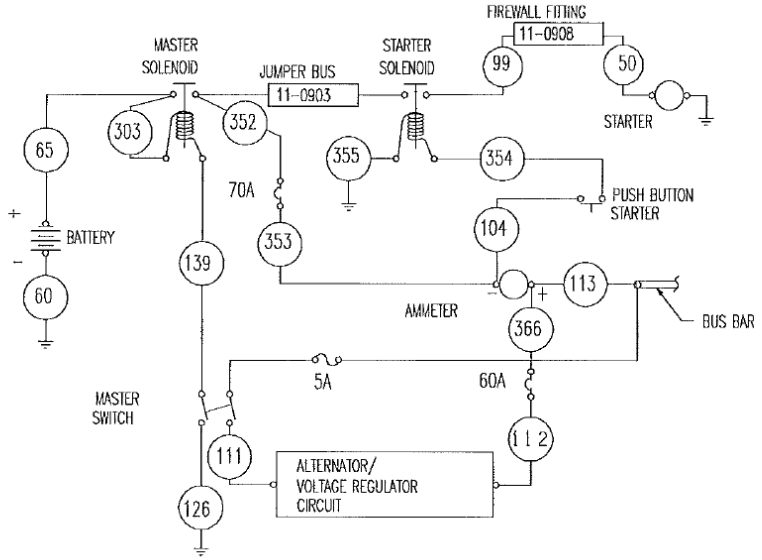

Figure 2 Schematic of Primary Electrical System (Aft Mounted Battery) After Modification

Note: Figure 1 is typical to rear mounted batteries. The wire numbers and exact wiring may vary slightly between aircraft. This letter will refer to the numbers given in Figures 1 and 2.

Conversion: The following paragraphs describe the changes needed to comply with this service letter. Before working on the electrical system, be sure all systems are shut off and the battery is not connected. Take all possible safety precautions before working on the aircraft. All splicing, wire routing, and terminal installation should be done in accordance to Advisory Circular (AC) 43.13-1B.

American Champion Aircraft Corp.
Rochester, WI 53167

Service Letter: 418 (page 3 of 5) Revision A

Date: January 19, 2001

Title: Electrical System Update

Conversion: (Continued) The first item that needs to be modified is the voltage regulator circuit. Wire number 17 must be replaced with an inline 5-amp fuse. This is a very short wire inside the electrical panel that runs from the bus bar to the alternator half of the master switch. Note that the master switch is a single throw double pole switch and connecting to the wrong pole will ground the bus bar when the switch is thrown. This fuse can be butt spliced in place or new terminals can be installed depending on application.

- The following procedures assume the battery is mounted on the firewall.

  A properly installed firewall mounted battery requires the installation of circuit protection from the battery and the alternator. Mount the 70-amp battery circuit breaker inside the firewall using an Adel clamp and 11-0902 bracket. On the output side of the master solenoid, disconnect wire #114 and, mount wire #367 to the input (line) side of 70-amp circuit breaker. The wire #114 should then be attached to the output (load) side of the circuit breaker. Figure 3 depicts a typical installation.

  Attach the 60-amp alternator circuit breaker to the diagonal fuselage tube with an Adel clamp and 11-0902 bracket. Disconnect the #112 wire from the ammeter and replace it with wire #366 attached to the input (line) side of the 60-amp circuit breaker. Attach alternator wire #112 to the output (load) side of the 60-amp circuit breaker. Figure 3 depicts a typical installation.

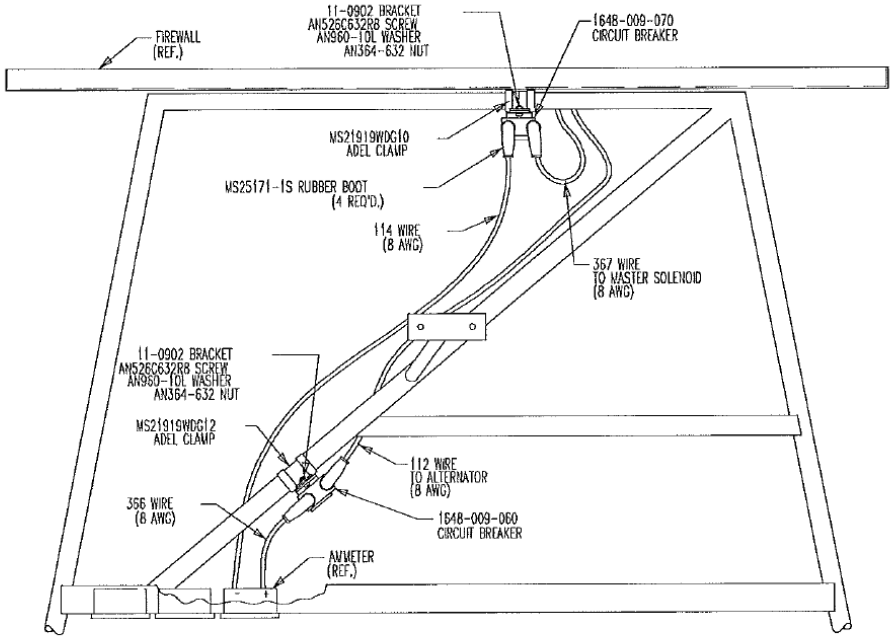

Figure 3 Typical installation for a Firewall Mounted Battery

American Champion Aircraft Corp.
Rochester, WI 53167

Service Letter: 418 (page 4 of 5) Revision A

Date: January 19, 2001

Title: Electrical System Update

- The following procedures assume the battery is mounted aft of the baggage compartment.

Conversion: (Continued) The best way to separate the starter circuit from the ammeter / bus bar circuit is to relocate the starter solenoid close to the master solenoid. First, disconnect the starter solenoid from all of its connections including wires 50, 99, 103, and 114. Wires 103 and 114 can be removed from the airplane, as they will be too short for further use.

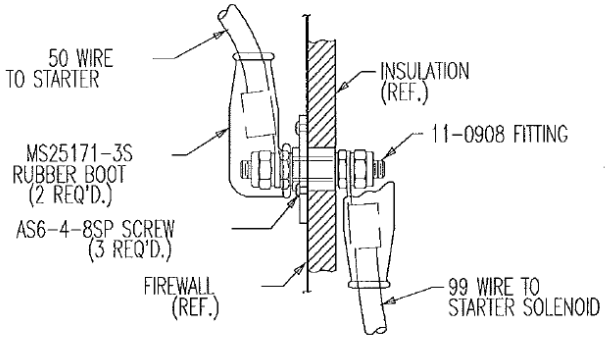

Figure 4 Assembly of Firewall Fitting

Remove the firewall fitting for wire #99 and push inside the airplane. Install fitting 11-0908 in the firewall in place of the former fitting. Mount wire #50 to the engine side of the fitting and wire #99 to the insulation side of the fitting. Use a rubber boot over each connection. The Assembly is depicted in figure 4. The starter solenoid should then be mounted to the battery board in close proximity to the master solenoid as depicted in Figure 5. This may require that the master solenoid be shifted as well. The wire #99 should be removed from the master solenoid and mounted to the starter solenoid. The 11-0903 jumper bus should then connect the two solenoids. The starter solenoid needs to be grounded if it is mounted on a wood battery board. Use wire #355 to connect to an appropriate ground. Route wire #354 up to the starter button in place of the former wire #103. Figure 5 depicts a typical installation.

Important: All connections should use an appropriate rubber boot to protect the connection

Power to the bus bar from the battery must be restored by replacing wire #114. On the output side of the master solenoid, mount the short wire #352 to a 70-amp circuit breaker. Mount the breaker to the battery board using an appropriate bracket. This is also depicted in figure 5. Route the longer wire #353 to the ammeter in place of wire #114. The #353 and #354 wires should be bundled with wire # 99 to keep them away from fuel lines and control systems.

Lastly, attach the 60-amp alternator circuit breaker to the diagonal fuselage tube with an Adel clamp and 11-0902 bracket.

American Champion Aircraft Corp.
Rochester, WI 53167

Service Letter: 418 (page 5 of 5) Revision A

Date: January 19, 2001

Title: Electrical System Update

Disconnect wire #112 from the ammeter and replace it with wire #366 attached to the input (line) side of the 60-amp circuit breaker. Attach alternator wire #112 to the output (load) side of the 60-amp circuit breaker. Figures 5 and 6 depict a typical installation.

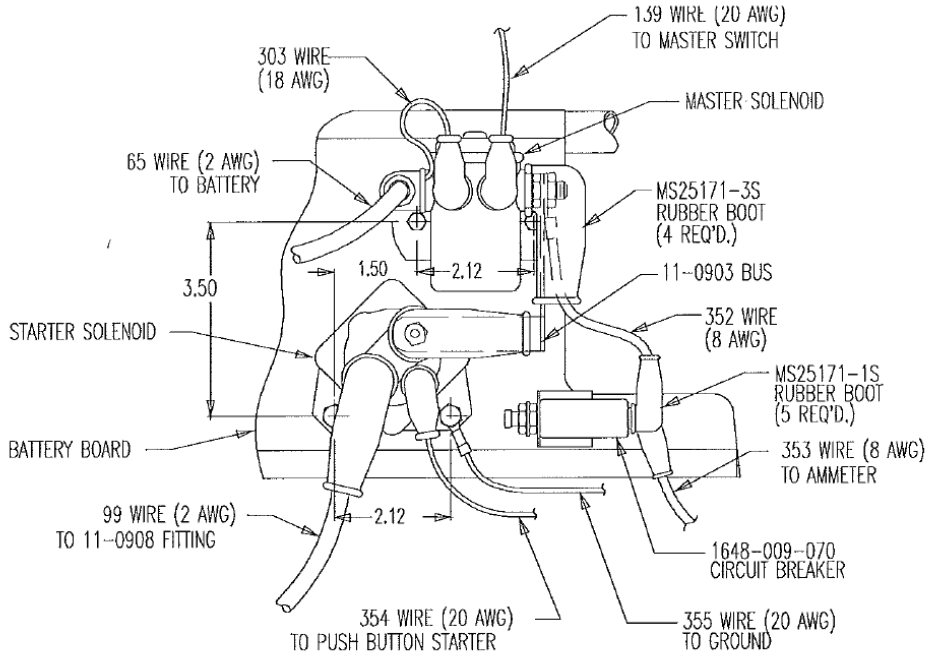

Figure 5 Typical Battery Board Installation

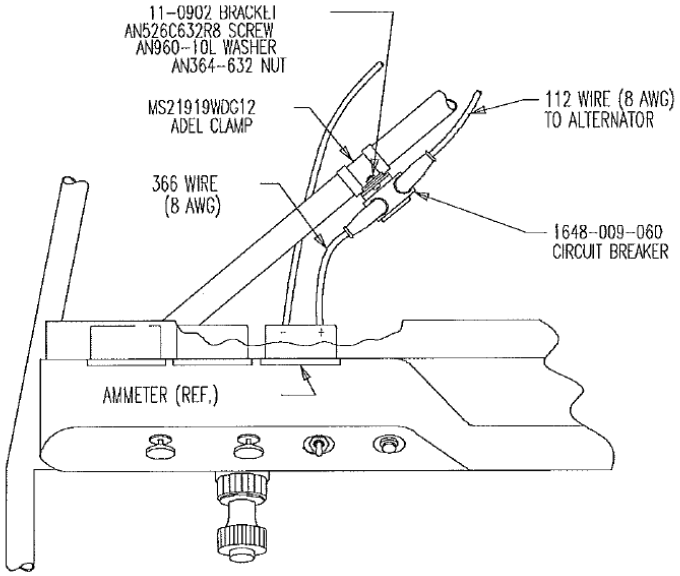

Figure 6 Under Dash Installation for Aft Mounted Battery

Annex 2: Special Airworthiness Information Bulletin (Number CE-18-20)

FAA
Aviation Safety

SPECIAL AIRWORTHINESS INFORMATION BULLETIN

SAIB: CE-18-20
Date: July 12, 2018

SUBJ: Electrical Power

This is information only. Recommendations aren't mandatory.

Introduction

This Special Airworthiness Information Bulletin (SAIB) advises you of an airworthiness concern for airplanes built by Aeronca, Bellanca, Champion, or American Champion Aircraft Corporation (ACAC) regarding possible electrical system shorts that could lead to fires. ACAC is the current type certificate holder for all of the airplane models affected by this SAIB.

The models include:

- **7AC, S7AC, 7BCM, 7CCM, S7CCM, S7DC, 7DC, 7EC, & S7EC; with electrical systems; (Type Certificate A-759)**
- **All 7FC, 7GC, 7HC, 7GCA, 7JC, 7GCB, 7KC, 7GCBA, 7KCAB, 7ACA. (Type Certificate A-759)**
- **7ECA, serial numbers 1 through 1381-2000. (Type Certificate A-759)**
- **7GCAA, serial numbers 1 through 438-2000. Type Certificate A-759)**
- **7GCBC, serial numbers 1 through 1288-2000. (Type Certificate A-759)**
- **8KCAB, serial numbers 1-70 through 859-2000. (Type Certificate A21CE)**
- **8GCBC, serial numbers 1-74 through 412-2000.(Type Certificate A21CE)**

At this time, this airworthiness concern is not considered an unsafe condition that would warrant an airworthiness directive (AD) action under Title 14 of the Code of Federal Regulations (14 CFR part 39).

Background

This SAIB resulted from an accident in the country of Hungary, where a Model 8GCBC airplane caught fire upon start-up of the engine and burned. The Transportation Safety Bureau of Hungary found the fire probably started at the passage of the high power cable through the firewall due to signs of electric discharge at the passage and melting of the electric cable in the line of the firewall. It was determined that ACAC Service Letter number 418, dated January 19, 2001, titled Electrical System Update, had not been incorporated on the Hungarian 8GCBC (see description below).

Until 2001, various 7 and 8 series airplane models were manufactured by Aeronca, Bellanca, Champion, and ACAC without electrical system short protection. Particularly prone to shorting are airplanes with the main battery mounted in the rear of the airplane that have the battery cable routed to the engine compartment with no fuses/circuit breakers/ (to automatically remove power) or relays (for the pilot to remove power) in the event of an electrical short. Most known electrical shorts have occurred where electrical power passes through the airplane firewall (either battery power going from the rear of the airplane to the engine compartment or alternator power going from the engine compartment to the airplane DC bus). There have also been occurrences of flight control cables burning through from electrical shorts to the rear-mounted positive battery cable. In these cases current flows into the flight control cable from the battery cable (+) contact point and exits the cable at a pulley or terminal (-).

In addition, the fact that there is no circuit protection in the electrical power to the voltage regulator/overvoltage relay is a problem when a short occurs in the regulator or the relay. In one service difficulty, a short in the overvoltage relay caused the power wire to the relay to melt. The heat also melted the ignition P-leads, causing them to short, which resulted in an in-flight engine stoppage.

ACAC issued Service Letter number 418, on January 19, 2001 to address the safety concerns, as described above, regarding the electrical systems on airplane models affected by this SAIB. The FAA conducted two risk analyses following the Small Airplane Risk Assessment (SARA) Handbook; one looking at the trend over 40 years and one looking at the last 20 years. The FAA found that the risk has been reduced since ACAC Service Letter number 418 was issued on January 19, 2001. Both our analyses showed the risk below a level requiring an AD. Although the risk does not rise to the level or warranting mandatory action, the FAA has decided to issue an SAIB to elevate the level of attention by owners/operators as well as by the civil aviation authorities of other countries where American Champion airplanes are owned and operated.

Recommendations

We recommend that all that ACAC model airplanes identified in the introduction above complete the installation of American Champion Service Letter number 418, dated January 19, 2001. We also recommend that the aircraft maintenance manual (AMM) be updated with pages from the American Champion service letter to address the addition of circuit protection devices. This will ensure the locations, mounting, and sizes of new fuses, circuit breakers, relays, and bulkhead feedthroughs, are available to maintenance personnel. Finally, we recommend the Airframe and Powerplant technician performing the minor alteration document the work with an aircraft logbook entry.

For Further Information Contact

Wesley Rouse, Aerospace Engineer, FAA Chicago ACO Branch, 2300 E. Devon, Des Plaines, IL 60018; phone: (847) 294-8113; email: wess.rouse@faa.gov.

For Related Service Information Contact

To obtain copies of American Champion service letter number 418, contact American Champion Aircraft Corporation, P.O. Box 37, 32032 Washington Ave. – Hwy. D, Rochester, WI 53167; or visit their website at www.amerchampionaircraft.com, select “Technical” and scroll down to service letter 418 to view or print.