National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 14, 1998
In reply refer to: A-98-109 through -110

Honorable Jane F. Garvey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On October 15, 1997, about 1030 mountain daylight time, a Cessna P210N, N731NX, operated by the Sheriff's Department of Mesa County, Colorado, experienced an in-flight electrical fire while cruising at 16,500 feet over Bryce Canyon, Utah. The commercial pilot initiated an emergency descent and landed uneventfully in Bryce Canyon with minor damage. The pilot and his passenger were not injured. Visual meteorological conditions prevailed, and a visual flight rules flight plan had been filed. The public-use flight was conducted under Title 14 Code of Federal Regulations Part 91, and originated from Grand Junction, Colorado, about 60 minutes before the incident.

The Safety Board's investigation revealed that the fire originated on the cabin sidewall, under the left side of the instrument panel, and resulted in burned vinyl, plastic, and insulation material.[1] The fire was caused by an overheated resistor used in an electric door seal inflation system. The resistor was used to reduce the 28-volt aircraft electrical system's voltage to meet the power requirements of the door seal system's 14-volt air pump motor. The system had been installed on the airplane in accordance with a Federal Aviation Administration (FAA)-approved supplemental type certificate (STC)[2] that was issued to the system's manufacturer, Bob Fields Aerocessories, Inc., in 1983. The purpose of the system is to decrease in-flight cabin

[1] Bryce Canyon, Utah, October 15, 1997, Cessna P210N, N731NX (FTW98TA051).

[2] A supplemental type certificate can be issued by the FAA for design changes to type-certificated aircraft when the change is not so extensive as to require a new type certificate for that aircraft. STCs are typically approved for optional after-market kits that improve an aircraft design. The STC applicant must submit sufficient technical data to the FAA to show compliance with the applicable certification requirements.

noise caused by ill-fitting cabin doors. According to Bob Fields Aerocessories, about 20,000 of these systems are currently installed in a wide variety of single- and twin-engine general aviation airplanes.

Since the Bryce Canyon incident in October 1997, the Safety Board has investigated one accident and two incidents that also involved in-flight fires originating in electric inflatable door seal systems manufactured by Bob Fields Aerocessories. Moreover, a review of the FAA's Service Difficulty Report database revealed four additional reports of overheated components associated with the door seal system, three of which cited smoke in the cockpit. A description of the recent accident and incidents investigated by the Safety Board follows.

On November 20, 1997, a Beech 95-B55, N3681K, sustained substantial damage after impacting trees during a precautionary landing in Burlington, Kansas. The landing was precipitated by smoke and an electrical fire in the cabin during cruise flight at 6,500 feet. Postaccident examination of the airplane revealed that a Bob Fields Aerocessories electric door seal inflation pump, mounted on the forward side of the nose bulkhead, was heavily charred. The Safety Board determined that the probable cause of the accident was, in part, "the door seal inflation pump catching fire."[3]

On June 25, 1998, the pilot of a Cessna P210N, N5083W, initiated a precautionary landing in Ithaca, New York, after heavy smoke had entered the cabin during cruise flight at 5,000 feet. Immediately after the landing, airport fire and rescue personnel discovered a self-sustaining fire originating under the left side of the instrument panel. Vinyl, plastic, and insulation material had burned in the fire. Subsequent examination of the airplane revealed that one of the resistors used in the Bob Fields Aerocessories electric door seal inflation system installed on the airplane was partially melted.[4] The Safety Board recently learned of a July 17, 1998, incident aboard a Beech 58 airplane in which the pilot reported a burning smell in the cockpit while in cruise flight. He landed in Toms River, New Jersey, and asked a mechanic to inspect the airplane. The mechanic reported that the pump assembly and resistors for the installed Bob Fields Aerocessories electric door seal inflation system, mounted in the nose compartment, were partially melted.[5]

The electric door seal inflation system manufactured by Bob Fields Aerocessories consists of an electric motor, an air pump, inflatable silicon door seals, a pressure sensing switch, an air supply control valve, a resistor assembly, a 7.5-amperes (amps) in-line fuse, a caution light, and electrical wiring. A 5-amp circuit breaker may also be provided as an option. The motor draws power directly from the airplane's battery bus and is used to inflate the door seals to a pressure of about 10 pounds per

[3] For more detailed information, see Brief of Accident CHI98LA041 (enclosed).
[4]Ithaca, New York, June 25, 1998, Cessna P210N, N5083W (NYC98SA138).
[5]Toms River, New Jersey, July 17, 1998, Beech 58, N53RD (NYC98SA167).

square inch (psi). A sensor on the air pump determines when the pressure drops below 10 psi, at which time the air pump motor cycles back on until the proper pressure is achieved. According to the STC-holder, it takes between 4 and 12 seconds after system activation for the air pump to inflate the door seal; during this time, the caution light remains illuminated. If the door seal has a small leak, the pump cycles on and off to maintain the desired inflation pressure. If the door seal has a larger leak, the air pump may run continuously to keep the door seal inflated.

The Safety Board's review of the system design revealed that the system incorporates two identical 1-ohm resistors, each rated for a maximum of 50 watts. The resistors are wired close together and in series. According to technical specifications provided by the vendor of the resistor, the resistor's wattage capability should be derated to no more than 20 watts if it is not mounted onto a sufficiently sized conductive structure for heat dissipation. Test data from the vendor further indicate that the aluminum housing of a single resistor will heat up to 313° F when the resistor carries the nominal wattage of the door seal inflation system and is adequately mounted to provide for heat dissipation.[6] The housing temperature rises to more than 600° F if the resistor is not mounted to conductive material for heat dissipation. The potential for overheating is increased by the two resistors being wired closely together.

The Safety Board reviewed the FAA-approved installation instructions for the Bob Fields Aerocessories electric inflatable door seal pump. The instructions state, "…be sure to mount the resistors pak [sic] to a metal plate to make a heat sink. This plate and resistors can be mounted at the parking brake support angle under the instrument panel." No other instructions are found related to the resistor mounting. The investigations into the Bryce Canyon, Ithaca, and Toms River incidents revealed that the resistors were either hanging freely, or were mounted to structure in a manner that was insufficient to dissipate the heat generated by the resistors. The Safety Board is concerned that the installation instructions are insufficient and do not provide enough detail or cautions regarding the proper installation of the resistors and the minimum specifications for a heat sink.

The Safety Board is also concerned about other aspects of the design of the door seal inflation system that can lead to the overheating of the resistors and other system components. The design calls for the system to be installed in confined areas on the aircraft. For example, in the two-door Cessna airplane models, the STC suggests that the system be mounted behind the pilot's "kick panel." The kick panel area is a confined space between the external skin of the airplane just forward of the door and an upholstered panel under the left side of the pilot's instrument panel. This space has limited ventilation and inhibits the cooling required for a continuously

[6] The door seal inflation system draws a nominal current of 6 amps, thereby producing 36 watts of power through each 1-ohm resistor. Test data indicate that 36 watts of applied power through the specified resistor that is mounted on top of a box-shaped, aluminum chassis for heat conduction (0.040 inch thick, 5 inches wide, 7 inches long, and 2 inches deep) will produce a housing temperature of 313° F.

operating electrical pump and its associated resistors. The space also provides potentially combustible materials in close proximity to heated electrical components, as illustrated by the Bryce Canyon and Ithaca incidents.

Another aspect of the door seal inflation system design that could lead to overheating involves the endurance rating of the electrically driven air pump. According to the vendor that supplies the air pump to Bob Fields Aerocessories, the pump was originally designed to be plugged into an automotive cigarette lighter socket and was intended to be used for the emergency inflation of automobile tires. In a letter forwarded to the Safety Board, the vendor stated that the continuous use of the pump "should not exceed 10 minutes without stopping for 30 minutes" to prevent overheating. The application of the air pump for the pressurization of airplane door seals during flight is inappropriate because the pump may be required to operate for more than 10 minutes, or to run continuously if the door seal leaks. This was illustrated in the Bryce Canyon incident when the caution light was observed by the pilot to be continuously illuminated. The Safety Board is concerned that extended or continuous operation of the air pump will lead to excessive heat buildup, causing an excessive current draw, and will exacerbate the potential for overheating that already exists under the nominal current draw.

Examination of the in-line fuses for the Bryce Canyon, Ithaca, and Toms River incidents revealed that a fuse rated for 10 amps had been installed in the door seal inflation system, exceeding the 7.5-amp-rated fuse specified by the approved STC installation instructions. The Safety Board notes that excessive current draw may result in frequent blown fuses and may prompt the improper installation of a higher-rated fuse. Although the improper use of a 10-amp-rated fuse increases the potential for overheating components, the use of the specified 7.5-amp-rated fuse would not eliminate the hazard because, as discussed above, testing has shown that overheating of the resistors can occur at the nominal door seal inflation system current of 6 amps.

The Safety Board is also concerned that the electric door seal inflation system design does not provide adequate warning of a potential overheat situation. The system incorporates an amber (caution) light on the pilot's instrument panel that illuminates when the pump is operating. The STC installation instructions specify that a placard be placed near the light stating, "CAUTION/DOOR SEAL PUMP ON." However, no information is provided on action to take if the light remains illuminated for an extended period.

The Safety Board concludes that the Bob Fields Aerocessories door seal inflation system design does not provide owners or operators with adequate information about corrective action if the system begins to overheat. Also, it may not become apparent to an operator that the system is overheating until there are indications of an electrical fire. The system design does not incorporate its own electrical cut-off switch; therefore, the pilot's only means to address an overheating

system or component is to turn off the airplane's entire electrical power system using the master switch.

The Safety Board is very concerned that these design deficiencies increase the likelihood of an in-flight electrical fire and/or smoke in the cockpit during flight, as evidenced by the accident and incidents discussed above, as well as additional incidents identified by SDRs. Therefore, the Safety Board believes that the FAA should issue an airworthiness directive to require that all owners and operators of airplanes equipped with electric door seal inflation pump systems manufactured by Bob Fields Aerocessories immediately disconnect them from the airplanes' electrical systems. In addition, the FAA should review all STCs that provide for the installation of electric door seal inflation pump systems manufactured by Bob Fields Aerocessories, and require revisions, as necessary, to ensure that the hazards associated with in-flight fire and/or smoke in the cockpit during flight are eliminated. Existing systems should be required to comply with those instructions before they are placed back into service.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Issue an airworthiness directive to require that all owners and operators of airplanes equipped with electric door seal inflation pump systems manufactured by Bob Fields Aerocessories immediately disconnect them from the airplanes' electrical systems. (Urgent) (A-98-109)
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> Review all supplemental type certificates that provide for the installation of electric door seal inflation pump systems manufactured by Bob Fields Aerocessories, and require revisions, as necessary, to ensure that the hazards associated with in-flight fire and/or smoke in the cockpit during flight are eliminated. Existing systems should be required to comply with those instructions before they are placed back into service. (A-98-110)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

[Original Signed]

By: Jim Hall
Chairman

Enclosure