Exemption No. 4838

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
WASHINGTON, DC 20591

In the matter of the petition of PORSCHE AVIATION PRODUCTS, INC. for an exemption from § 23.991(a)(1) of the Federal Aviation Regulations	Regulatory Docket No. 038CE

GRANT OF EXEMPTION

By letter dated March 19, 1987, Mr. Douglas Marwill, R.D. Marwill and Associates, 400 Oak Square, San Antonio, Texas 78216, petitioned on behalf of Porsche Aviation Products, Inc., for an exemption from § 23.991(a)(1) of the Federal Aviation Regulations (FAR) to permit supplemental type certification of a Cessna Model 172 Airplane using the Porsche PFM3200Nol engine, which will not comply with § 23.991(a)(1). By letters dated May 13, and June 9, 1987, Mr. Marwill further clarified his petition. The Cessna Model 172 is a small, single reciprocating engine, four-place airplane.

Sections of the FAR affected:

Section 23.991(a)(1) requires, for reciprocating engine installations having fuel pumps to supply fuel to the engine, at least one pump for each engine must be directly driven by the engine and must meet § 23.955. This pump is a main pump.

The petitioner's supportive information is as follows:

Description

"The PFM 3200Nol engine (TC E 23 NE) incorporates two identical electric driven pumps which supply fuel to the fuel injecting system. No fuel pump, directly driven by the engine, is provided. Therefore, this engine, as installed in an aircraft, will not comply with § 23.991(a)(1). This exemption would allow the use of two electric driven fuel pumps, which have been certified with the engine, to replace the engine driven pump specified in the regulation.

"Porsche Aviation Products believes that the two electric driven fuel pumps provided as part of the type certificated PFM3200Nol engine can provide an equal or better level of safety than the engine driven fuel pump specified in § 23.991(a)(1)."

Operation

"One fuel pump is capable of providing the total fuel quantity required by § 23.955(c), which will be substantiated later in the certification program. The second identical pump is installed in the fuel system, parallel to the primary pump, as a standby in the event of a primary pump failure.

"Typical operation calls for both pumps to be operating during takeoff and landing where flight conditions prohibit sufficient time to switch to the standby pump. Where altitude and time allow, the standby pump would be switched off and the engine operated on the primary pump."

Related Electrical System

"Each pump is operated by a separate and totally independent electrical system consisting of an alternator, battery, engine ignition system and fuel pump. Failure of one electrical system could not cause failure of both fuel pumps."

Reason for Electric vs. Engine Driven

"These pumps are manufactured by Teldix (a subsidiary of Bosch) exclusively for use with the K-Jetronic fuel system used on the PFM3200Nol engine. The electric fuel pump provides a consistent fuel flow independent of engine rpm. This characteristic is important for the operation of the K-Jetronic fuel system. This system requires a constant fuel flow at all times to automatically maintain the correct air-fuel ratio at all altitudes and during all engine operating regimes. A mechanical engine driven fuel pump would be grossly oversized to provide sufficient flow at low engine speeds and flow excessive amounts of fuel at high engine speeds."

Reliability

"The performance and reliability of the proposed fuel pumps and the concept of the electrical system, support the request for the exemption. Report RDM134-5, "Porsche PFM 3200 Engine Fuel Pump Safety Analysis" was submitted to ACE-140C on March 24, 1987 to provide substantiating data. This report discusses system operation, power source independence, fuel flow characteristics, reliability and a failure analysis."

Safety Features

"Additionally, the electrical system has been designed to provide several safety features to enhance the operational safety and redundancy of the system. These features are:

"(1) At least 10 amperes electrical current from each independent engine alternator shall (1) be dedicated to use by the ignition system and the fuel pump dependent on that alternator for normal

electrical power, and (2) be protected from airframe electrical loads and/or faults.

"(2) Except during the engine starting operation, the independent engine electrical systems shall not be connected to any common electrical load, either engine or airframe, during normal operations.

"(3) The fuel pump control switches in the cockpit shall be independent from each other and individually guarded to prevent inadvertent actuation.

"(4) One fuel pump shall be designated as the main fuel pump and the second fuel pump shall be designated as the emergency pump.

"(5) The fuel pumps shall have a TBO time of 2000 hours or less.

"(6) Both ignition systems are independent battery ignition systems and each system shall comply with FAR 23.1165.

"(7) Each electrical system shall have its respective battery connected to its electrical buss during normal operation.

Conclusion

"Porsche Aviation Products believes that the electric fuel pumps used on the PFM3200Nol engine meet the intent of paragraph 23.991(a)(1), which is to provide a reliable fuel pump that is compatible with the engine. This, coupled with two identical fuel pumps, powered by two independent redundant electrical systems provides a safety level equal to or better than that found in present single-engine aircraft."

Comments to published petition summary:

A summary of this petition for exemption was published in the FEDERAL REGISTER for public comment on June 30, 1987 [52 FR 24363]. The comment period closed July 8, 1987. No comments were received.

The Federal Aviation Administration's (FAA) analysis is as follows:

To obtain the exemption, the petitioner must show, as required by § 11.25(b)(5) of the Federal Aviation Regulations, that: (1) granting the request is in the public interest, and (2) the grant of the exemption would not adversely affect safety, or that a level of safety will be provided which is equal to that provided by the rule from which the exemption is sought.

The FAA has carefully reviewed all of the information contained in the petitioner's request for exemption.

The petitioner has applied for approval of a reciprocating engine installation having several design features not envisioned when Part 23 was promulgated, and features that do not comply with specific

requirements in Part 23. This petition addresses one non-complying design feature of that installation.

Policy and practice are well established for reciprocating engine CAR 3/FAR Part 23 airplanes wherein the fuel system and the ignition system are isolated from each other and from all other airplane systems whose failure could adversely affect engine operation. In current approved installations, any required main fuel pump is attached to and mechanically driven directly by the engine. Each magneto ignition system is mechanically driven directly by the engine. Both of these systems are critical to continued engine operation, and are isolated from each other and from other systems so that any other system failure, such as total collapse of the airframe electrical system, will not affect engine operation. As long as fuel is available, the engine will continue to supply motive power. This is the level of safety expected to be maintained, or the petitioner must show that what he proposes provides a level of safety appropriate to the type design.

The petitioner's design does not provide the isolation between fuel pumps and ignition systems typical of reciprocating engine powered small airplanes and as envisioned in Part 23. Each of the two independent electrical systems powers its own fuel pump and ignition system. However, the petitioner claims that each system, operating alone, is capable of maintaining full engine performance. The petitioner's design does provide for isolation between engine electrical systems so that a failure in one system will not adversely affect any part of the other system. This isolation must be maintained; however, they may be connected for emergency purposes and for starting.

Although not specifically addressed in the petition, the FAA understands the petitioner intends that both engine electrical systems be used, or to be available, to power airframe electrical systems. Therefore, any failure in the airframe systems may adversely affect engine (fuel pump and ignition system) operation unless adequate precautions are taken to avoid such adverse affect. Design provisions must be incorporated to quickly isolate the failed airframe electrical system/component from the engine electrical power source to allow the engine to continue operating.

The petitioner presented qualification test results and failure rate statistics in support of Porsche's claim of very high reliability for the electric fuel pumps. Petitioner stated the cited reliability was achieved using a 2000-hour TBO time. To maintain the cited reliability, the 2000-hour TBO limitation must be applied to the pumps installed in the airplane.

The traditional, engine-mounted fuel pump provided no means to turn it on or off -- when the engine runs, the pump runs. The electric fuel pumps furnished as part of the type certificated Porsche engine must be switched on from the cockpit prior to engine start-up and turned off after engine shutdown. By the same switches, the fuel pumps can be turned on and off in flight. Design provisions must be incorporated to prevent inadvertent switch operation.

The Porsche engine has a unique previous history as an automobile engine. This very successful previous history and the provisions available to assure continued engine fuel supply and ignition, notwithstanding current requirements, leads the FAA to conclude such engine, when properly installed, will be equally successful in airplane installations.

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not adversely affect safety. Therefore, pursuant to the authority contained in Sections 313(a) and 601(c) of the Federal Aviation Act of 1958, as amended, delegated to me by the Administrator (14 CFR 11.53), Porsche Aviation Products is hereby granted an exemption from § 23.991(a)(1) of the Federal Aviation Regulations to the extent necessary to permit the supplemental type certification of its Cessna Model 172 Airplane with the Porsche PFM3200Nol engine installed provided the airplane type design is shown to comply with the following:

1. At least 10 amperes electrical current from each independent engine alternator must: (a) be dedicated to use by the ignition system and the fuel pump dependent on that alternator for normal electrical power, and (b) be protected from airframe electrical loads and/or faults.

2. The circuit breaker coupling the airframe bus to the engine bus, the circuit breaker coupling the engine bus' dedicated alternator, the circuit breaker coupling the engine bus' dedicated battery, and the circuit breaker coupling the two isolated engine buses together in an emergency must be of the same design (trip response time versus load percent of rating) and must be sized to assure compliance with limitation Number 1 of this exemption. The system design must assure that the engine electrical bus' dedicated battery is connected to the bus during all normal operations. Tests must be conducted to demonstrate that when the airframe bus supply breaker trips, the engine ignition and fuel pumps are not adversely affected, and the specified limits are not exceeded. All engine electrical functions must continue to operate satisfactorily after disconnect (load dump) from all airframe electrical systems.

3. Except during the engine starting operation, the independent engine electrical systems must not be connected to any common electrical load, either engine or airframe, during normal operations.

4. The fuel pump control switches in the cockpit must be independent from each other and individually guarded to prevent inadvertent actuation.

5. One fuel pump must be designated as the main fuel pump and, notwithstanding the exception of § 23.991(b), the second fuel pump is required and must be designated as the emergency pump.

6. The fuel pumps must have a TBO time of 2000 hours or less.

7. Both ignition systems are considered independent battery ignition systems and each system must comply with § 23.1165.

Issued in Kansas City, Missouri on August 27, 1987.

Paul K. Bohr

Paul K. Bohr, Director
Central Region