



# Federal Aviation Administration

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## Memorandum

Date: JUN 09 2006

From: Manager, Standards Office, ACE-110

To: Margaret M. Kline, Manager, Wichita Aircraft Certification Office, ACE-115W

Prepared by: Peter L. Rouse

Subject: **Action:** Guidance on Compliance with 14 CFR, part 23, § 23.1141(e) for the Cessna Model 510 Aircraft (Project TC3801WI-A). ACE-05-24

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**REFERENCES:** FAA Issue Paper, P4, Cessna Aircraft Company Model 510, Project # TC3801WI-A, Compliance with § 23.1141(e), from ACE-115W, dated November 30, 2005.

### **SUMMARY:**

The Wichita Aircraft Certification Office (ACO) has requested policy in regards to compliance with 14 CFR, part 23, § 23.1141(e) in order to certificate the Cessna 510 Mustang aircraft using the Pratt & Whitney Canada, Inc. Model PW615F turbofan engine. The PW615F uses a single fuel-metering valve for power modulation and engine shutdown. Traditionally, there have been two separate valves used for power modulation and engine shutdown, and both were engine resident. An engine equipped with a single fuel-metering valve for power modulation and engine shutdown will lose the ability to shut down in the event of a thrust control malfunction, unless there is an additional system used for engine shutdown. This memorandum provides project specific policy to allow certification of an engine installation using a single fuel-metering valve for power modulation and engine shutdown.

### **POLICY STATEMENT:**

This policy is applicable only to the certification of the Cessna model 510 aircraft using the Pratt & Whitney Canada, Inc. Model PW615F turbofan engine (project TC3801WI-A).

In order to comply with 14 CFR, part 23, § 23.1141(e), the pilot must be able to shut down the engine. The inability to shut down an engine is an unsafe condition. An aircraft using an engine with single fuel metering valve for power modulation and engine shutdown must comply with the following items in the event of a thrust control malfunction:

- The aircraft must have an additional means to shut down the engine.
- The operation of the additional engine shutdown system must be transparent to the pilot, and use the same procedure as a normal engine shutdown.
- The time for the engine shutdown to occur must be no more than one second greater than a normal engine shutdown. The shutdown time includes the time for engine shutdown command and engine response. The engine shutdown time does not include the pilot reaction time.
- The additional engine shutdown system can be engine resident and certificated under 14 CFR, part 33, or airframe resident and certificated under 14 CFR, part 23. If the additional engine shutdown system is airframe resident, then the engine installation instructions must provide clear and concise guidance for the additional engine shutdown system requirements: airframe interface, component response time, component power requirements, component reliability, etc.
- The additional engine shutdown system must have a means to detect any latent failures.

### **BACKGROUND:**

Traditionally, turbine engines have used separate valves for power modulation and engine shut down, and both were engine resident. An engine equipped with a single fuel metering valve for power modulation and engine shutdown will lose the ability to shut down in the event of a thrust control malfunction, unless there is an additional engine shutdown system. There are two regulations that address the engine shutdown requirement: 14 CFR, part 33, § 33.75(d) and 14 CFR, part 23, § 23.1141(e).

14 CFR, part 33, § 33.75 states:

Section 33.75, Safety analysis:

It must be shown by analysis that any probable malfunction or any probable single or multiple failure, or any probable improper operation of the engine will not cause the engine to--

- (a) Catch fire;
- (b) [Burst (release hazardous fragments through the engine case);
- (c) Generate loads greater than those ultimate loads specified in Sec. 33.23(a);  
or]
- (d) Lose the capability of being shut down.

14 CFR, part 23, § 23.1141 states:

Section 23.1141, Powerplant controls: general.

- (a) Powerplant controls must be located and arranged under Sec. 23.777 and marked under Section 23.1555(a).
- (b) [Each flexible control must be shown to be suitable for the particular application.]

- (c) Each control must be able to maintain any necessary position without—
  - 1. Constant attention by flight crew members; or
  - 2. Tendency to creep due to control loads or vibration.
- (d) Each control must be able to withstand operating loads without failure or excessive deflection.
- (e) For turbine engine powered airplanes, no single failure or malfunction, or probable combination thereof, in any powerplant control system may cause the failure of any powerplant function necessary for safety.
- (f) The portion of each powerplant control located in the engine compartment that is required to be operated in the event of fire must be at least fire resistant.
- (g) Powerplant valve controls located in the cockpit must have—
  - 1. For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position; and
  - 2. For power-assisted valves, a means to indicate to the flight crew when the valve—
    - i. Is in the fully closed position; or
    - ii. Is moving between the fully open and fully closed position.

The engine and installation certification requirements basically state that no single failure, or probable combination of failures will result in an unsafe condition. Thus, there is a requirement for redundancy. As stated earlier, the redundant shutdown systems have traditionally been engine resident.

The inability to shut down an engine is an unsafe condition. The 14 CFR, part 33 engine certification allows for reliance on an airframe resident system for compliance with § 33.75(d). The Pratt & Whitney Canada, Inc. Model PW615F engine is being certificated with a single fuel metering valve for power modulation and engine shutdown. Therefore, there is a requirement for an additional engine shutdown system in order to comply with 14 CFR, part 23, § 23.1141(e).

The Pratt & Whitney Canada, Inc. Model PW615F draft Installation Manual, PW Engineering Report No. 5829, draft Rev B, dated January 2005, paragraph 7.3 Shutoff states: "An airframe supplied fuel shutoff device must be installed. The device shall have a MTBF equal to or better than 10<sup>-4</sup>." (Failure rate is intended rather than MTBF.) Additional information relating to the purpose, function, or operation of this valve is not included.

This background identifies that a redundancy requirement in part 23, which has previously been accommodated within part 33, has become an issue. The Pratt & Whitney Canada, Inc. Model PW615F uses a single fuel-metering valve for power modulation and engine shutdown. With the reduction of valves within the PW615F engine control system, this engine is certifiable under 14 CFR, part 33 but is not compliant as is for installation under 14 CFR, part 23, unless an additional engine shutdown system is installed.

**CONCURRENCES**

  
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Manager, Standards Office, ACE-110

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