



Federal Aviation Administration

Memorandum

Date: 11/27/2013

To: Manager, New York ACO, ANE170

From: Manager, Transport Airplane Directorate, ANM-100

Prepared by: Kent Fredrickson, ANE-173

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Bombardier Aerospace Inc. Engine Ignition Switches on the BD-500-1A10 and 1A11, FAA Project TC4948NY-T

ELOS Memo#: TC4948NY-T-P-41

Regulatory Ref: §§ 21.21(b)(1) and 25.1145(a)

This memorandum informs the certificate management aircraft certification office of an evaluation made by the Transport Airplane Directorate (TAD) on the establishment of an equivalent level of safety (ELOS) finding for the Bombardier BD-500-1A10 and 1A11.

Background

Title 14, Code of Federal Regulations (14 CFR) 25.1145 (a) requires “Ignition switches must control each ignition circuit on each engine.” The Bombardier Aerospace (BA) C Series airplane models BD-500-1A10 and 1A11 do not provide separate ignition switches for each engine, as required. This requirement dates back to the Civil Aviation Regulations (CAR) 4b, and pre-dates the introduction of Electronic Engine Controls (EECs). Other modern aircraft have been certified without separate ignition switches for each engine following a finding of equivalent level of safety. On such aircraft, the ignition is controlled by the EECs and power to the ignition system is controlled by a switch that also opens and closes fuel flow to the respective engine.

Applicable regulation(s)

§§ 21.21(b)(1) and 25.1145(a)

Regulation(s) requiring an ELOS finding

§ 25.1145(a)

Description of compensating design features or alternative standards which allow the granting of the ELOS (including design changes, limitations or equipment need for equivalency)

The CSeries engine ignition control system design uses a highly robust electronic engine control (EEC) and aircraft DC power to perform the igniter configuration functions once the pilot has selected engine run switch to “ON”. On the ground, the EEC software will automatically alternate each engine ignition system on successive starts and set an appropriate fault message if the ignition system is malfunctioning. In-flight, the EEC will command both ignition systems “ON” to start the engine. The EEC automatic control of the ignition is carried out through Auto-start and Auto-relight software logic. All EEC software is Level A and flight critical per DO-178B and is therefore shown through extensive testing to exhibit high reliability. An EEC failure of ignition control is remote and would only occur as a software error in the EEC, which would be anticipated to affect other features of engine control. As a result, the loss of direct control of ignition power, selection, or excitation due to an EEC software error will not directly impact safety of flight and is not impacted by the absence of manual ignition switches for each of the ignition circuits.

The ignition control is by means of the engine run switches. Left and right engine run switches are located on the Throttle Quadrant Assembly (TQA), directly behind the respective engine lever. This lift and move toggle acts as the respective engine ignition switch.

Ignition is powered using the aircraft DC essential power, controlled and monitored by the EEC at engine start.

The engine run switches are located side by side on the TQA. In the OFF position, each switch disables ignition and fuel. There is no master ignition switch which affects all engines simultaneously.

Igniters come on when the engine run switch is in the Run position. Engine start is selected by the EEC and the igniters are disabled once the engine is stable (single igniter alternate starts on the ground , and dual igniters in flight).

There are no failure modes that require the crew to shut off the engine ignition while leaving the engine running. The ignition system is disabled when the respective FIRE push button switch is pressed, to ensure this potential ignition source is removed under fire conditions..

The Pratt & Whitney Canada engine ignition system for the BD-500-1A10 and 1A11 airplanes utilize Electronic Engine Control (EEC) software to manage the selection of igniters in lieu of pilot actuated flight deck igniter selection required by CFR 25.1145(a). The use of the EEC to select the igniter, to command power to the igniter and to monitor the igniter for faults during ground and in-flight starts, provides a level of safety equivalent to a pilot actuated flight deck switch for each engine ignition circuit.

Below is the justification to show that in the absence of dedicated control switches for each circuit on the flight deck, there is sufficient automatic control of the ignition circuit, providing an Equivalent Level of Safety (ESF) to direct compliance with CFR 25.1145 (a).

Explanation of how design features or alternative standards provide an equivalent level of safety to the level of safety intended by the regulation

The incorporation of engine ignition control into the EEC also simplifies the flight deck design and flight crew procedures because pilots are not required to configure the igniters for ground and in-flight starts, allowing them to focus on other tasks. The EEC auto-start software logic monitors indicated turbine temperature (ITT), shaft speed, and shaft speed rate-of-changes during all start attempts, ground and in-flight, until the engine stabilizes, ensuring no abnormal behavior. The auto-start software applies corrective action if there is a hung start, locked rotor, hot start, low starter duct pressure or failure of the combustor to light-off. Actions initiated by the auto-start software include flight crew notification via display of “IGN” icon on the Engine Indications (EI) page whenever igniters are commanded to spark, implementation of dual ignition, modified fuel scheduling, fuel supply cycling, or aborting the start sequence (which applies to ground start attempts only) prior to another start attempt.

When the engine is running, the auto-relight logic is initiated if a flameout or rollback is detected by the EEC software. Autorelight corrective action includes fuel rescheduling and selection of dual ignition to assist in engine recovery or to sustain engine operation. The design features and integrity provided by the EEC automated functions provide an ESF to flight deck igniter circuit control switches for each ignition circuit through software logic that posts ignition system failures and automatically provides configuration control of the engine ignition system without the need for pilot input. The EEC commands dual-igniter continuous ignition ON for certain conditions on the ground and in-flight to assist re-light/starting or to prevent flameout. The automated EEC software function provides control and fault detection of individual engine igniter circuits, therefore provides a level of safety equivalent to a design that would be directly compliant with CFR 25.1145 (a)(b).

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in project Issue Paper P-41, titled Engine Ignition Switches. This memorandum provides standardized documentation of the ELOS finding that is non-proprietary and can be made available to the public. The TAD has assigned a unique ELOS memorandum number (see front page) to facilitate archiving and retrieval of this ELOS. This ELOS memorandum number should be listed in the type certificate data sheet under the Certification Basis section in accordance with the statement below:

Equivalent Level of Safety Findings have been made for the following regulation(s):
§ 25.1145(a) Ignition Switches
(documented in TAD ELOS Memorandum TC4948NY-T-P-41)

Original signed by Robert Hettman for VW

11/27/13

Transport Airplane Directorate,
Aircraft Certification Service

Date

ELOS Originated by NYACO:	Gaetano Sciortino 516 228-7316	ANE-170
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