



Federal Aviation Administration

Memorandum

Date: February 22, 2010

To: Manager, Small Airplane Directorate, ACE-100

From: Manager, Project Support Office, ACE-112

Prepared by: Peter Rouse, Regulations and Policy Office, ACE-111

Subject: Extension of Equivalent Level of Safety (ELOS) to 14 CFR, part 23, § 23.1061 Liquid Cooling – Installation, and § 23.1063 Liquid Cooling -- Coolant tank tests for the Diamond Aircraft Industries DA-42 M-NG Airplane.

ELOS Memo#: ACE-05-07B

Regulatory Ref: 14 CFR, part 23, § 23.1061

Diamond Aircraft Industries (DAI) requests extension of an existing equivalent level of safety (ELOS), ACE-05-07A, for the use of a coolant tank that has a capacity less than that required by § 23.1061(b) to the model DA-42 M-NG airplane.

Background:

The DA-42 M-NG is a derivative model airplane to be included on type certificate A57CE, along with the prior certificated model DA-42. The FAA is currently validating two nearly identical model airplanes (DA-42 NG and DA-42 M-NG). FAA has issued an ELOS for the currently certificated model DA-42 and for the model DA-42 NG. The model DA-42 M-NG is identical to the model DA-42NG except for the following design changes:

- Cockpit Canopy - The canopy provides more headroom and improved visibility to the sides of the airplane without any appreciable effect on the performance and handling qualities.
- Mission Equipment Electrical Bus - This system provides provision for mission equipment electrical power supply. This system is installed as a provision only and any equipment is not permitted to use this electrical bus.
- Nose Cone - This nose cone installation uses an adapter ring that provides the capability to remove the cone. The nose cone approved for this model airplane has the identical

loft lines of the DA-42NG nose cone; therefore having no effect on the airplane performance or flight characteristics.

The FAA has made a determination that the design differences listed above do not affect any areas of consideration for the ELOS granted for the model DA-42 NG. Therefore, FAA has made the determination that it is acceptable to grant an extension of the ELOS issued for the model DA-42 NG to the model DA-42 M-NG.

The remainder of this ELOS memorandum provides the background information and justification for the original approval of ELOS ACE-05-06 to the model DA-42 that has been extended to the DA-42 NG and that is requested to be extended to the DA-42 M-NG:

The model DA-42 incorporated the use of a closed-loop liquid cooling system with an expansion tank. The major change with respect to this amended type design is that the DA42NG replaces the Thielert model TAE 125-01 aircraft diesel engines (ADE) installed on the DA-42 with the Austro model AE300 aircraft diesel engines; however, the coolant design is fundamentally identical for the requested ELOS extension to that of the original ELOS. The respective design of the DA-42 M-NG is identical to that of the DA-42 NG, thus justifying the extension of this ELOS.

The Diamond Aircraft Industries (DAI) DA-42 aircraft is a new fully composite, four place, twin-engine airplane with retractable gear, cantilever low wing and T-tail. The airplane was certified by European Aviation Safety Agency (EASA) on type certificate (TC) number A005, dated May 13, 2004. The airplane is powered by two Thielert Aircraft Engines GmbH (Thielert) TAE 125-01 aircraft diesel engines (ADE), type certificated in the United States (U.S.), type certificate number E00069EN. The Thielert engine requires a liquid cooling system be installed; however, the system does not have the capacity mandated by § 23.1061(b). Under the Bilateral Airworthiness Agreement (BAA) between the U.S. and the Austrian Exporting Civil Aviation Authority (ECAA), the Austro Control GmbH (ACG), an application for U.S. Type Certification of Diamond Aircraft Industries (DAI) model DA-42 was made on August 2, 2004, by the DAI through the EASA.

The Federal Aviation Administration has researched the origins of § 23.1061(b) concerning the coolant tank volume requirements. The coolant tank volume requirements date from at least 1945 and have been unchanged since then. The types of liquid coolant systems in service at that time were systems used on lower powered gasoline engines, neither the type of engines nor the type of system that the requirement was applicable to were envisioned when the requirement originated.

Because of this, we believe that, despite the prescriptive nature of this regulation, its basis in five-decade-old technology compels the FAA to review the need for the requirement. In reviewing the Thielert coolant system, we determined that the relevant goal is maintaining the operability of the engine. While not complying with the prescriptive requirements of § 23.1061(b), the Thielert cooling system demonstrated appropriate engine cooling capability, including expected cases of coolant loss.

Applicable Regulation:

The applicable section of 14 CFR, part 23, § 23.1061(b) requires the following:

§ 23.1061(b) Installation

(b) Coolant tank. The tank capacity must be at least one gallon, plus 10 percent of the cooling system capacity.

Regulations Requiring an ELOS Finding:

14 CFR, part 23, § 23.1061

Description of Compensating Design Features:

The Austro model AE300 diesel engine is very similar to the Thielert TAE-125 ADE, in that it uses a closed-loop liquid cooling system with an expansion tank for engine cooling. In normal operation, such a system does not have a loss of cooling fluid, with the expansion tank ensuring a proper fluid level with various temperature and pressure situations. This type of cooling system is state-of-the-art in automobile liquid cooling systems and has been tested for functionality. Otherwise, it complies with all provisions of the applicable airworthiness standards; and the only deviation from the regulations is the volume of the tank.

To ensure an ELOS to the general intent of § 23.1061(b) for a safety margin in case of coolant fluid loss, the following is required by Austro Control GmbH (ACG) on the original DA-42 Thielert installation:

- The expansion tank capacity was shown to be large enough to ensure safe operation of the cooling system in case of cooling fluid loss that could be expected in service. This was demonstrated by analysis and tests. The minimum and maximum fluid levels were established.
- It was demonstrated that the reduced thermal buffer capacity of the TAE 125 cooling tank does not affect the safe operation and the emergency capability adversely. This was shown for both heating up and cooling down. The cooling capacity of the system was shown to be able to compensate for the reduced thermal buffer capacity.
- The expansion tank must be able to withstand the vibration, inertia and fluid loads to which it may be subjected in operation, as required in § 23.1063.

The same provisions constituted the FAA equivalent level of safety for the DA-42 with the Thielert TAE-125 ADE.

Based on the functional identity of the respective designs, we concur with the requested extension of the DAI model DA-42 ELOS for the use of a coolant tank that has a capacity less than that required by § 23.1061(b) to the DAI model DA-42NG with the Austro AE300 ADE installation.

FAA Approval:

The Small Airplane Directorate concurs with the extension of ELOS ACE-05-07A for the DAI model DA-42 NG to the model DA-42 M-NG. The DAI model DA-42 M-NG is granted ELOS number ACE-05-07B.

James E. Jackson for

2-22-10

Manager, Small Airplane Directorate
Aircraft Certification Service

Date

ELOS Originated by: Small Airplane Directorate	Project Support Branch Manager: William J. Timberlake	Symbol: ACE-112
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