



Federal Aviation Administration

Memorandum

Date: June 2, 2011

To: Manager, Small Airplane Directorate, ACE-100

From: Manager, Project Support Branch, ACE-112, Small Airplane Directorate

Prepared by: Peter L. Rouse, Regulations and Policy Branch, ACE-111

Subject: **INFORMATION:** Equivalent Level of Safety (ELOS) to 14 CFR Part 23, § 23.1061, Liquid Cooling Installation, for Diamond Aircraft Industries (DAI) model DA-40NG Airplanes with Austro E4 Aircraft Diesel Engine (ADE)

ELOS Memo#: ACE-11-06

Regulatory Ref: 14 CFR § 23.1061

This memorandum requests your office to review and provide concurrence with the proposed finding of equivalent level of safety (ELOS) for the DAI model DA-40NG finding to the requirements of 14 CFR, part 23, § 23.1061, Liquid Cooling Installation.

Background:

The DAI model DA-40NG airplane 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 DA-40NG replaces the Textron Lycoming IO-360 M1A engine installed on the DA-40 with the Austro model E4 aircraft diesel engine.

The DAI model DA-40NG airplane is a fully composite, four-place, single-engine airplane with fixed gear, cantilever low wing and T-tail. The original model DA-40 airplane was certified by Austro Control Group/Joint Airworthiness Authority on October 24, 2000. Subsequently, the European Aviation Safety Agency (EASA) reissued type certificate (TC) number A022 on January 21, 2005. EASA approved the variant (amended) model DA-40 NG type design on April 8, 2010. Under the Bilateral Airworthiness Agreement (BAA) between the United States (U.S.) and the Austrian Exporting Civil Aviation Authority (ECAA), the Austro Control GmbH (ACG), DAI applied for U.S. Type Certification for the DAI model DA-40NG on May 11, 2010, through the EASA.

The Austro E4 engine requires a liquid cooling system be installed; however, the system does not have the capacity mandated by § 23.1061(b). The Federal Aviation Administration (FAA) 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 current type of engines nor cooling systems 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 Austro engine 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 Austro engine 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.

(1) Each coolant tank must be able to withstand the vibration, inertia, and fluid loads to which it may be subjected in operation;

(2) Each coolant tank must have an expansion space of at least 10 percent of the total cooling system capacity; and

(3) It must be impossible to fill the expansion space inadvertently with the airplane in the normal ground attitude.

Regulations Requiring an ELOS Finding:

14 CFR, part 23, § 23.1061

Description of Compensating Features:

The Austro model E4 diesel engine installed on the DA-40NG airplane is very similar to the Austro model E4 diesel engine installed on the DA-42NG airplane, which 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-40NG 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.
- The reduced thermal buffer capacity of the Austro E4 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 also 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 § 23.1061.

FAA Approval and Documentation of the ELOS Finding:

The FAA concurs with the requested ELOS for the Austro E4 engine installation's use of a liquid cooling tank that does not meet the capacity required by § 23.1061(b).

John Colomy
for Manager, Small Airplane Directorate,
Aircraft Certification Service

6/2/11
Date

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