



U.S. Department
of Transportation
**Federal Aviation
Administration**

Memorandum

Subject **ACTION:** 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 Type Certificate with Thielert
TAE-125-01 Diesel Engines in the DA-42 Airplane; ACE-
05-07.

Date: June 22, 2005

From: Propulsion Engineer – Technical Specialist,
Regulation and Policy Branch, ACE-111

Reply to Peter L. Rouse
Attn. of: (816) 329-4135

To: Manager, Small Airplane Directorate, ACE-100

This memorandum documents concurrence for the subject finding of ELOS. We request your office to review and concur with the proposed ELOS finding to 14 CFR part 23, 14 CFR part 23, § 23.1061(b) Liquid Cooling -- Installation. The proposed ELOS will allow for the use of a coolant tank that has a capacity less than that required by § 23.1061(b).

BACKGROUND:

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 EASA on type certificate 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, 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 European Aviation Safety Agency (EASA).

The 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 lowered powered gasoline engines,

neither the type of engines nor the type of system that the requirement was applicable to was 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 REGULATIONS:

Section 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.

DESCRIPTION OF COMPENSATING FEATURES:

The Thielert TAE-125 reciprocating diesel engine 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 was required by Austro Control GmbH (ACG) on the 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 will constitute the FAA equivalent level of safety.

RECOMMENDATION:

We concur that the substantiation of the functionality of a coolant tank size smaller than mandated by regulation provides an ELOS to that intended by § 23.1061(b), and recommend the issuance of this ELOS.

Concurred by:

<u>William J. Timberlake</u> Manager, Project Support Branch, ACE-112	<u>6-21-05</u> Date
<u>John Colomy</u> for Acting Manager, Standards Office, ACE-110	<u>6-22-05</u> Date
<u>John Colomy</u> for Acting Manager, Small Airplane Directorate, ACE-100	<u>6-22-05</u> Date