Federal Aviation Administration

Memorandum

Date: NOV 0 3 2006

From: Manager, Special Certification Office, ASW-190

To: Manager, Small Airplane Directorate, ACE-100

Prepared by: Jurgen Priester, Special Certification Office, ASW-190

Subject: Equivalent Level of Safety to § 23.1091(b)(4); Flight Crew Override Means for Automatic Alternate Air Door in Cirrus Design SR22 with Engine Technologies, Inc. Turbo Normalizer STC, ACE-06-06

This memorandum requests your office to review and concur with the proposed Equivalent Level of Safety (ELOS) finding to the alternate air door flight crew override means requirement of § 23.1091 (b)(4). The proposed ELOS will confirm that the design of the Engine Technologies, Inc. turbo normalizer STC installation on the Cirrus SR22 inherently precludes ice accumulating on the door, which eliminates the need for a manual override feature.

Background:

SR22 is a 3,400 pound single-engine, four-place, fixed-gear airplane powered by a 310 hp Teledyne Continental Motors, Inc. reciprocating engine. The SR22 is a conventional tractor configuration and uses composites for the structure. Some unique features of the SR22 include sidestick controls, a ballistic recovery system, and a single combination throttle/propeller control lever.

The standard SR22 complies with 14 CFR part 23, § 23.1091(b)(4) by incorporating a manual-controlled cable that can be used to force the alternate air door to open if it ices over. Engine Technologies, Inc. of Ada, Oklahoma designed a turbo normalizing system for the Cirrus SR22 that does not use the existing alternate air system. The Engine Technologies, Inc. alternate air system employs an automatic alternate air door that is intentionally located in the hot area beneath the engine and does not incorporate the manual override required by 14 CFR part 23, § 23.1091(b)(4). Therefore, an Equivalent Level of Safety must be identified for the Air Induction System requirements of 14 CFR part 23, § 23.1091(b)(4).

Applicable Regulations:

The rule applicable to air induction system is 14 CFR, part 23, § 23.1091(b)(4), which states:

> Air induction system.
>
> (a) The air induction system for each engine and auxiliary power unit and their accessories must supply the air required by that engine and auxiliary power unit and their accessories under the operating conditions for which certification is requested.
> (b) Each reciprocating engine installation must have at least two separate air intake sources, and must meet the following:
> (1) Primary air intakes may open within the cowling, if that part of the cowling is isolated from the engine accessory section by a fire-resistant diaphragm, or if there are means to prevent the emergence of backfire flames.
> (2) Each alternate air intake must be located in a sheltered position and may not open within the cowling, if the emergence of backfire flames will result in a hazard.
> (3) The supplying of air to the engine through the alternate air intake system may not result in a loss of excessive power in addition to the power loss due to the rise in air temperature.
> (4) Each automatic alternate air door must have an override means accessible to the flight crew.
> (5) Each automatic alternate air door must have a means to indicate to the flight crew when it is not closed.
> (c) [Not shown as it is a turbine engine requirement]

Regulations Requiring an ELOS:

In considering the current design, the applicant requested an ELOS for § 23.1091(b)(4), Air Induction System. The Federal Aviation Administration (FAA) determined that an appropriate level of safety can be provided by the issuance of an ELOS, in accordance with the provisions of 14 CFR, part 21, § 21.21.

As discussed above, this ELOS is applicable only to the Cirrus SR22 airplane with the Engine Technologies, Inc. turbo normalizer STC installation. Should Engine Technologies, Inc. later apply for addition of a follow-on Cirrus model aircraft on the same supplemental type certificate, it must request and substantiate an extension of this ELOS to the later model.

Description of Compensating Features:

Engine Technologies, Inc. intentionally placed the automatic alternate air door featured by their turbo normalizing design under the engine near the exhaust. This maintains the temperature of the air door high enough that it is not possible for the air doors to freeze shut, even under the most extreme cold weather conditions. The design uses magnets to hold the alternate air door closed until the difference in air pressure on either side of the door is great enough to open it. The alternate air door is shaped to ensure that the air flowing to the turbochargers forces the door completely open. There are no springs on the air door. The magnets provide the only force to overcome when opening the air door. The alternate air door system is automatic. A microswitch on the door activates an indicator on the MFD in the cockpit to indicate when the door is open.

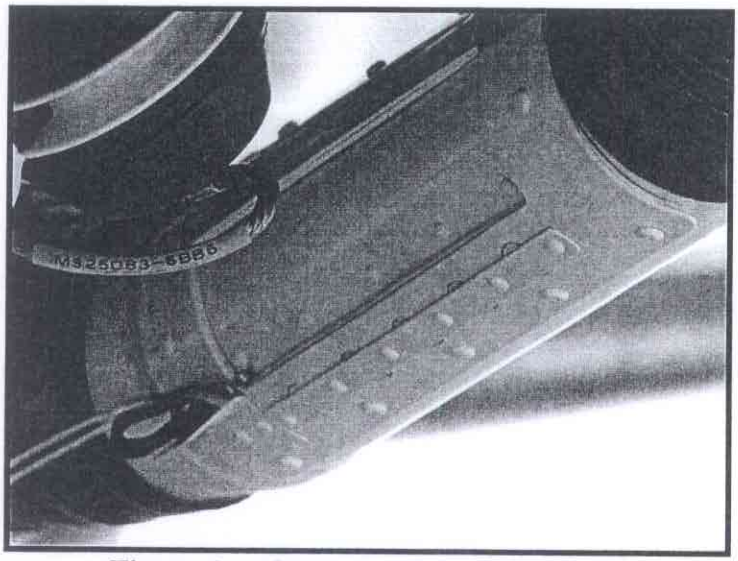

Figure 1 - Alternate Air Door (closed)

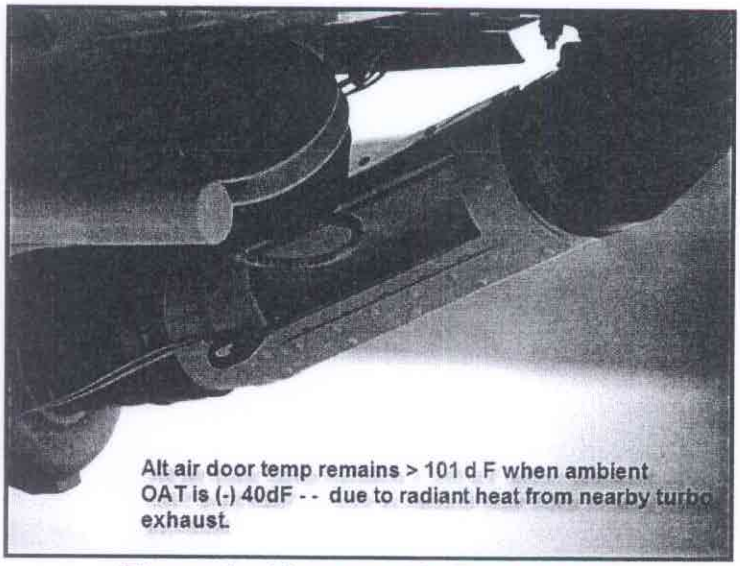

Figure 2 - Alternate Air Door (open)

Explanation of Compensating Features:

Company flight testing shows that air temperatures will always be high enough to preclude icing of the alternate air door. For this testing, the air filter was blocked and the aircraft flown at various altitudes at 75 percent power. The results are using a configuration with a left and right alternate air door. The final configuration omits the right side alternate air door and only uses the left side door to provide alternate air. The results are shown below (preheat of alternate air above 60°F in all cases):

CIT = compressor inlet temperature

Altitude	% Power	Ind OAT	Ind CIT R	Ind CIT L	Cal OAT	Cal CIT R	Cal CIT L	Preheat of Alt Air
1400	75	88	139	162	88	141	163	75
5000	75	68	120	155	68	122	157	89
11500	75	48	138	176	48	140	177	129
15200	75	38	114	147	38	116	149	111
17000	75	30	115	154	30	117	156	126

Table 1. Measured actual alternate air induction air temperature increases from local "pre-heating" from the turbo exhaust system. Minimum pre-heat > 75 °F.

Company testing also substantiated that the measured temperature of the metal alternate air door was 101 °F on an actual day when the OAT was -40 °F, with the engine operating at cruise power settings in flight. Flight test data shows that the heat rise at the alternate air door location is > 75 °F. From that data and other data, in environmental conditions where the OAT is -22 °F, that the induction air temperature at the inlet to the throttle body with the proposed alternate air door system will be at least 81 °F, assuring that there will not be any downstream icing. Furthermore, the alternate air door is located several feet downstream of the air filter, in a highly protected location. The combination of air filter location and alternate air door location, coupled with nearby intense radiant heat from the engine turbo exhaust system ensures that icing of both the air filter element and the alternate air door is nearly impossible. These aspects of the design provide for an inherent equivalent level of safety to the required regulation. Consequently, a manual override means is not required.

Recommendation:

We concur that the automatic alternate air door design used by Engine Technologies, Inc provides an equivalent level of safety to the requirements of 14 CFR, part 23, § 23.1091(b)(4).

Concurred by:

S. Frances Cox — *11-01-06*
Manager, Special Aircraft Certification Office, ASW-190 — Date

11/3/06
Acting Manager, Standards Office, ACE-110 — Date

James E. Jackson — 11-3-06
acting Manager, Small Airplane Directorate, ACE-100 — Date