Federal Aviation Administration

Memorandum

Date: February 15, 2012

To: Melvin D. Taylor, Manager, Atlanta Aircraft Certification Office, ACE-115A

From: Manager, Transport Airplane Directorate, ANM-100

Subject: INFORMATION: Equivalent Level of Safety (ELOS) Finding for Cabin Pressurization for High Altitude Takeoff and Landing Operations for ARC Avionics Corp. Supplemental Type Certificate (STC) for 737-300/-500 Aircraft
(FAA Project Number ST13518AT-T, STC Number ST03945AT)

ELOS Memo#.: ST13518AT-T-S-1

Reg. Ref.: §§ 25.841(a), and 25.841(b)(6)

The purpose of this memorandum is to inform 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 an ARC Avionics Corp. (ARC) Supplemental Type Certificate (STC) for Boeing 737-300/-500 aircraft.

This memorandum has been issued to provide an ELOS finding for operations into airports up to 13,500 feet landing field elevation.

Background

Title 14, Code of Federal Regulations (14 CFR) 25.841(a), states that under normal operating conditions, the cabin pressure altitude can not exceed 8,000 feet. FAA considers takeoff and landing to be a normal operating condition, even at a high elevation airport. As a result, allowing the cabin pressure to exceed 8,000 feet would not be in direct compliance with § 25.841(a). An allowance for this deviation can be granted as long as the duration that the cabin altitude exceeds 8,000 feet is minimized. Section 25.841(b)(6) requires a warning when a safe or preset cabin pressure altitude limit is exceeded. The rule states that the warning requirement for cabin pressure altitude limits may be met if the warning is set for 10,000 feet. The ARC STC intends to modify 737-300 and -500 aircraft for takeoff and landing at airports with field elevations up to 13,500 feet. If the cabin altitude warning is set for 10,000 feet, the flight crew will receive nuisance warnings during high altitude takeoff and landing operations unless special design features are incorporated. Accordingly, the ARC STC shifts the cabin pressure altitude warnings

from 10,000 feet to 14,000 feet under specific conditions for these high altitude operations. ARC has requested an ELOS to § 25.841(b)(6) under certain operating conditions so as to allow incorporation of this design features.

Applicable regulation(s)

§§ 25.841(a) and 25.841(b)(6) Amendment 25-87

Regulation(s) requiring an ELOS finding

§§ 25.841(a) and 25.841(b)(6) Amendment 25-87

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 intent of § 25.841(a) is to maintain a safe pressure environment within the cabin during normal operations. The FAA has determined that the cabin altitude can exceed 8,000 feet during the time the airplane is operating at the high altitude airport provided that the duration that the cabin altitude exceeds 8,000 feet is minimized. In addition, the intent of § 25.841(b)(6) is to warn the crew when the safe or preset cabin pressure altitude limit is exceeded. The FAA has determined that the safe cabin altitude can be above 10,000 feet when operating into a high altitude airport, provided there is a means to warn the crew when the cabin altitude exceeds the field elevation by some margin and the system reverts back to the normal cabin altitude warning setting for all other operations. The FAA approved airplane flight manual (AFM) must include appropriate limitations and procedures. The FAA has determined that when operating with the cabin altitude warning shifted to an altitude above 10,000 feet, at least one pilot is required to use oxygen continuously during descent. In addition, the AFM shall contain information regarding the operation of the cabin altitude warning system when operating into the high altitude airfields.

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

The design of the pressurization system and approved procedures in the AFM supplement ensure that, as soon as the aircraft lifts-off, the pressurization controller will command the cabin altitude to be driven down to its normally scheduled altitude (i.e., less than or equal to 8,000 feet) as per the original design. Note that this procedure comes directly from AD 2011-03-14, paragraph (i)(3)(ii). With the system in AUTO, re-pressurization of the cabin will occur at a rate of no more then 700 FPM. When operating at the maximum requested altitude of 13,500 (worst case) and at the design rate of pressurization, the times to reach 8,000 feet pressure altitude range from 11 to 7.8 minutes. FAA finds this to be acceptable.

The added components are integrated into the modified aircraft to increase the threshold for the cabin altitude warning system from 10,000 ft to 14,000 ft when the HIGH ALT LDG switch is engaged. Additionally, a new cabin altitude sensor is installed which drops the passenger oxygen masks at 14,650 ± 350 ft regardless of landing altitude or HIGH ALT LDG switch position.

The high altitude airport operation landing warning system consists of the following individual components:

1. A selector switchlight.
2. Two cabin pressure sensors.
3. An oxygen-mask-drop 14,000 feet sensor.
4. Two warning annunciators.

1. The HIGH ALT LDG switchlight on the cabin altitude panel lets the crew configure the aircraft for landing at a high altitude airport. When the HIGH ALT LDG switchlight is in the OFF position (not depressed or illuminated), the cabin altitude warning circuit and the beep alert are enabled to 10,000 ± 1,000 feet. When the HIGH ALT LDG switchlight is in the ON position (depressed and illuminated cyan), the cabin altitude warning circuit and the beep alert are enabled to 14,650 ± 350 ft.

2. A 10,000 feet Cabin Pressure Sensor is installed in parallel with the existing 10,000 foot Cabin Pressure Sensor. The two cabin pressure sensors are functionally identical and either one will trigger the alert above 10,000 +/- 1,000 feet cabin pressure during normal operations. The two sensors provide an increased safety factor with their redundancy.

   A 14,000 feet Cabin Pressure Sensor is installed as a secondary selectable sensor. This sensor will be active when the crew depresses the HIGH ALT LDG Switchlight located in the Pilot Overhead Panel near the Pressurization controller; this sensor will trigger the alert above 14,650 ±350 feet cabin pressure during high altitude landing operations.

3. The existing 10,000 ft pressure sensor for the automatic deployment of the Passenger Oxygen System (oxygen masks) has been replaced to avoid accidental mask deployment. The new sensor activates at 14,650 ± 350 ft regardless of the landing altitude or the HIGH ALT LDG switch position.

4. Visual warning lights are provided to help discriminate between the cabin altitude alert and the takeoff configuration alert (both alerts have the same intermittent aural beep). Two warning lights, CABIN ALTITUDE and TAKEOFF CONFIG, are located on the center instrument panel in the flight crew compartment. These lights will provide a visual indication of the specific cause of an intermittent aural beep alert.

FAA approval and documentation of the ELOS finding

The FAA has approved the aforementioned ELOS finding in project Issue Paper S-1. 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 limitations and conditions section of the STC. An example of an appropriate statement is provided below.

Findings have been made for the following regulation: §§ 25.841(a) and 25.841(b)(6) Pressurized cabins (documented in TAD ELOS Memo ST13518AT-T-S-1)

Transport Airplane Directorate,
Aircraft Certification Service

FEBRUARY 16, 2012
Date

ELOS Originated by Atlanta ACO:	Project Manager: Ned Teeny P.E. Flight Test Pilot: Craig Edkins	Routing Symbol ACE-115A