



U.S. Department
of Transportation

**Federal Aviation
Administration**

Memorandum

Subject: **ACTION:** Equivalent Level of Safety to
§ 23.1321(d)(4); Chelton PFD for CAPSTONE
Program; ACE-02-14

Date: JAN 03 2003

From: Manager, Anchorage Aircraft Certification Office,
ACE-115N

Reply to
Attn. of: L. Foster
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To: Manager, Small Airplane Directorate, ACE-100

This memorandum requests your office to review and provide concurrence with the proposed finding of equivalent level of safety to the heading requirements of § 23.1321(d)(4) of 14 CFR part 23.

SUMMARY OF ISSUE:

Part 23. § 23.1321(d)(4) requires that the instrument that displays heading information be located below the attitude indicator. This rule was based on Part 23 airplanes using individual round dial instruments. Prior to this rule, there was no consistent location for primary flight instruments. Standardizing the location of instruments, for example, meant that pilots could learn instrument flying in one airplane and their instrument scan would not have to change from plane to plane.

Consequently, when electronic flight information system (EFIS) displays were developed for transport and business airplanes, their designs continued to incorporate the “basic T” for instrument locations even though the pilot’s scan area was condensed. It follows that on typical integrated EFIS displays, the heading information is still presented at the bottom of the display.

In contrast to typical EFIS displays, the Chelton primary flight display (PFD) for the CAPSTONE program displays the heading information on the top of the display. On condensed EFIS displays, it is just as safe and easy for the pilot to use the heading on the top; the only issue is that it breaks from standardization. For the Chelton PFD display, the heading displayed on top is easy for the pilot to see because terrain, airport details, and navigation information are displayed at the bottom of the PFD.

APPLICABLE REGULATIONS:

Amendment 23-14, added § 23.1321(d)(4) for heading indicator location. It stated, “The instrument that most effectively indicates direction of flight must be adjacent to and directly below the instrument in the top center position.”

The preamble explained the change; “This proposal is considered necessary because of the increasing complexity of the new high performance airplanes and the increasing volume of air traffic. In addition, the proposed new paragraph (d) is in furtherance of the principle of cockpit standardization.”

DISCUSSION:

The development and evolution of electronic systems over the past several decades has led to the evolution of avionics devices from single-purpose mechanical indicators into integrated displays. These integrated displays allow for a greater amount of information to be presented to the pilot in a clear and concise manner. Two integrated avionics display examples are Electronic Flight Instrument Systems (EFIS) displays and Heads Up Displays (HUDs).

EFIS displays are intended to integrate the traditional independent round flight instruments into a single consolidated display. They have been designed using the existing rules for flight instruments as much as practical. For example, the standard “T” arrangement, as explained in § 23.1321(d), has dictated the layout of instrument panels for decades. This “T” locates the attitude indicator top center, with the airspeed top-left and the altitude top-right and the heading indicator below-center. This mandate has been used in the design of current EFIS displays.

Head-Up Displays (HUDs) have been used by the military for decades and are now installed on civil airplanes. HUDs allow the pilot to “see” essential flight information displayed on a clear medium while looking out the front window because they look through the display to the outside. Most HUDs locate the heading on the top of the display so that the heading movement doesn’t distract the pilot’s visibility down towards the ground.

A synthesis of these two concepts has led to the development of several new panel mounted displays that present terrain and landmark information in the background where before there was only blue and brown shading divided by a horizon line, as on a typical attitude indicator. In many ways the new displays resemble a HUD more than the original instrument designs of the past. Therefore, the same rationale for locating the heading information at the top of the display has been applied to these panel-mounted integrated displays.

In the panel-mounted display example developed by Chelton, information is presented at the bottom edges of the display. This information is relatively stationary and leaves the center open to display ground reference objects such as towers, airports, and terrain. The top of the display is left open so the blue background offers better contrast for the heading tape and it’s related symbology, making it easy for the pilot to see.

The original "T" layout was a successful first-step to standardize the pilot's scan between different aircraft types and avionics systems. EFIS displays further advanced avionics design by integrating more information into a smaller device, allowing pilots to consolidate their scan. Like a typical EFIS display, the Chelton display presents all the information critical to flying the airplane without forcing the pilot to scan. Also, the Chelton design presents additional terrain and airport information which improves the situational awareness of the pilot.

COMPENSATING FEATURES:

The FAA finds that the Chelton PFD benefits the public by providing more situational awareness than the traditional instruments located in the standard "T" configuration. The Chelton PFD also offers the same level of safety as provided for in §23.1321(d)(4) heading indicator location because the size and integration of the PFD allows the pilot to see the heading display anytime the pilot is looking at the attitude display.

Concurred by:

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