



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

Memorandum

Subject: **ACTION:** Equivalent Level of Safety, Beechcraft E33,
FAR 23.1321(d)(4), HUD Heading Presentation; ACE-98-6

Date: NOV 27 1998

From: Manager, Special Certification Office, ASW-190

Reply to
Attn. of: Aaron Cornelius
(817) 222-4637

To: Manager, Small Aircraft Directorate, ACE-100
THRU: Manager, Standards Office, ACE-110

This memorandum requests your office to review and provide concurrence to the proposed findings of equivalent level of safety to the heading position requirements of FAR 23.1321(d)(4). There is no current FAA published criteria which address this requirement for the HUD developing technology.

Background:

This project will install a Model 600 Head-Up-Display (HUD) System on a Model Raytheon/Beech BE-33 aircraft which the applicant makes reference to as a general aviation type HUD. The HUD will provide basic navigation information which provides guidance equivalent to existing standard navigational instruments in the cockpit.

Applicable Regulation:

FAR paragraph 23.1321(d)(4), Instruments; Arrangements & Visibility, as amended by Amendment 23-41, states "The instrument that most effectively indicates direction of flight other than the magnetic direction indicator required by FAR 23.1303(c) must be adjacent to and directly below the instrument in the top center position."

Applicant Position:

Compliance with the mentioned FAR is not possible for a HUD. Conventional HUD design places its heading on or above the horizon line to enhance visibility and avoid interference with guidance information displayed at the bottom of the HUD field-of-view.

There are safety benefits from the implementation of this design which will greatly enhance the pilot ability to fly.

Safety benefits of HUD: HUDs offer several advantages over conventional instruments:
Reduced pilot workload - Pilot workload is reduced when the overall piloting tasks require head-up, outside-the-cockpit flight reference.

Increased flight precision - The expanded flight data format allows the pilot to fly instrument tasks more precisely. The overlay of HUD-presented flight data on the external visual scene allows the pilot to fly visual tasks more precisely.

Direct visualization of trajectory - A conformal display allows the pilot to directly assess aircraft performance relative to the real world.

Increased flight safety - Essential flight information on the HUD reduces eyes-in-the-cockpit during flight in congested traffic patterns.

Rationale for deviation: While performing operations for visual conditions, information at bottom gets lost in ground clutter. Under such conditions heading information is more important than precise bank scale information. Virtually every HUD to date has followed this arrangement with no reports of difficulties caused by a deviation from the “basic T” or by deviation from the head down instrument panel.

The rationale to place heading as mentioned is documented in two documents (U. S. Air Force’s Head-Up Display Design Guide, and Department of Defense Flight Symbolology Working Group). As Crew Systems noted, civilians use HUDs certified by FAA display heading at the top, and no accidents have been attributed to this design. The absence of reported problems, incidents, or accidents should be ample support of the requested equivalency.

If needed, a cockpit and flight evaluation of the Model 600 HUD heading arrangement can be included during certification flight tests.

FAA Position:

Placement of the heading above the attitude and pitch scales in the HUD display top center position should not increase risk to the crew. The heading information in this position is clear and unambiguous, alerting the crew as to instant conditions at a quick glance. The existing cockpit instrument requirements were predicated upon older technology, therefore not being relevant to today’s technology shift for HUD applications.

Compensating Features:

- a. The cockpit instruments are to remain in their original approved configuration.
- b. The HUD allows the pilot to get a quick glance of the outside view and enhance his judgment about situational awareness.

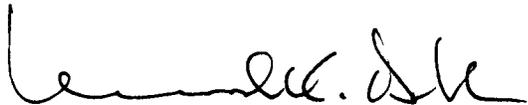
Recommendation:

We concur with the applicant’s suggested proposal to place the heading information in the top center quadrant of the display. This application should provide an equivalent level of safety as envisioned in the regulations and thus meets the requirements of paragraph 23.1321(d)(4).

Concurred by:


Manager, Special Certification Office, ASW-190

11-27-98
Date


Manager, Standards Office, ACE-110

2/19/99
Date


Manager, Small Airplane Directorate, ACE-100

2/19/99
Date