

TABLE C2E—ALTERNATIVE DATA SOURCES, PROCEDURES, AND INSTRUMENTATION—Continued  
 [The standards in this table are required if the data gathering methods described in paragraph 9 of Appendix C are not used]

Table of objective tests		Level By only	QPS requirements	Information
Test entry number and title			Alternative data sources, procedures, and instrumentation	Notes
2.d.3.c. Handling Qualities. Dynamic Lateral and Directional Stability. Adverse/Proverse Yaw.		X	Data may be acquired by using an inertial measurement system and a synchronized video of the calibrated helicopter instruments, the force/position measurements of flight deck controls.	

BEGIN INFORMATION

18. VISUAL DISPLAY SYSTEMS.

a. Basic principles of a FFS collimated display:

(1) The essential feature of a collimated display is that light rays coming from a given point in a picture are parallel. There are two main implications of the parallel rays:

(a) The viewer's eyes focus at infinity and have zero convergence, providing a cue that the object is distant; and

(b) The angle to any given point in the picture does not change when viewed from a different position so the object behaves geometrically as though it were located at a significant distance from the viewer. These cues are self-consistent, and are appropriate for any object that has been modeled as being at a significant distance from the viewer.

(2) In an ideal situation the rays are perfectly parallel, but most implementations provide only an approximation to the ideal. Typically, an FFS display provides an image located not closer than about 20-33 ft (6-10 m) from the viewer, with the distance varying over the field-of-view. A schematic representation of a collimated display is provided in Figure C2A.

(3) Collimated displays are well suited to many simulation applications as the area of interest is relatively distant from the observer so the angles to objects should remain independent of viewing position. Consider the view of the runway seen by the flight crew lined up on an approach. In the real world, the runway is distant and the light rays from the runway to the eyes are parallel. The runway appears to be straight ahead to both crew members. This situation is well simulated by a collimated display and is presented in Figure C2B. Note that the distance to the runway has been shortened for clarity. If drawn to scale, the runway would be farther away and the rays from the two seats would be closer to being parallel.

(4) While the horizontal field-of-view of a collimated display can be extended to approximately 210°-220°, the vertical field-of-

view has been limited to about 40°-45°. These limitations result from tradeoffs in optical quality and interference between the display components and flight deck structures, but were sufficient to meet FFS regulatory approval for Helicopter FFSs. However, recent designs have been introduced with vertical fields of view of up to 60° for helicopter applications.

b. Basic principles of a FFS dome (or non-collimated) display:

(1) The situation in a dome display is shown in Figure C2C. As the angles can be correct for only one eye point at a time, the visual system in the figure has been aligned for the right seat eye point position. The runway appears to be straight ahead of the aircraft for this viewer. For the left seat viewer, however, the runway appears to be somewhat to the right of the aircraft. As the aircraft is still moving towards the runway, the perceived velocity vector will be directed towards the runway and this will be interpreted as the aircraft having some yaw offset.

(2) The situation is substantially different for near field objects encountered in helicopter operations close to the ground. In those cases, objects that should be interpreted as being close to the viewer will be misinterpreted as being distant in a collimated display. The errors can actually be reduced in a dome display.

(3) The field-of-view possible with a dome display can be larger than that of a collimated display. Depending on the configuration, a field-of-view of 240° by 90° is possible and can be exceeded.

c. Additional display considerations

(1) While the situations described above are for discrete viewing positions, the same arguments can be extended to moving eye points produced by the viewer's head movement. In the real world, the parallax effects resulting from head movement provide distance cues. The effect is particularly strong for relative movement of flight deck structure in the near field and modeled objects in the distance. Collimated displays will provide accurate parallax cues for distant objects, but increasingly inaccurate cues for