Flight Simulation Training Device Qualification Guidance

Liquid Crystal on Silicon (LCoS) Visual Display System Evaluation

FSTD Qualification Guidance Bulletin 06-02

Purpose: This bulletin provides additional criteria for the evaluation of visual systems using LCoS projection display systems on level C and D simulators.

Background: For many years the NSP and other aviation authorities have approved FSTDs with visual display systems using cathode ray tube (CRT) technology. These systems inherently, through the use of phosphor as the light source, have fundamentally different characteristics than the new technology display systems currently available. Basically CRT systems use an electron beam to generate and modulate light to create an image that can vary from off, or no light, to as bright as the phosphor can get without 'burning' an image on the face of the CRT. LCoS systems have a constant light source that is always on and the light is then modulated to lower levels to generate an image. The LCoS projectors demonstrated to date cannot achieve the low light levels of a CRT based system. To accommodate the use of the newer generation systems for use in FSTDs, there needs to be an objective standard established for the black level or maximum brightness allowable in an unlit low visibility night scene.

Another image characteristic that is not currently tested is referred to as smear, or loss of image resolution or quality when the image is in motion across the display surface. This was not a problem with CRTs as long as the CRT employed had the proper persistence characteristic. With newer display technology, the image is made up of individual pixels that are 'switched' to control their color and intensity with every image update. The smear is observed when the apparent switch time of each pixel cannot keep up with the movement of the image, causing the loss of some higher resolution detail and image quality.

Procedure: When qualifying an LCoS visual system on a level C or D simulator, two demonstrations need to be accomplished in addition to the established statement of compliance demonstration tests and validation tests.

1. **Black Level:** The display brightness for a low visibility night scene should be no more than .015 candelas/square meter (cd/m²) in an unlit portion of a displayed scene as measured from the pilot eye-point. This test can be accomplished using a low visibility night scene (preferred) or with a test pattern and procedure acceptable to the NSP such as using the lower intensity measurement while accomplishing the light point contrast ratio test.

2. **Smear:** The test pattern in figure 1 or 2 may be used to measure this image characteristic. This pattern should be displayed in each channel, so that the bars are displayed representing the specified arc minute spacing at the pilot eye-point. The image should then be rotated, first in pitch and then in heading, at 10 deg/sec while observing the 5 arc minute bars on the pattern. As they move across the display, the image of these bars and gaps must be maintained at this number or lower for the smear to be acceptable. The test pattern in figure 2 may provide better results since it is designed to eliminate the effects of temporal aliasing.

   It is important to note that if the aircraft being simulated can routinely achieve high angular rates in normal operation or training, this type of visual system may not be acceptable do to smearing.

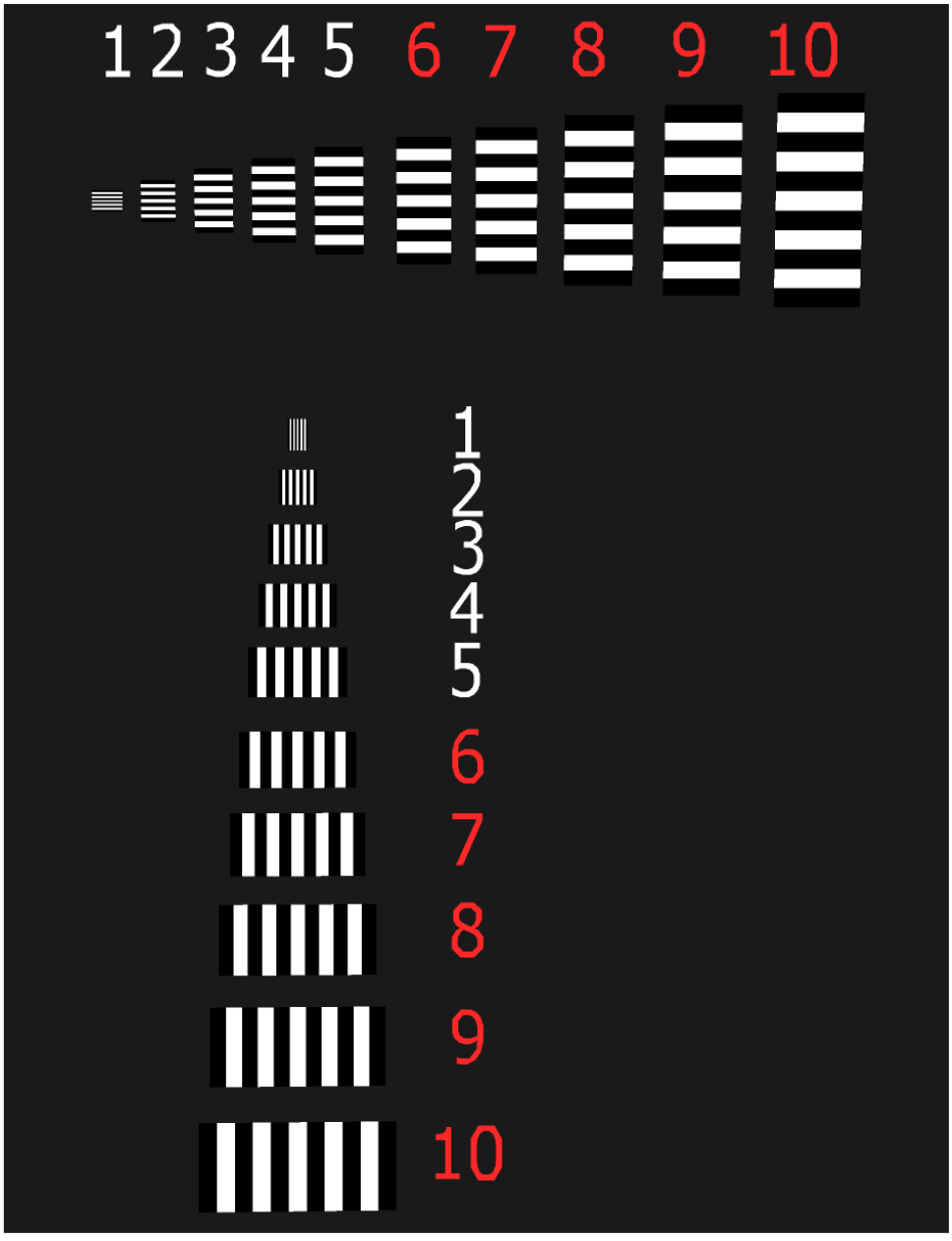

Figure 1 – Smear or Persistence Test Pattern - The numbers correspond to the size in arc minutes of the white bars and spaces between them as measured at the pilot eye-point.

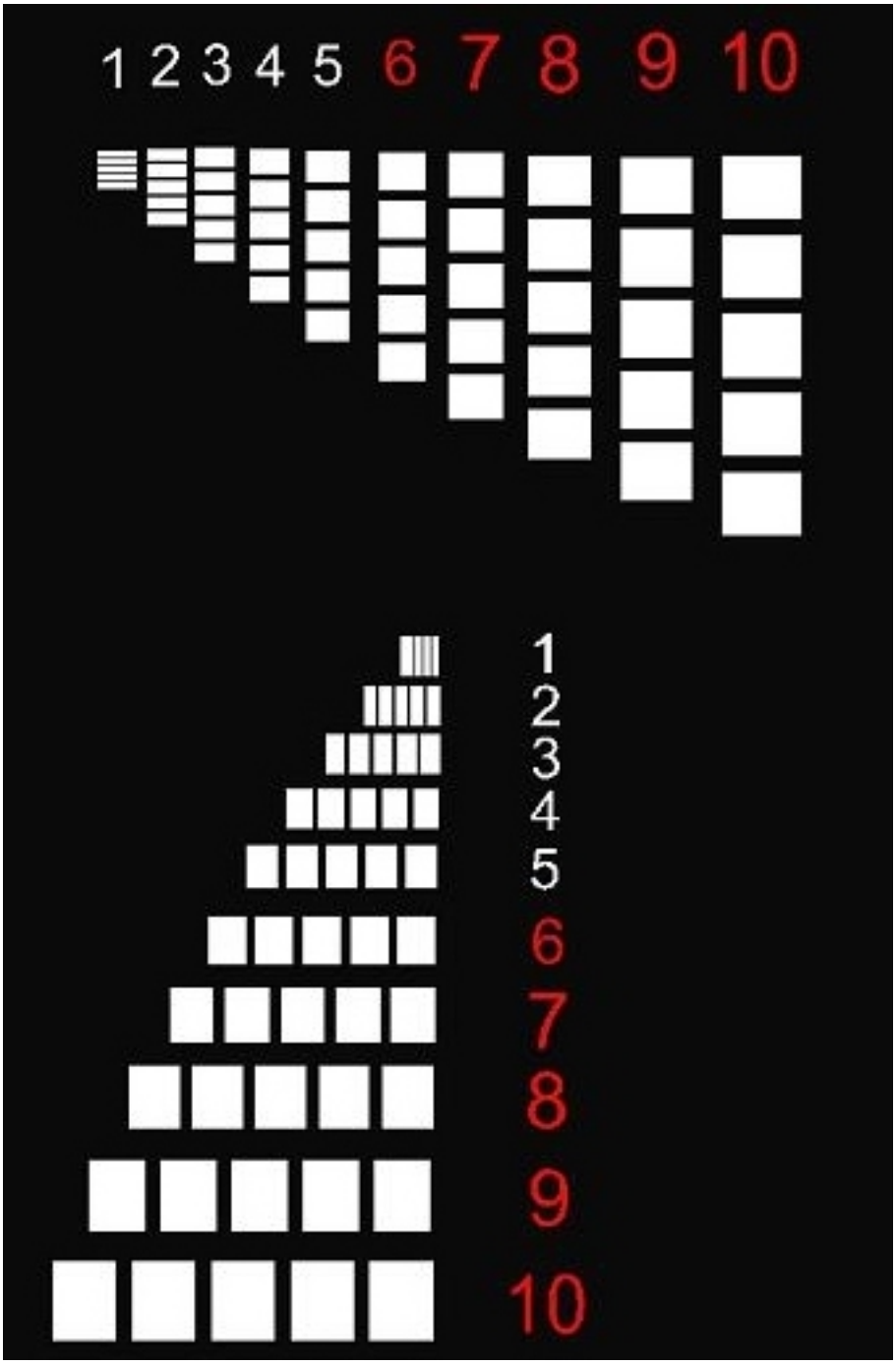

Figure 2 – Smear or Persistence Test Pattern - The numbers correspond to the size in arc minutes of the spaces between the white bars as measured at the pilot eye-point.