ISSN 1232-3829

tts 10/2013

Technika Transportu Szynowego koleje ▪ tramwaje ▪ metro

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IMAGE GENERATORS VALIDATION TESTS REQUIREMENTS

Abstract

Every type of Flight Simulation Training Device (FSTD) should comply with different requirements. Compliance with these requirements shall be assessed in the validation tests and functions & subjective tests. This paper provides overview of new FSTD validation test parameters defined by third edition of ICAO 9625 Manual of Criteria for the Qualification of flight Simulators.

INTRODUCTION

Internationally accepted regulation ICAO 9625 third edition defined seven types of Flight Simulation Training Devices (FSTDs) from highest-fidelity - FSTD Type VII to most basic type - FSTD Type I. Simulator International Working Group for a new ICAO 9625 Document defined FSTD fidelity based on training needs, with respect to simulation feature fidelity levels, however the new levels of FSTD are not consistent with the systems defined under FAA and EASA regulations.

1. VALIDATION TESTING

Every type of FSTD should comply with different requirements. Compliance with these requirements shall be assessed in the validation tests and functions & subjective tests. Validation tests are a series of technical measurements of various parameters defined via regulatory effort in order to standardize FSTD manufacture and to bring FSTD features close to training needs. Following chapters state validation parameters specific for particular device types.

1.1. FSTD TYPE VII and VI

FSTDs type VI and VII use continuous cross-cockpit collimated display providing each pilot with a minimum 200 degrees horizontal and 40 degrees vertical field of view. The system should be free from optical discontinuities and artefacts that create non-realistic cues.

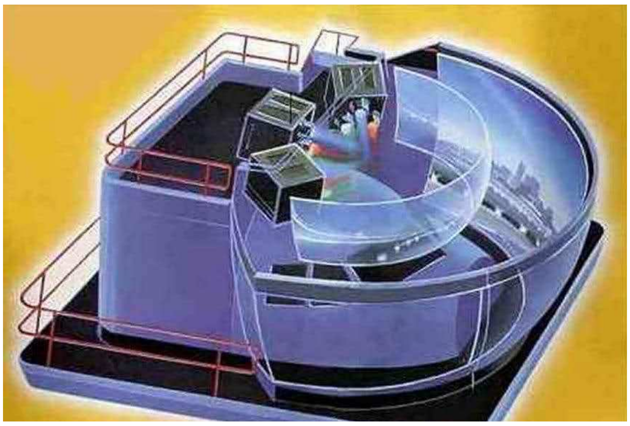

Fig. 2. Cross-Cockpit Collimated display system [8]

For larger fields of view there should be no distracting discontinuities outside this area. The geometry of the final image should be positioned horizontally between 0 degrees and 2 degrees inboard and within +/- 0.25 degrees vertically. The image position should be checked relative to the FSTD centreline taking into account any designed vertical offset. The absolute geometry of any point on the image should fall within 3 degrees of the design position as measured from each pilot eye point. This tolerance applies to the central 200 degrees by 40 degrees. For larger fields of view there should be no distracting discontinuities outside this area. Testing of the relative geometry should measure every visible 5 degree point on the vertical lines and horizontal lines (from the eye position of both pilots) and 1 degree points below -10 degrees at the -90, -60, -30, 0, 30, 60, and 90 azimuth points. Also at +15 azimuth measure all visible 1 degree points from the -10 to the lowest visible point from the Pilot eye position and from the Co-pilot position measure 1 degree points below - 10 degrees at the -15 azimuth points. This field of view is divide up into 3 zones to set tolerances for relative geomety. Zone 1 = +10° to -10°; Zone 2 = +10,1° to +15° and -10,1° to -15° plus +10° to -10° between 90,1°and 100° horizontal and Zone 3 = +15,1° to +20°and -15,1° to -20°. The relative spacing of points should not exceed 0.075 deg/deg. in Zone 1, 0.15 deg/deg. in Zone 2 and 0.2 deg/deg. in Zone 3.

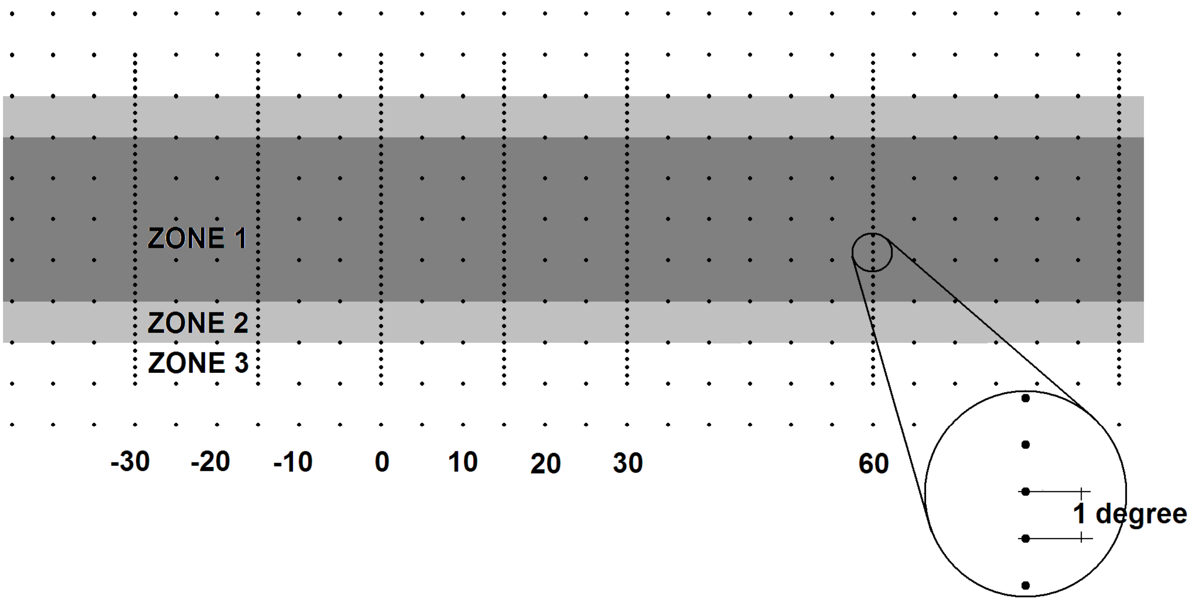

Fig. 1. Relative Geometry test pattern showing zones

Surface resolution should be indicated by a test pattern of objects shown to occupy a visual angle of less than 2 arc minutes in each visual display used on a scene from the pilot's eye point. This test should be demonstrated horizontally and vertically. Light point size shouldn't be greater than 5 arc minutes. Measurement should use a test pattern containing a centrally located single row of white light points displayed as both a horizontal and vertical row. A calculation should be made to determine the light spacing at a point where modulation is just discernible in each visual channel. Raster surface contrast ratio should be at least 5:1. The entire visual scene consisting of a matrix of black and white squares (5°per square) with a light points at the intersections, should be measured during testing of the surface contrast ratio. Every centre bright square should be measured by using a 1° spot photometer. This value should have a minimum brightness of 7 cd/m2 (2 ft lamberts). The contrast ratio is calculated as the bright square value divided by the dark square value. Light point contrast ratio should be at least 25:1 and should be measured using a test pattern. This should be a surface of greater than 1° area filled with white light points and should be compared to the adjacent background. Light-point brightness should be at least 30 cd/m2 (8.5 ft-lamberts). Light points should be displayed as a matrix creating a square. On calligraphic systems the light points should just merge. On raster systems the light points should overlap and individual lights could not be visible. The surface brightness should not be less than 20 cd/m2 (5.8ft- lamberts). Measuring the surface brightness should be using the 1° spot photometer and should be done on a white raster. Light points are not acceptable. It is allowed to use calligraphic capabilities to enhance raster brightness. Intensity of black colour should be less than 0.015 Candelas/m2 (0.004ft lamberts) and sequential contrast at least 2000:1. The light meter should be mounted in a fixed position viewing the forward centre area of each display. Registration test of Enhanced Flight Vision System (EFVS) is realized during Takeoff and on approach at 200ft. Alignment between EFVS display and out of the window image should represent the alignment typical for the aircraft and system type. A test of visual ground segment is made in landin configuration at 30 m (100ft) wheel height above touchdown zone on glide slope. Correct number of approach lights at the near end with tolerance ±20% at the far end and should be visible. Visual System Capacity during the day mode should be at least: 10,000 visible textured surfaces, 6,000 light points and 16 moving models (while displayed simultaneously). During the twilight/night mode it should be at least: 10,000 visible textured surfaces, 15,000 light points, 16 moving models. [1]

1.2. FSTD TYPE V and III

FSTDs type V and III use continuous field of view textured representation of all ambient conditions for each pilot with a minimum 200 degrees horizontal and 40 degrees vertical field of view. Even though collimation is not required, the parallax effects should be minimised. Fields of view is measured by visual test pattern. Testing of the relative geometry should measure every visible 5 degree point. Surface resolution should be indicated by a test pattern of objects shown to occupy a visual angle of less than 4 arc minutes in each visual display used on a scene from the pilot's eye point. Light point size should be equal or less than 8 arc minutes. Measurement should use a test pattern containing a centrally located single row of white light points displayed as both a horizontal and vertical row. A calculation should be made to determine the light spacing at a point where modulation is just discernible in each visual channel. Raster surface contrast ratio should be at least 5:1. The entire visual scene consisting of a matrix of black and white squares (5°per square) with a light points at the intersections, should be measured during testing of the surface contrast ratio. This value should have a minimum brightness of 7 cd/m2 (2 ft lamberts). Light point contrast ratio should be at least 10:1 and should measured using a test pattern. This should be a surface of greater than 1° area filled with white light points and should be compared to the adjacent background. Light-point brightness should be at least 20 cd/m2 (5.8 ft-lamberts). Light points should be displayed as a matrix creating a square. On calligraphic systems the light points should just merge. On raster systems the light points should overlap and individual lights could not be visible. The surface brightness should be at least 14 cd/m2 (4 ft- lamberts). Measuring the surface brightness should be using the 1° spot photometer and should be done on a white raster. Light points are not acceptable. Registration test of Enhanced Flight Vision System (EFVS) is realized during Takeoff and on approach at 200ft. Alignment between EFVS display and out of the window image should represent the alignment typical of the aircraft and system type. A test of visual ground segment is made in landing configuration at 30 m (100ft) wheel height above touchdown zone on glide slope. Correct number of approach lights at the near end and with tolerance ±20% at the far end should be visible. Visual System Capacity during the day mode should be at least: 10,000 visible textured surfaces, 6,000 light points and 16 moving models (while displayed simultaneously). During the twilight/night mode it should be at least: 10,000 visible textured surfaces, 15,000 light points, 16 moving models. [1]

1.3. FSTD TYPE IV, II and I used for Multi-crew Pilot Licence Phase 1 (MPL 1)

These types of FSTDs use field of view textured representation of all ambient conditions for each pilot with a minimum 45 degrees horizontal and 30 degrees vertical field of view unless restricted by the type of aeroplane. Distance from the pilot's eye position to the surface of a direct view display should be at least like the distance to any front panel instrument. Geometry of image should have no distracting discontinuities. Raster surface contrast ratio should be at least 5:1. The entire visual scene consisting of a matrix of black and white squares (5°per square) with a light points at the intersections, should be measured during testing of the surface contrast ratio. This value should have a minimum brightness of 7 cd/m2 (2 ft lamberts). Light-point brightness should be at least 20 cd/m2 (5.8 ft-lamberts). Light points should be displayed as a matrix creating a square. On calligraphic systems the light points should just merge. On raster systems the light points should overlap and individual lights could not be visible. The surface brightness should not be less than 14 cd/m2 (4 ft-lamberts). Measuring the surface brightness should use the 1° spot photometer and should be done on a white raster. Light points are not acceptable but it is allowed use of calligraphic capabilities to enhance raster brightness. Visual System Capacity should be at least: 3,500 visible textured surfaces, 5,000 light points and 16 moving models (while displayed simultaneously). [1]

1.4. FSTD TYPE I used for Private Pilot Licence (PPL) and Commercial Pilot Licence (CPL)

These types of FSTDs use continuous field of view textured representation of all ambient conditions for each pilot with a minimum 200 degrees horizontal and 40 degrees vertical field of view. Fields of view is measured by visual test pattern. Testing of the relative geometry should measure every visible 5 degree point. Surface resolution should be indicated by a test pattern of objects shown to occupy a visual angle of less than 4 arc minutes in each visual display used on a scene from the pilot's eye point. Light point size should be equal or less than 8 arc minutes. Raster surface contrast ratio should be at least 5:1. Light point contrast ratio should be at least 10:1 and should be measured using a test pattern. This should be a surface of greater than 1° area filled with white light points and should be compared to the adjacent background. Light-point brightness should be at least 20 cd/m2 (5.8 ft-lamberts). Light points should be display as a matrix creating a square. On calligraphic systems the light points should just merge. On raster systems the light points should overlap and individual lights could not be visible. The surface brightness should be at least 14 cd/m2 (4 ft- lamberts). Measuring the surface brightness should use the 1° spot photometer and should be done on a white raster. Light points are not acceptable. Visual System Capacity during the day mode should be at least: 10,000 visible textured surfaces, 6,000 light points and 16 moving models (while displayed simultaneously). During the twilight/night mode it should be at least: 10,000 visible textured surfaces, 15,000 light points, 16 moving models. [1]

CONCLUSION

Exactness of flight simulation training devices validation requirements definition determines level of FSTD manufacturing standarts unification. The stricter the certification parameters, the higher level of fidelity can be achieved. The validation tests requirements established by new edition of ICAO 9625 Manual of Criteria for the Qualification of flight Simulators provide possibilities to more closely check compliance of new FSTDs with qualitative requirements of training level.

This work has been supported by the Grant Agency of Slovak Republic under the grant "Basic research of safety at airports with poorly developed infrastructures using GNSS navigation." VEGA No. 1/0844/12.

This paper is published as one of the scientific outputs of the project: „The research on virtual reality elements application: the significant improvement of simulator performance characteristics“, CODE: 26220220167.

Operačný program VÝSKUM a VÝVOJ

Európska únia

We support research activities in Slovakia. Project is co-financed by EU.

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