End-Around Taxiway Screen Evaluation

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16. Abstract

The Federal Aviation Administration (FAA) Airport Safety Technology Research and Development Section was tasked to design and evaluate an end-around taxiway (EAT) visual screen to mask aircraft using the EAT. This evaluation effort was conducted to investigate the most conspicuous material, configuration, pattern, color, and lighting methods that would make the EAT visual screen visible to pilots operating on a runway equipped with an EAT. The visual screen should be visible during both daytime and nighttime conditions and should be adaptable for use at airports that have already constructed, or are planning to construct, this type of taxiway.

This report describes the research, development, and evaluation efforts that were performed to determine the best design characteristics for the visual screen. The evaluation was conducted through a series of comparative evaluations at the Atlantic City International Airport, including a final evaluation involving pilots of various aviation backgrounds.

The results of this evaluation showed that a screen height of 13 feet was satisfactory; the color and size combination of a 12-foot-wide, red and white diagonal striping proved most effective; and that the use of engineering-grade reflective material prevents the need for additional external lighting to enhance screen visibility at night. Additional findings were made regarding effective access for emergency equipment and verification that the effectiveness of the screen was not degraded by tilting the screen surface 14 degrees to avoid interference with airport-based radar systems.

Ninety-eight percent of the subject pilots involved ranked the proposed screen design as being effective in performing the function of masking an aircraft on the EAT.

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LIST OF ACRONYMS

ACY	Atlantic City International Airport
ATC	Air traffic control
DFW	Dallas-Ft. Worth International Airport
EAT	End-around taxiway
FAA	Federal Aviation Administration
LED	Light emitting diode
R&D	Research and development

EXECUTIVE SUMMARY

The Federal Aviation Administration (FAA) Airport Safety Technology Research and Development Section was tasked to design and evaluate an end-around taxiway (EAT) visual screen that would mask aircraft using the EAT. This evaluation effort was conducted to investigate the most conspicuous material, configuration, pattern, color, and lighting methods that would make the EAT visual screen visible to pilots operating on a runway equipped with an EAT. The visual screen should be visible during both daytime and nighttime conditions and should be adaptable for use at airports that have already constructed, or are planning to construct, this type of taxiway. This report describes the research, development, and evaluation efforts that were performed to determine the best design characteristics for the visual screen. The evaluation was conducted through a series of comparative evaluations at the Atlantic City International Airport, including a final evaluation involving pilots of various aviation backgrounds.

Because of the need to increase operational capacity, airports have added dual and sometimes triple parallel runways. Usually, departing aircraft will use the inboard runways for takeoff, while arriving aircraft will use the outboard runways for landings. To increase operational capacity and to mitigate the risk of potential runway incursions, airports may construct taxiways that go out around the end of the runway, commonly called end-around taxiways. In some cases, depending on geometry, a potential problem exists for aircraft taking off on a runway with an EAT, since an aircraft taxiing on the EAT may look like it is actually crossing the departure end of the runway. The pilot may perceive that there is a runway incursion and abort the takeoff or perform an inappropriate maneuver to avoid a possible accident. To mitigate this situation, the FAA Airport Obstructions Standards Committee Executive Steering Group directed that a visual screen type device be designed and installed to assist pilots on a takeoff roll to better discern when a aircraft is crossing the active runway versus the aircraft operating on the EAT (except where the EAT is sufficiently shielded by natural terrain). The basic design was based on other previous simulator evaluations of a screen that was 13 feet in height and 700 feet in length. This project was intended to determine the most effective visual characteristics of the EAT screen design.

The results of this evaluation showed that a screen height of 13 feet was satisfactory, the color and size combination of a 12-foot-wide, red and white diagonal striping proved most effective; and that the use of engineering-grade reflective material prevents the need for additional external lighting to enhance screen visibility at night. This report also contains information on research that was conducted to verify that the visual screen can be constructed in a staggered pattern that would allow emergency equipment to maneuver through openings in the visual screen structure. In addition, research was conducted to verify that the visual panels performed effectively if they were tilted away from the runway area at an angle of 14 degrees to avoid interference with airport-based radar systems.

Ninety-eight percent of the subject pilots involved ranked the proposed screen design as being effective in performing the function of masking an aircraft on the EAT.

INTRODUCTION

PURPOSE.

This evaluation effort was conducted to investigate and determine the most conspicuous configuration and combination of color and materials for providing conspicuity of aircraft using airport end-around taxiways (EAT). The Federal Aviation Administration (FAA) Airport Safety Technology Research and Development (R&D) Section was tasked to design and evaluate an EAT visual screen for use at airports that have constructed, or are planning to construct, this type of taxiway. This report describes the research, development, and evaluation of the design determined previously to be effective during a series of EAT visual screen project evaluations. The basic design was based on other previous simulator evaluations of a screen 13 ft in height and 700 ft in length. This project was intended to determine the most effective characteristics of the EAT design.

BACKGROUND.

Because of the need to increase operational capacity, airports have added dual and sometimes triple parallel runways. Usually, departing aircraft will use the inboard runways for takeoff, while arriving aircraft will use the outboard runways for landings. To increase operational capacity and to mitigate the risk of potential runway incursions, airports may construct taxiways that go out around the end of the runway, commonly called end-around taxiways.

The EAT is a taxiway that circumvents an inboard or outboard runway by providing a path for aircraft to taxi around the end of an active runway, thus avoiding the necessity of crossing the runway. In some cases, depending on geometry, a potential problem exists for aircraft taking off on a runway with an EAT, since an aircraft taxiing on the EAT may look like it is actually crossing the departure end of the runway. The pilot may perceive that there is a runway incursion and abort the takeoff or perform an inappropriate maneuver to avoid a possible accident. To mitigate this situation, the FAA Airport Obstructions Standards Committee (AOSC) Executive Steering Group directed that a visual screen type device be designed and installed to assist pilots on a takeoff roll. This new screen will help determine when an aircraft is crossing the active runway versus the aircraft operating on the EAT (except where the EAT is sufficiently shielded by natural terrain). The Dallas Fort Worth International Airport (DFW) was selected as a viable test site, since this airport is planning to construct such taxiways at each of the four quadrants of the airport in the latter part of 2006.

In October 2005, a prototype EAT screen design and development meeting was held at DFW. Attendees included FAA Airport Visual Guidance personnel, DFW airport personnel, research support contractor personnel, and other invited subject matter experts. The purpose of the meeting was to discuss the status of the EAT screen development, and share a number of preliminary designs developed by working groups both at the DFW airport and the FAA William J. Hughes Technical Center. The working groups, at an earlier meeting, had previously reviewed and discarded a number of proposed screening materials and designs. Primary issues were the ability to light the material and avoid light penetration from behind the screen. Consequently, it was decided to use solid materials with reflective panels and exterior lighting for highlighting the screen. Backlighting was one option considered as well as top and bottom reflective lighting. Honeycomb aluminum panels were the preferred mounting material, as they provide the necessary strength for adequate wind and weather resistance. Through other human factor studies and analysis specific to EAT, it was determined that the partial screening of an aircraft (up to the top of wing-mounted engines) on the EAT would adequately mitigate the pilots visual assessment of the runway environment. The recommended basic design was based on previous simulator evaluations of a screen that was 13 ft in height above runway end elevation and 700 ft in length. Criteria for visibility include the ability to view the screen at 6800 ft from the runway end and an additional 1100 ft to the screen, for a total distance of 7900 ft away. The distance of 6800 ft was selected to represent the point on the runway where a pilot of a typical air carrier aircraft would make the decision to continue with the takeoff and would, therefore, require as much information as possible on whether or not an aircraft in front of him is on the EAT or actually on the runway. Other considerations included a resistance to bird roosting and sufficient firefighting vehicle access. For nighttime visibility, various means of lighting the screens were to be tested. It was decided that a mockup design of the EAT screen would be developed at the FAA William J. Hughes Technical Center, where a series of day and nighttime evaluations of a prototype could be accomplished. These evaluations were to result in a final configuration design resulting in a standard for use at airport locations throughout the country.

SCOPE.

This research effort was limited to investigating and determining the most conspicuous configuration and combination of color and materials for providing conspicuity of aircraft using the EAT. The evaluation was also limited to the prespecified screen height of 13 ft as determined in the simulator tests. Additional constraints involved issues such as frangibility, construction design, and environmental requirements, which are considered site-specific and were not addressed. The evaluation was completed over a 6-month period to meet time constraints of planned publications and construction.

RESEARCH OBJECTIVES.

The objectives of this research effort were to

1. determine if a screen height of 13 ft above runway elevation is effective in highlighting aircraft position.

2. determine the most effective combination of color to highlight screen location.

3. determine the best screen configuration/pattern for highlighting aircraft in front of and behind the EAT screen.

4. determine the best screen materials to provide reflectivity and screen illumination at night.

5. determine that the final screen design is effective in providing access for emergency vehicles.

6. determine the visual effects of tilting the screen surface to an angle of 14 degrees.

7. determine the best means for illumination of the screen at night.

8. determine that the final screen design is effective in providing conspicuity of aircraft in front of and behind the screen.

RELATED ACTIVITIES AND DOCUMENTS.

The following is a list of the applicable documents related to various aspects of the EAT screen:

1. AC No: 150/5345-44G, Specifications For Runway and Taxiway Signs

2. AC No: 150/5340-18, Standards for Airport Sign Systems

3. John E. Lebron, J.E., Feerrar, W., Cherniavsky, E.A., Love, W.D., and Trigeiro, W.W. "Risk Analysis for Aircraft Transiting a Departure-End Runway Protection Zone," 2005.

4. MIL-STD-810F, 1 January 2000, Environmental Test Methods

5. The MITRE Corporation, "Analysis of Impact of National End-Around Taxiway Departure Standard on Existing NAS Airports," 2005.

EVALUATION APPROACH

During the development of the EAT screen concept, several design elements were identified that would need to be evaluated prior to defining the final EAT screen design that would be evaluated in a final evaluation with subject pilots. As a result of this, it was determined that a series of preliminary evaluations would be conducted initially to answer the design questions and lead researchers to the final, most preferred presentations. The preliminary evaluations were conducted over a period of 4 months by Airport Safety Technology Section personnel, followed by a 1-month period of final evaluation activity. To fully investigate the best EAT screen design, it would be necessary to perform a subjective and objective evaluation on various EAT screen designs.

The preliminary evaluations were conducted at the FAA William J. Hughes Technical Center located at Atlantic City International Airport, NJ (ACY). The first step in the design and evaluation of an EAT screen involved construction of several prototype screens that could be used to evaluate various elements of the final screen design. Though the prototypes were not full size, they each were constructed at the height of a full size screen but were not as wide. The size requirement for the full size EAT screen at DFW airport had been identified as 700 ft in length and 13 ft in height.

During earlier tabletop discussions with EAT screen experts, several key design criteria were discussed that would be essential for the final screen design. While these criteria were not required for the prototypes, they were to be carefully considered as constraints for the final design. It was determined that the final screen design would include the following requirements:

1. Ease of construction
2. Ease of maintenance/replacement
3. Resistance to wind and jet blasts
4. Visually continuous to pilots on the runway
5. Allow for passage of ground vehicles beyond the screen

During the preliminary evaluations, there were several design elements that would require evaluation to lead to the final screen design. The preliminary evaluations, which will be described in the next section of this report, initially focused on the color, pattern, conspicuity, reflective material, and lighting of the EAT screen. Included in each of these areas were several specific items to be included in the evaluation. Those items are as follows:

- Color:
    - Red
    - White
    - Orange
- Pattern:
    - Solid
    - Checkerboard
    - Chevron
    - Diagonal
- Conspicuity:
    - Day
    - Night
    - Low visibility
- Reflective Material:
    - Engineering-grade reflective sheeting
    - High-intensity grade prismatic sheeting
- Lighting:
    - Overhead
    - Direct
    - Ground
    - Surface/Perimeter

Engineers determined that the best way to construct the test screens was to mount the desired screen designs on the side of four towable trailers (13 ft high and 56 ft long each). The trailers allowed for mobility during the evaluations, rapid reconfiguration of different patterns, and rapid removal from the runway environment if required. Placing them end to end produced a total length available of 224 ft, which is more than sufficient to exceed the width of an average air carrier runway (150 ft). Each of the trailers was modified with a wood framework so that the various test panels could be easily secured to a smooth, level surface on the exterior of the trailers.

The Airport Safety Technology Research Team conducted this research at the FAA William J. Hughes Technical Center, located at ACY. ACY is optimal for this activity, since the airport has a runway and parallel taxiway that is 10,000 ft long. This distance allows for optimal viewing, since it more than covers the 7900 ft distance selected by the EAT Project Team as being the critical distance at which a pilot would need to see the screens.

Most of the preliminary evaluations used a screen arrangement of 13 ft high and 112 ft long, which was two of the 56-ft-long trailers placed end to end. This was done to minimize the time and costs associated with configuring all four trailers at the same time. The two-trailer configuration was more than enough to evaluate certain design elements. Later in the evaluations, four trailers were used to more closely mimic the size of the end screen design.

PRELIMINARY EVALUATIONS

FIRST EVALUATION.

On January 5, 2006, members of the Airport Safety Technology Research Team conducted an initial evaluation of the EAT screen for various FAA personnel related to the project. Representatives were present from various FAA organizations, including the Office of Airport Engineering, Air Traffic, Southwest Region, and Airport Safety Technology R&D Section. The project involved locating two trailers at the end of taxiway Bravo at ACY for observation by the team. The trailers had been configured with checkerboard and diagonal designs in accordance with the project test plan. The trailers were initially moved into position to display the checkerboard configuration which consisted of alternating red and white 4- by 10-ft panels. Team members proceeded down the full length of taxiway Bravo, viewing the array at various distances up to the full length of the 10,000-ft runway. Visibility at the time of the evaluation was 5 to 6 miles with some haze. Observations indicated that the screens were visible at all distances. The trailers were then reversed to display the diagonal striping configuration. This display consisted of alternating red and white stripes 8 ft wide and 13 ft high, angled at approximately 45 degrees. A similar procedure was used to view the array from a 10,000-ft maximum distance, progressing along the full length of taxiway Bravo toward the trailers. The diagonal striping display was also visible throughout the range of distances. Photographs of the various configurations are shown in appendix A.

After completion of the evaluation, a meeting was held to discuss the results and future plans for follow-on work of the two patterns, observers agreed that the diagonal striping presentation was the most effective. It was decided, however, that patterns featuring larger shapes should be explored. Suggested sizes included widening the checkerboard to 6- by 10-ft blocks, and diagonal-striped patterns enlarged to 12-ft-wide stripes. It was decided that these two new patterns should be evaluated next.

While visual guidance issues were the primary purpose of these evaluations, discussions also took place regarding possible interference that the screens might cause for airport-based radar systems. To mitigate any possibility of radar interference or multipath errors, the end screen design would require that it be slanted or tilted back at an angle of 12 to 14 degrees. While tilting the screens would not affect the appearance of the screens during the day, there potentially could be a problem with the reflectivity of the screen at night. Reflective surfaces typically need to be at right angles to their light source for optimal performance. It was decided that the effects of tilting needed to be addressed during this research.

SECOND EVALUATION.

On January 17, 2006, a second evaluation of the EAT screens was completed at the FAA William J. Hughes Technical Center. The trailers were modified to incorporate larger sections of materials in accordance with the recommendations from the initial evaluation. One trailer had the checkerboard configuration modified to alternating red and white, 6- by 10-ft panels. The diagonal-striped side was also modified to increase the size of the red and white stripes to a width of 12 ft. The two trailers were positioned on the FAA ramp adjacent to the end of taxiway Bravo at ACY for observation. The trailers were initially moved into position end to end allowing a total array length of 112 ft, with the original pattern placed immediately next to the new larger pattern. Positioning the trailers this way allowed for an instant comparison between the two versions. The new diagonal stripe display was first to be viewed, as shown on the left in figure A-4.

The Airport Safety Technology Research Team members proceeded down the length of taxiway Bravo viewing the arrays at various distances ranging to the full 10,000-ft length. Visibility at the time was in excess of 10 miles. Observations indicated that the platforms were visible at all distances. Following the new diagonal-striped configuration, the trailers were reversed to display the checkerboard configuration, as depicted in figure A-5. The new configuration is shown on the right side.

The same procedure was used to view the array from the 10,000-ft maximum distance progressing along the full length of taxiway Bravo toward the trailers. The checkerboard display was also visible throughout the range of distances. Figure A-6 illustrates the two diagonal-striped designs at approximately 8000 ft away, with the larger stripes on the left side. Figure A-7 illustrates the two checkerboard designs at approximately the same 8000-ft distance. After completion of the evaluation, the results of the demonstration and plans for follow-on work were discussed. All observers were in agreement that the 12-ft-wide, diagonal-striped presentation was the most effective pattern shown thus far. While the 6- by 10-ft checkerboard was more effective than the smaller 4- by 10-ft version, neither was as effective from the longer distances as either of the diagonal patterns. As a result, it was decided that future testing should be focused on the 12-ft-wide diagonal configuration.

THIRD EVALUATION.

On February 27, 2006, a third evaluation of an updated configuration of the EAT screen was conducted at the FAA William J. Hughes Technical Center. Four trailers featuring the latest configurations were towed from the staging area to the FAA ramp. All four trailers were configured in 12-ft diagonal stripes. Two were red and white stripes using engineering-grade reflective sheeting. The other two trailers were configured with a new material combination of diamond-grade reflective sheeting in an orange and white combination (figure A-8). In addition, the reverse side of one platform was configured with opposite direction stripes (chevron) to provide a comparison of single- and opposite-direction stripes during the evaluation.

Following completion of the evaluation, the results and plans for follow-on work were discussed. All observers were in agreement that the 12-ft-wide striped red and white presentation was the most effective of the two-color combinations. The orange color tended to wash out at the extended distances of observation. In addition, the arrangement of opposing diagonal stripes was determined to be less effective and less desirable than the continuous striping arrangement.

FOURTH EVALUATION—NIGHT.

Following determination of the best color and presentation during daylight testing, the trailers were configured to the red and white, diagonally striped format. On March 17, 2006, night tests were performed on each of the two reflective surfaces using a variety of lighting techniques, as listed below.

1. Overhead lighting
2. Overhead direct lighting
3. Baseboard of screen lighting
4. Ground level lighting
5. light emitting diode (LED) outline lighting

A graphic depiction of the five selected lighting options is shown in figure 1. Two trailers had been previously positioned in linear fashion for comparison. The following lighting arrangements were used:

1. A floodlight was mounted overhead on a boom and aimed directly at the platform. The unit was positioned 9 ft away from the surface.

2. A floodlight was positioned at a height of 6 ft and aimed directly at the screen surface. The standing unit was located 9 ft from the platform.

3. A floodlight positioned at ground level 9 ft from the platform to illuminate the surface of the screen.

4. Similar to the third lighting configuration, but this configuration may result in the light being significantly lower than the screen, depending on the terrain in front of the screen.

5. An arrangement of LED light strips around the perimeter of the platform to outline the shape of the screen.

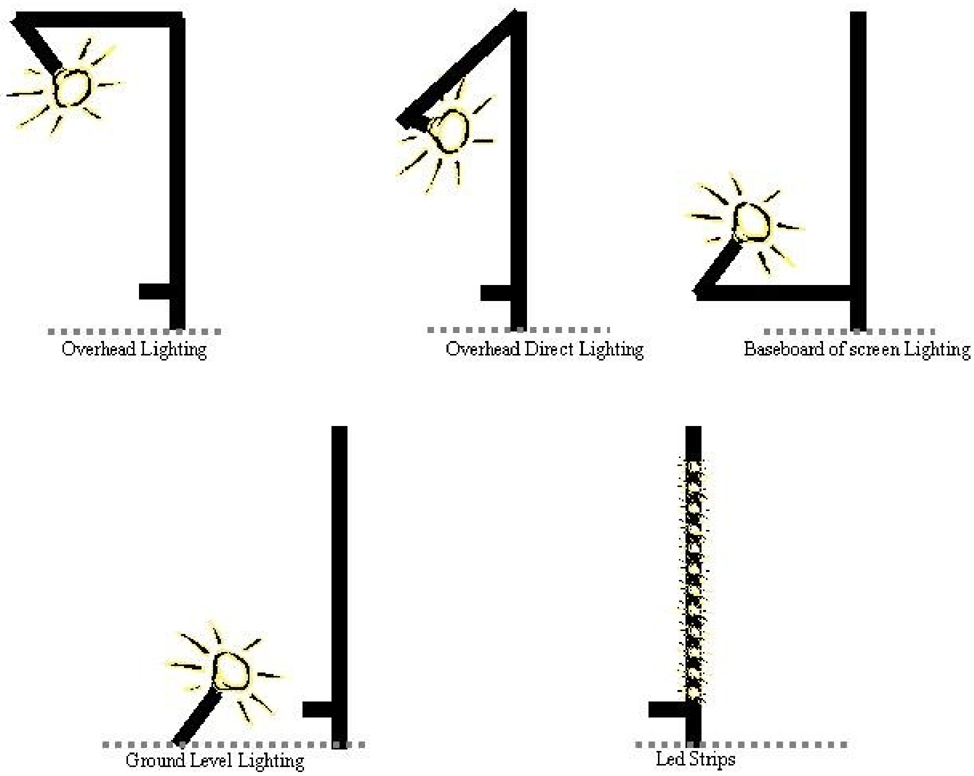

Figure 1. Lighting Options

Each flood lamp assembly contained two 500-watt lamps. The platforms were configured with red and white striped (12-ft) engineering-grade reflective sheeting. After the setup was complete, all units were viewed simultaneously, then each lighting arrangement was examined separately to determine effectiveness. The following results were noted:

1. The LED arrangement proved effective in illuminating an outline of the screen surface, but did not illuminate the surface of the screen itself. The benefit was that an observer at a distance would detect the presence of an aircraft due to the LEDs being blocked from view. This method, however, was the most expensive.

2. The ground- and baseboard-mounted floodlights were the most effective lighting technique. While the presentation was not perfect, the colors and pattern were visible.

3. The direct light arrangement proved effective in illuminating the screen. However, hotspots directly in front of the lamps created uneven illumination, making the color of the striping disappear.

4. The overhead boom-mounted lamps were also aimed directly at the screen surface and performed equal to the direct units. Colors and striping were easily visible to observers; however, the same hotspots were visible directly in front of the light fixtures.

The last evaluation of the evening involved testing the effects of lighting when the reflective panels were placed at a tilted angle. It has been suggested that the EAT screen may have to be tilted at angle of 14 degrees to mitigate problems with radar reflection. Engineers were concerned that tilting the panels may have negative effects on the lighting arrangements. A tiltable model was fabricated using two panels of engineering-grade vinyl in a red and white configuration. These were placed in an upright configuration and adjusted to an angle of 14 degrees from the perpendicular surface of the trailers. The angle was verified using an inclinometer. From the point of observation, the unit was observed for differences in effectiveness of lighting. No discernable difference in effectiveness could be determined by the observers as a result of the tilt.

FIFTH EVALUATION.

On March 21, 2006, a fifth evaluation of the EAT screen was conducted at the FAA William J. Hughes Technical Center. This involved a broad group of participants from many areas of the FAA with interest in the project. All four trailers were configured in the 12-ft diagonal stripe configuration (see figure A-8). The first configuration showed two trailers with red and white diagonal engineering-grade 12-ft stripes. These were viewed at varying distances, from 10,000 ft to close proximity. Two trailers configured with orange and white diamond-grade 12-ft stripes were then moved into position next to the first two trailers, creating a total screen length of 224 ft. The fourth trailer, which had its opposite side configured with the same material but leaning in the opposite direction, was reversed in direction to create a chevron configuration (see figure A-11). The last arrangement involved switching the order of the third and fourth trailers to create a reversed chevron, with the arrows converging at the bottom of the screen. Later, an airport rescue and firefighting vehicle was moved into position between the trailers to demonstrate vehicle access during emergencies (refer to figures A-10 and A-11).

In the evening of the same day, testing resumed to examine nighttime effectiveness. Each lighting arrangement was examined separately to determine effectiveness. The ambient lighting condition was sufficiently dark for effective observation. A third trailer was moved into position, configured with the high-intensity prismatic material to compare reflectivity.

A meeting was held following the test to discuss results and to determine future direction. It was agreed that the red and white engineering-grade material was the best choice for use in the 12-ft stripe configuration. In addition, the lighting configuration that proved to be best was the ground-mounted floodlighting; however, problems were identified with hotspots on the reflective surface. It was noted that the reflective characteristics of the screen materials were sufficiently good in both day and night lighting conditions. Engineers noted that a variety of light sources, including flashlights, vehicle-mounted spot lights, and aircraft landing and taxi lights, could be used to illuminate the screen surface from more than 6000 ft away. It was decided to further explore the possibility of relying on aircraft lighting exclusively, eliminating the requirement for lighting the screen itself.

SIXTH EVALUATION—NIGHT.

Following discussions about the use of aircraft lights for highlighting the screen, an additional night evaluation of the EAT screen was conducted at ACY. Personnel from the Airport Safety Technology R&D Section towed two of the screen trailers with the red and white engineering-grade reflective material in a diagonal pattern out onto the perimeter road of the airport, outside the airport boundary fence, at the approach end of runway 31. The location chosen for the trailers was approximately 1330 ft beyond the end of runway 13 (or 1330 ft before the threshold of runway 31), with each trailer slightly offset from centerline on opposite sides of the extended runway centerline.

Following placement of the trailers, the aircraft using the runways and taxiways were observed from various positions on the airport to determine how well the EAT screen trailers were illuminated by departing and taxiing aircraft. A variety of aircraft were observed during the course of the evening, including Airbus 320s, Boeing 737s, and DC-9s. While traffic direction was primarily on runway 31, aircraft were also observed landing on runway 13. Aircraft taxiing on the Bravo taxiway toward the EAT screen were asked to turn on their landing lights to illuminate the EAT screen. Many aircraft flight crews that illuminated the screens with their landing lights verbally commented over the radio that the screens looked good or that they really stood out. Prior to completion of the evening tests, several approaches were made to the screen in a vehicle, on the runway itself, to view the screens from the runway centerline and to take photographs. As a result of observations during the course of the evening, it was determined that aircraft lighting provided sufficient illumination of the screens.

SUMMARY OF PRELIMINARY RESULTS.

A summary of the findings, based on the results of the preliminary evaluations, follow:

1. The 13-ft screen height was sufficient enough to be visible in daylight and night conditions.

2. The 12-ft-wide diagonal red and white stripes provided the most effective presentation, particularly at the 6,000- to 10,000-ft ranges.

3. Continuous diagonal stripes proved to be the preferred configuration over the chevron.

4. The engineering-grade vinyl proved superior in this application due to the material's uniform reflectivity and performance, as well as its resistance to reflection or glare.

5. Offsetting the platforms by 15 to 35 ft was sufficient to allow access to fire and rescue vehicles and did not affect the visual effectiveness of the screen.

6. Tilting of the screens at 14 degrees did not affect visual effectiveness during daytime or nighttime conditions.

7. Ground- or baseboard-mounted floodlights proved effective in illuminating the screen surface. Colors and the striping pattern were visible. Problems, however, were identified with hotspots on the reflective surface.

8. Aircraft landing and taxi lights alone proved sufficient to adequately illuminate screen location.

FINAL EVALUATION

EVALUATION METHOD.

After 5 months of testing, the EAT screen design had reached its final stage and needed to be validated. To fully investigate this issue, an evaluation plan was developed to obtain subjective evaluation data. The evaluations were conducted at the FAA William J. Hughes Technical Center during April 2006. Three EAT screen trailers were positioned on the FAA hangar ramp to provide a screen length of 168 ft. (See figure 2 for the locations on the airport.) All platforms were configured with 12-ft-wide red and white diagonal stripes throughout the test period as depicted in figure A-15. Both day and night tests were conducted. A B-737 aircraft from the FAA William J. Hughes Technical Center was employed during the test, as depicted in figure A-16. The concept of operations involved towing the B-737 with an aircraft tug in a circuitous route in front of and behind the EAT screen, as depicted in figures 3 and 4. Sufficient circuits were planned to allow each subject pilot to observe three aircraft in front of the screen and three behind the screen.

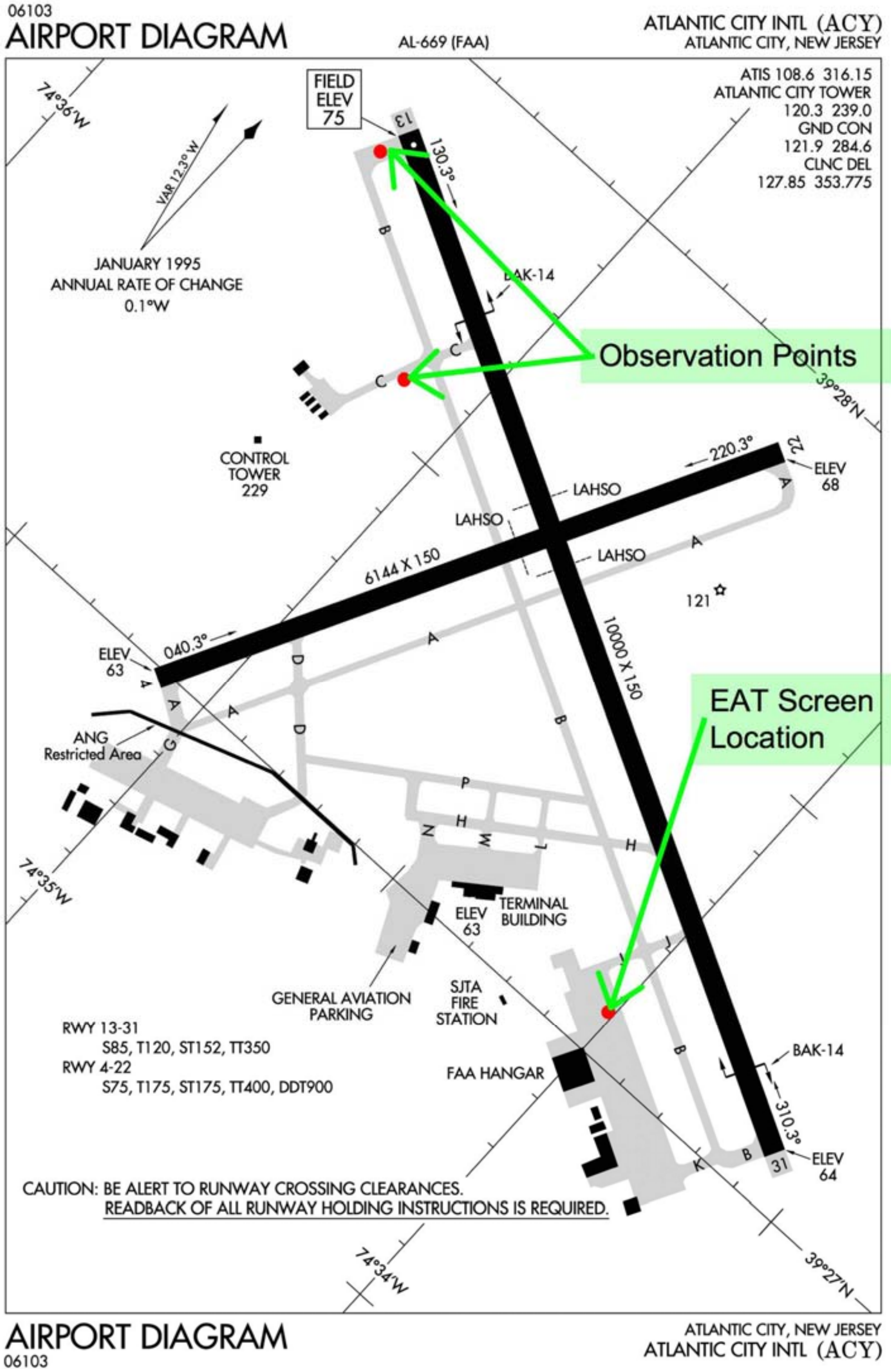

Figure 2. Atlantic City International Airport

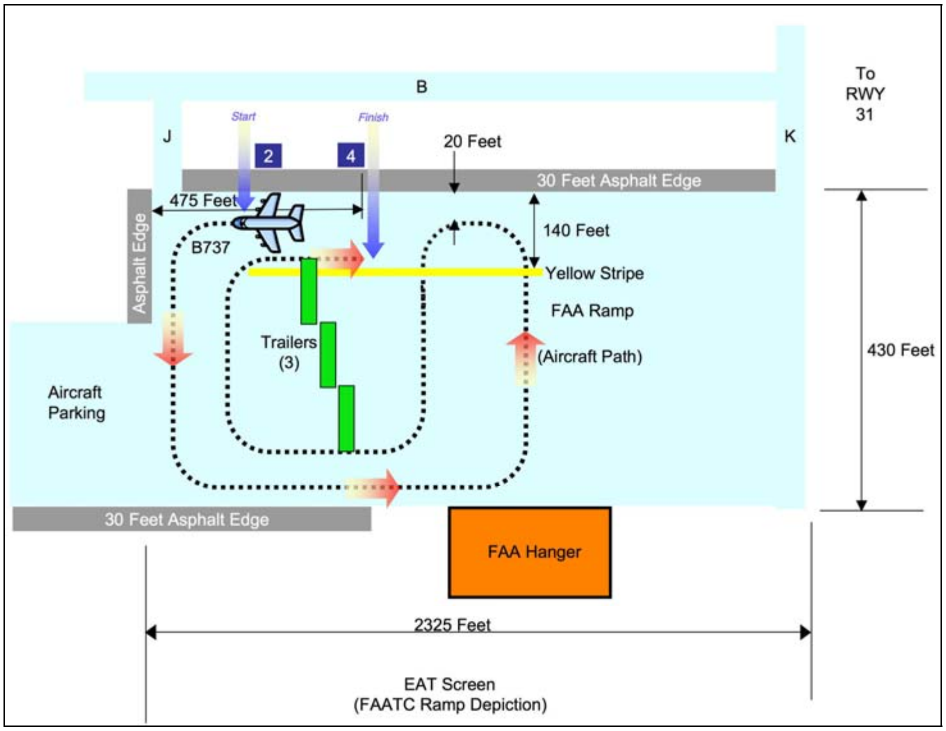

Figure 3. B-737 Route 1

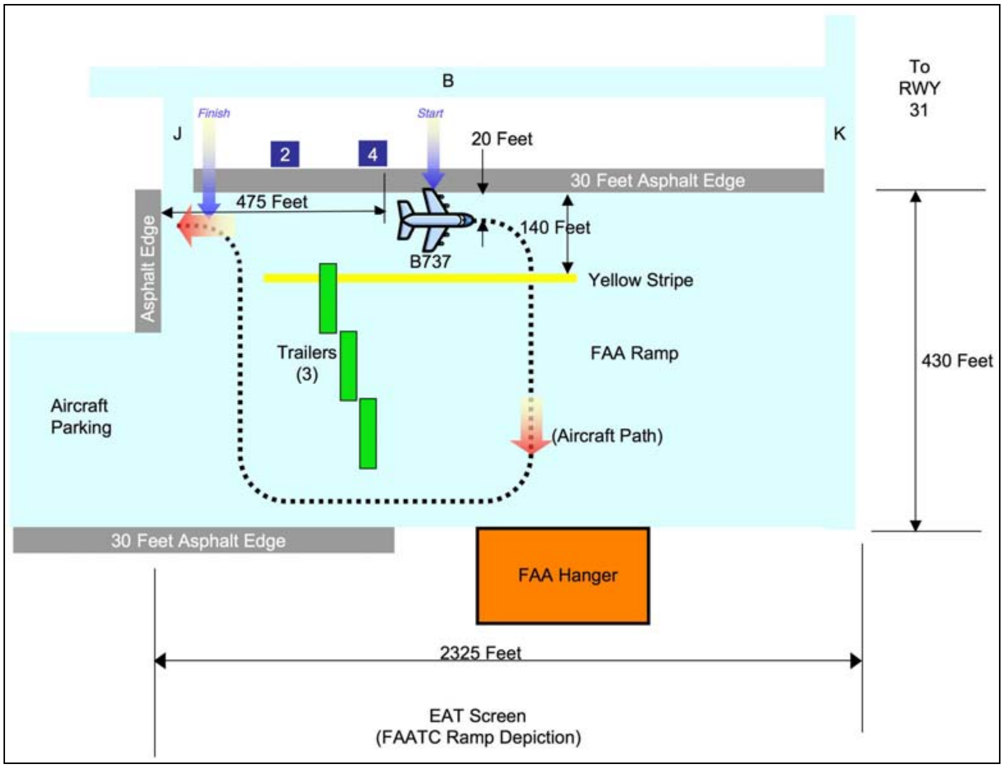

Figure 4. B-737 Route 2

EVALUATION PILOTS.

Forty-eight pilots participated in this study, 32 for daytime evaluations and 16 for night evaluations. A diverse and experienced group of pilots throughout the aviation community were employed as subject pilots. These included active and retired airline, corporate, and charter pilots; FAA test pilots; and military pilots from the Air National Guard and U.S. Coast Guard. In addition, there were several experienced pilots from the general aviation community that participated. Flight hours ranged from 25,000 to 100 hours. The average number of flight hours per subject pilot was in excess of 7000 hours.

TEST PROCEDURES.

All test sessions consisted of a pre-evaluation briefing, the actual evaluation, and a brief postevaluation debriefing period for each participant. During the pre-evaluation briefing, the subject pilot was provided with a short narrative explaining the purpose and conduct of the effort, along with details of his or her duties during the evaluation (figure A-21). Upon completion of the pre-evaluation briefing, the subject was transported to the initial observation position. The project observer, also in the vehicle, provided all radio contact with air traffic control (ATC) while on the movement area. The subject pilot was instructed to announce to the accompanying project observer the point at which they first identified the EAT screen. The project observer onboard the vehicle documented the sequence and recorded his observations. The form used for this purpose is shown in figure A-23. Observations were recorded and questionnaires (figure A-22) were filled out by the subject pilots upon completion of the task. The questionnaires focused on observations of shape and color as well as position of the aircraft in relation to the screen.

The test procedures were as follows:

1. Observation distances were conducted at the 10,000- and 8,000-ft remaining markers.

2. Four pilots at a time were initially transported to the 10,000-ft observation site in individual vehicles.

3. The target aircraft (B-737) was pre-positioned on the FAA hangar ramp.

4. The target aircraft first performed passes in front of and then behind the screen, then reversed direction, passing again both behind and in front of the screen.

5. Test subjects were relocated to the 8000-ft remaining marker prior to the second run.

6. The target aircraft then again passed behind and in front of the screen.

DATA COLLECTION.

Three phases of data collection were accomplished during the course of the final evaluation. The first phase involved the completion of the questionnaire by the subject pilot. Following completion of the second run, the subjects were transported to the debrief area. At this location, the subjects completed the questionnaire, were interviewed, and their observations recorded.

The second phase of data collection involved the use of test monitors in the field to record various aspects of subject performance. Each test monitor completed a data collection form on the individual subject pilot responses in correctly identifying the characteristics of the screen and test aircraft position in relationship to the screen.

The third phase involved a debriefing session that offered an opportunity for debriefers to gather subjective comments about the screen. The questionnaire and debrief comments are included in appendix B.

RESULTS

QUESTIONNAIRE RESPONSES.

Four statements and one question were posed to the test subjects. The four statements measured the participant's perception of various attributes of the EAT screen. The attributes consisted of:

1. Location and visibility
2. Color
3. Pattern
4. Aircraft position discrimination

The responses to the first four statements were measured on a 7-point Likert scale, where 7 equals totally agree, 4 equals neutral, and 1 equals totally disagree. The last question allowed the test subject to rate the overall concept of the EAT screen on a 7-point scale where 1 equals poor, 4 equals neutral, and 7 equals excellent.

STATEMENT ONE. Figure 5 gives the responses as a percentage of the total for the statement "I can easily determine the location of the EAT screen." Based on the responses, approximately 90% of the responses agreed to some degree that they could easily determine the location of the EAT screen. Only about 10% were either neutral or disagreed. No one totally disagreed with this statement.

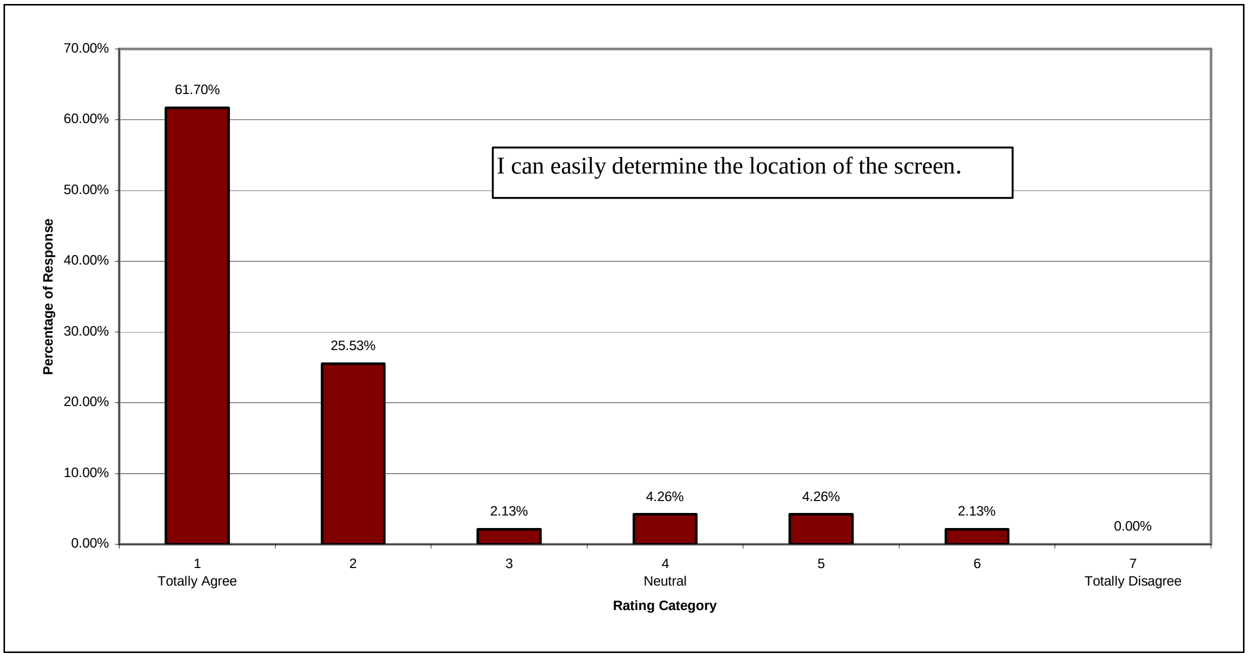

Figure 5. Responses to Statement One

<u>STATEMENT TWO</u>. The second statement was "The color of the EAT screen visually stands out in relation to other objects in the vicinity." The results are provided in figure 6. As with the first statement, nearly 90% of the responses agreed to some degree that the color of the EAT screen made it stand out from the airport background. Only about 10% were either neutral or disagreed. No one totally disagreed with this statement.

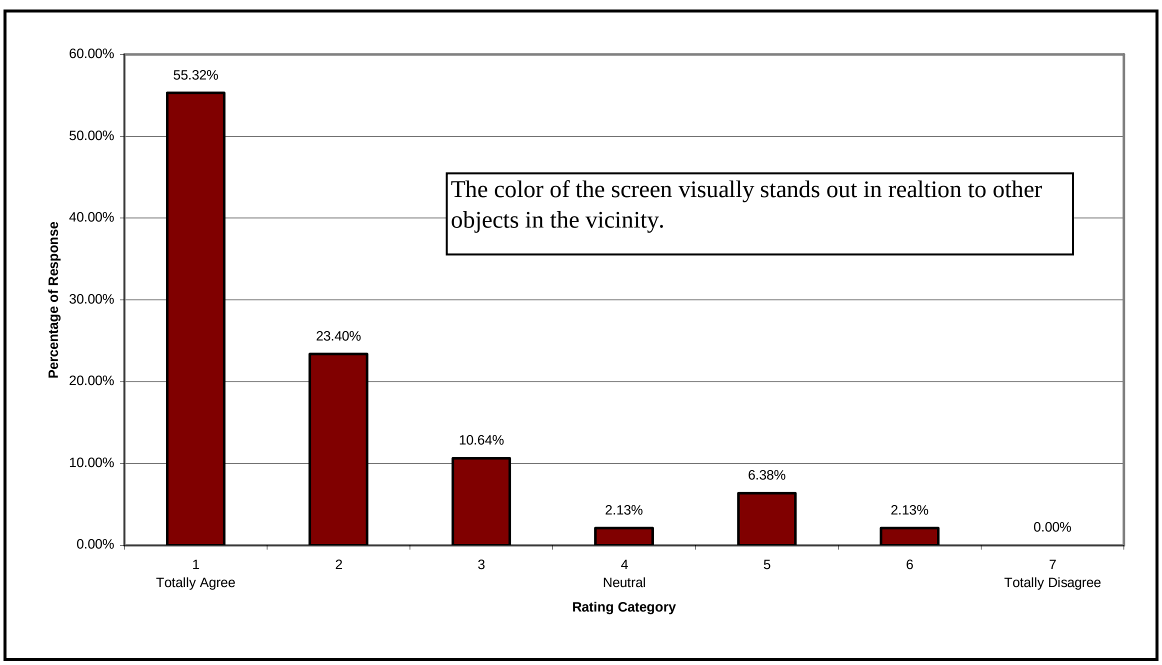

Figure 6. Responses to Statement Two

STATEMENT THREE. Figure 7 shows that approximately 98% of the test subjects agreed positively with the statement, “The pattern was unique enough that it stood out on the airport.” No one indicated disagreement with this statement, and approximately 2% were neutral.

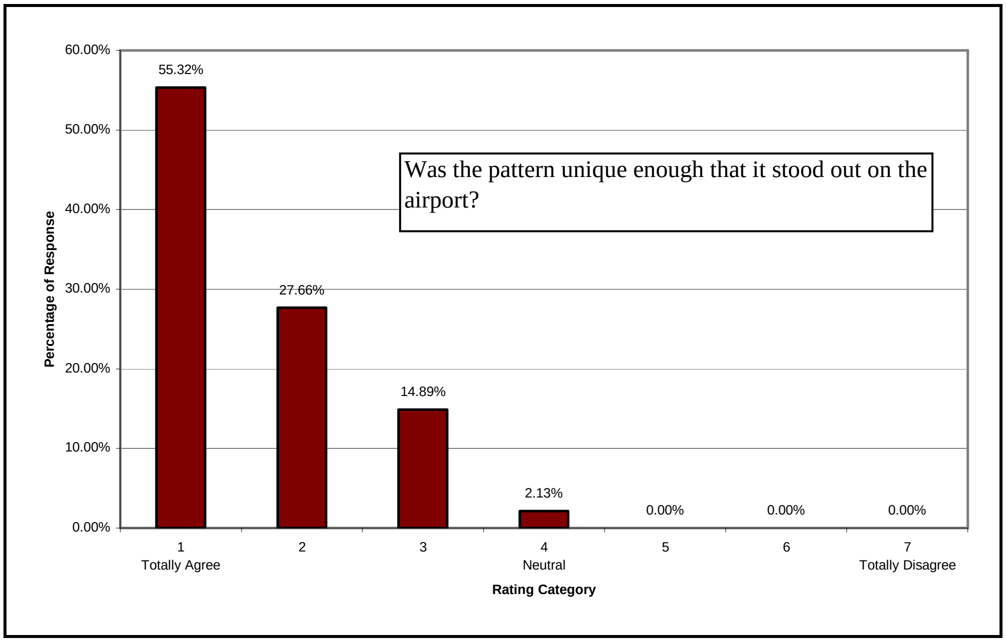

Figure 7. Responses to Statement Three

STATEMENT FOUR. The fourth statement on the questionnaire was “The EAT screen enables you to properly discriminate between an aircraft that is in front of or behind the EAT screen.” Figure 8 shows the rating for this statement in percentage. Ninety-six percent of the test subjects agreed to this statement to some degree, about 4% were neutral, and no one disagreed with the statement.

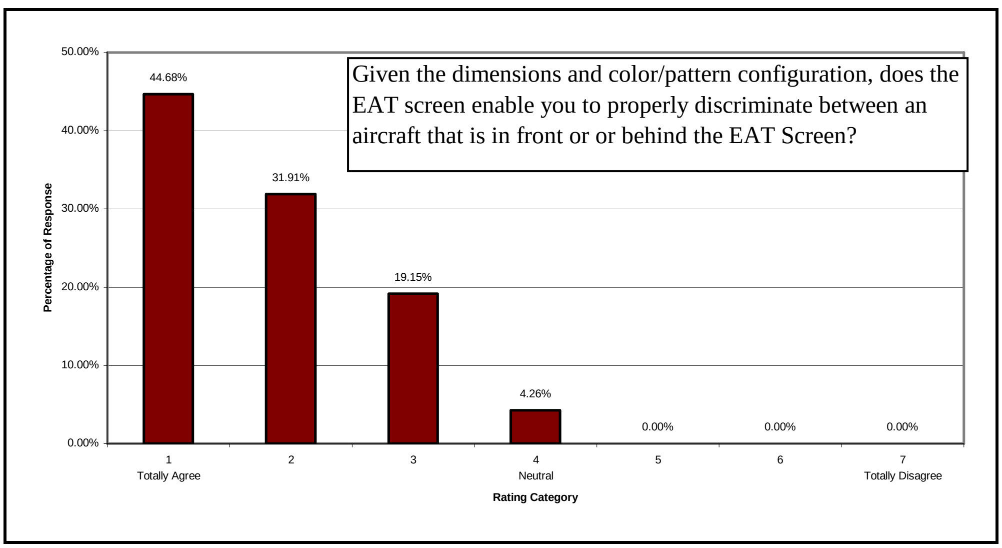

Figure 8. Responses to Statement Four

QUESTION ONE. The question asked for the opinion of the test subjects on the overall concept of the EAT screen. Figure 9 reflects the number of responses by rating category from poor to excellent for this question. Over 89% of the responses were positive in nature. A little over 8% of the test subjects were neutral on their perception of the EAT screen as an operational concept, and 2% had negative opinions about the EAT concept of operations.

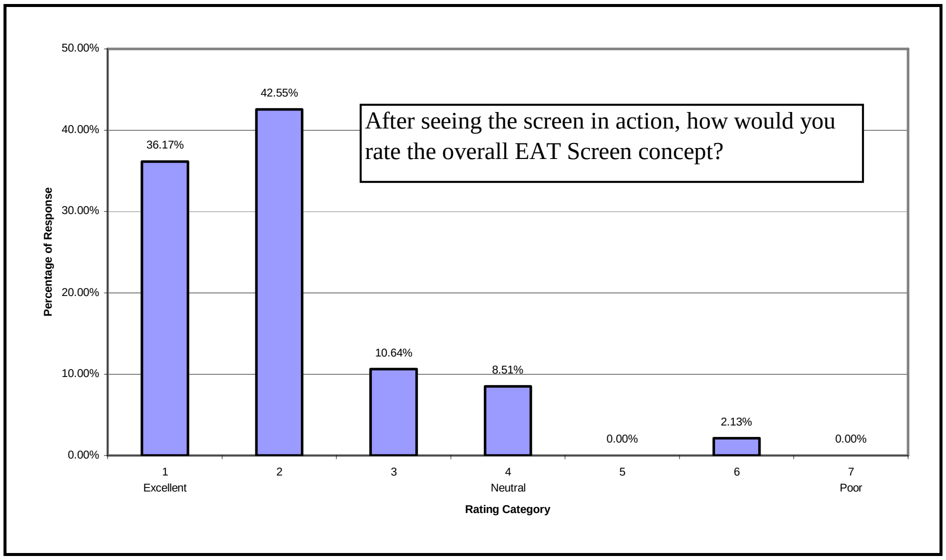

Figure 9. Responses to Question One

OVERALL SYNOPSIS. An average rating score was calculated for each statement and the overall concept question (see figure 10). Out of a potential score of 7, the rating scores for the statements varied from as low as 5 to as high as 5.36, confirming that the test subjects agreed with the various attributes of the EAT screen. The average overall score for all of the questions combined was 5.19.

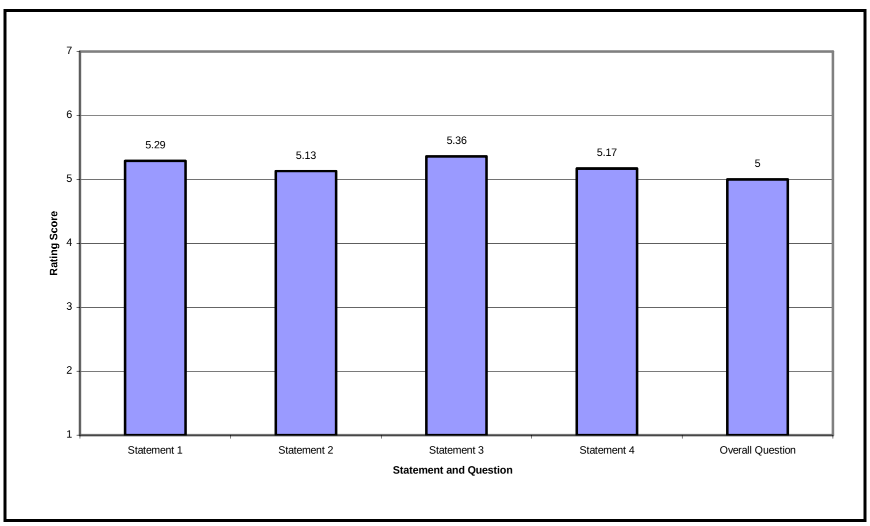

Figure 10. Average Rating Scores for Each Statement and Final Question

IN-FIELD TEST MONITOR OBSERVATION RESULTS.

Test monitors in the field completed data collection forms on each individual subject pilot. A variety of observation data was collected during the course of the evaluation. The data collection form used in the field included questions on the color of the screen, evaluations of how quickly the subjects detected the aircraft, and whether or not they were correct in their detection. The answers and/or position of the aircraft at the time the subject pilots made their observations were documented on the data collection form. The subjects were not allowed to see the data collection form.

SPEED TO DETECT EXISTENCE OF EAT SCREEN. One of the first measurements to be recorded was how quickly it took the test subjects to identify the existence of the EAT screen. This identification was conducted at markers 10 and 8. The detection time was broken down into four categories:

1. Quickly
2. Moderately
3. Slowly
4. Unable to detect

The results of time to detect the existence of the EAT screen are presented in table 1 as percentages of total observations.

Table 1. Speed Category at Which Existence of EAT Screen was Detected at the Two Markers as Percentage of Total Number of Observations

Distance to EAT Screen	Speed at Which Existence of EAT Screen was Detected			
	Quickly (%)	Moderately (%)	Slowly (%)	Not Detected (%)
10,000 ft, marker 10	65.96	23.40	8.51	2.13
8,000 ft, marker 8	100	-	-	-

IDENTIFICATION OF THE EAT SCREEN COLOR. At markers 10 and 8, the test subjects were asked to identify the color of the EAT screen. In each case, the test subject either identified the color correctly or did not. Correct and incorrect responses were calculated as a percentage of total observations, and the results of this test are shown in table 2. Of those subjects that answered incorrectly, most answered orange. This is possible due to the shade of the red that was used in the evaluation.

Table 2. Identification of the Color of the EAT Screen at the Two Markers as Percentage of Total Number of Observations

Distance to EAT Screen	Identification of Color	
	Correctly Identified Color (%)	Incorrectly Identified Color (%)
10,000 ft, marker 10	91.49	8.51
8,000 ft, marker 8	93.62	6.38

<u>TIME TO DETECT AIRCRAFT POSITION</u>. The average speed to detect whether an aircraft was passing in front of or behind the EAT screen was measured at markers 10 and 8. The speed to detect was measured on how much of the aircraft was behind the screen before the study participant was able to make a determination as to whether or not the aircraft was behind the screen. By using the relative position of the aircraft as an indication of detection speed, each participant was able to make their own record as to when they determined whether the aircraft was behind or in front of the EAT screen. The speed scale was divided into the following categories:

- Immediate (aircraft begins to move towards the screen)
- First third (when the nose of aircraft passes behind or in front of the screen)
- Second third (when the nose and wing of the aircraft are behind or in front of the screen)
- Entire aircraft (when almost the entire aircraft is either behind or in front of the screen)
- Unable to determine at all

Figures 11 and 12 give the cumulative percentage of observations in each of the above categories for the EAT screen located at both 10,000 ft (marker 10) and 8,000 ft (marker 8), respectively. Figure 11 indicates that in 3.23% of the observations, the aircraft's position was determined immediately, and in 95.16% of the total observations of the aircraft's position was determined by the time the entire aircraft was either behind or in front of the EAT screen. In 4.84% of the observations, the test subjects could not determine the position of the aircraft relative to the screen.

Figure 12 shows a slight increase in the ability to determine the position of the aircraft at marker 8, with 13.83% of the observations determining the position of the aircraft immediately. At this distance, 100% of the observations determined the position of the aircraft by the time the entire aircraft was either behind or in front of the screen. There were no unable to determine observations at 8000 feet.

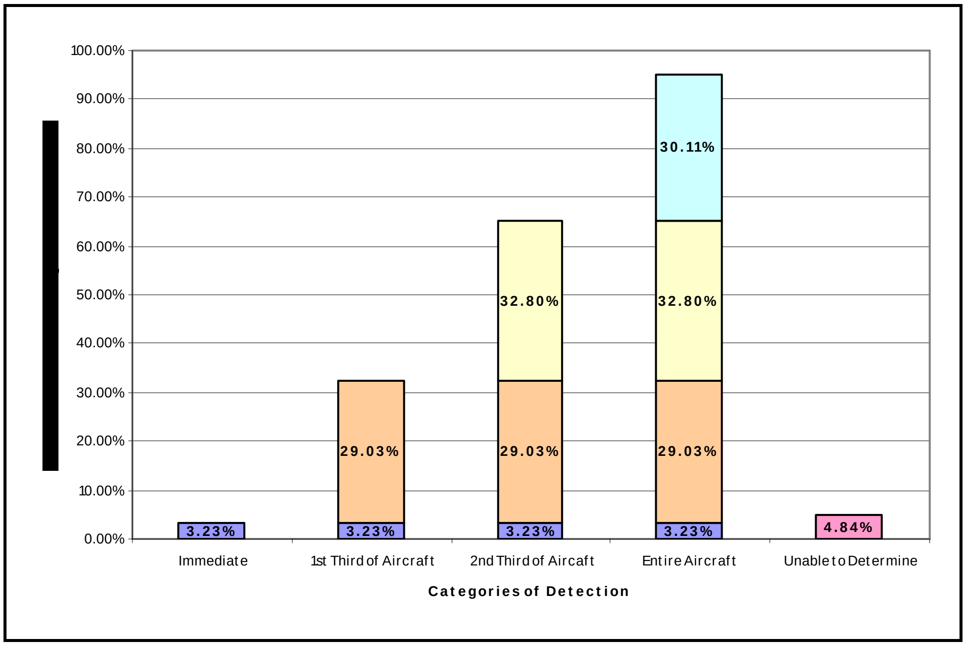

Figure 11. Cumulative Percentage of Observations by Category to Determine Position of Aircraft at 10,000 Feet

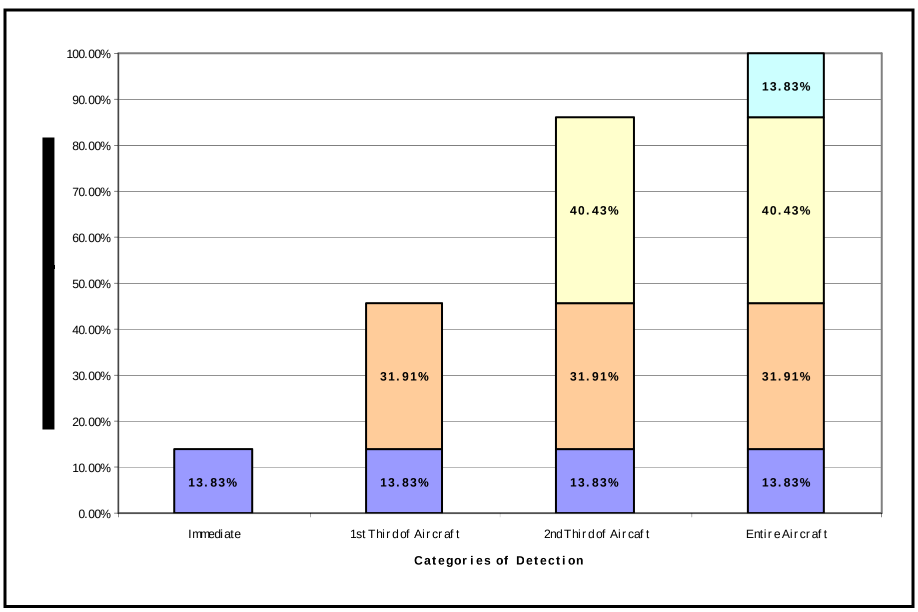

Figure 12. Cumulative Percentage of Observations by Category to Determine Position of Aircraft at 8000 Feet

CORRECTLY IDENTIFYING POSITION OF AIRCRAFT. In addition to measuring the time it took to identify whether the aircraft was in front of or behind the EAT screen, the correctness of the identification was recorded (see table 3). In other words, did the test subject correctly identify whether the aircraft passed in front of or behind the screen. This test was done to determine if there was a speed versus accuracy tradeoff.

Table 3. Identification of Position of Aircraft

	Runs Conducted at 10,000 ft				Runs Conducted at 8000 ft	
	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
Percentage of correct observations	95.7%	95.7%	95.7%	97.9%	100%	100%

DAY AND NIGHT OPERATIONS. There were 32 test subjects for daytime operations and 16 test subjects for nighttime tests. Table 4 provides a comparison of the day and night operations.

Table 4. Comparison of Day and Night Operations

Metric	Average Value Daytime Operations	Average Value Nighttime Operations	Difference	Significance
Quickness of identifying screen at marker 10	1.6	1.3	0.3	No significant difference
Correct identification of screen color at marker 10	1.1	1.1	0.0	No significant difference
Quickness of identifying screen at marker 8	1.0	1.0	0.0	No significant difference
Correct identification of screen color at marker 8	1.1	1.0	0.1	No significant difference
Speed to detect position of aircraft at marker 10	2.1	2.2	0.1	No significant difference
Speed to detect position of aircraft at marker 8	1.8	1.9	0.1	No significant difference

No significant differences were noted between the responses received during the day and those received during the nighttime evaluations.

SUMMARY

Subjective data from the questionnaires indicate that there was a general consensus among the test subjects that the EAT screen was easily identifiable both at night and during the day. In addition, the color, pattern, and type of materials used to construct the screen provided good conspicuity. These combined attributes make the EAT screen an effective aid to help pilots determine whether the aircraft is passing behind or in front of the screen. Overall, the test subjects felt that the operational concept of the EAT screen was good.

In addition to being rated highly, the visibility of the red and white 12-foot-wide screen color was also easy to identify. The test results showed that the color of the screen could be correctly identified over 90% of the time from either marker 10 or marker 8, with accuracy being slightly higher when the test subject was closer to the screen.

Both day and night operations were tested to determine if a pilot could recognize the EAT screen and tell if a taxiing aircraft was passing in front of or behind the screen. Results indicate that there is no statistically significant difference between day and night operations.

When an EAT and an EAT screen exists at an airport, it is critical for the pilot of an aircraft taking off to quickly identify whether a taxiing aircraft is crossing an active runway or taxiing on the EAT. Thus, the speed at which the pilot can detect the position of a taxiing aircraft relative to the EAT screen is important. The results showed that pilots could correctly identify the relative position of a taxiing aircraft between 96% and 98% of the time at a distance of 10,000 feet. At a distance of 8000 feet, the pilots could correctly identify the position of the aircraft 100% of the time.

At the conclusion of the questionnaire, the test subjects were asked to provide any comments concerning the EAT screen, test procedures, etc. Thirty-seven of the test subject provided comments. A list of these comments is provided in appendix B. Of the 37 comments, 21 came from the daytime evaluation, 14 from the nighttime evaluation, and 2 were not specified. The comments were generally positive in nature, with most subjects providing suggestions for improvements. The comments fell into four main categories (1) suggestions to improve the lighting of the EAT screen, (2) improvements to the physical construction of the screen, (3) changes to the color of the screen, and (4) general comments on the effectiveness of the screen.

In addition to the written comments provided, many of the test subjects made verbal comments in the debriefing to the data recorders. The data recorders felt that these comments provided insight to important issues concerning the EAT screen, and as such, these comments were captured by the data recorders when possible. Appendix B provides an abbreviated and edited list of the verbal comments made by test subjects.

CONCLUSIONS

Upon review of the data collected throughout the evaluation effort, the following conclusions may be drawn from the results of this study:

1. A screen height of 13 feet above runway elevation proved effective in highlighting aircraft position.

2. The color combination of red and white proved most effective for screen acquisition.

3. Continuous 12-foot-wide diagonal stripes set at a 45-degree angle proved to be the most effective configuration.

4. Reflective materials (engineering-grade or equivalent) were effective in enhancing screen visibility for both day and night.

5. Offset of the platforms (15-35 feet) was sufficient to allow access to fire rescue vehicles and did not affect the visual effectiveness of the screen.

6. Tilting of the screen surface 14 degrees (to avoid impacts to radar signals) did not affect the visual appearance of the screen.

7. Aircraft landing lights and taxi lights alone proved sufficient to adequately illuminate screen location.

8. Of the subject pilots involved in the evaluation, the vast majority (98%) ranked the screen as effective in performing the function of highlighting aircraft on the EAT.

APPENDIX A—END-AROUND TAXIWAY SCREEN DEVELOPMENT

Figures A-1 through A-20 are photographs of the various stages of the end-around screen tests. Figures A-21 through A-23 show the briefing and data collection material.

Figure A-1. Construction

Figure A-2. Checkerboard Configuration

Figure A-3. Diagonal Stripe Configuration

Figure A-4. Large and Small Diagonal Stripes

Figure A-5. Small and Large Checkerboard

Figure A-6. Diagonal Stripes at 8000 ft

Figure A-7. Checkerboard at 8000 ft

Figure A-8. Red, Orange, and White Diagonal Stripes (224 ft)

Figure A-9. Screen Panel Separation

Figure A-10. Aircraft Rescue Firefighting Truck Demonstration

Figure A-11. Aircraft Rescue Firefighting Vehicle Between Screen Segments

Figure A-12. Night View of Screens With Variety of Lighting

Figure A-13. Night View With Surface Lighting

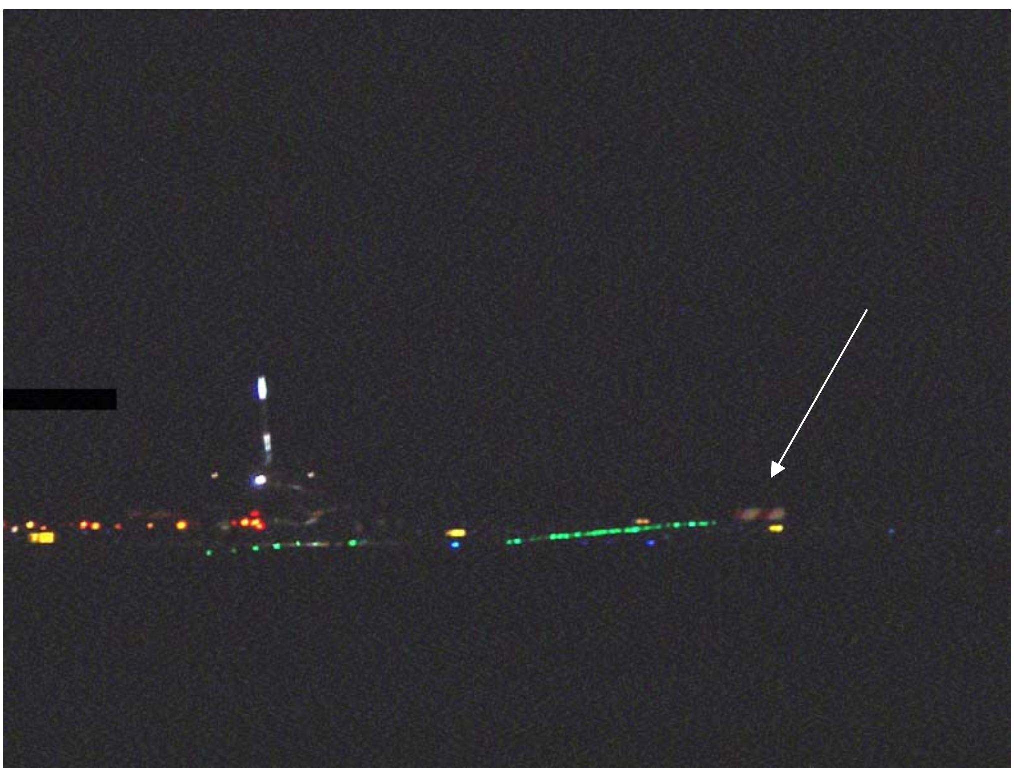

Figure A-14. Night View of Screen With Aircraft Lights Only

Figure A-15. Final Test Configuration

Figure A-16. A B-737 Test Aircraft

Figure A-17. A B-737 in Front of EAT Screen

Figure A-18. Distance View of Aircraft in Front of Screen

Figure A-19. A B-737 Test Aircraft Behind Screen

Figure A-20. A B-737 Test Aircraft in Front of Screen

Project Description

Thank You for serving as a subject pilot during our test! Your input is very important to us and the aviation community.

The End-Around Taxiway, nicknamed the "EAT", is a taxiway that circumvents an inboard or outboard runway by providing an optional path for aircraft to taxi around the end of an active runway thus avoiding the necessity of crossing the runway. (Please see the attached diagram.)

A potential problem may exists for aircraft taking off on a runway with an EAT, since an aircraft taxiing on the EAT may look like it is actually crossing the departure end of the runway. The pilot may perceive that there is a runway incursion and abort the takeoff.

To mitigate this situation, the FAA Airport Obstructions Standards Committee (AOSC) Executive Steering Group` directed that a visual screen type device be designed and installed to assist pilots on a takeoff roll, to better discern when a aircraft is crossing the active runway versus the aircraft operating on the EAT (except where the End-Around Taxiway is sufficiently shielded by natural terrain). We are evaluating this Visual screen today.

During the evaluation, you will be taken to two locations on the Atlantic City International Airport. Once at the locations, you will be asked to indicate whether or not you can identify the screens. You will see an aircraft moving within the vicinity of the screen and will be asked to determine whether or not the aircraft is in front of or behind the screen. When you are confident that you can make a decision on your response, please let your test monitor know your answer as soon as you can. After viewing the screen in action, you will be taken to the test site, and then asked to complete a simple five question survey regarding your observations. There is also space for you to provide any comments you may want to make. Please feel free to write as much as you would like. Your feedback is very valuable to our evaluation.

Your participation is greatly appreciated and we thank you again for your assistance.

Have fun!

Figure A-21. Sample Briefing Sheet

EAT screen Pilot Questionnaire

Your Name:________________

Estimated Flight Hours:____________ Circle: DAY or NIGHT

Please help us evaluate the effectiveness of the End-Around Taxiway (EAT) screen by circling the number the best indicates your response.

The rating is on a scale of 1- to 7; 1 implying a favorable answer", 4 "neutral" and 7 implying a negative answer.

Evaluation

1. I can easily determine the location of the screen.

1	2	3	4	5	6	7
Totally Agree			Neutral			Totally Disagree

2. The color of the screen visually stands out in relation to other objects in the vicinity.

1	2	3	4	5	6	7
Totally Agree			Neutral			Totally Disagree

3. Was the pattern unique enough that it stood out on the airport?

1	2	3	4	5	6	7
Totally Agree			Neutral			Totally Disagree

4. Given the dimensions and color/pattern configuration, does the EAT screen enable you to properly discriminate between an aircraft that is in front of or behind the EAT screen?

1	2	3	4	5	6	7
Totally Agree			Neutral			Totally Disagree

5. After seeing the screen in action, how would you rate the overall EAT screen concept?

1	2	3	4	5	6	7
Excellent			Neutral			Poor

Please provide us any additional comments or opinion that you may have:

____

____

____

Figure A-22. EAT Screen Pilot Questionnaire

EAT screen Daylight Data Collection Form

Date:______________ Time:________________

Subject Name:_______________ Affiliation:___________________

Evaluators Names:___________________

Weather Conditions: Vis:_______ Mi Wx (circle): Clear Hazy Cloudy Overcast

Distance Position Marker 10:

1. "Please let me know if you are able to identify anything that might resemble an EAT screen."

   Pilot responded: Quickly Moderately Slowly Unable to locate

2. "Would you please tell me what color the EAT screen is?"

   Pilot responded: Correctly Incorrectly

3. "You will now see the EAT screen in action. Please indicate to me when you are able to tell if the moving aircraft travels in front of or behind the screen. As soon as you are able to make your assessment, please indicate your answer to me by saying 'In front" or "Behind". "

Run1F Was the pilot: Correct Incorrect

Response occurred when what part of aircraft was passed edge of screen:

Immediate 1st Third (Nose) 2nd Third (Wing) 3rd Third (Tail) Unable

Run2BWas the pilot: Correct Incorrect

Response occurred when what part of aircraft was passed edge of screen:

Immediate 1st Third (Nose) 2nd Third (Wing) 3rd Third (Tail) Unable

Run3B Was the pilot: Correct Incorrect

Response occurred when what part of aircraft was passed edge of screen:

Immediate 1st Third (Nose) 2nd Third (Wing) 3rd Third (Tail) Unable

Figure A-23. Data Collection Form (p.1)

Run 4FWas the pilot: Correct Incorrect

Response occurred when what part of aircraft was passed edge of screen:

Immediate 1st Third (Nose) 2nd Third (Wing) 3rd Third (Tail) Unable

Distance Position Marker 8:

1. "Again, please let me know if you are able to identify anything that might resemble an EAT screen."

   Pilot responded: Quickly Moderately Slowly Unable to locate

2. "Again, would you please tell me what color the EAT screen is?"

   Pilot responded: Correctly Incorrectly

3. "You will again see the EAT screen in action. Please indicate to me when you are able to tell if the moving aircraft travels in front of or behind the screen. As soon as you are able to make your assessment, please indicate your answer to me by saying 'In front" or "Behind". "

Run1B Was the pilot: Correct Incorrect

Response occurred when what part of aircraft was passed edge of screen:

Immediate 1st Third (Nose) 2nd Third (Wing) 3rd Third (Tail) Unable

Run1F Pass 2 Was the pilot: Correct Incorrect

Response occurred when what part of aircraft was passed edge of screen:

Immediate 1st Third (Nose) 2nd Third (Wing) 3rd Third (Tail) Unable

"That concludes the field portion of this evaluation. Once we receive clearance from ATC, we will continue ahead towards the EAT screens. Please take a moment to collect any thoughts you might have about the screen, or what you just experienced. Once we arrive at the test site, you will be asked to complete a simple five question questionnaire. You are encouraged to provide any comments or suggestions you might have. Again, thank you for your participation."

Figure A-23. Data Collection Form (p.2) (Continued)

APPENDEX B—LIST OF COMMENTS FROM THE EAT SCREEN PILOT QUESTIONAIRE

"If you did not concentrate on determining the passing of an A/C you may not discriminate." Night, 6,000 Flight Hours

"I found it easy to determine/judge when the aircraft was in front of the JAE screen. Effective and the aircraft in end around taxi-way." Night, 16,000 Flight Hours

No Comment, Night, 5500 Flight Hours

"Much Better in day light, difficult at night and improving at the closer range." Night, 20,000 Flight Hours

"Night is different than day-color scheme of A/C can be of some significance." Night, 25,000 Flight Hours

"The EAT must be lighted in some way. Without the lighting tonight, I could not see the EAT, let alone determine aircraft in front/behind. With lighting on the EAT and aircraft anti-collision/ position lights, determining position was easy and useful." Night, 2,400 Flight Hours

No Comment, Night, 100 Flight Hours

"Some more reflective "unnatural" color schemes would be helpful to deciding between the aircraft color and screen (ie. Hunter Orange and Aviation Yellow)" Night, 1,350 Flight Hours

"Other red & white construction at the airport took away from noting screen at first glance. Reason for neutral rating above is you have to be looking for screen at least in this test environment which may be a distraction while handling you're A/C." Day, 6,000 Flight Hours

No Comment, Day, 100 Flight Hours

"To these 65 year old eyes, I would prefer the screen to be a foot or two higher. I think it would enable quicker identification." Day, 20,000 Flight Hours

"Consider changing the colors such that the end of the signs are red. As it currently is configured the right side of the screen starts white and was difficult to distinguish with the white 747, the white building in the distance and the white test aircraft." Day, Flight Hours not specified

"My concern would be with vary colors of aircraft and night operations" (Day or Night & Flight Hours are not specified)
"It was very favorably contrast view for movement of aircraft." Day, 18,000 Flight Hours

No comment, Day, 350 Flight Hours

No comment, Day, 8,300 Flight Hours

"Would like to see larger aircraft with higher (greater vertica) land gear evaluated. Low visibility, night time – (ie. Beacons and aircraft lights)" Day, 25,000 Flight Hours

"I thought the demonstration was easy to determine when the A.C. was in front or behind the screen." Day 16,000 Flight Hours

"Smaller white strips. Since most A/C are light colors smaller white strips or a color other then white may be more effective." Day, 8,500 Flight Hours

"Felt that the height of the screen was too low-easy to see vertical stabilization and portion of fuselage and A/C possed behind the screen. With A/C- believe the distraction to a departing or landing aircraft would be even greater." Day, 6,000 Flight Hours

"Color resembles Southwest's orange and the angle of the diagram may match an aircraft's tail assembly." Day, 9,000 Flight Hours

"Red color appears to be orange in distance. White would be a little whiter." Day, 11,000 Flight Hours

No comment, Day, 15,000 Flight Hours

"Making the screen taller would help (I understand TERPS limitation) Also, the white portion of the screen blended in with the passing aircraft cab." Day 1,350 Flight Hours

"Excellent, However, I feel in low light/vis lighting would better provide visual cues as to A/C movement." (Day/Night not specified) 5,500 Flight Hours

"Mr. Gallagher indicated that 13ft is the height of the devices used today. Based on the terrash of each airport or the curvature of the runway or airfield, I might suggest a greater height if the features of the airport dictate as such. Otherwise, a great tool." Day, 800 Flight Hours

"In the convair the taxi light was more effective than the landing lights. Unless I was looking specifically at the EAT screen, I would not have noticed the screen." Night, 15,500 + Flight Hours

"Much more difficult at night depending on angle of landing lights and strength of landing light." Night, 950 Flight Hours

"Night conditions certainly changed the ability to discern the barrier from other airport lights buildings in the immediate vicinity. Otherwise, the barrier performed as well as if did in daylight conditions." Night, 800 Flight Hours

"screen was difficult to see without A/C lighting. Good resolution of where target A/C position due to the scallop of screen." Night, 11,000 Flight Hours

“Depends on arc of landing lights. Aircraft appears as silhouette, and difficult to discriminate.” Night, 4,500 Flight Hours

“Maybe towards the very bottom of the EAT screen the panels could be narrower to better depict smaller aircraft such as small twins and single engine aircraft.” Day, 950 Flight Hours

“ To be fully effective I feel the screen should be long enough to encompass total length of large aircraft. Runways are seldom flat. At some airports it may be impossible to see the EAT screen. Does T/O data for some aircraft change with screen in place?” Day 15,500+ Flight Hours

No comment, Day, 4,500 Flight Hours

No comment, Day, 11,000 Flight Hours

No comment, Day , 7,500 Flight Hours

“What id ACY had been painted red & white also- may be a problem” Day, 8,300 Flight Hours

“Once I knew what the screen looked like and where it was, it was easy to determine when the plane passed in front of the screen, harder to see the plane crossing behind. Training about the use of the screen should be provided to the pilot.” Day, 3,100 Flight Hours

“Only difficult when aircraft was first approaching the end of the screen.” Day 1,500 Flight Hours

“I would like to see a red & white color aircraft taxi in front of the panels just to see if aircraft colors blend in with the panels.” Day, 8,500 Flight Hours

“Can’t tell A/C is there others behind it, easy to see silhouette when in front, reflects material shows up great!” Night 400 Flight Hours

“Looking at A/C Nav lights, it sometimes was hard to determine which side the A/C was on. A/C silhouette was easy to see when A/C was in front.” Night 200+ Flight Hours

“With a dark background, aircraft with dark tail, I would see the aircraft pass behind the EAT screen. (Ignoring L1011 in backbround).” Night 50 Flight Hours

“Had to wait until the nose completely passed the red stripe before I was confident calling it in front.” Day, 0 Flight Hours

“Good Job” Day 100 Flight Hours

“The aircraft to the rear of the EAT screen made it a little difficult to make out the 757 until the 757 was entirely in front or behind the EAT screen.” Day 0 Flight Hours

LIST OF COMMENTS DURING DEBRIEF

Day, Tuesday 2:30pm #1

1. Simple and Effective
2. For departing aircraft
3. Waiting until more of the aircraft was in front or behind aircraft
4. As soon as orange disappears, assuming aircraft with orange or red, can you see it?
5. RVR is red and white, screens behind it , what would happen?
6. Check for RVR near a screen
7. Black tail blended with trees
8. Could not really tell what was happening behind, but could tell when the aircraft was in front
9. Need notice of EAT
10. Would be interesting if 747 went across

Day, Tuesday 3:30 pm #1

1. Visible
2. As far as the screen goes it was quite visible, I would consider education
3. Do you see the EAT? Oh that what these are for.
4. Need an approach plate and noted where they are
5. The only way it would be intuitive is if you see none of the aircraft.
6. Not like red, like green light
7. When I first saw the screen, I thought it was construction.

Night, Tuesday 8:30 pm #1

1. First thing you could see was the beacon A
2. Tough time discriminating the aircraft going across
3. 700ft would be better
4. Refocus to note the screen
5. Black and white, though it would stand out more.
6. The taxi light was more effective then the landing lights.
7. Controversy on how to run your lights. Landing lights on for the take off. Clear for take off lights to.. Some taxi lights were making the screen standout more than landing lights.
8. Off center purposely taxing.

Day, Wednesday 2:00 pm #1

1. I think it is very effective. Might be better to have more orange and less white.
2. I though movement of aircraft behind the screen could be distracting. Color is not that important. screen covers all of the aircraft.
3. Are you going to test smaller planes?
4. Breaking the strip. The nose breaking the strip. The angle is similar to a plane tail. The only time that will be a distraction, is when the tail matches the angle of the tail.

Day, Wednesday 3:00 pm #1

1. I thought it was very easy to tell. Simple. I liked the marking.
2. Generic paint job on the aircraft versus some other color. 747 bus, different color scheme.
3. Could be hard to tell if the aircraft is the same color.
4. Is it frangible? Suppose you really had an abort. Still does not convince me. 1000ft zone.
5. Lighting at night? 747 I know that your rear end is sticking out. What do you do for night time operation?
6. Half way down the runway I think you could see at night, but not any farther.

Day, Wednesday 4:30 pm #1

1. Yes, Pretty cute.
2. Today, conditions numerous variables, weather, aircraft color concerns.
3. One of the things you have at DFW is a hazy hot day because of the heat rise you can not see the aircraft.
4. Shape of red background. Color of red, what about a red aircraft?
5. What was the design consideration, parallel would be good. We looked and it did not work.
6. When we were at the threshold at DFW 1300 or 1400. You could be too far too see. Based on elevation and landscaping.
7. If there going to have maybe on you test, but at those distances 1500ft you may not see the screen.

Tuesday, 4:30 pm

1. Cockpit height might be an issue, cockpits are higher.
2. Relative height of EAT screen.
3. Stripes were smaller, picked up more movement
4. Was when the nose hit the red section
5. How about if the whole screen is red?
6. Would it be intuitive to notice?
7. It draws your attention

Wednesday, 5:10pm #1

1. It did for me. The indicated perhaps not so well with Southwest. Hundereds with outstanding color schemes.
2. White nose on red slate. Guess which side front or back
3. I thought it was, I would almost be worried that it would be a distraction looking for it. I am busy looking for it.
4. I would have to see 700ft screen.
5. I am not comfortable with taking off with airplane overhead.
6. Hopefully, there would be no confusion because there would be training
7. Compensation for depth perception problems.

Wednesday, 9:20 am #1

1. Night optimal
2. Wondering if a dark tail would cause a problem without other planes.
3. Instead of lighting the screen and light before the screen bring the lights back.
4. Light it enternally
5. Trying to hide what is behind the screen
6. If it is behind it I have no definition of what kind of aircraft it is.
7. What do you do with bad weather?
8. It will limit the LTOs, limited take offs, He will know and not hesitate.
9. Besides the incursions, how many go arounds are there going to be?