FAA VISUAL AIDS - SIGNAGE & LIGHTING

Present to: ICAO Regional Workshop on Air Navigation Visual Aids
Airfield Markings and Lighting System
Bangkok, Thailand
July 6-8, 2015

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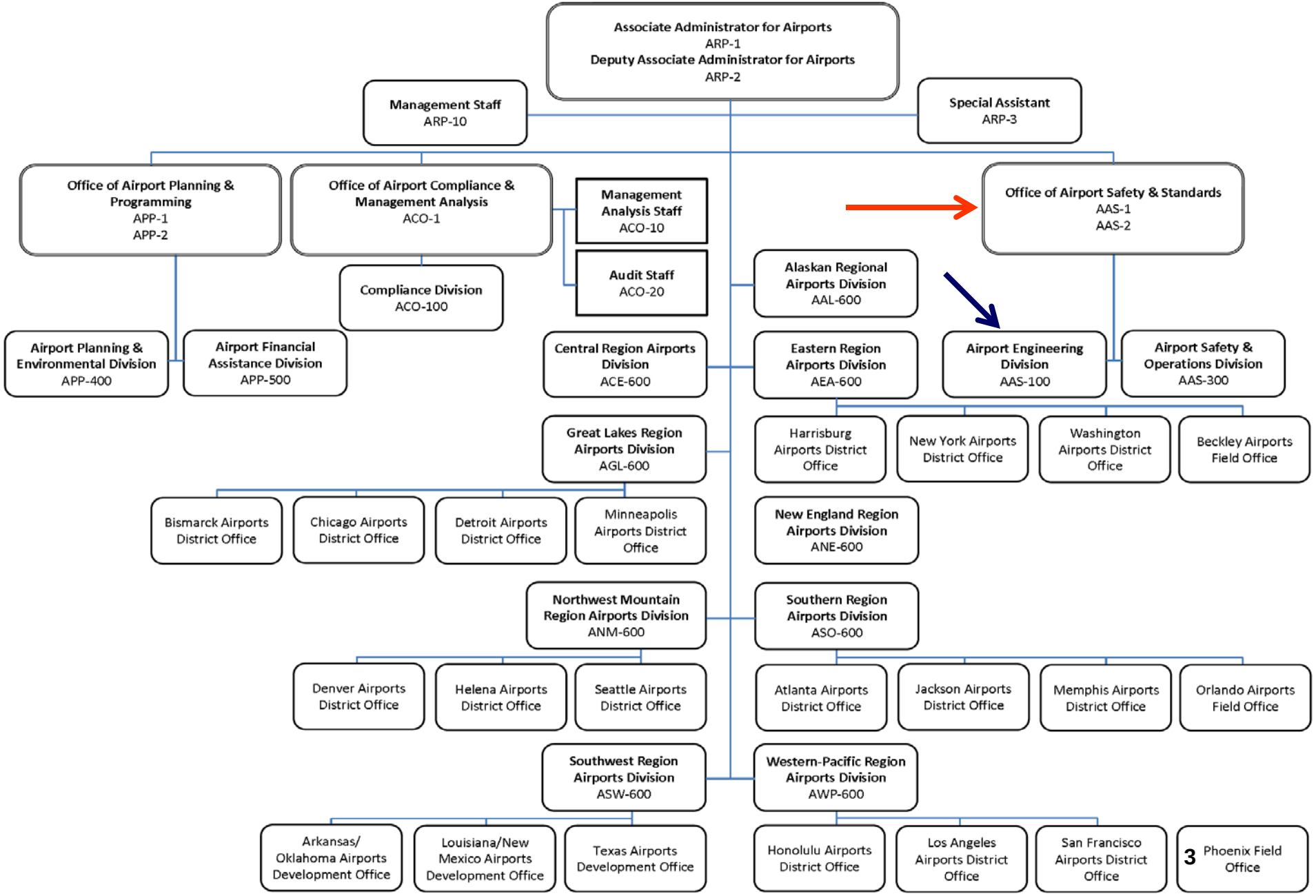
Federal Aviation Administration

OUTLINE

- Overview of FAA, Office of Airports Safety and Standards
- FAA Airfield Lighting Equipment Standards Development
- FAA Airport Lighting Equipment Certification Program
- Draft AC 5340-18G, Standards for Airport Sign Systems
- Engineering Brief, EB 67D, “Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures”- FAA LED Specification
- Enhanced Flight Vision Systems (EFVS)
- Electrical Infrastructure Research Team (EIRT)
- Q&A

FAA OFFICE OF THE ASSOCIATE ADMINISTRATOR FOR AIRPORTS (ARP)



OFFICE OF AIRPORT SAFETY AND STANDARDS AIRPORT ENGINEERING DIVISION (AAS-100)

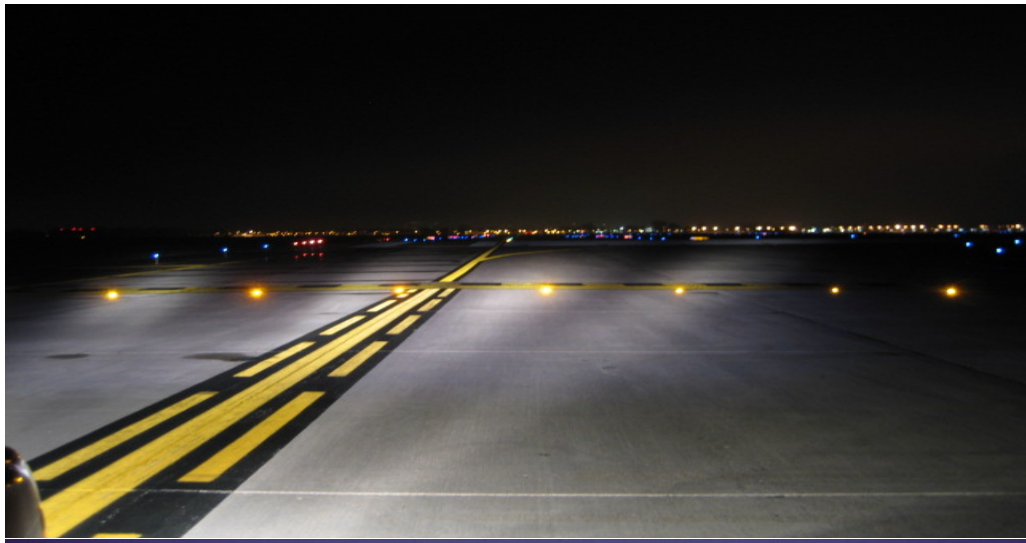
AAS-100 is responsible for developing engineering, design, and construction standards for civil airports, heliports, and seaplane bases. This includes standards for airport design and configuration; airspace; airfield pavement, lighting, marking and signage, navigational aids equipment; Airport GIS; deicing, ARFF equipment and other facilities.

FAA GUIDANCE

- FAA guidance is part of the authorizing legislation for airport development using Federal funds.
- FAA airport design, construction, and maintenance guidance are contained in Advisory Circulars (AC), the 150's series.
- Interim FAA airports engineering guidance is provided in Engineering Briefs (EB).
- FAA airport guidance is available from FAA web sites : http://www.faa.gov/arp/

AIRFIELD LIGHTING EQUIPMENT

- Runway / Taxiway Lights
- Runway / Taxiway Signs
- Beacons
- Obstruction Lights
- Wind Cones
- Isolation Transformers
- Retroreflective Markers
- Cables & Connectors
- ALCMS
- Portable Runway Lights
- Light Bases
- Constant Current Regulators
- Precision Approach Path Indicators (PAPI)
- Runway End Identification Lights (REIL)
- Radio Controls
- Many more…

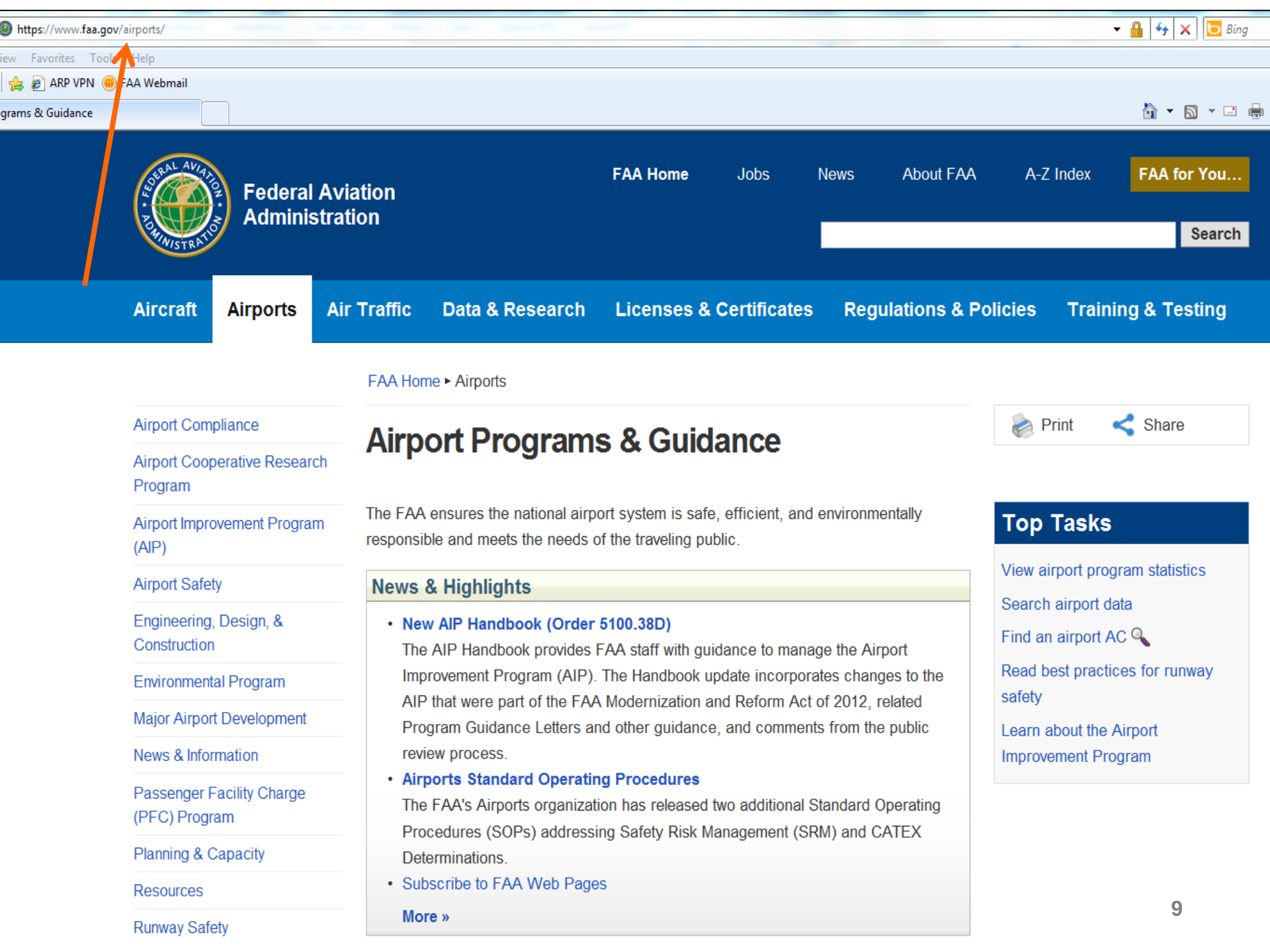


AIRFIELD LIGHTING STANDARDS DEVELOPMENT

- AAS-100 develops airfield lighting standards in the form of Advisory Circulars (ACs) or Engineering Briefs (EBs)
- Our visual aid standards for lighting, marking and signage are based solely on visual acquisition (i.e. intensity, color, beam spread, configuration and spacing)
- Coordinate with the FAA WJHTC (FAA Tech Center) to conduct lighting R&D and evaluate /validate findings before incorporating applicable recommending results into the ACs.
- Collaborative effort with our stakeholders. All ACs & EBs are circulated to internal FAA and Industry Stakeholders for review
- AC's & EB's updated when technologies change and/or 3-4 year cycle.
- Generally, all AC's & EB's will become regulatory requirements when Airports receive federal funding on their projects or Part 139 airports

AIRFIELD LIGHTING EQUIPMENT ADVISORY CIRCULARS (AC's)

Number	Title	Date
150/5340-5D	Segmented Circle Airport Marker System	9/25/2013
150/5340-18F	Standards for Airport Sign Systems	8/16/2010
150/5340-26C	Maintenance of Airport Visual Aid Facilities	6/20/2014
150/5340-30H	Design and Installation Details for Airport Visual Aids	7/21/2014
150/5345-3G	Specification for L-821, Panels for the Control of Airport Lighting	9/29/2010
150/5345-5B	Circuit Selector Switch	9/14/2006
150/5345-7F	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits	8/19/2013
150/5345-10H	Specification for Constant Current Regulators and Regulator Monitors	11/5/2014
150/5345-12F	Specification for Airport and Heliport Beacons	9/24/2010
150/5345-13B	Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits	9/20/2007
150/5345-26D	FAA Specification For L-823 Plug And Receptacle, Cable Connectors	9/30/2008
150/5345-27E	Specification for Wind Cone Assemblies	9/26/2013
150/5345-28G	Precision Approach Path Indicator (PAPI) Systems	9/29/2011
150/5345-39D	Specification for L-853, Runway and Taxiway Retroreflective Markers	9/26/2011
150/5345-42G	Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories	1/23/2013
150/5345-44J	Specification for Runway and Taxiway Signs	9/29/2010
150/5345-45C	Low-Impact Resistant (LIR) Structures	4/6/2007
150/5345-46D	Specification for Runway and Taxiway Light Fixtures	5/19/2009
150/5345-47C	Specification for Series to Series Isolation Transformers for Airport Lighting Systems	7/22/2011
150/5345-49C	Specification L-854, Radio Control Equipment	6/27/2007
150/5345-50B	Specification for Portable Runway and Taxiway Lights	9/20/2007
150/5345-51B	Specification for Discharge-Type Flashing Light Equipment	9/8/2010
150/5345-52A	Generic Visual Glideslope Indicators (GVGI)	9/5/2007
150/5345-53D	Airport Lighting Equipment Certification Program	9/26/2012
150/5345-54B	Specification for L-884, Power and Control Unit for Land and Hold Short Lighting Systems	9/30/2009
150/5345-55A	Specification for L-893, Lighted Visual Aid to Indicate Temporary Runway Closure	6/27/2007
150/5345-56B	Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)	9/29/2011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Airport Compliance
Airport Cooperative Research Program
Airport Improvement Program (AIP)
Airport Safety
Engineering, Design, & Construction
Environmental Program
Major Airport Development
News & Information
Passenger Facility Charge (PFC) Program
Planning & Capacity
Resources
Runway Safety
Airport Programs & Guidance
Print
Share
The FAA ensures the national airport system is safe, efficient, and environmentally responsible and meets the needs of the traveling public.
News & Highlights
New AIP Handbook (Order 5100.38D)
The AIP Handbook provides FAA staff with guidance to manage the Airport Improvement Program (AIP). The Handbook update incorporates changes to the AIP that were part of the FAA Modernization and Reform Act of 2012, related Program Guidance Letters and other guidance, and comments from the public review process.
Airports Standard Operating Procedures
The FAA's Airports organization has released two additional Standard Operating Procedures (SOPs) addressing Safety Risk Management (SRM) and CATEX Determinations.
Subscribe to FAA Web Pages
More »
Top Tasks
View airport program statistics
Search airport data
Find an airport AC
Read best practices for runway safety
Learn about the Airport Improvement Program

Airport Compliance
Airport Cooperative Research Program
Airport Improvement Program (AIP)
Airport Safety
Engineering, Design, & Construction
- Aircraft Characteristic Database
- Airport Lighting
- Construction Standards
- Design Software
- Design Standards
- Engineering Briefs
- Modifications of Standards for New Large Aircraft
- Obstruction Evaluation/Airport Airspace Analysis
- Opening or Closing an Airport
- Pavement Design

Environmental Program

Airport Engineering, Design, & Construction

Airports

Print Share

The FAA develops engineering, design, and construction standards for civil airports, heliports, and seaplane bases. This includes standards for airfield pavement; airport lighting, marking, signs, and other visual aids; safety during construction; surveying and GIS data; deicing, ARFF, and other facilities; bird radar and foreign object detection systems; and more.

- Acquiring Land for Airports and Relocation Assistance
- Airport Lighting
- Airport Pavement Design and Construction
- Foreign Object Debris Program
- Modifications of Standards for A380s, B747-8s, & New Large Aircraft
- Obstruction Evaluation/Airport Airspace Analysis
- Open or Close an Airport or Runway
- Procurement and Contracting under the AIP
  - Federal Provisions for Construction, Equipment, & Professional Services (A/E) Contracts
  - Equipment Meeting Buy American Requirements (PDF)
- **Standards**
  - Airport Construction Standards
  - Airport Design and Engineering Standards

Top Tasks

View airport program statistics
Search airport data
Find an airport AC
Read best practices for runway safety
Learn about the Airport Improvement Program

Airport Compliance
Airport Cooperative Research Program
Airport Improvement Program (AIP)
Airport Safety
Engineering, Design, & Construction
Environmental Program
Major Airport Development
News & Information
Passenger Facility Charge (PFC) Program
Planning & Capacity
Resources
Acronym Glossary
Advisory Circulars
Data and Statistics
Draft Advisory Circulars

Series 150 Advisory Circulars (ACs) for Airport Projects

Airport Lighting

Print Share

« Back to Advisory Circulars main page

Will search within 'Airport Lighting' only. Search all ACs.

Search Content, Number, Title, Description, or Office

Topic: Airport Lighting

Status: Current

Search

1 - 25 of 30 results. Export (CSV) < Previous 1 2 Next >

Number	Office	Title	Date
150/5000-13A	AAS-100	Announcement Of Availability: RTCA Inc., Document RTCA-221	09-05-2008

FAA AIRPORT LIGHTING EQUIPMENT CERTIFICATION PROGRAM (ALECP) AC 150/5345-53D

- Established January 1990.
- Under the ALECP, the FAA has established a list of accepted certification bodies (3rd party certifiers)
- Manufacturer submits certification request to the 3rd party certifiers; they in turn evaluate and certify airport lighting equipment against our AC's.
- Certificate is then issued and the product is listed and maintained in AC 150/5345-53C Addendum. This list is provided to assist airport sponsors to determine that equipment has met the applicable FAA specifications.

FAA AC 150/5345-53D

- **Third Party Certifier Acceptance Criteria**
  - Conformance with ANSI Z34.1, Third Party Certification Programs.
  - Compliance to FAA audit; and other criteria
- **Third Party Certifier Application (every 4 years)**
  - Background as a certification body
  - Competency verification (accreditations)
  - Resumes of related staff
  - Copy of procedural guide and license agreement

FAA AC 150/5345-53D

GENERAL OUTLINE

- Manufacturer submits certification request to 3rd party lab
- Qualification testing
- Documentation submittal and engineering review
- Initial manufacturing facility audit
- License Agreement
- Certificate issued and product listed in 53D Addendum (updated monthly)
- Certification process covered under ANSI accreditation to ISO Guide 65

AC 150/5345-53D- Qualification Testing

- **AC 150/5345-53D, Appendix 2, Section 5.C.i**
- **Must be done IAW ISO 17025**
- **At 3rd party Certifier's testing facility**
- **Outside 3rd party Certifier's testing facility**
  - Covered by audit and witness
  - Test Plan Review and Acceptance
  - Assignment to 3rd Party Representative
  - Formal Report issued by Manufacturer

AC 150/5345-53D- Qualification Testing

When is testing required?

1. **8 year re-qualifications (4 years for L-890 ALCMS)**
2. **Product modifications**
3. **Specification updates**

Airport Lighting Equipment Certification

***Certification Program covers all equipment specified in the FAA AC 150/5345 series*:**

- **Rotating Beacons**
- **Obstruction Lights**
- **Wind Cones**
- **Isolation Transformers**
- **Taxiway / Runway Lights**
- **Retroreflective Markers**
- **Cable Connectors**

- **Underground Cable**
- **Runway & Taxiway Signs**
- **Portable Runway Lights**
- **Light Bases**
- **Constant Current Regulators**
- **Precision Approach Path Indicators (PAPI)**
- **Runway End Identification Lights (REIL)**

ALECP ELIGIBLE PRODUCT TYPES

- L-801 Beacons,Medium Intensity (AC 150/5345-12)
- L-802 Beacons, High Intensity (AC 150/5345-12)
- L-804 Light, Holding Position Edge (AC 150/5345-46)
- L-806 Wind Cones, Frangible (AC 150/5345-27)
- L-807 Wind Cones, Rigid (AC 150/5345-27)
- L-810 Lights, Obstruction (AC 150/5345-43)
- L-821 Panel, Airport Lighting Control (AC 150/5345-3)
- L-823 Connectors, Cable (AC 150/5345-26)
- L-824 Underground Electrical Cable for Airport Lighting Circuits (AC 150/5345-7)
- L-827 Monitors, Regulator (AC 150/5345-10)
- L-828 Regulators, Constant Current (AC 150/5345-10)
- L-829 Regulators, Monitored Constant Current (AC 150/5345-10)
- L-830 Isolation Transformers, 60Hz (AC 150/5345-47)
- L-831 Isolation Transformers, 50Hz (AC 150/5345-47)
- L-841 Cabinet, Auxiliary Relay (AC 150/5345-13)
- L-847 Switch, Circuit Selector (AC 150/5345-5)
- L-849 Lights, Runway End Identification (AC 150/5345-51)
- L-850 Lights, Runway, Inpavement (AC 150/5345-46)
- L-852 Lights, Taxiway, Inpavement (AC 150/5345-46)
- L-853 Markers, Retroreflective (AC 150/5345-39)
- L-854 Radio Controls (AC 150/5345-49)
- L-856 Lights, Obstruction, High Intensity,White, 40 FPM (AC 150/5345-43)
- L-857 Lights, Obstruction, High Intensity,White, 60 FPM (AC 150/5345-43)
- L-858 Signs, Runway and Taxiway (AC 150/5345-44)
- L-859 Lights, Flashing, Omnidirectional (AC 150/5345-51)
- L-860 Lights, Runway Edge, Low Intensity (AC 150/5345-46)
- L-861 Lights, Runway & Taxiway Edge, Medium Intensity (AC 150/5345-46)
- L-862 Lights, Runway Edge, High Intensity (AC 150/5345-46)
- L-863 Lights, Portable Runway (AC 150/5345-50)
- L-864 Lights, Obstruction, Red, 20-40 FPM (AC 150/5345-43)
- L-865 Lights, Obstruction, Medium Intensity, White, 40 FPM (AC 150/5345-43)
- L-866 Lights, Obstruction, Medium Intensity, White, 60 FPM (AC 150/5345-43)
- L-867 Light Base, Non-Load Bearing (AC 150/5345-42)
- L-868 Light Base, Load Bearing (AC 150/5345-42)
- L-880 Precision Approach Path Indicator (AC 150-5345-28)
- L-881 Abbreviated Precision Approach Path Indicator (AC 150/5345-28)
- L-882 Generic Visual Approach Descent Indicator (AC 150/5345-52)
- L-883 Generic Visual Approach Descent Indicator (AC 150/5345-52)
- L-884 Power and Control Unit for Land and Hold Short Lighting Systems (AC 150/5345-54)
- L-885 Lights, Obstruction (AC 150/5345-43)
- L-890 Airport Lighting Control and Monitoring Systems (AC 150/5345-56)
- L-891 Frangible Support Structure (lower to service) (AC 150/5345-45)
- L-892 Frangible Support Structure (lower to service) mounted on a rigid steel tower (AC 150/5345-45)
- L-893 Lighted Visual Aid to indicate runway closure (AC 150/5345-55)

OUTLINE

- Overview of FAA, Office of Airports Safety and Standards
- FAA Airfield Lighting Equipment Standards Development
- FAA Airport Lighting Equipment Certification Program
- Draft AC 5340-18G, Standards for Airport Sign Systems
- Engineering Brief, EB 67D, “Light Sources Other than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures”- FAA LED Specification
- Enhanced Flight Vision Systems (EFVS)
- Electrical Infrastructure Research Team (EIRT)
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AC 5340-18G (Draft Rev G) Standards for Airport Sign Systems

U.S. Department
of Transportation

**Federal Aviation
Administration**

Advisory Circular

Subject: STANDARDS FOR AIRPORT SIGN SYSTEMS	**Date:** 08/16/10 **Initiated by:** AAS-100	**AC No:** 150/5340-18F **Change:**

1. PURPOSE. This Advisory Circular (AC) contains the Federal Aviation Administration standards for the siting and installation of signs on airport runways and taxiways.

2. BACKGROUND. This AC incorporates mandatory hold signs that reflect changed standards for the Precision Obstacle Free Zone (POFZ) and Category (CAT II/III) operations. These changes correspond to revisions to AC 150/5300-13, Airport Design, that change the Precision Object Free Area (POFA) to the POFZ and incorporate new separation standards for taxiways that parallel runways used for certain low visibility operations.

The Federal Aviation Administration (FAA) also has revised low visibility operation procedures; these revised procedures require that the POFZ be clear when an aircraft on a vertically guided final approach is within 2 nautical miles of the runway threshold and the reported ceiling is below 250 feet (75 m) and/or visibility less than a ¾ statute mile (runway visual range below 4,000 feet (1 km)). If the POFZ is not clear, the minimum authorized height above touchdown (HAT) and visibility are 250 feet and a ¾ statute mile respectively. The POFZ is considered clear even if the wing of the aircraft holding on a taxiway penetrates the POFZ; however, neither the fuselage nor the tail may infringe on the POFZ (see the most recent versions of AC 150/5300-13 and FAA Order 8260.3, United States Standard for Terminal Instrument Procedures).

The FAA is revising Terminal Instrument Procedures (TERPS) standards for the separation distance between a runway equipped for CAT II/III operations and the parallel taxiway that requires aircraft to hold, in certain circumstances, at a location other than the runway holding position.

AC 5340-18G Draft, Standards for Airport Sign Systems-Principal Changes

- Introduce new “Approach” signs
- In corporate EB 89, Clarifications of Taxiway Nomenclature
- Introduce “new” Orange Construction signs
- Update drawings

AC 5340-18G Draft, Standards for Airport Sign Systems-Principal Changes

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- Introduce “new” Orange Construction signs
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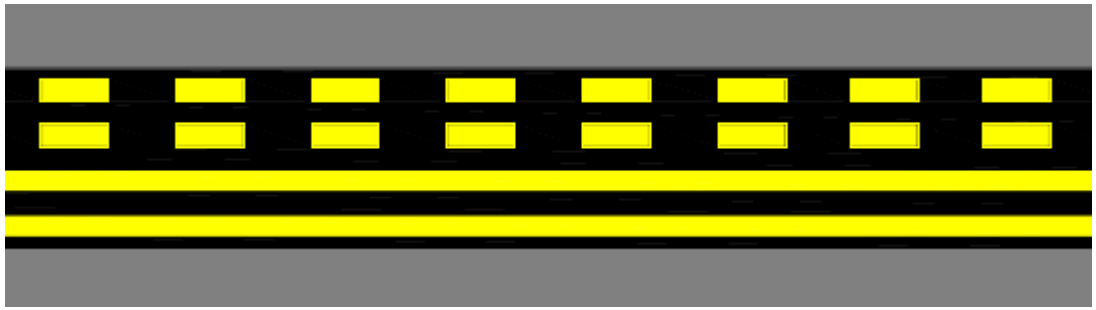
Draft AC 5340-18G- New Proposed Signs

Figure 13. Construction Ahead Signs

Figure 14. Construction on Ramp

Figure 15. Take-Off Run Available Signs

Existing Mandatory Instruction Signs With Markings



AC 150/5340-18F, Para 5:

Mandatory instruction signs have a white inscription with **black outline** on a **red** background. They denote taxiway/runway intersections, runway/runway intersections, ILS critical areas, CAT II/III operations areas, POFZ boundaries, runway approach areas, military landing zones and no entry areas. At controlled airports (i.e., airports with an operating air traffic control tower), vehicles and aircraft are **required to hold at these signs unless cleared by air traffic control**.

AC 150/5340-1K

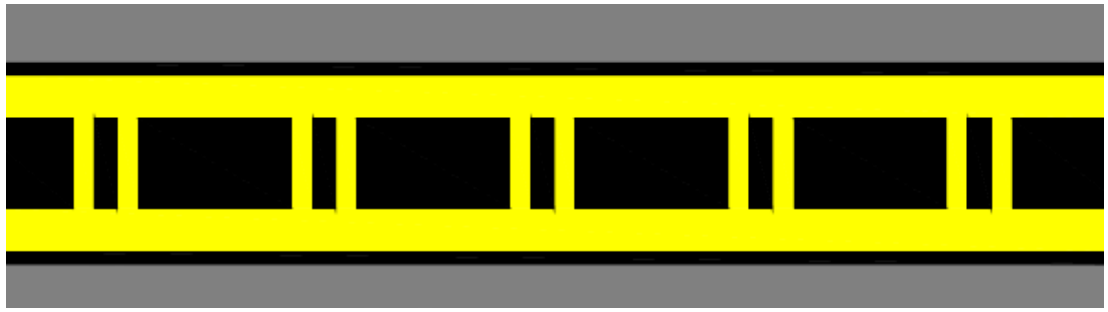
3.3. CASE 3 – APPLICATIONS OF PATTERN A FOR THE RUNWAY HOLDING POSITION MARKING ON TAXIWAYS.

a. Purposes:

….For a taxiway that intersects a runway at an airport with an operating airport traffic control tower (ATCT), the Pattern A marking scheme identifies the location on a taxiway where pilots and vehicle drivers ***are to stop until they receive a clearance from ATCT to proceed onto the runway.***

…..For a taxiway that does not intersect a runway but ***crosses through a runway approach area or the runway safety area***, the Pattern A marking scheme identifies the location on a taxiway where pilots and vehicle **drivers *are to stop to receive clearance from the airport traffic control tower before proceeding through the protected area.***

Existing Mandatory Instruction Signs With Markings



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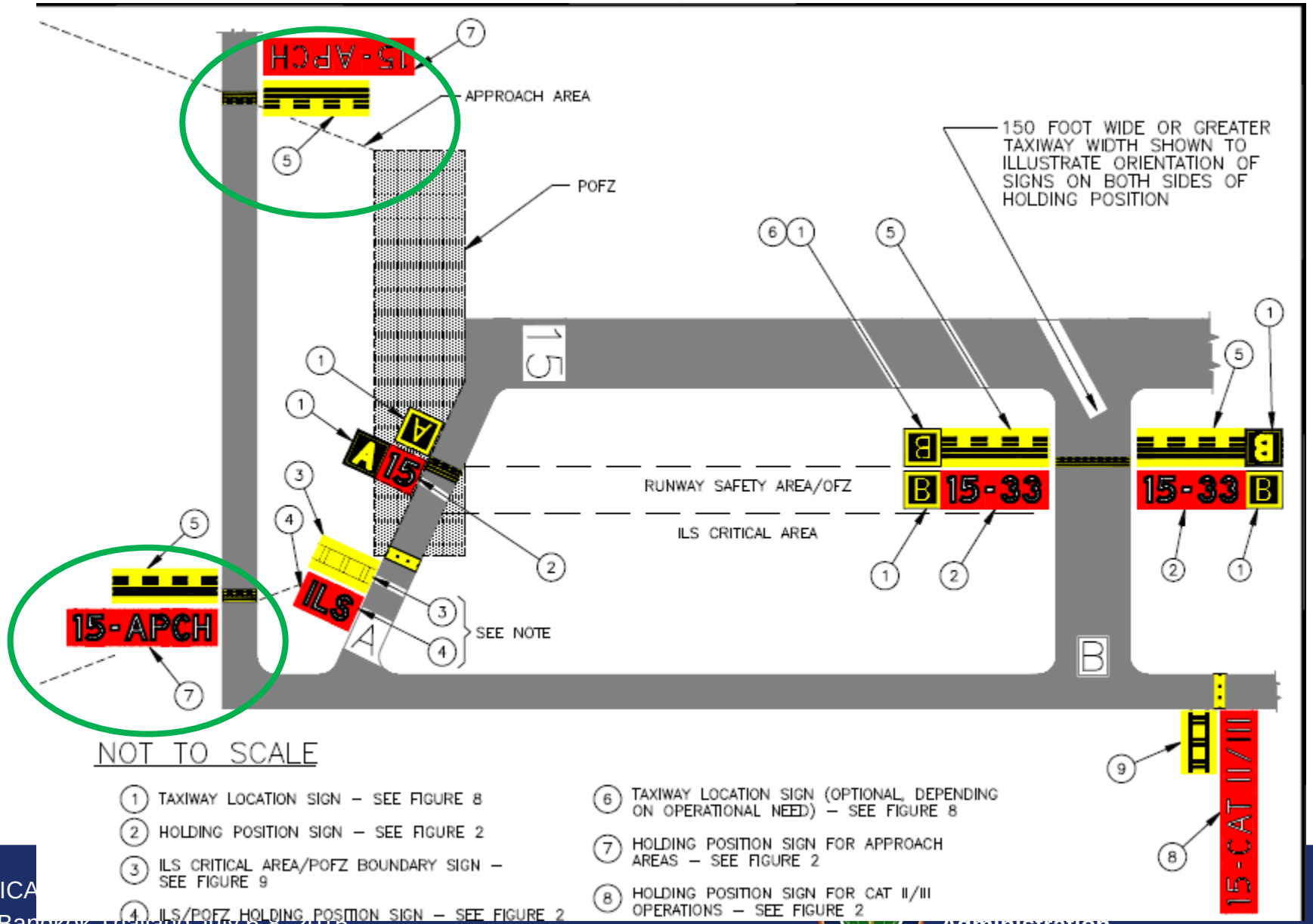
AC 150/5340-1K

3.4. CASE 4 – APPLICATIONS OF PATTERN B FOR THE ILS/MLS HOLDING POSITION MARKING.

a. Purposes. Pattern B for the ILS/MLS holding position marking as shown in figure 12 identifies the location on a taxiway or holding bay where a pilot or vehicle driver ***is to stop when they have received instructions from the airport traffic control tower (ATCT) to hold before entering an ILS/MLS critical area.*** The intent of the marking is to protect the signal of the ILS/MLS navigational aid by identifying the holding position for CAT I operations and protecting the approved TERPS for CAT II/III operations.

AC 150/5340-18F, Fig 3



APPROACH HOLD ISSUES

APPROACH HOLD SIGNAGE & MARKING

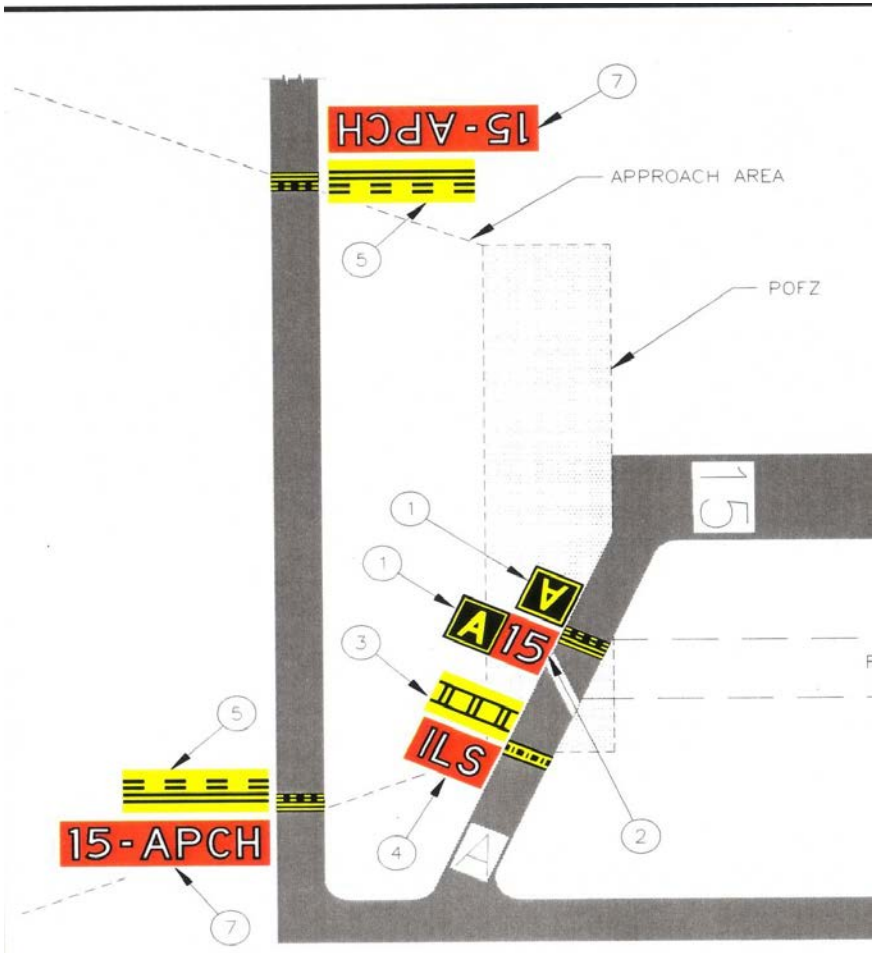
- There are inconsistencies in implementing approach hold signs, marking and procedures among the nation's airports, causing confusion among ATC, pilots, airport operators and cert inspectors.

- Protect other areas such as RSA, approach, departure, or other critical surfaces of a runway intersecting with another runway's RSA or critical surfaces.

APPROACH HOLD ISSUES

- Standard (regular) hold short markings in conjunction with approach hold sign result in pilot confusing if crossing hold short markings requiring ATCT clearance

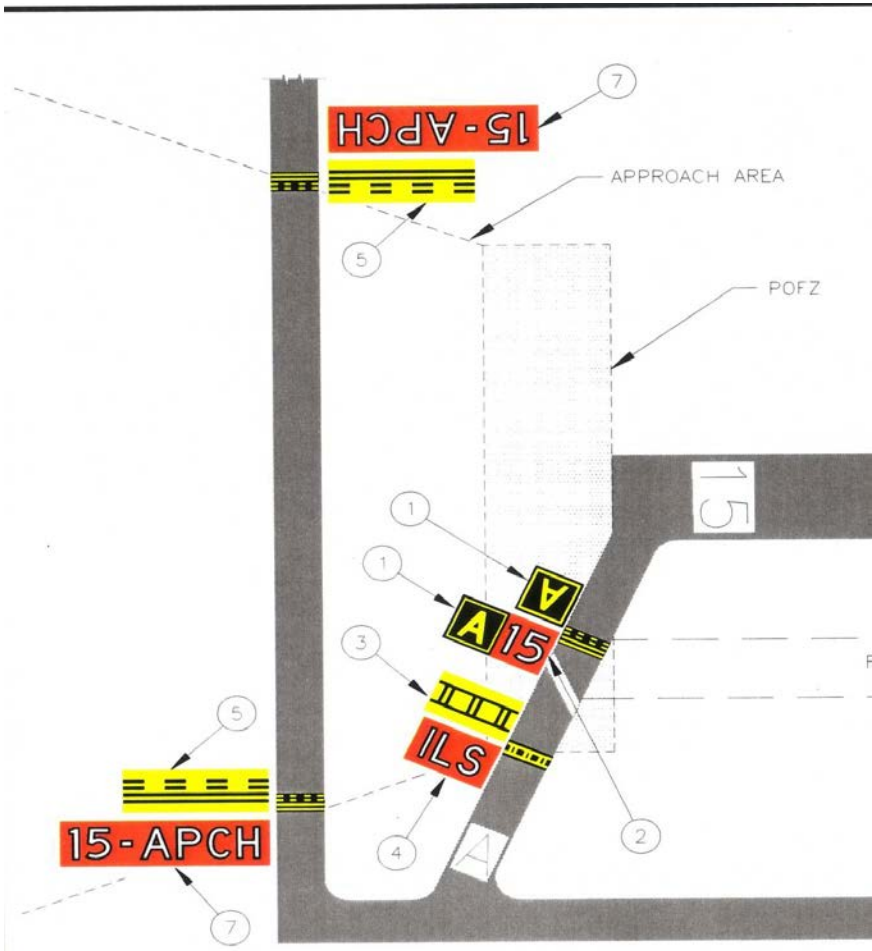
- Most pilots expect hold short markings to be located in the vicinity of a runway entrance. Both the approach hold & POFZ hold marking positions may cause confusion when the hold is not associated directly with a runway entrance or it's a long distance from the rwy.



APPROACH HOLD ISSUES

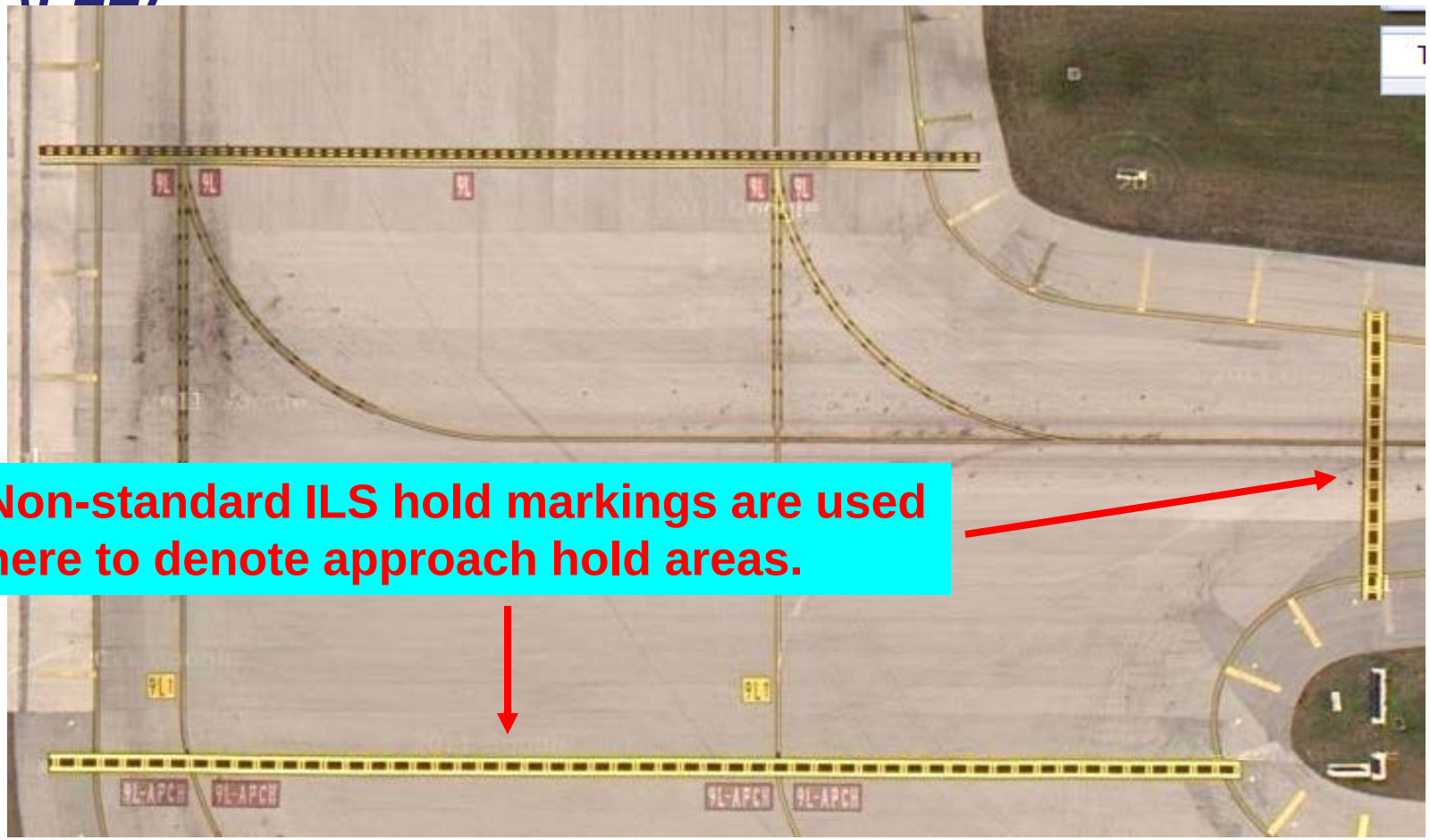
- Having only one rwy indicated on the approach hold sign causes confusion when the approach hold is used for protection with departing traffic at the other end of the runway.

- Requiring specific clearance to pass a holding position marking when the associated runway is not active will unnecessarily increase air traffic controller workload.



Example – Standard Markings (BIL)

Issue – Non-Standard Markings (FLL)



Issue – Runway Protection *(PUB)*

Approach hold markings and signs protect Runway 26L arrivals and Runway 8R departures. They also protect access onto the runway.

Procedures are not covered in the SOP.

Current

Proposed

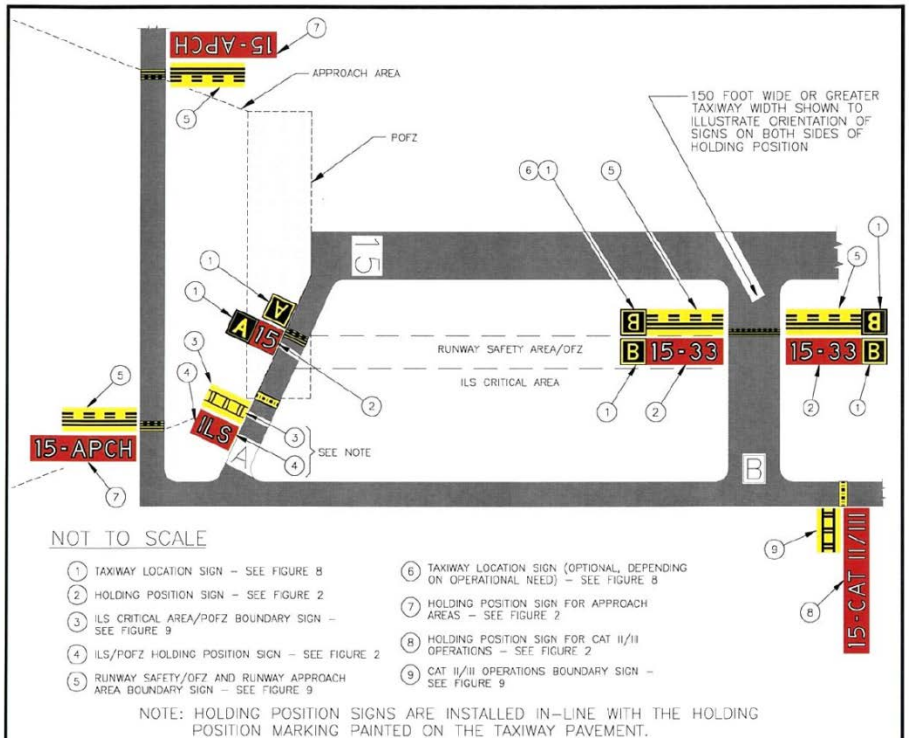
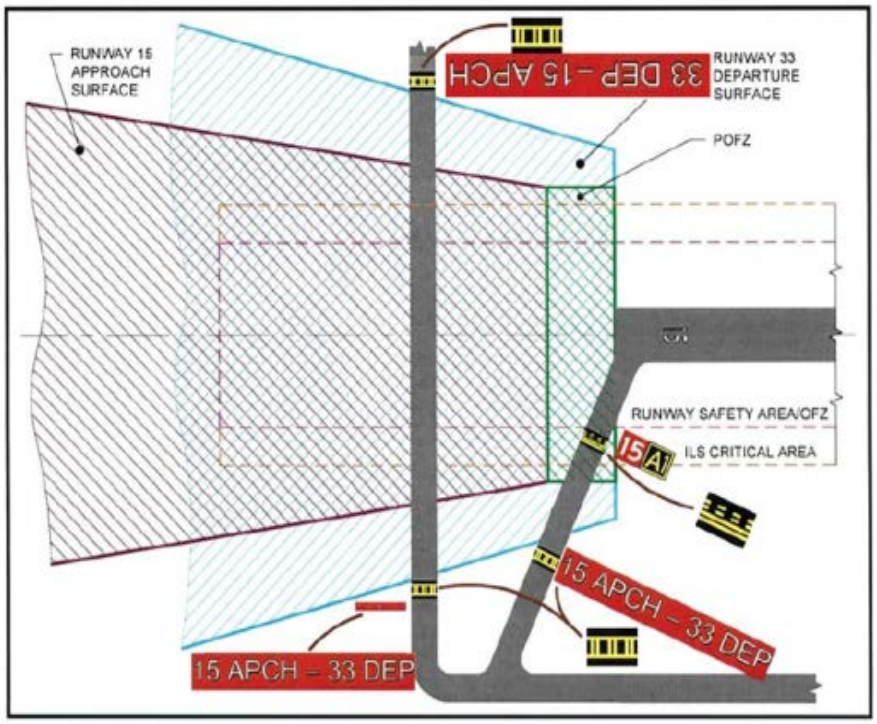
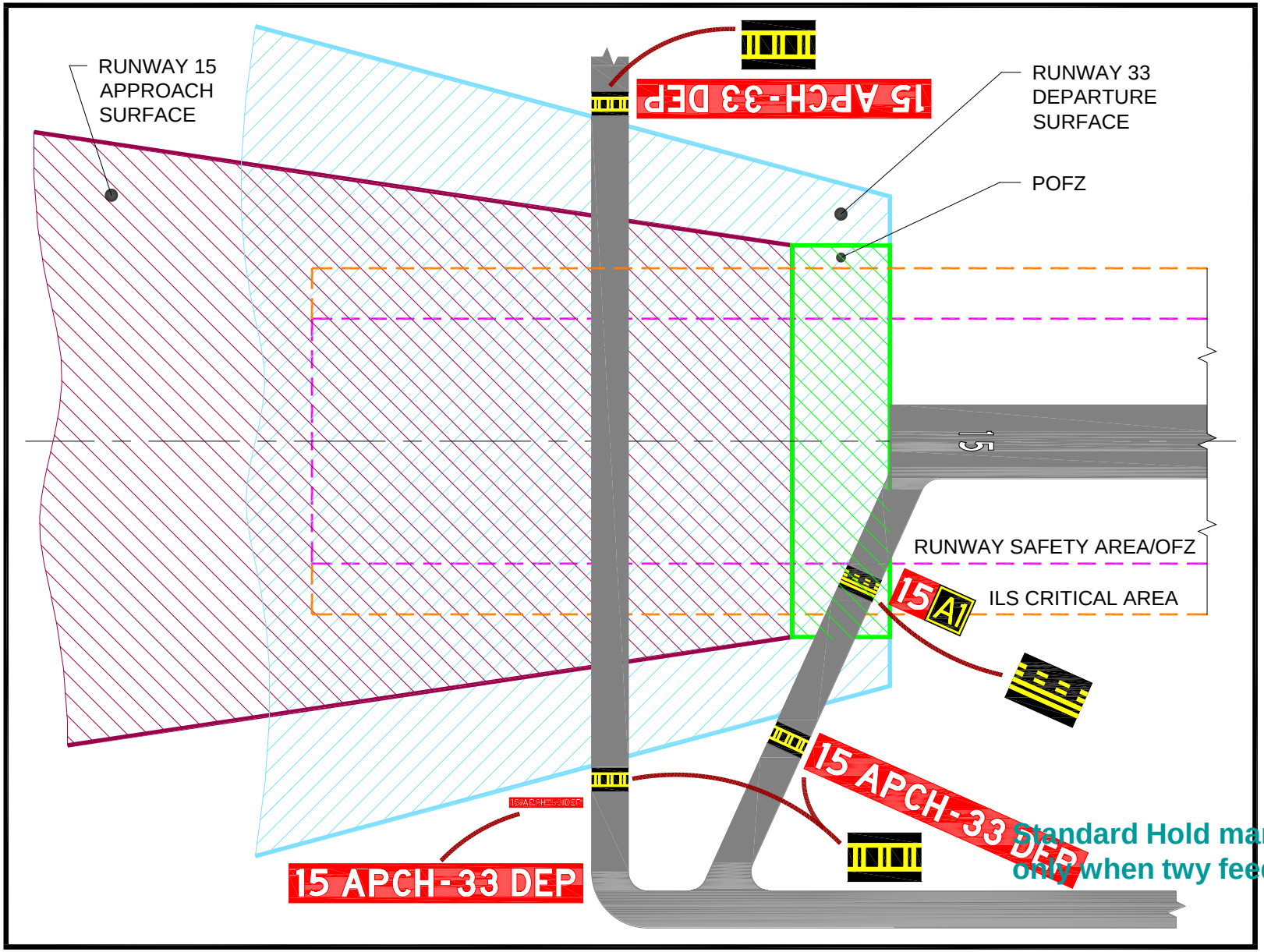
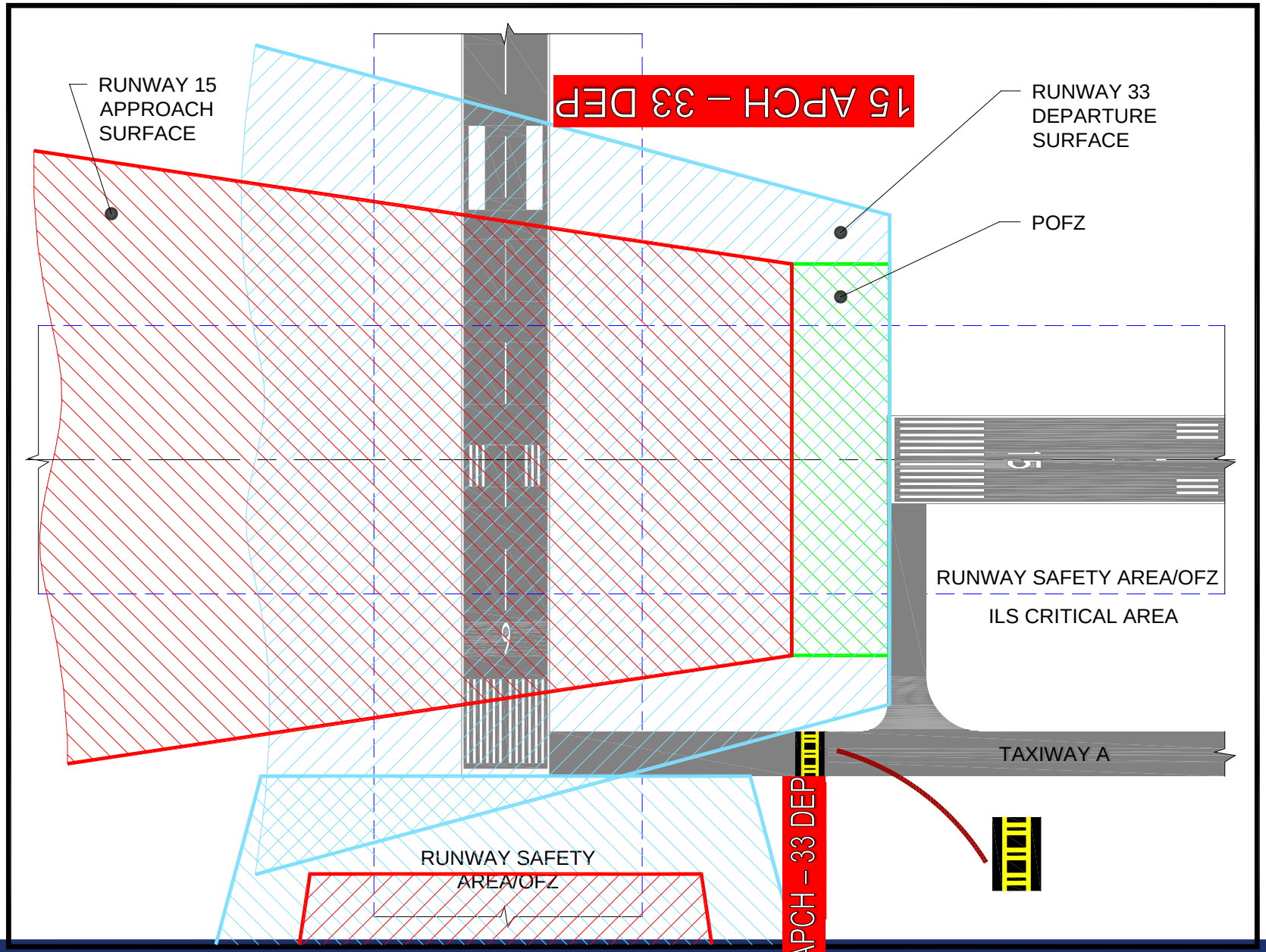


Figure 3. Application Examples for Holding Position Signs.




RUNWAY 15
APPROACH
SURFACE
15 APCH-33 DEP
RUNWAY 33
DEPARTURE
SURFACE
POFZ
RUNWAY SAFETY AREA/OFZ
15 A1
ILS CRITICAL AREA
15 APCH-33 DEP
15 APCH-33 DEP
Standard Hold markings
only when twy feeds a rwy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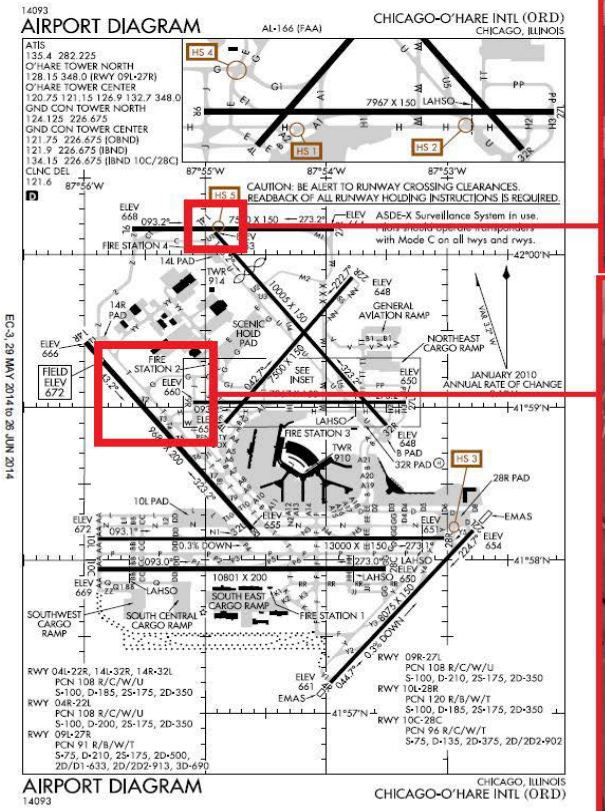
TAXIWAY A
RUNWAY SAFETY
AREA/OFZ
15 APCH – 33 DEP

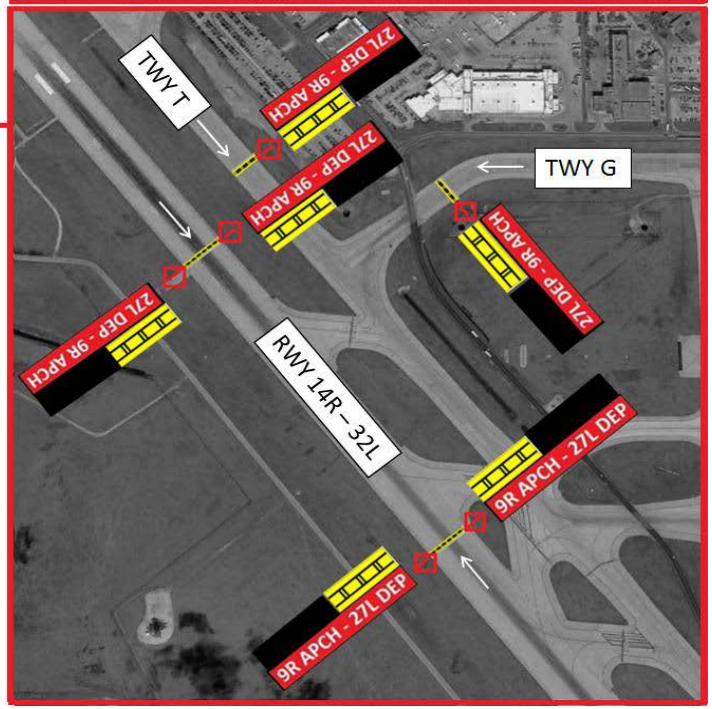
R&D Study Overview

- FAA Airport Safety R&D Branch is conducting evaluations of new signage, surface markings, and ATC phraseology at three airports:

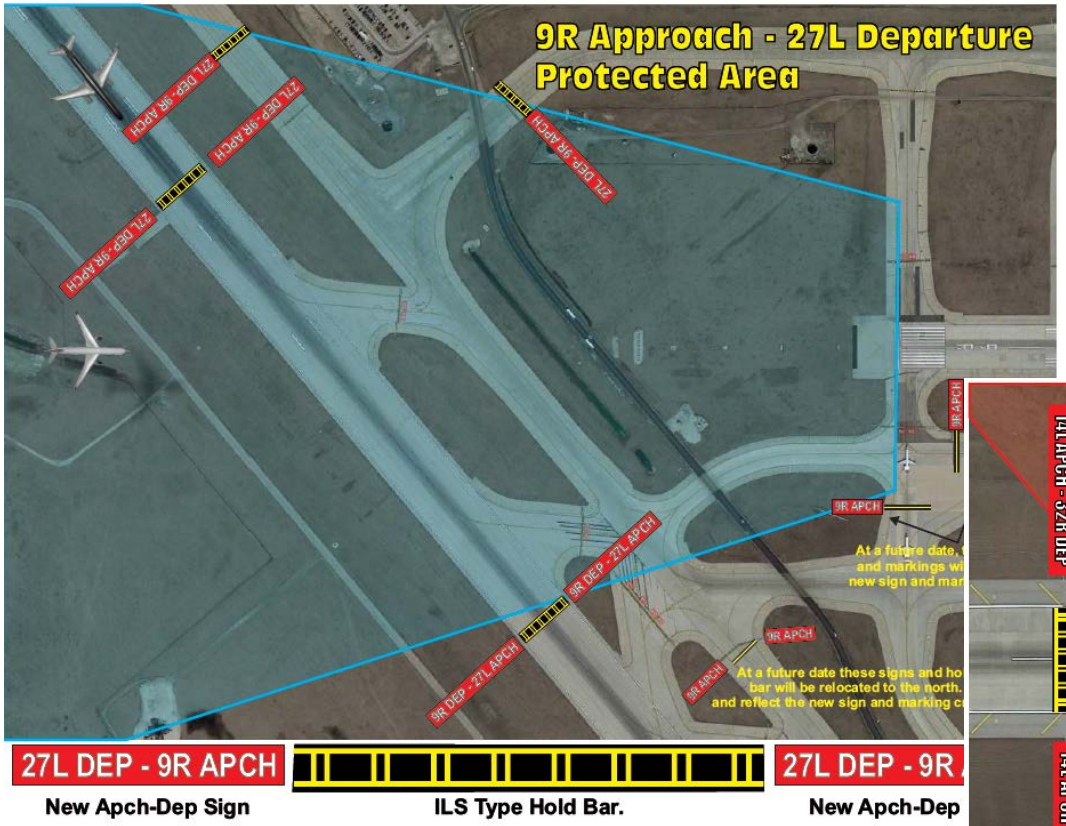
- Chicago O'Hare International Airport (ORD)
  - Installed July 2014
- Cleveland Hopkins International Airport (CLE)
  - Installed October 2014
- Nashville International Airport (BNA)
  - Installed: June 2015

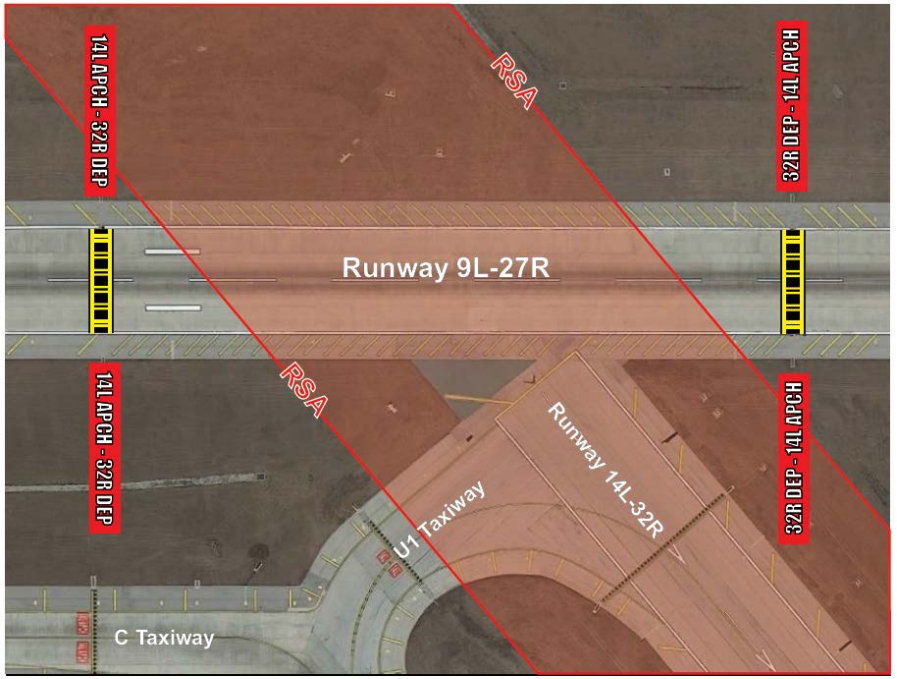
Chicago O'Hare International Airport (ORD) R&D Testing Locations





ORD – R&D Testing Locations



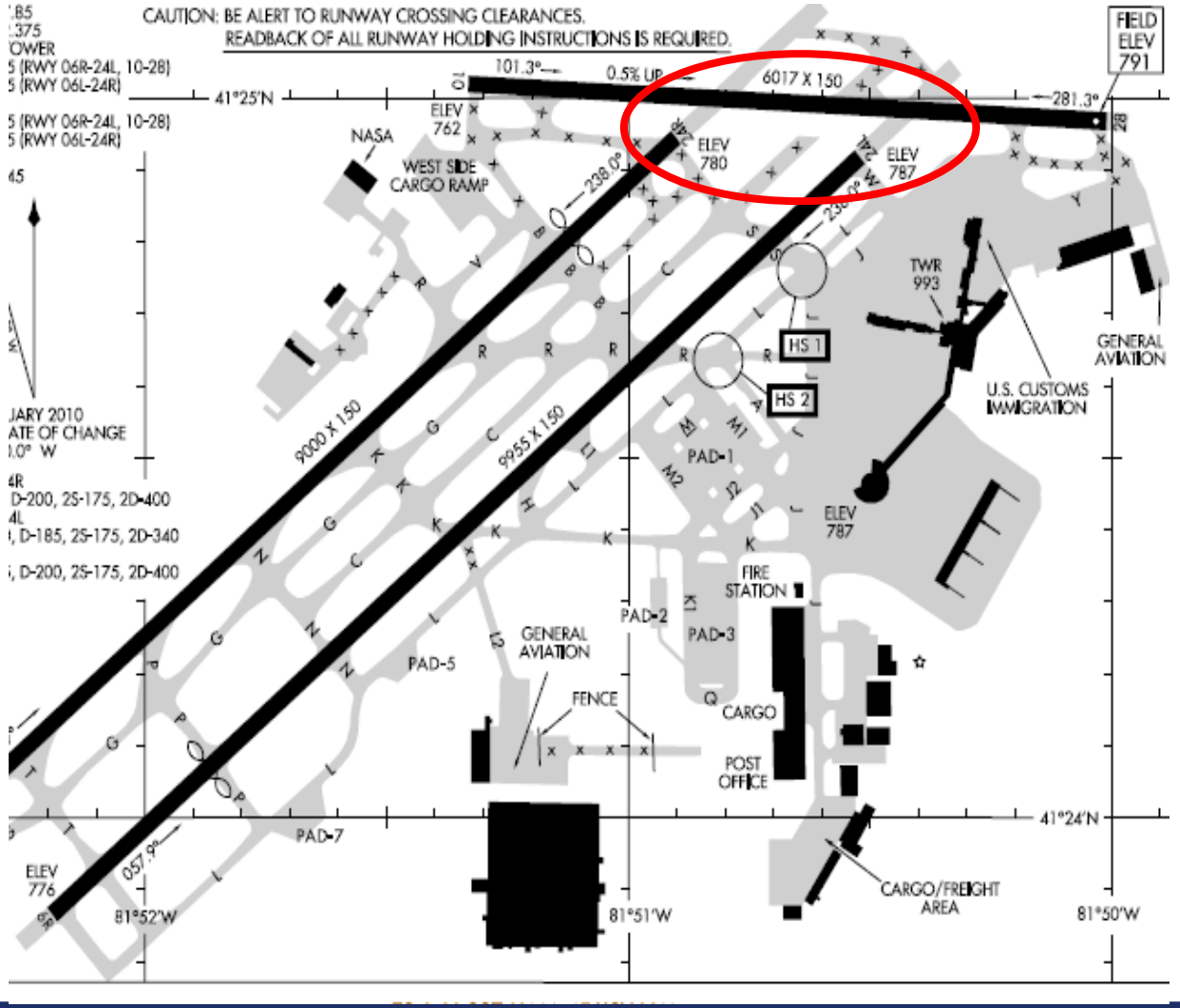


ORD has standard sized font, making the sign much longer than currently allowed in AC

ORD Installation

Cleveland Hopkins International Airport (CLE) R&D Testing Locations

8 signs and 4 markings on runway 10-28 have been changed.



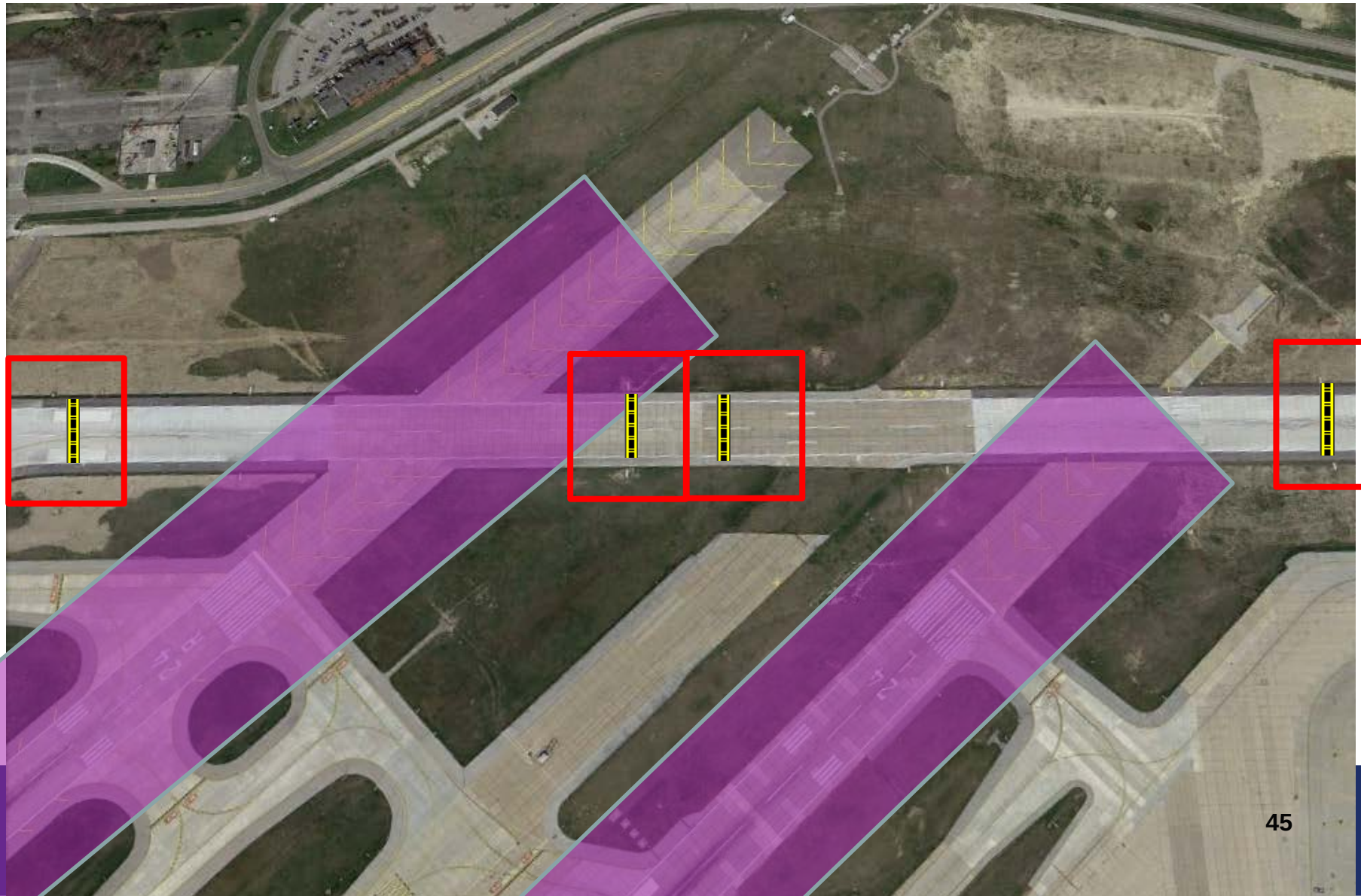
CLE - Signage Prior to R&D Testing

Prior to study, signs protecting the approach/departure surfaces for runways 24L/R and 6L/R (shown below)

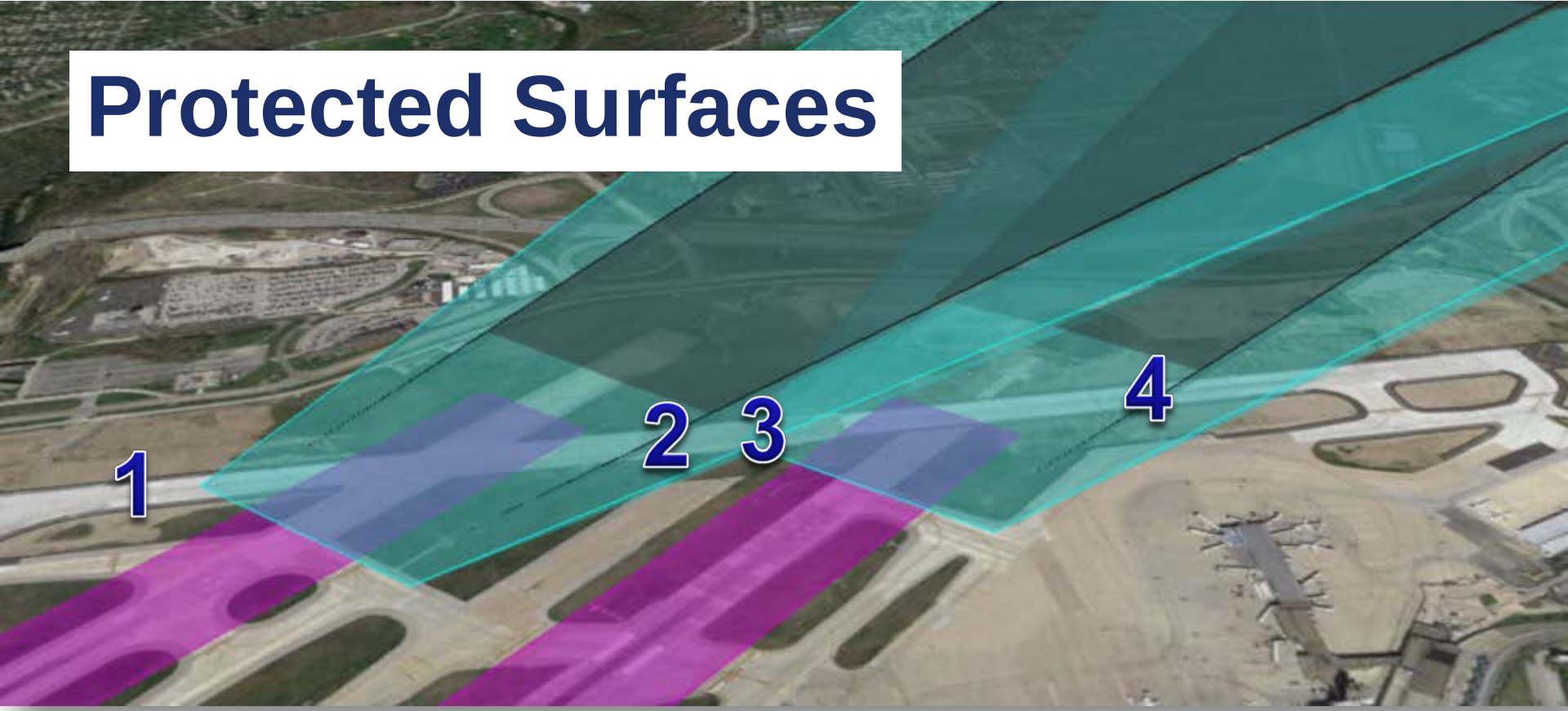
CLE- New Signs/Markings with R&D Testing

CLE has reduced font on standard length (4-mod) sign

New Surface Markings (Not to scale)



Protected Surfaces



RUNWAY SAFETY AREA

DEPARTURE SURFACE

APPROACH SURFACE

New Phraseology - Examples

If an aircraft is landing:

If an aircraft is departing:

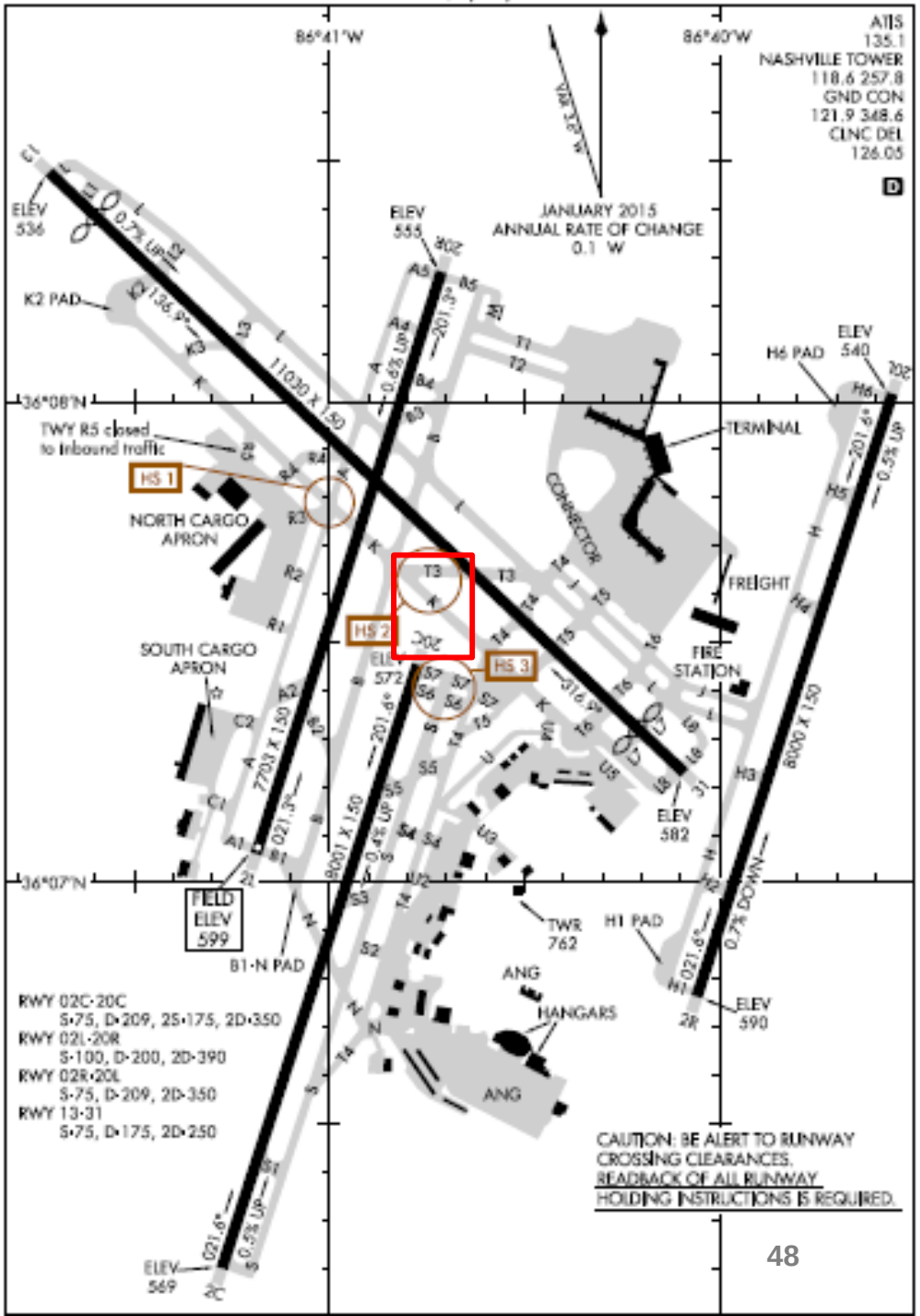
"Hold Short Runway 24L Approach."

or

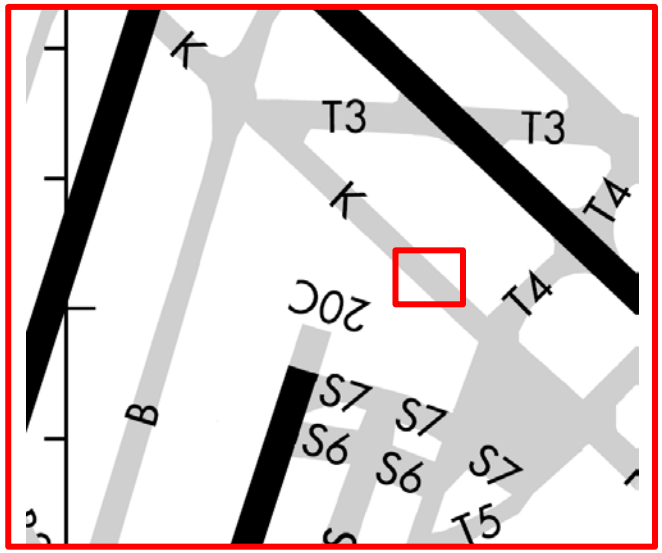
"Hold Short Runway 6R Departure."

Nashville International Airport (BNA) R&D Testing Locations

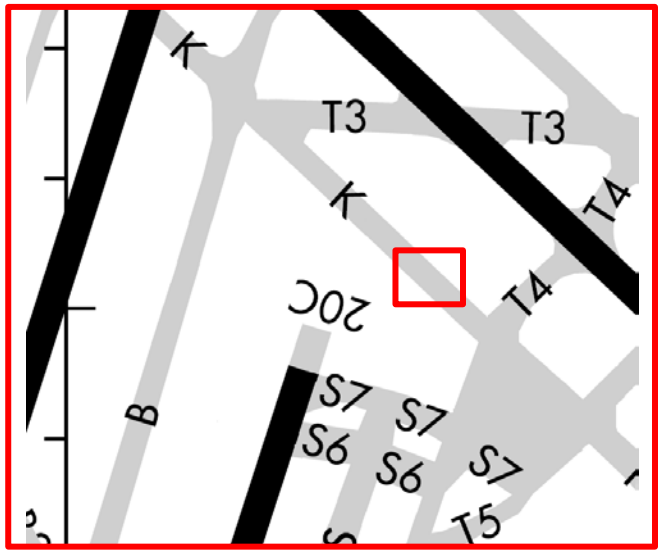
Holding position signs and surface markings protecting the approach/departure surfaces for RWY 2C-20C will be modified for this evaluation.



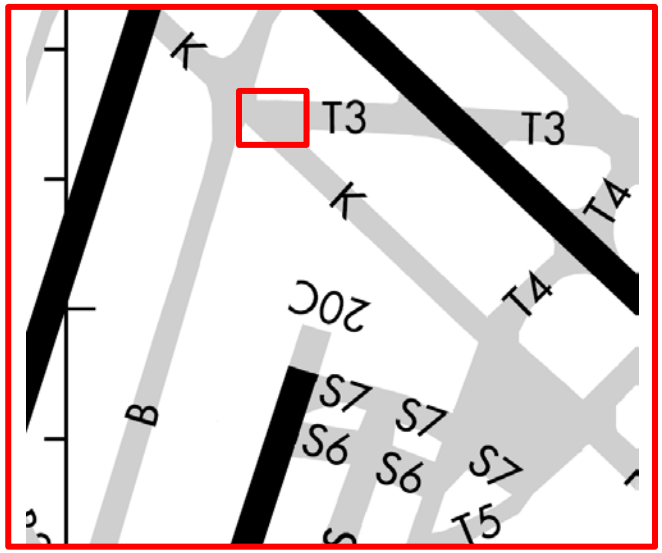
Existing Sign and Surface Marking – TWY K



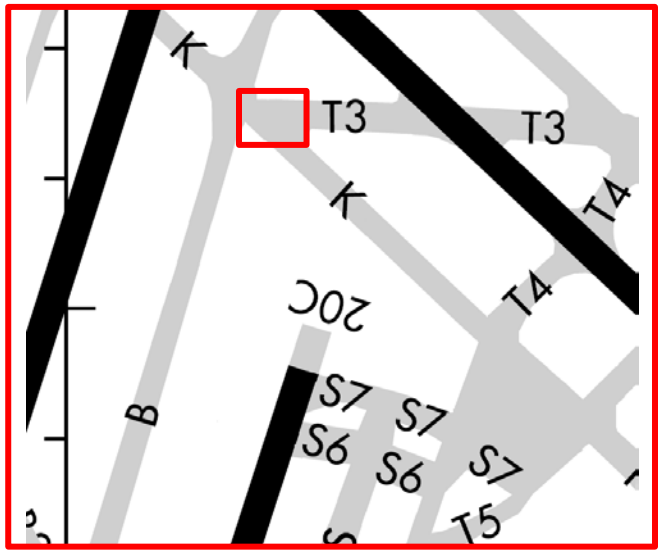
New Sign and Surface Marking – TWY K



Existing Signage and Marking – TWY T3/K Intersection



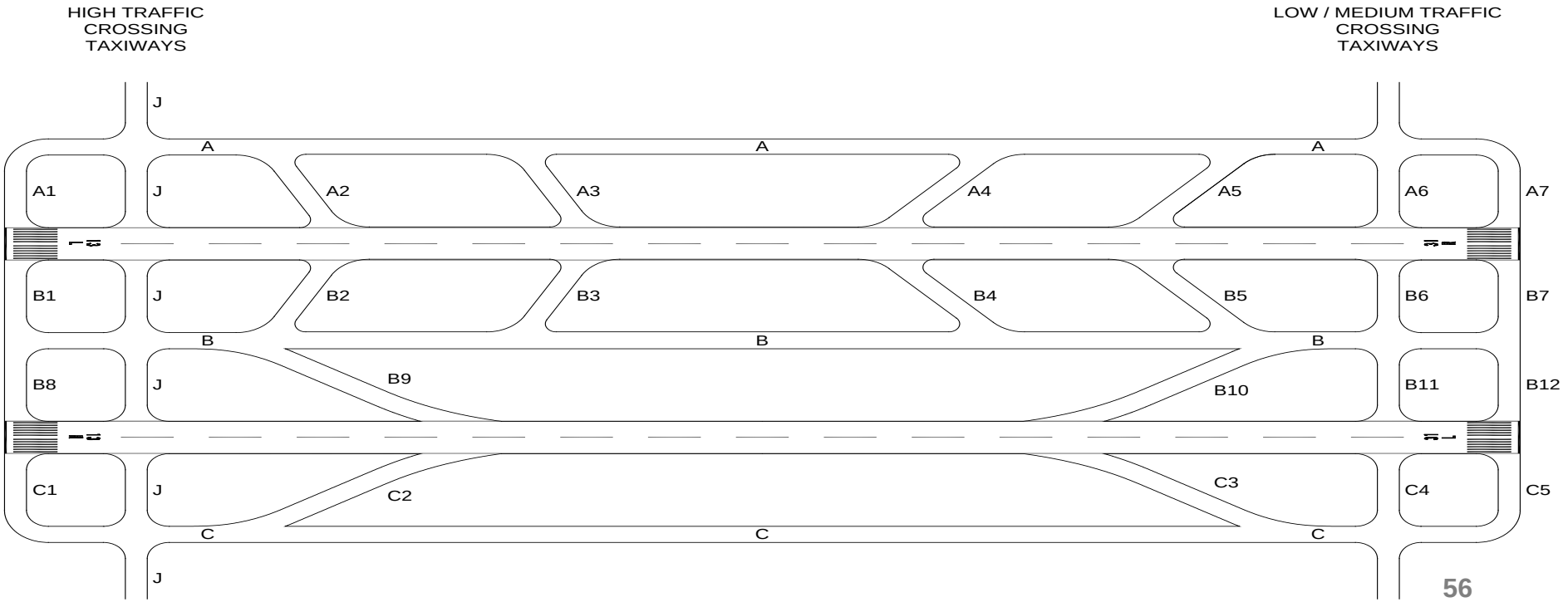
New Signage and Marking – TWY T3/K Intersection



Examples of New Signs

CONTENTS

EB 89- Taxiway Naming Standards



EB 89- Taxiway Naming Standards

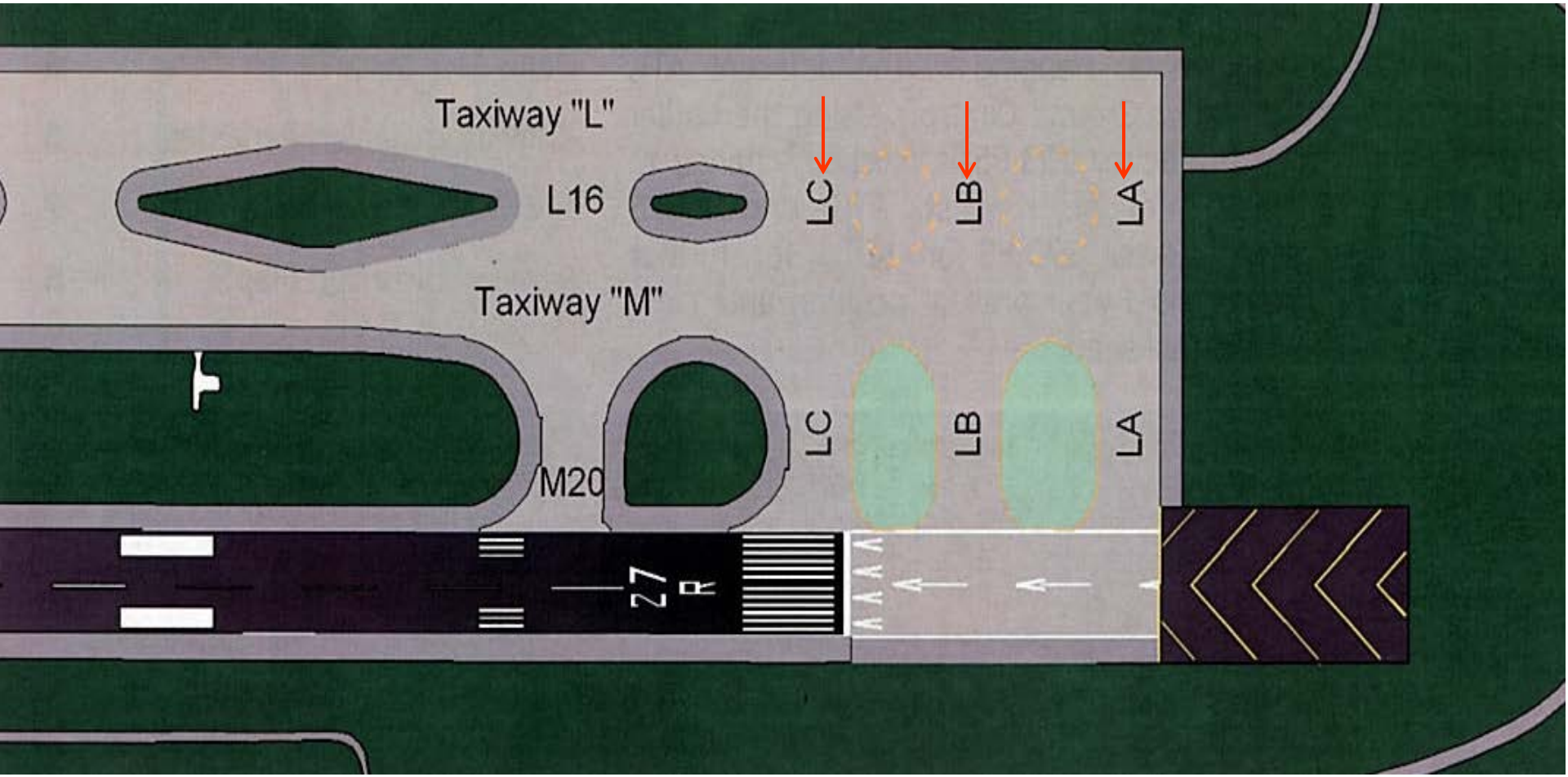
d. After all available single alphabet letters have been utilized, then designate taxiways with double-same alphabet letters (for example, AA, BB, …, ZZ). Double-different alphabet letters (e.g., AB, CD,…. ZW) taxiway designations are not allowed.


BB
CC


A8
AA

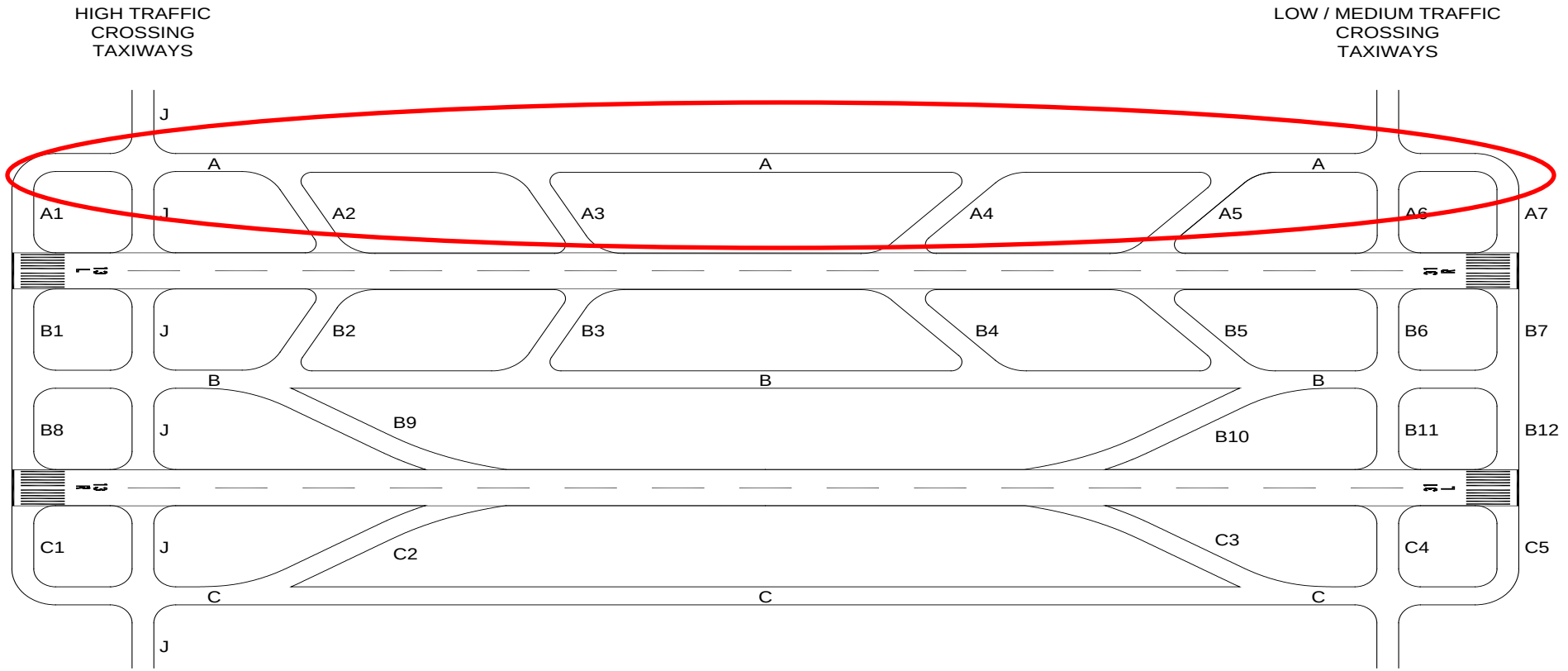
Double-different

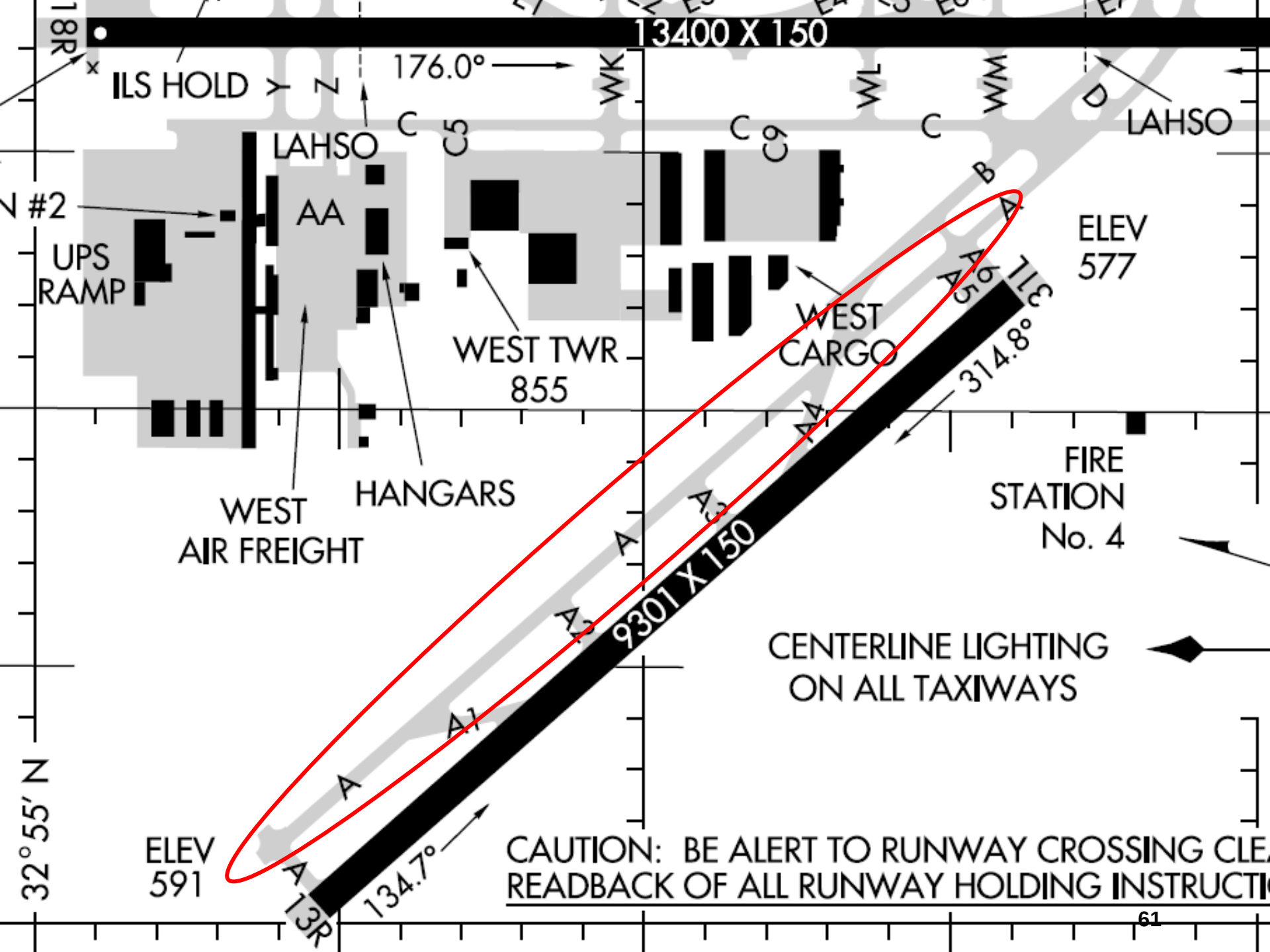
not allowed



EB 89- Taxiway Naming Standards

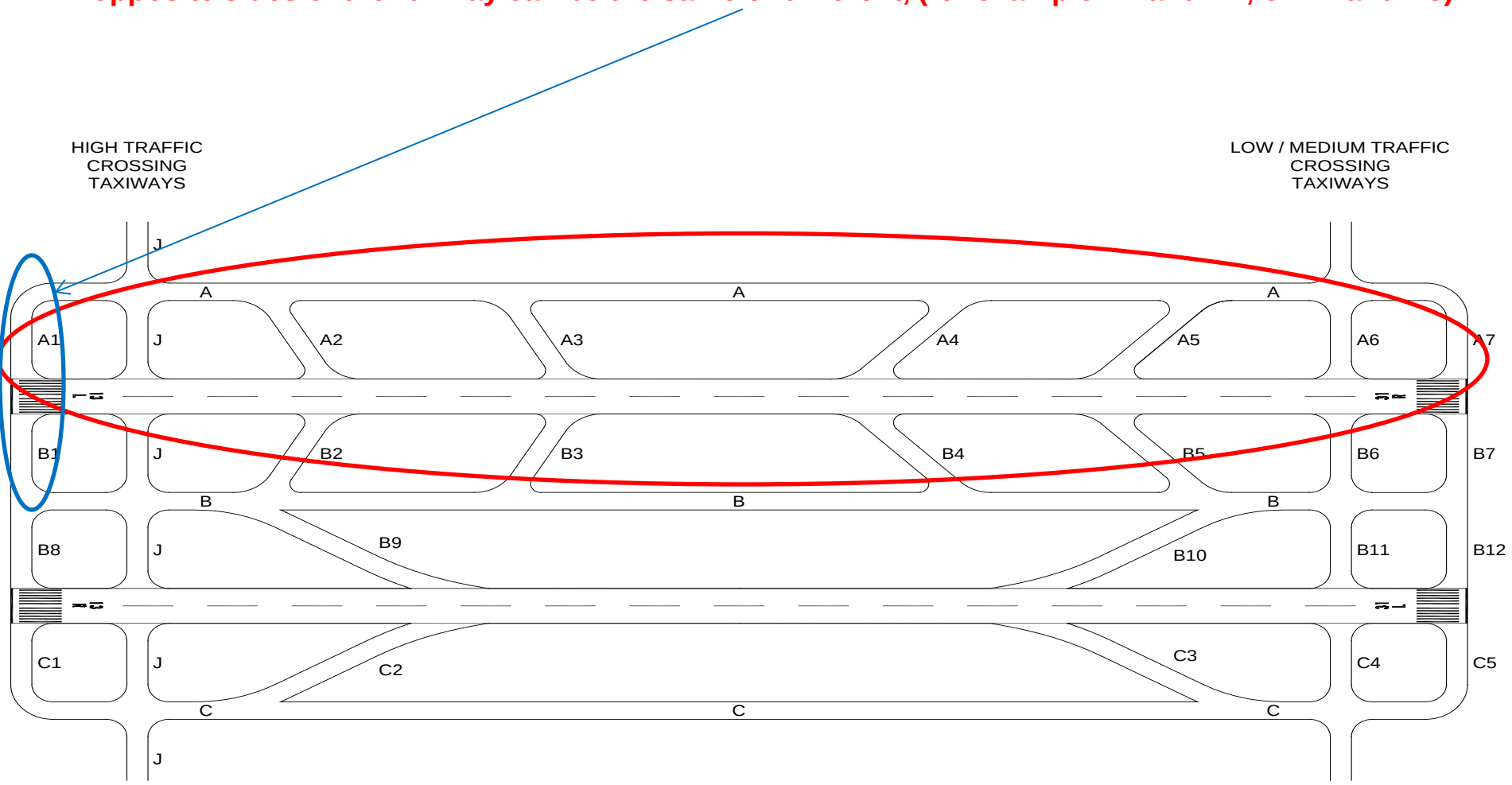
e.(2) For a runway with a parallel taxiway, the entrance and exit taxiways located at the ends and along the runway must use alphanumeric designators and follow an increasing, sequentially numbered pattern from one runway end to the other runway end, such as A1, A2, …., A5.



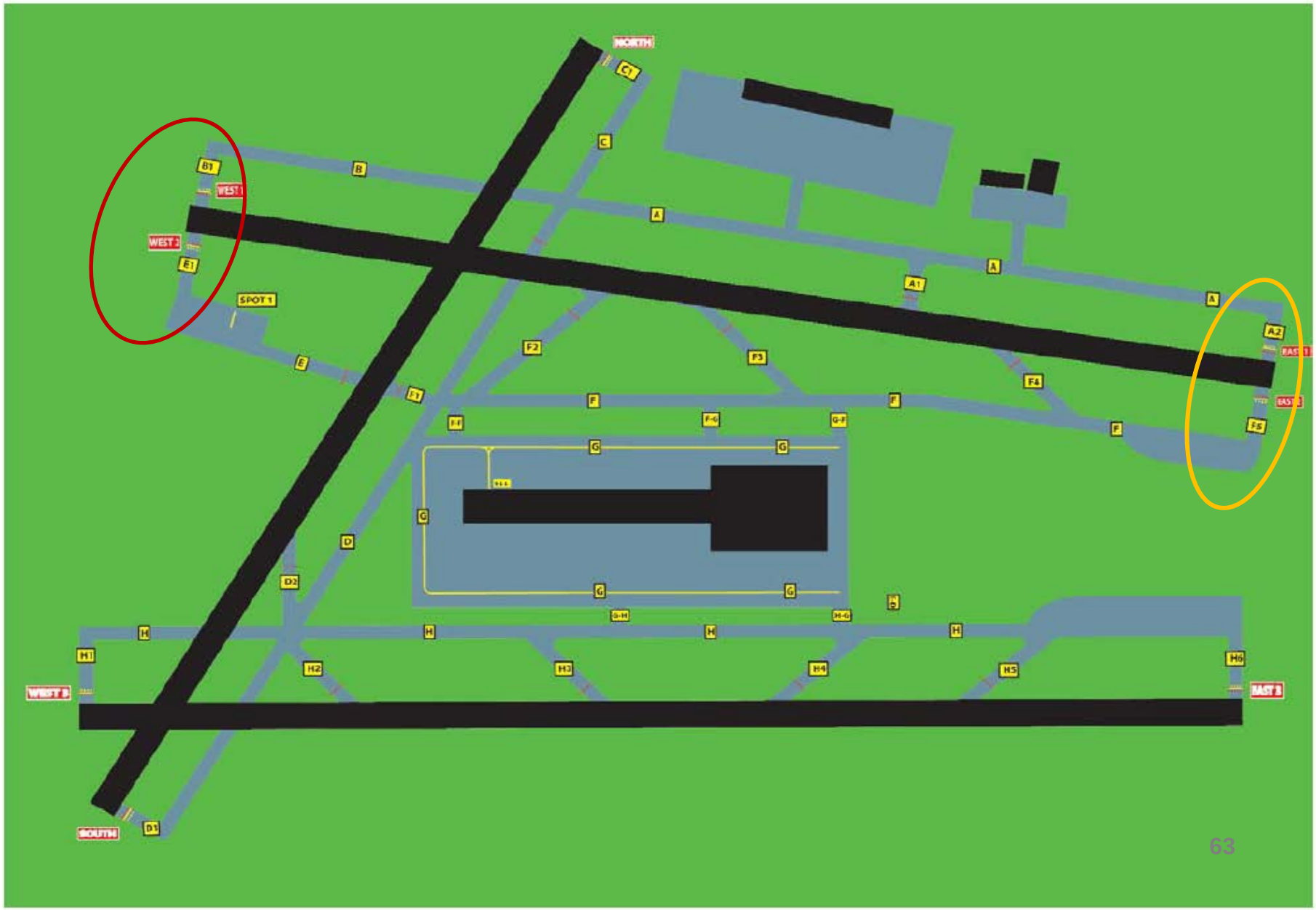

13400 X 150
ILS HOLD
176.0°
LAHSO
LAHSO
LAHSO
N #2
UPS
RAMP
AA
C5
C9
WK
WL
WM
D
B
A
ELEV
577
WEST
CARGO
WEST TWR
855
HANGARS
WEST
AIR FREIGHT
FIRE
STATION
No. 4
9301 X 150
314.8°
134.7°
CENTERLINE LIGHTING
ON ALL TAXIWAYS
ELEV
591
32° 55′ N
CAUTION: BE ALERT TO RUNWAY CROSSING CLEA
READBACK OF ALL RUNWAY HOLDING INSTRUCTI

EB 89- Taxiway Naming Standards

e.(3) For a runway with parallel taxiways on opposite sides of the runway, entrance taxiways at the same runway end must use their respective parallel taxiway's single alphabet designation with the addition of a numeric designation, such as A1 and B1. In this situation, the numeric designation on opposite sides of the runway can be the same or different, (for example A1 and B1, or A1 and B5).



IFALPA Taxiway designation system



AC 5340-18G Draft, Standards for Airport Sign Systems-Principal Changes

- Introduce new “Approach” signs
- In corporate EB 89, Clarifications of Taxiway Nomenclature
- Introduce new “Orange” Construction signs
- Update drawings

Draft AC 5340-18G- New Proposed “Orange Construction” Signs

Figure 13. Construction Ahead Signs

Figure 14. Construction on Ramp

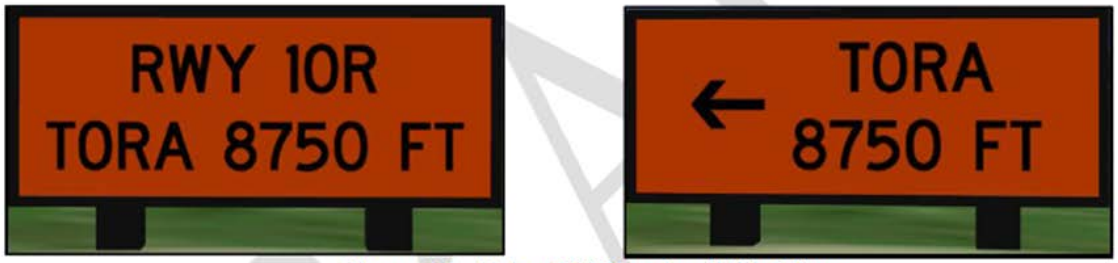


Figure 15. Take-Off Run Available Signs

FAA AIRFIELD LED LIGHTING

Phasing out Incandescent Lamps

- The Energy Independence and Security Act of 2007 (formerly Clean Energy Act of 2007)
  - Begins to phase out incandescent lamps that produce 310-2600 lumens of light between 2012 & 2014 unless they can meet energy efficiency standards mandated by the 2007 Act.
  - Directs DOE within five years to create an LED replacement for the 60-W incandescent light and PAR Type 38 halogen light

LED's in US

- LED technology was first used in airfield lighting in 1999 for elevated taxiway edge
- Applications for medium and high intensity runway lighting first appeared between 2009-2010 timeframe
- United States- Top 75 commercial airports*
  - — All 75 airports have LED airfield lighting products
- 25% of runways in the top 20* airports have LED fixtures
- 50% of taxiways in the top 20* airports have LED fixtures

Based on FAA Airport Ranking of CY2013 (Source ADB)

LED's in US & Internationals

- United States:
  - All LED airfield products from all manufacturers: 700,000 to 800,000 fixtures
- Worldwide Total:
  - All LED airfield products from all manufacturers: 1,000,000 to 1,300,000 fixtures
- These numbers do not include:
  - LEDs fixtures in production
  - LEDs fixtures in the process of being installed
  - LEDs fixtures in the design phase

Source ADB

LED International

- Sample of airports outside the United States

with a large percentage of LED fixtures

— Amsterdam (Schiphol)
— Brussels
— Changi (Singapore)
— Dubai
— Frankfurt
— Heathrow
— Paris (CDG)
— Abu Dhabi *[In Process]*

- It is mandated in Australia to reduce green house

gases emissions considerably by 2020 and for this reason most airports are going to LED

Source ADB

Why LEDs?

- Longer lifetime
- Reduced maintenance time and cost
- Reduced energy consumption
- Better quality light output
- Intrinsically safe - low voltage
- Greater durability- no filament to break
- Higher reliability
- Economic benefits
- Safety benefits

Some LED Safety Benefits

- Color shift

— Current airfield lighting fixtures are known to color shift due to the tungsten halogen lamp and color filter at different intensity steps; and wide angles

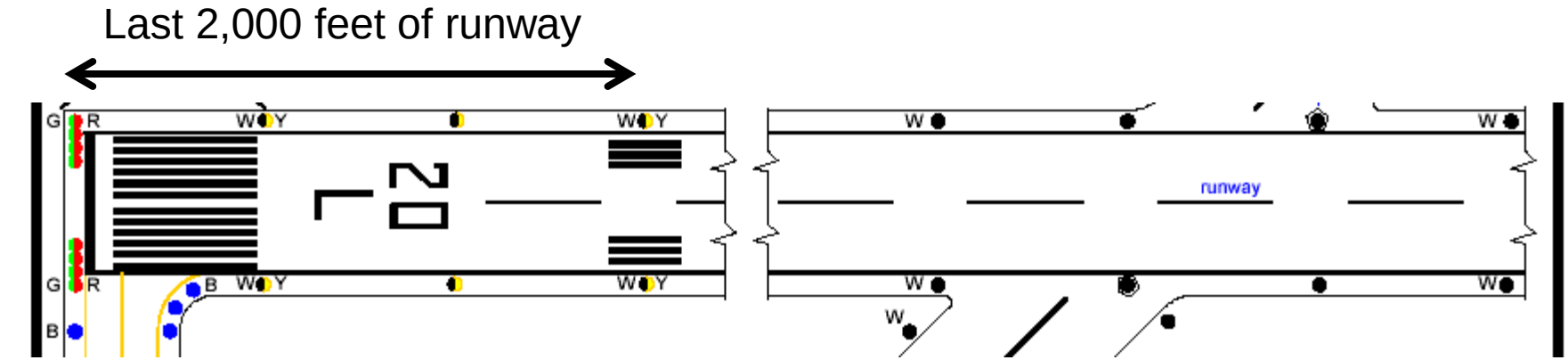
— LEDs effectively stay the same color at different intensities and wide angles

- LEDs improve safety due to better pilot recognition

LED Safety Benefits- No Color Shift

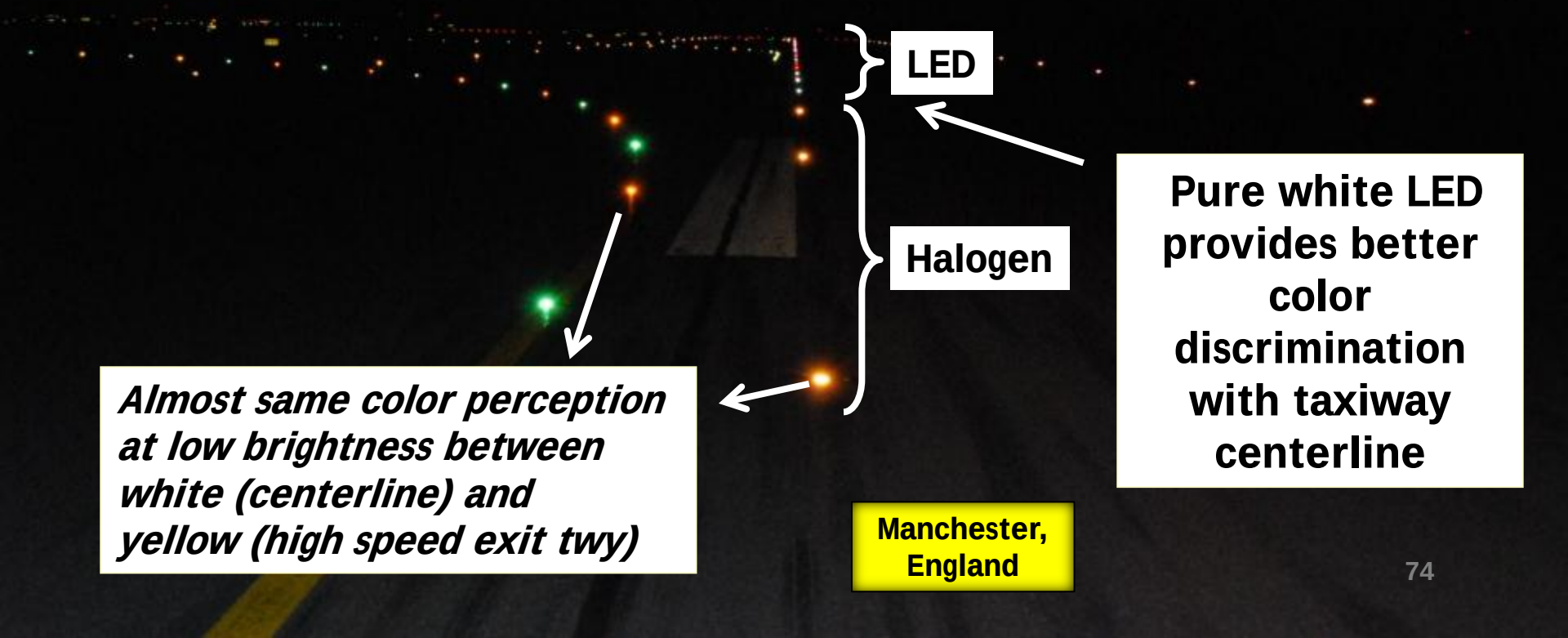
- White incandescent fixtures have a “yellowish” appearance at lower CCR steps
- Use of white LED on runway edge maximizes discrimination of runway caution zone (Yellow) information

White/Yellow in the Caution zone

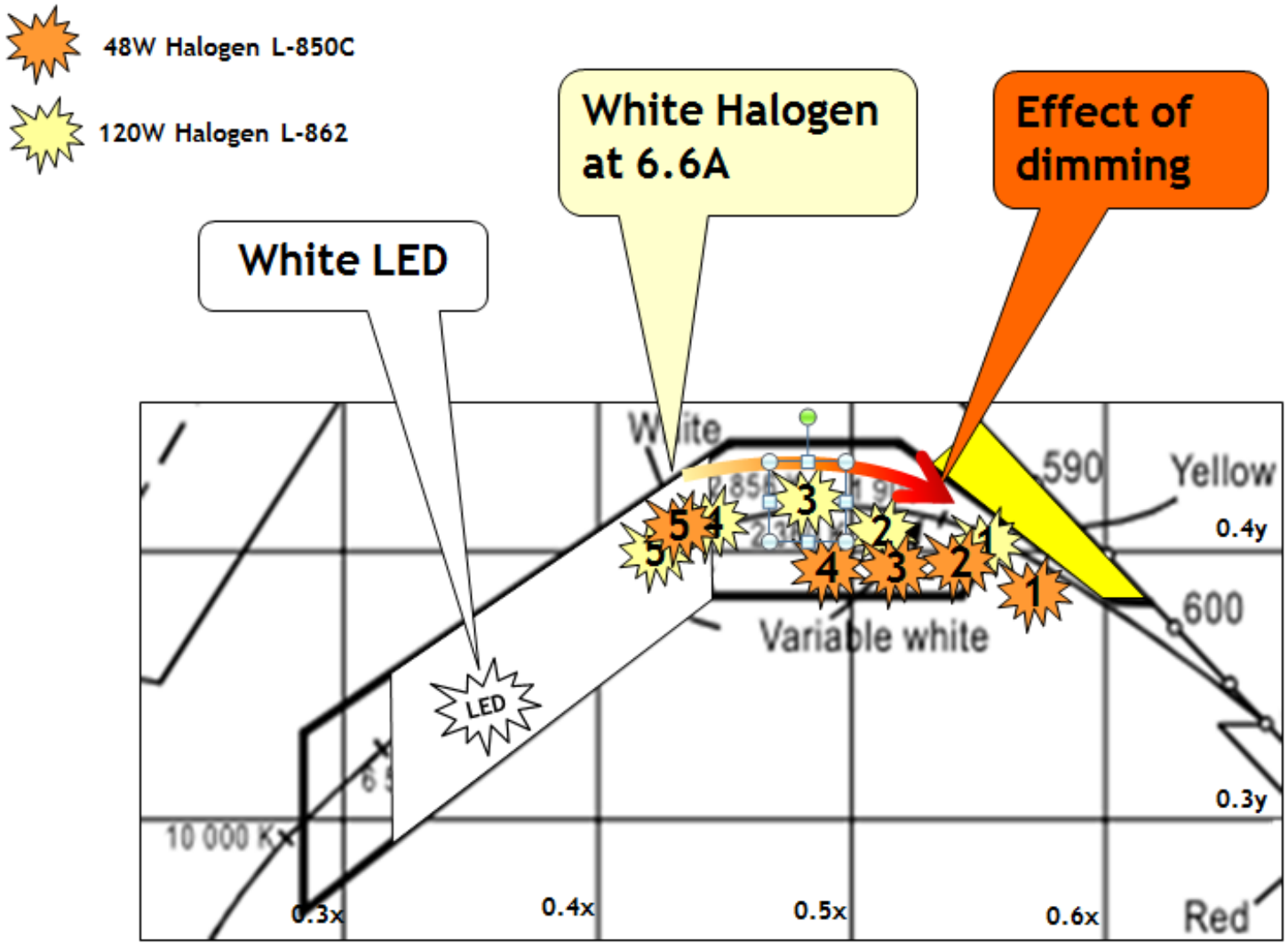


LED Safety Benefits- No Color Shift

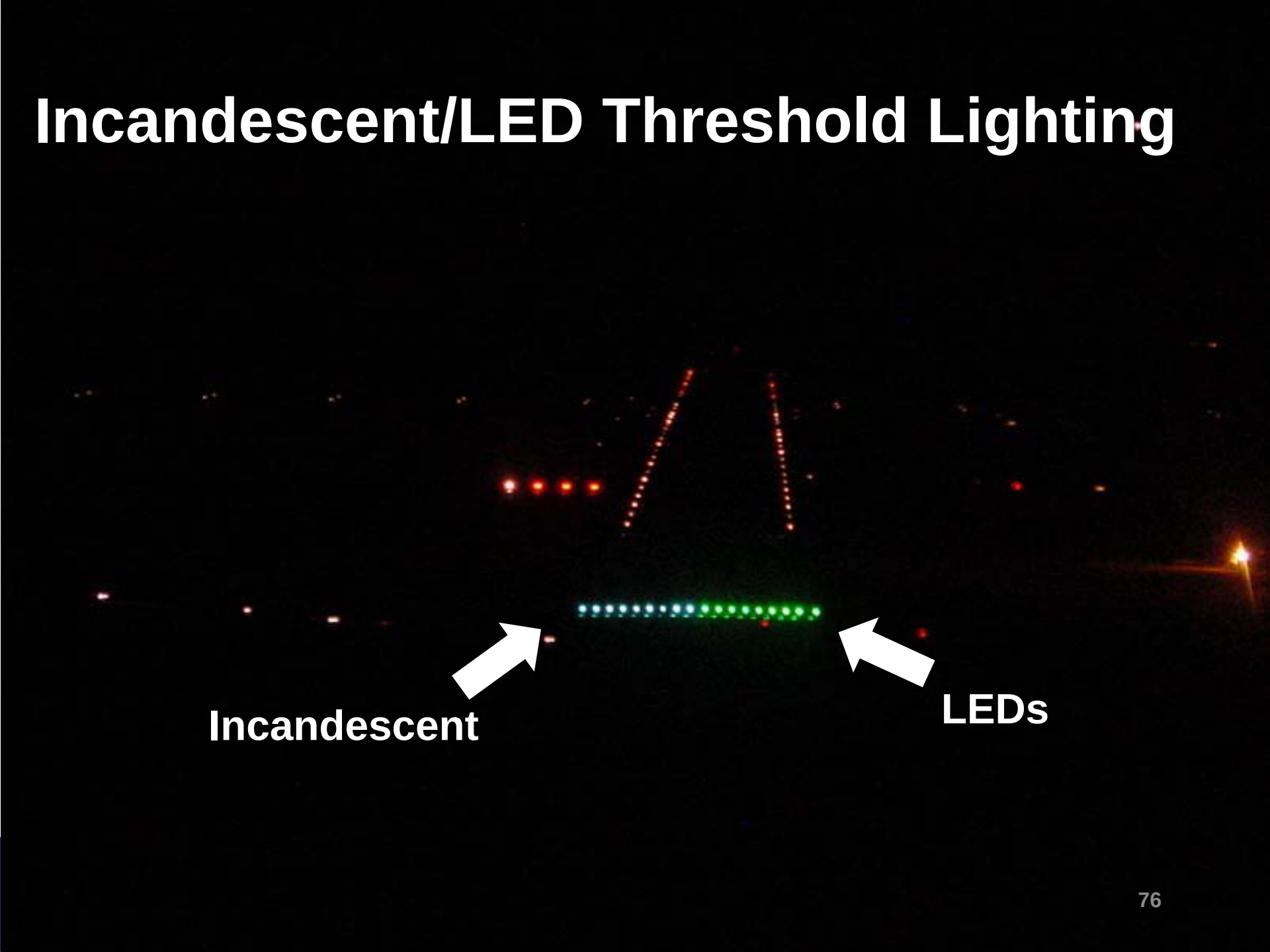
- **In this example, LED runway centerlines would provide better color discrimination from the yellow high-speed turn off lights**



White LED vs. Halogen



Incandescent/LED Threshold Lighting



Evolution of LEDs in Airfield Lighting Systems

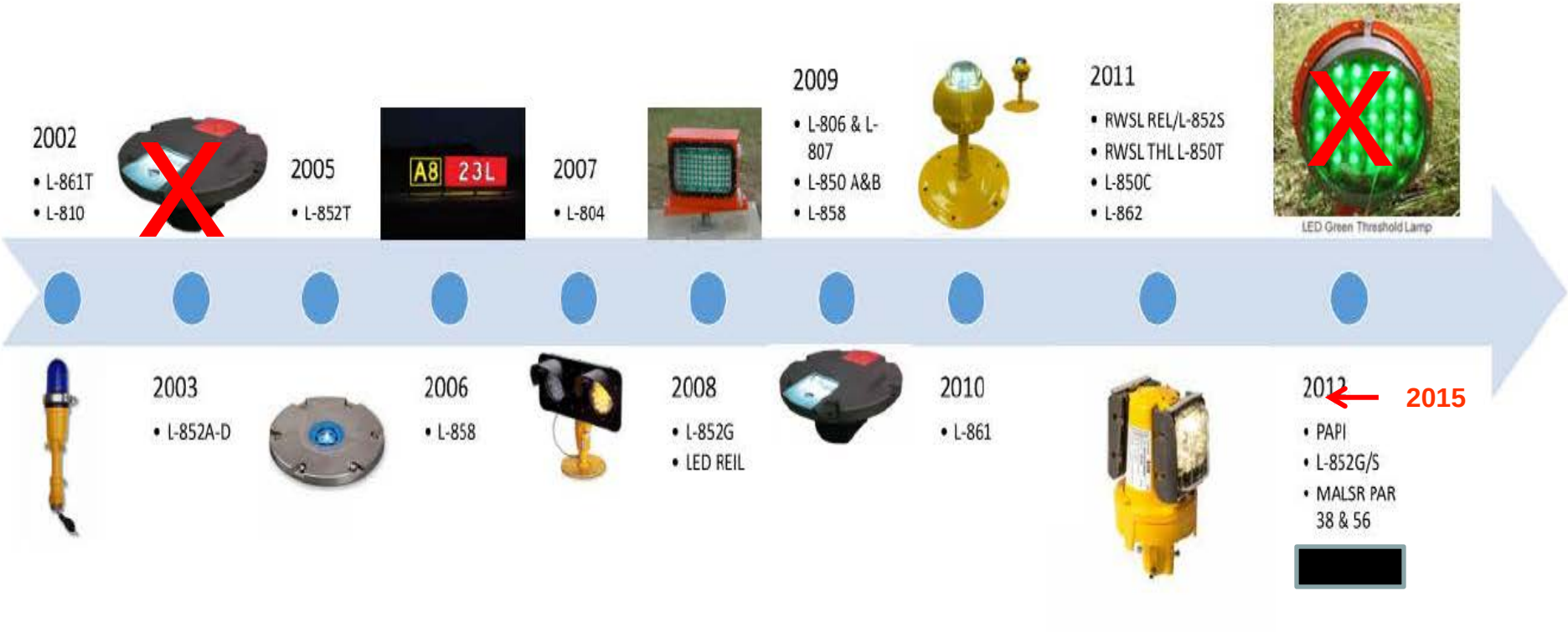


Figure 1. Timeline of FAA Approval for LED Fixtures

Source: ACRP 09-09 Draft Report

FAA Airfield LED Lighting Applicable Document

- **Engineering Brief (EB) No 67 “Light Sources Other Than Incandescent and Xenon For Airport and Obstruction Lighting Fixtures”**

Memorandum

U.S. Department
of Transportation

**Federal Aviation
Administration**

Subject:	**INFORMATION:** Engineering Brief No.67D Light Sources Other Than Incandescent and Xenon For Airport and Obstruction Lighting Fixtures	Date:	March 6, 2012
From:	Manager, Airport Engineering Division, AAS-100	Reply to Attn. of:	
To:	All Regions Attn: Manager, Airports Division		

Engineering Brief No.67D provides additional requirements for light sources other than incandescent and xenon technologies subject to certification under Advisory Circular (AC) 150/5345-53, *Airport Lighting Equipment Certification Program*, and other applicable documents as required. It includes the required specific test and design requirements for alternative light sources that will be used in certified airfield lighting fixtures. This Engineering Brief ensures these new lighting technologies are seamlessly integrated with existing lighting technologies on the airfield.

Airfield Lighting Equipment Manufacturers employing alternative light sources in equipment certified under AC 150/5345-53 must meet the requirements contained in each applicable AC. The third party certification activity must verify the airfield lighting manufacturers' equipment meets the design and operational provisions as dictated by changing illuminating technology.

John R. Dermody

FAA EB 67 HISTORY

- First certification of LED Obstruction Light in ALECP- Sept 1999
- “FAA Supplemental Performance Requirements for LED Lighting Source” – July 10, 2001
- EB “XX”- Dec 2003 thru Nov 2004
- EB 67 - Nov 4, 2004
- EB 67 – Oct 26, 2005
- EB 67 B - March 12, 2007
- EB 67 C – December 29, 2010
- EB 67 D – March 6, 2012

FAA EB 67D Background Information

- **Purpose Statement from EB 67D**

This Engineering Brief provides additional requirements for "Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures" subject to certification under AC 150/5345-53, *Airport Lighting Equipment Certification Program*, and/or other applicable documents.

- **Background Statement from EB 67D**

Manufacturers utilizing alternative light sources, such as Cold Cathode, Light Emitting Diodes (LED), fiber optics, etc. in equipment certified under the U.S. Department of Transportation, Federal Aviation Administration, Advisory Circular No. 150/5345-53, must meet the requirements contained in each applicable equipment Advisory Circular. Additionally, the third party certification body must verify that the manufacturer's equipment meets the following design and operational provisions as dictated by changing illumination technology.

FAA EB 67

- Provides additional requirements for “Light Sources Other Than Incandescent and Xenon For Airport and Obstruction Lighting Fixtures”
- Includes the required specific test and design requirements for alternative light sources (includes LEDs) that will be used in 3rd party certified airfield lighting fixtures.
- EB 67 ensures that new lighting technologies are seamlessly integrated with existing lighting technology.
- LED airport lighting manufacturer certified under ALECP must also meet the requirements contained in each applicable ACs

EB 67 EVOLUTION

- AAS-100 has been working with airfield lighting manufacturers & WJHTC Workgroup.
- Coordinated/Identified/Developed additional design requirements specific to LED and other alternate light sources (e.g. cold cathode, gas discharge, electroluminescent).
  - Consensus between FAA and manufacturers for LED requirements developed
- Prepared EB 67 separately from AC 150/5345-46, Runway & Taxiway Lighting Fixtures, and AC 150/5345-43, Specification for Obstruction Lighting Equipment, to facilitate addressing the rapid evolution of LEDs without changing AC.

EB 67 D- PRINCIPAL CHANGES

- **Intensity ratio (1.0)**
- **Colors (2.1)**
- LED High Temperature (2.2)
- Power Factor (2.5 and 2.5.1)
- Accelerated Life / LED junction temperature (2.4)
- C2 Surge (2.12)
- Arctic Kit (2.13)
- Flicker (2.15)
- Warranty (4.1)
- “L” Suffix (5.0)

Photometric Requirements

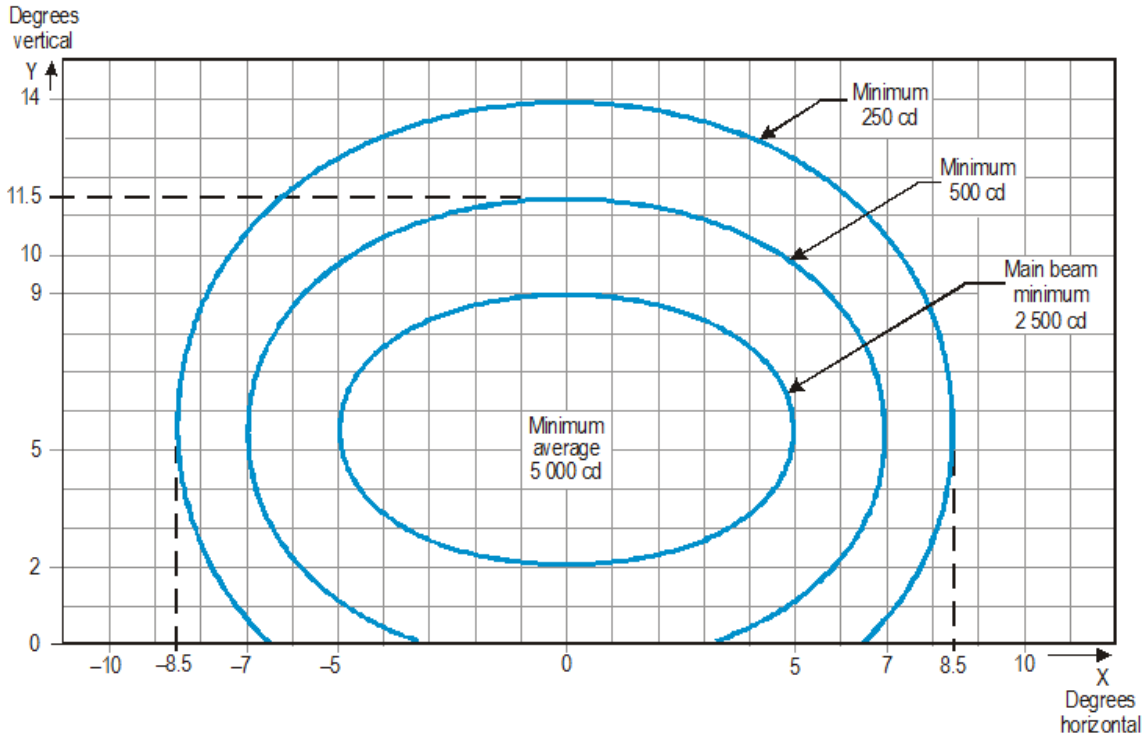
- FAA Advisory Circular AC 150/5345-46D (May 2009)
- ICAO Annex 14, Volume 1, sixth edition (July 2013)
- FAA Engineering Brief 67D (March 2012)

AC 5345-46D

Table 1. Photometric Requirements for In-pavement Lights.

Type	Minimum beam coverage (degrees) (a)				Intensity (candelas) (b)				
	Main beam (c)		10 percent (d)						
	H	V	H	V	White	Yellow	Green	Red	Blue
L-850A	±5	0.2 to 9	±7	-4 to 13	5,000			750	
L-850T (g)	±5	0.2 to 9	±7	-4 to 13				1500	
L-850B (i)	-1 to 9	2 to 9	-3 to 11	-0.5 to 11.5	5,000				
L-850C	-2 to 9	0.2 to 7	-4 to 11	-2.5 to 9.5	10,000	5,000	3,300	1,500	
L-850D	-2 to 9	1 to 10					3,300		
	±6	0.2 to 4.7	±7.5	-2.5 to 7.5				2,500	
L-850E	±6	1 to 9					5,000		
L-850F	±5	0.2 to 9	±7	-4 to 13	5,000(e)				

L-850A, CL light
L-850B, TDZ light



Notes:

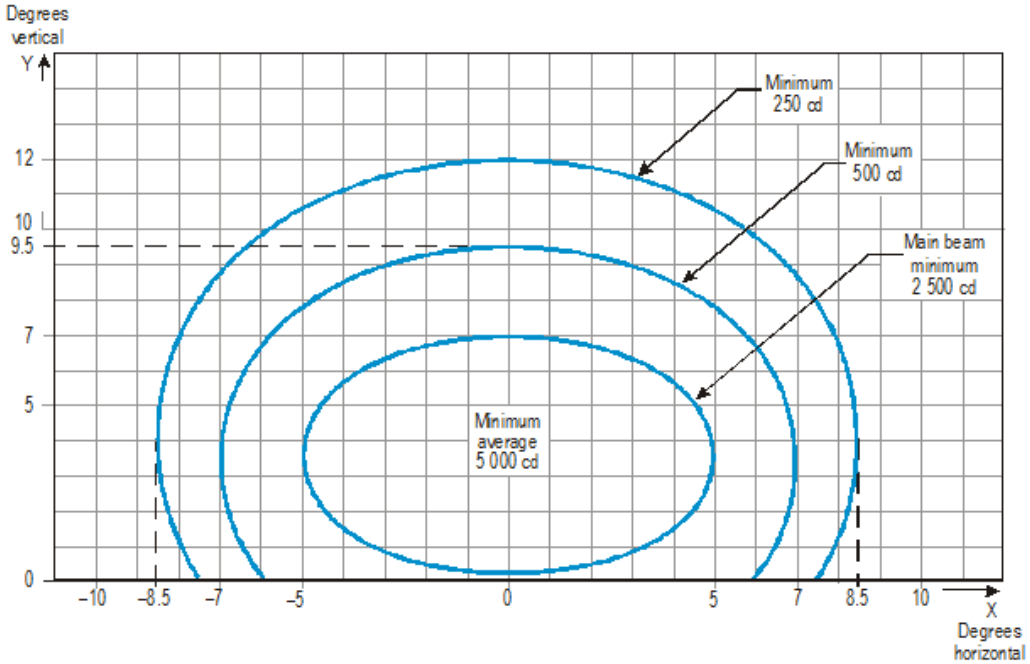
1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. Toe-in 4 degrees

3. See collective notes for Figures A2-1 to A2-11.

Figure A2-5. Isocandela diagram for touchdown zone light (white light)



Notes:

1. Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	3.5	6.0	8.5

2. For red light, multiply values by 0.15.
3. For yellow light, multiply values by 0.40.
4. See collective notes for Figures A2-1 to A2-11.

Figure A2-6. Isocandela diagram for runway centre line light with 30 m longitudinal spacing (white light) and rapid exit taxiway indicator light (yellow light)

LIGHT INTENSITY FAA vs. ICAO

Type	Description	FAA (in cd)	ICAO (in cd)
L-850A	Rwy Centerline	5000	5000
L-850B	Rwy TDZ	5000	5000
L-850C	Rwy Edge light	10,000/1500	10,000/2500
L-850D	Rwy Threshold/End light	2500	2500

EB 67D Principal Changes – Intensity Ratios

- Light intensity must vary according to the specified curves
- Two Curves – White and Colored
- Light output must change with input current and must be based on continuous curve
- No discrete step intensity changes
- Detailed relative brightness requirements found in Tables 3 and 4
- Current is measured at primary and secondary
- Primary current is value used for compliance
- Testing must be done with both SCR and sine wave CCRs
- Testing must be done with full and half loaded CCRs

EB 67D Principal Changes-Intensity Ratios

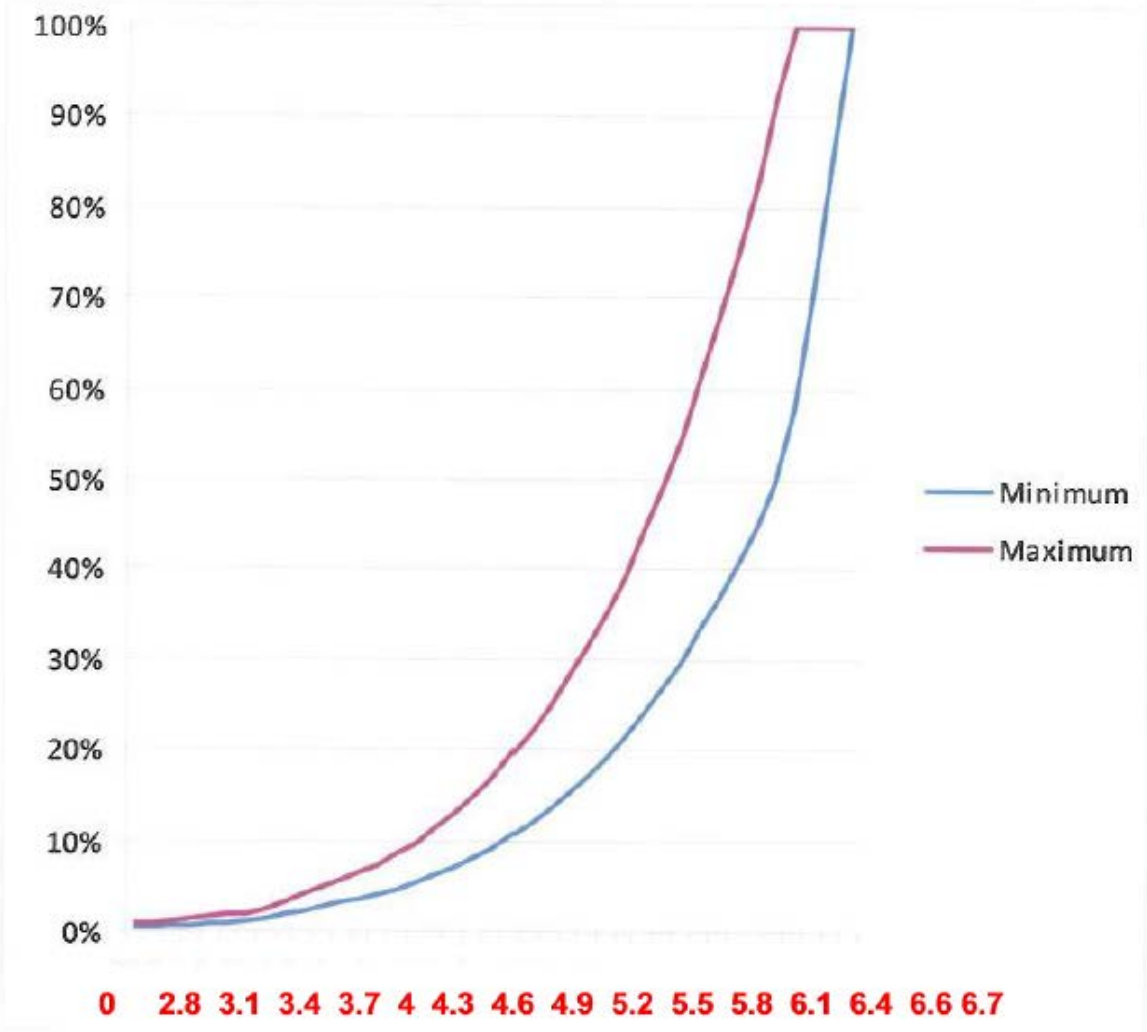


Figure 1: Dimming Curve (Applies To White Light Only)

-Dimming Curve (Applies to White LED Only)

-Table 3 contains requirements in 0.10A increments

LAMP CURRENT	% MINIMUM INTENSITY	% MAXIMUM INTENSITY
6.6	100	n/a
5.5	23.9	44.1
5.2	16.9	31.3
4.8	10.4	19.2
4.1	3.9	7.3
3.4	1.0	2.0
2.8	0.15	0.7

Table 1 (Applies To White Light Only)

EB 67D Principal Changes-Intensity Ratios

Appendix I – Additional Information

Table 3. Detailed Version of Table 1 (White Light Only)

Current	Minimum	Maximum
2.7	0.15%	0.70%
2.8	0.15%	0.70%
2.9	0.28%	0.92%
3	0.41%	1.14%
3.1	0.54%	1.35%
3.2	0.67%	1.57%
3.3	0.80%	1.78%
3.4	1.00%	2.10%
3.5	1.36%	2.75%
3.6	1.79%	3.50%
3.7	2.22%	4.25%
3.8	2.65%	5.00%
3.9	3.08%	5.75%
4	3.51%	6.50%
4.1	3.94%	7.35%
4.2	4.57%	8.45%
4.3	5.28%	9.76%
4.4	6.08%	11.23%
4.5	6.98%	12.89%
4.6	7.99%	14.75%
4.7	9.11%	16.83%
4.8	10.37%	19.15%
4.9	11.76%	21.73%
5	13.31%	24.59%

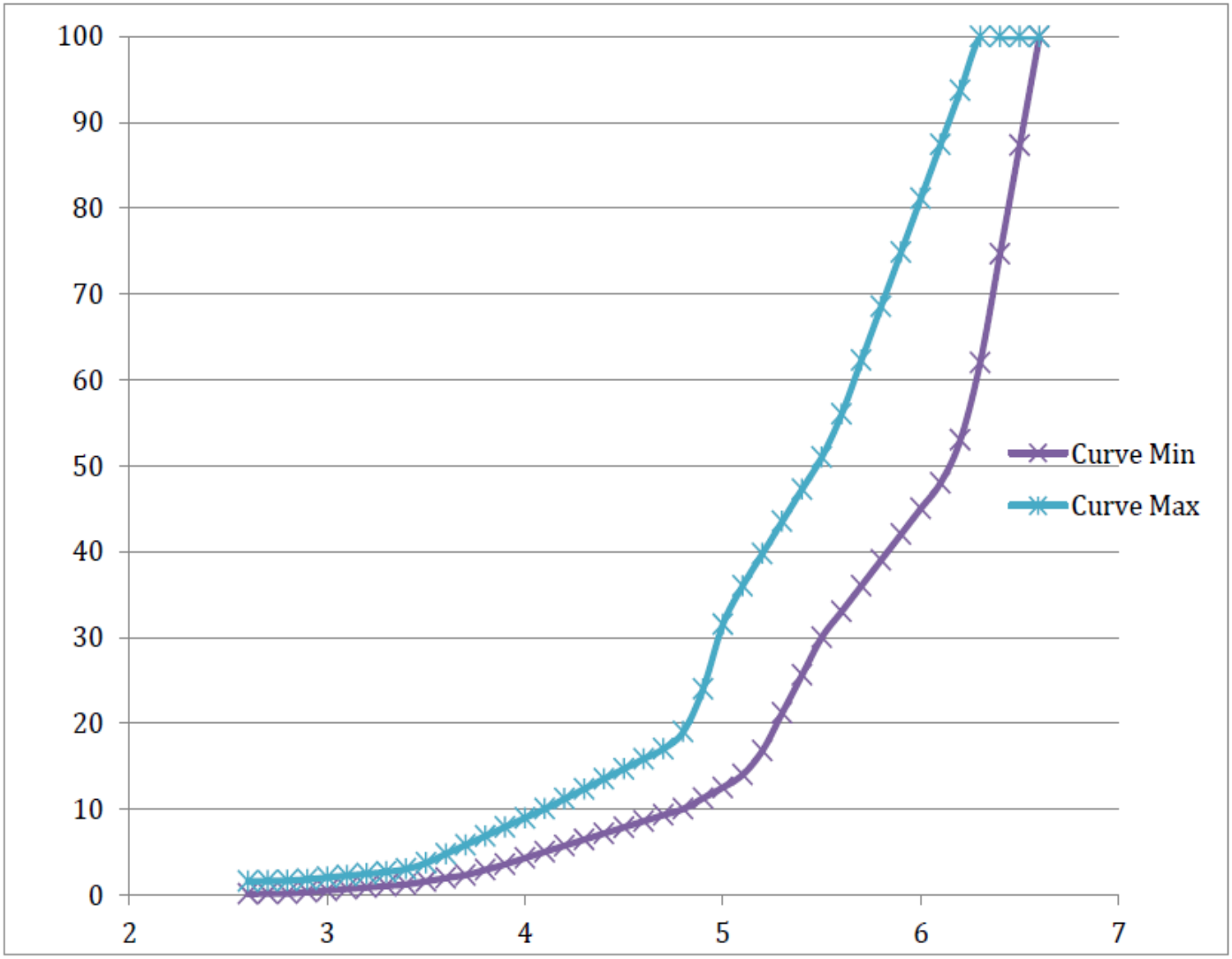


Figure 2. **Detailed Current/intensity Graph of Figure 2 for LED Light Colors Blue, Red, Green, and Yellow**

EB 67D Principal Changes – Intensity Ratios

-Detailed current/intensity graph for LED light colors of Blue, Red, Green, and Yellow

-Table 4 contains requirements in 0.10A increments

LAMP CURRENT	% MINIMUM INTENSITY	% MAXIMUM INTENSITY
6.6	100	n/a
5.5	30.0	51.0
5.2	16.8	39.75
4.8	10.0	19.0
4.1	5.0	10.0
3.4	1.2	3.0
2.8	0.15	1.65

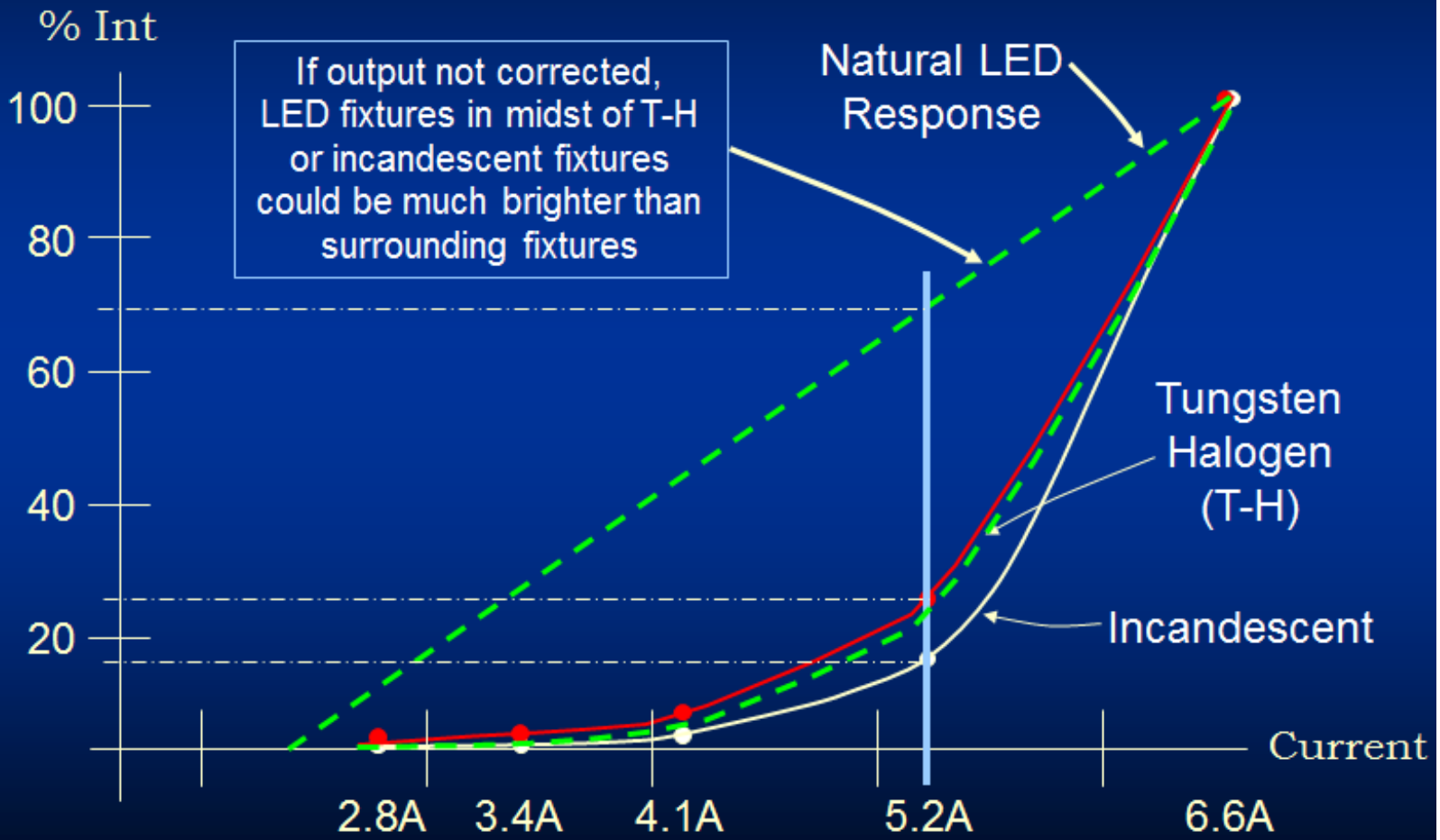
Table 2. Applies To Colored Light Only (see Appendix 1 for detailed table)

Table 4. Detailed current/intensity for color LEDs

		Curves	
Step	I(A)	Dmin(%)	Dmax(%)
	2.7	0.13	1.6
B1	2.8	**0.15**	**1.65**
	2.9	0.33	1.8
	3	0.5	2.01
	3.1	0.68	2.23
	3.2	0.85	2.44
	3.3	1.03	2.65
B2	3.4	**1.2**	**3**
	3.5	1.57	3.7
	3.6	1.93	4.75
	3.7	2.3	5.8
	3.8	2.9	6.85
	3.9	3.55	7.9
	4	4.28	8.95
B3	4.1	**5**	**10**
	4.2	5.71	11.17
	4.3	6.43	12.33
	4.4	7.14	13.5
	4.5	7.86	14.67
	4.6	8.57	15.83
	4.7	9.29	17
B10	4.8	**10**	**19**
	4.9	11.25	24
	5	12.5	31.5
	5.1	14	36
B4	5.2	**16.8**	**39.75**
	5.3	21.2	43.5
	5.4	25.6	47.25
B30	5.5	**30**	**51**
	5.6	33	56
	5.7	36	62.29
	5.8	39	68.57
	5.9	42	74.86
	6	45	81.14

Use of LED L-861T if corrected output not implemented

See Eng Brief 67 Par 1.0



LED Brightness Resolution-Summary

- **LED Runway Lighting System**
- **LED Taxiway Lighting System**

LED Brightness Resolution-
LED Runway Lighting System

- **Combined manufacturer/WJHTC recommendations resulted in re-defining intensity curves in EB 67 for LEDs (current vs. out intensity).**
- **Revised dimming curves (based on lamp current and intensity) for white and color LEDs in FAA Engineering Brief 67D are now standard used for all new LED runway lighting.**
- **The max allowable percentage of White light output:**
  - For the lowest setting (Step 1) was changed from 1.65% to a minimum of 0.15% and maximum 0.7%
  - For step 2, changed from 3.% to minimum of 1% and maximum 2%
- **AC 5340-30H prohibits mixing LED and incandescent technologies on the same lighting system. Interpersing LED light fixtures with incandescent fixtures is also prohibited.**

LED Brightness Resolution-
LED Taxiway Lighting System

- Several airports, including RIC reported brightness issues with LED taxiway centerline lighting system.
- Investigation concluded “Green” twy centerline lighting brightness issues are associated with the airport using a 3-step CCR power source versus a 5-step CCR. 5-step CCR provides more latitude with brightness steps especially when utilizing LED
- We added a “Note” to AC 5340-30H to read “Note: A 5-step CCR is necessary to control LED high intensity lighting systems. This is because a 3-step CCR may not adequately reduce LED intensity at the lowest step…”
- This NOTE recommends 5-step CCR system for retrofitting an existing installation that are problematic.
- The use of 5-step regulator for an LED taxiway centerline lighting system is now the standard for new installations.

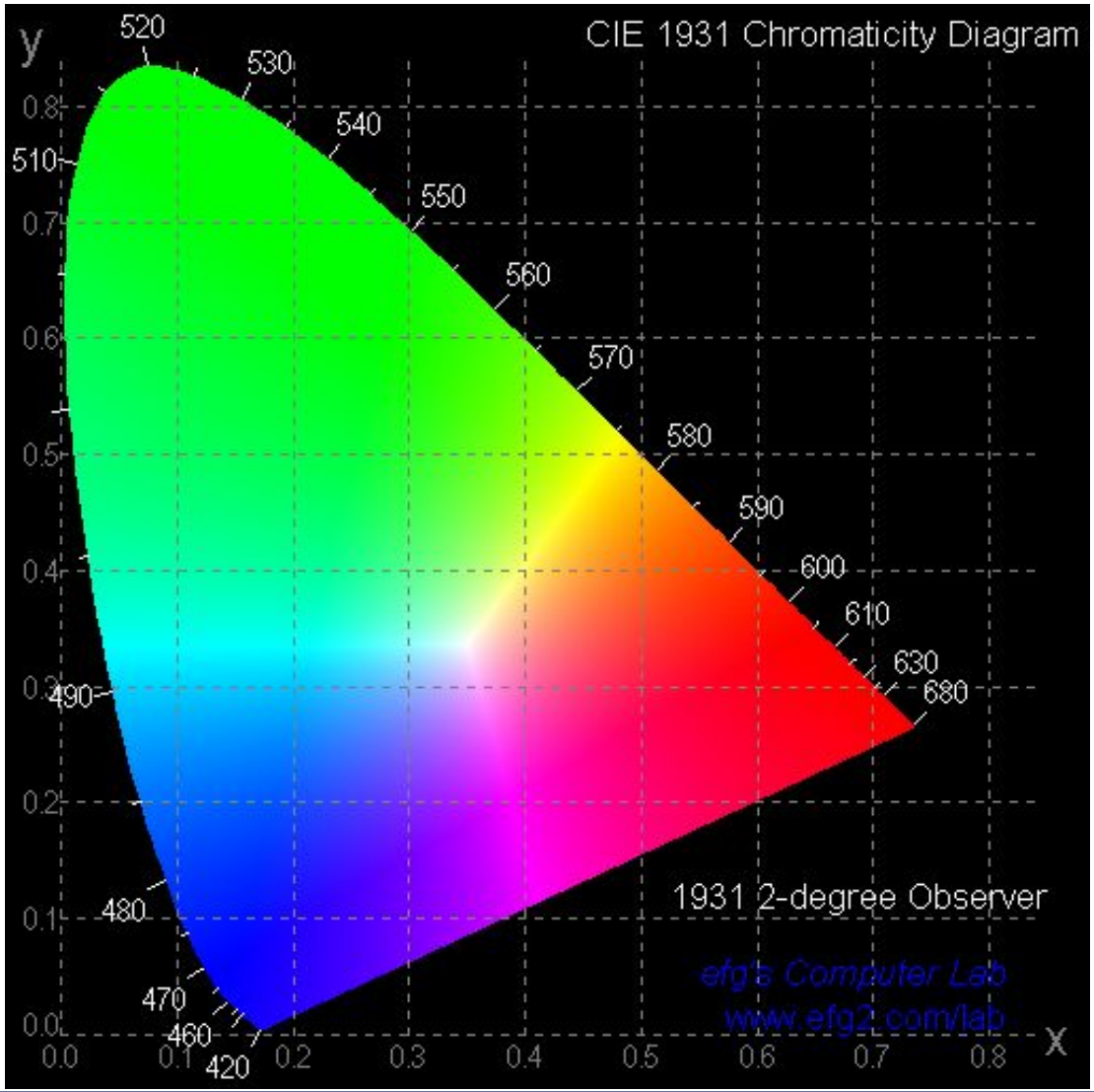
EB 67D Principal Changes - Colors

- Refined a standard white chromaticity range. Boundary intersection points for aviation white LED chromaticity boundaries were added. (CIE coordinates (line equations and boundary limits) for white and color LEDs.)
- Reduced range CIE1931 chromaticity coordinates are used to prevent undesirable color changes within the chromaticity range.
- The objective of defining ranges of chromaticity that are smaller than the AS 25050 spec is to promote better color uniformity when using LEDs. This way, for example, when one looks at green centerline lights, they will all appear to be the same color. Under the old AS 25050 spec. there was sufficient range that different color shades would be readily apparent.
    - Prohibit the mixing LED and incandescent technologies on the same runway or taxiway. Interspersing LED fixtures with incandescent is also prohibit. (AC 150/5340-30)

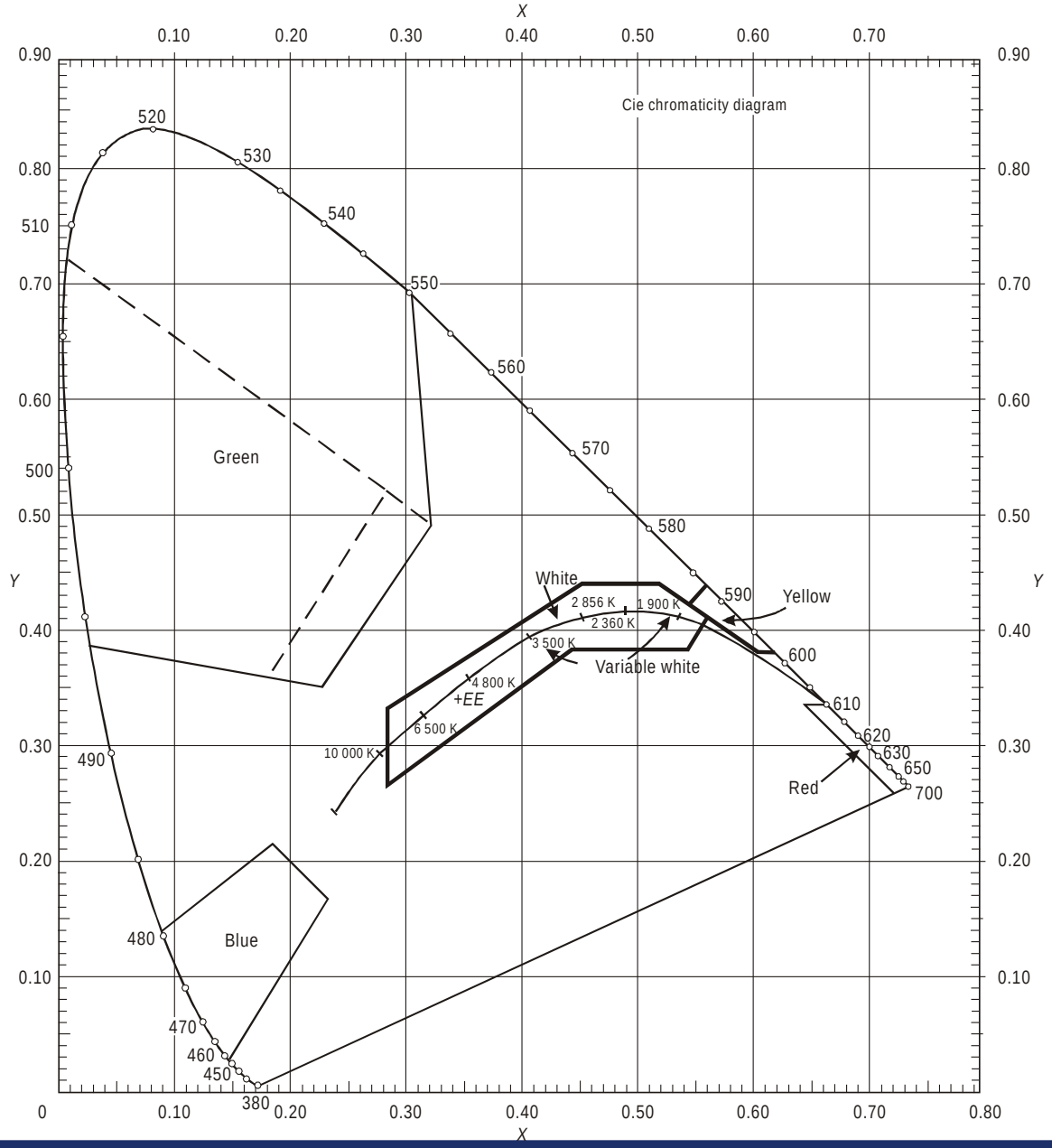
EB 67D Principal Changes – Colors

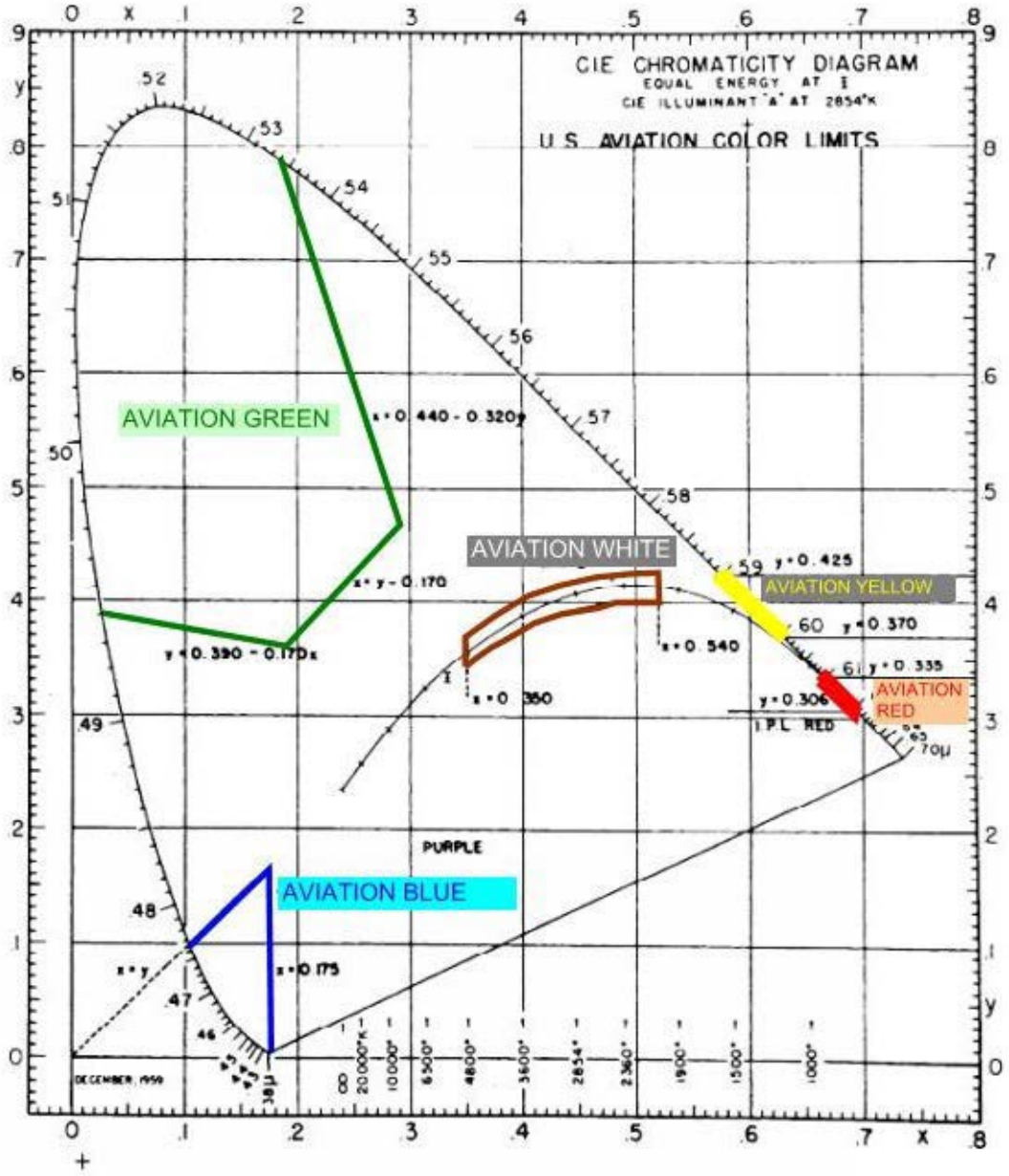
- Does not apply to LED L-858 signs
- Does not apply to white and red obstruction lights
- White
- Red (CIE S 0004/E2001 restricted region)
- Blue (ICAO)
- Green (ICAO Modified)
- Yellow (CIE S 0004/E2001)

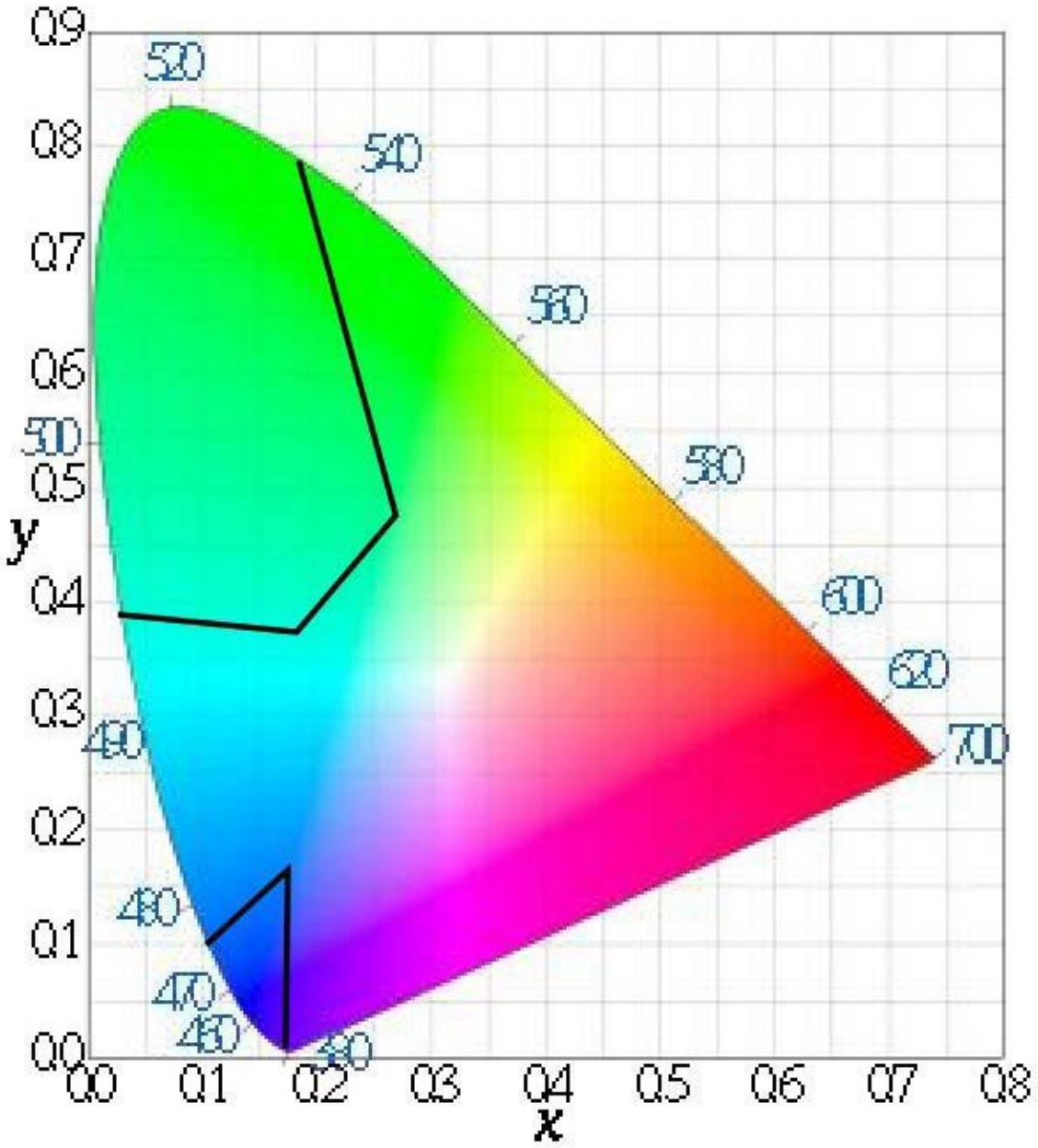
CIE 1931 x,y Chromaticity Diagram



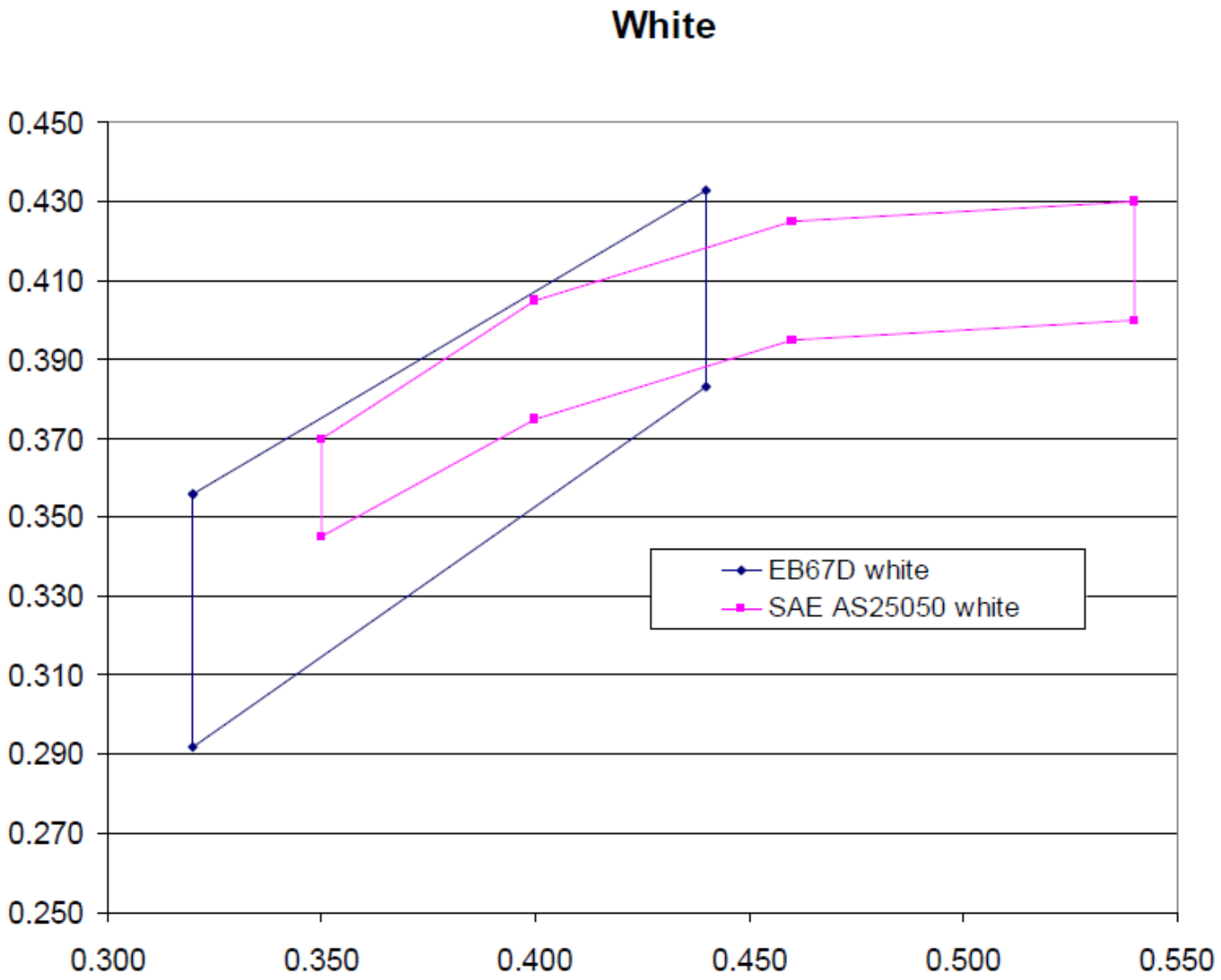
ICAO Annex 14
Figure A1-1. Colours for aeronautical ground lights




CIE CHROMATICITY DIAGRAM
EQUAL ENERGY AT E
CIE ILLUMINANT 'A' AT 2854°K
U.S. AVIATION COLOR LIMITS
AVIATION GREEN
y = 0.440 - 0.320x
y = x - 0.170
y = 0.390 - 0.171x
AVIATION WHITE
x = 0.540
x = 0.350
AVIATION YELLOW
y = 0.425
y = 0.370
y = 0.335
AVIATION RED
y = 0.306
IPL RED
PURPLE
AVIATION BLUE
x = 0.175
x = y
DECEMBER 1959


520
540
560
580
600
620
700
490
480
470
460
500
y
x
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9

EB 67D Principal Changes – Colors



EB 67D Principal Changes – LED High Temp.

- 15 minute 25°C warm-up only applies to products specified in FAA AC 150/5345-46D
- All other products are operated until stable at 25°C
- The operation condition at 25°C should be consistent with the photometric procedure.

EB 67D Principal Changes – Power Factor

2.5 Performance Characteristics

- Applies to all LED product
- Must be measured at both fixture and L-830 (Isolation Transformer, 60Hz) inputs

2.5.1 Power Factor of 0.7 minimum

- Only applies to fixtures that are powered by a CCR
- Measured at L-830 primary at all CCR current steps
- Testing is done with a sine wave source
- Must be true PF measured over a bandwidth of 100kHz

EB 67D Principal Changes – Accelerated Life

- Applies to all LED light fixture types
- 500 Hours with 20 hours on / 4 hours off cycling
- 55°C ambient air temperature
- Acceptance criteria is from FAA AC 150/5345-46D
- Can be conducted with other long term tests:
  - FAA AC 150/5345-46D accelerated life
  - FAA AC 150/5345-43F system operational test
  - Duration may need to be adjusted to address all parameters

EB 67D Principal Changes – LED Junction Temp.

- Manufacturer submits test plan and test report
- Should be based on LED supplier recommendations
- Compare to LED manufacturer's ratings
- Make sure that expected life claims are consistent

EB 67D Principal Changes – C2 Surge

- Increased severity from category C1
- Obstruction Lights are exempt
- References ANSI/IEEE C62.41-1991
- Combination Wave
- • 1.2/50 microsecond 10KV open circuit
- • 8/20 microsecond 5KA short circuit

EB 67D Principal Changes – Arctic Kit

- Optional
- If option is provided, must comply with 2.13.1
- Self-activating
- Applies to all fixture types including in-pavement fixtures.
- Temperature measured on light emitting surface
- All fixture types must achieve a 15°C rise in 30 minutes.

EB 67D Principal Changes – Flicker

- Applies to designs that utilize PWM
- No numerical values given at this time
- Must document pulse frequency and duty cycle
- Must be evaluated over full current range
- Similar specifications:
  - ITE (100 Hz)
  - IEC 61000-4-15 (measurement guidance)

EB 67D Principal Changes – Warranty

- Obstruction Lights are exempt
- Minimum of 4 years after date of installation
- Includes LEDs and associated electronics

EB 67D Principal Changes – “L” Suffix

- FAA AC 150/5345-53C Addendum is updated
- Certificates will also use the “L” suffix

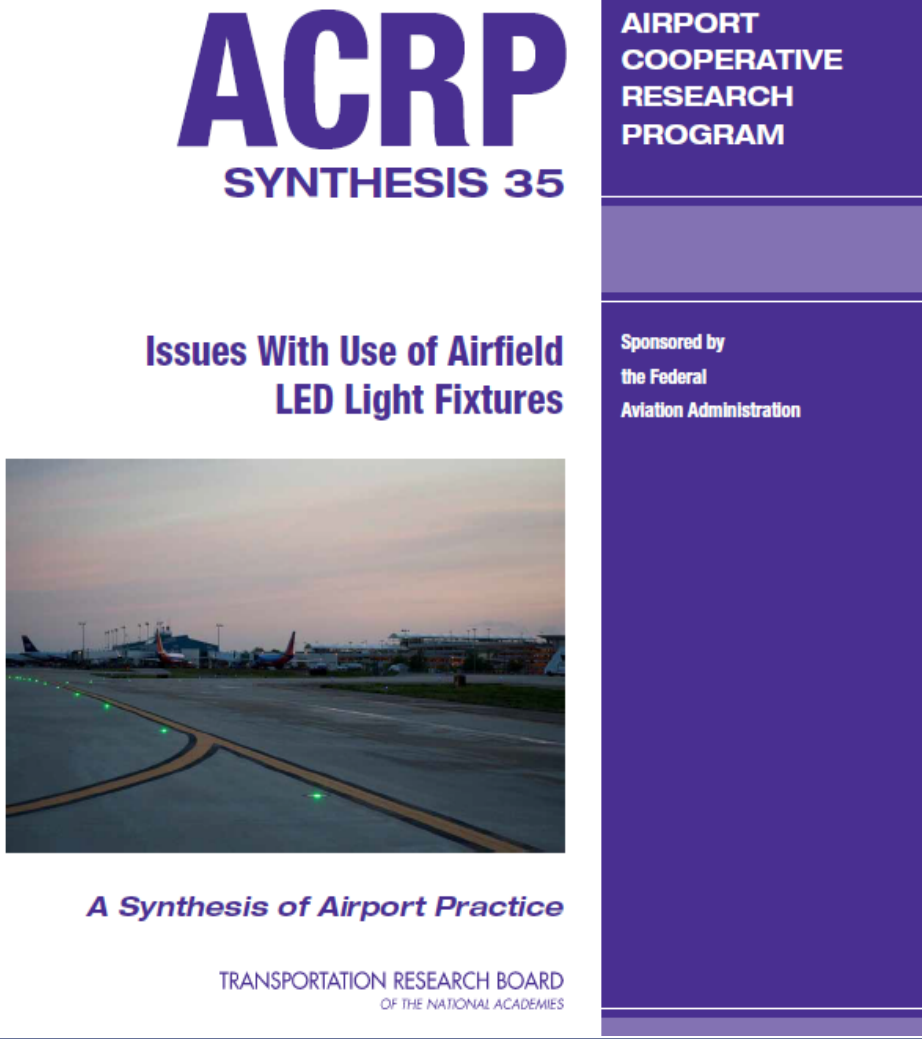
Airport Cooperative Research Program (ACRP) LED Studies

- ACRP Synthesis 35 “Issues With Use of Airfield LED Light Fixtures”. Published 2012

- ACRP Project 09-09 “LED Airfield Lighting System Operation and Maintenance”- On-going

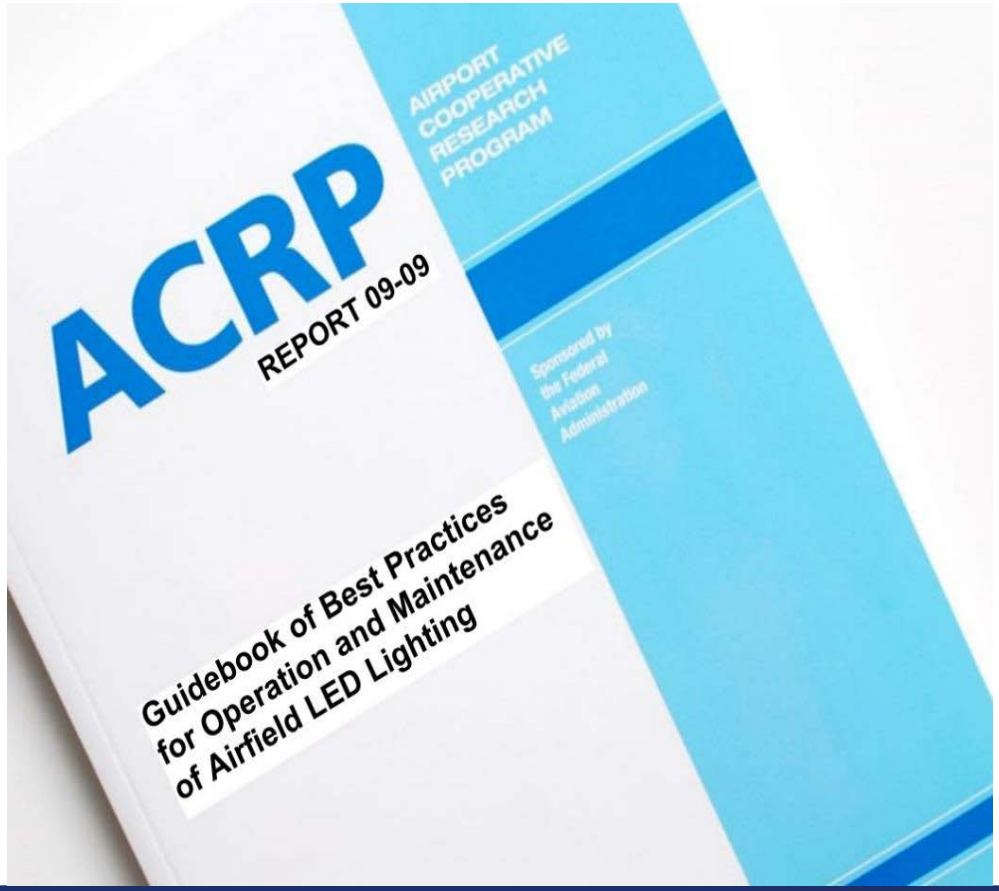
ACRP Synthesis 35

- 22 Airports participated in data collection with 100% response rate.
- Addresses:
  - LED Lighting Installation Issues
  - Failure Modes and Frequency
  - Response of Flight Crews
  - Compatibility with Legacy Systems
  - Life-Cycle Cost and Return on Investment
  - Operating Cost



ACRP 09-09: LED Airfield Lighting System Operation and Maintenance

- This Guidebook is for airports nationwide describing best operating and maintenance practices for LED airfield lighting systems, and issues to be considered during design and construction.
- Anticipated publish by end of 2015



FAA TC LED R&D

- The William J. Hughes Technical Center, Atlantic City, N.J. has conducted LED lighting research for the FAA including but not limited to:
  - Defining LED color boundaries
  - LED brightness issues
  - LED color vision deficiencies for pilots
  - LED strip lighting applications

Enhanced Flight Vision Systems (EFVS)

What is EFVS?

- 14 CFR 1.1 defines EFVS as –

  "Enhanced flight vision system (EFVS) means an electronic means to provide a display of the forward external scene topography (the natural or manmade features of a place or region especially in a way to show their relative positions and elevation) through the use of imaging sensors, such as a forward looking infrared, millimeter wave radiometry, millimeter wave radar, low light level image intensifying. "

Performance-Based Cockpit Technology in Low Visibility Operations- Benefits

- Enhances low visibility flight and ground operations.
- Increases access, efficiency and throughput at many airports when low visibility is a factor.
- Reduces infrastructure necessary to support low visibility operations.

Performance-Based Cockpit Technology in Low Visibility Operations- Benefits

- Provides flight guidance on a HUD

HUD + Sensor Imagery = EFVS

- Provides a real time display of the outside world in low visibility conditions through the use of imaging sensors (forward looking infrared, millimeter wave RADAR, low-light level intensifying, etc.)

Operational Concept for EFVS

- **Permitted on straight-in landing instrument approach procedures other than Category II or Category III *(i.e., nonprecision, Category I precision, and APV).***
- **Provides another means of operating in the visual segment – EFVS in lieu of natural vision.**
- **EFVS enables descent below DA or MDA to 100 feet above TDZE provided certain requirements are met --**
  - Enhanced flight visibility equal to/greater than that specified in the IAP.
  - Required visual references must be distinctly visible/identifiable.
  - All other requirements of § 91.175 (l) must be met.
- **Requires natural vision to be used to identify required visual references for descent below 100 feet above TDZ**

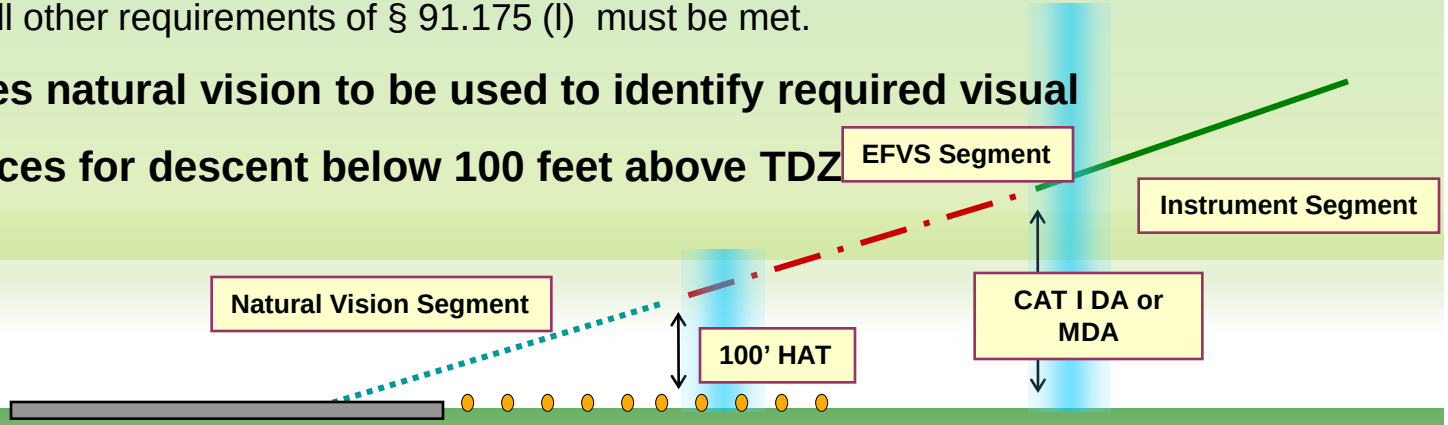


Illustration Courtesy of Mitre CAASD

FAA LED MALSR DEVELOPMENT

- FAA, NAV Service Office, has awarded development contracts to two companies to develop prototype LED PAR 38/PAR 56 fixtures with optional IR emitters
- These devices are currently undergoing flight testing at the FAA Tech Center in Atlantic City, NJ
- From a design standpoint, PAR 38 150W will continue to be used for the white steady burning lights on MALSR
- The sequenced flasher and threshold lights remain unchanged

Electrical Infrastructure Research Team (EIRT)
Evaluation Of Alternate LED Infrastructure

EIRT COMMITTEE

- The FAA Office of Airport Engineering and the Airport Safety Technology Research and Development Branch began research with industry in 2006 on alternative airfield lighting technologies

Federal Aviation Administration

Memorandum

Date:	January 24, 2006
To:	Satish K. Agrawal, Manager, Airport Technology Research and Development Branch, AAR-410
From:	David L. Bennett, Director Airport Safety and Standards, AAS-1
Prepared by:	Alvin Logan, Airport Lighting Engineer, Airport Engineering Division, AAS-100
Subject:	Request for Investigation of Airfield Lighting Infrastructure for Light Emitting Diodes (LED) Airfield Lighting Fixtures

Issues resulting from LED implementation in the Current 6.6 A Series Airfield Lighting System

- **Added complexity and cost to the LED fixture due to the addition of electronics to mimic the non-linear dimming curve of incandescent lighting.**
- **LEDs must convert the supplied AC current to a DC current of lower amplitude at the array.**
- **Active electronic elements within each fixture may introduce high levels of total harmonic distortion or other electrical quality issues which are largely unregulated.**

Electrical Infrastructure Research Team (EIRT)

Goals

- A system that promotes interoperability.

- Reduced life cycle cost without dependence upon a single source.

- A standards-based, robust architecture airfield lighting system.

EIRT Testing Team Recommended Two Paths

- **Path # 1:**
  - **Fixture Centric**
    - **An airfield lighting architecture where the fixture controls its intensity**
    - **Intelligent systems with improved features**

- **Path # 2:**
  - **Vault Centric**
    - **An airfield lighting architecture that directly controls the fixture intensity from the power source in the vault (same as the traditional 6.6 amp)**
    - **Low energy/complexity systems**

Setup of the Fixture Centric Integration

Federal Aviation Administration

Roadmap Testing Phase

- ***Alpha testing at FAATC, May 2015***
  - Integration including mixing of product
  - Fixtures will be instrumented and monitored by FAA equipment to determine performance
  - Identify any deficiencies, or adjustments to be made

- ***Beta testing at PEGASAS Airport July, 2015***
  - Similar set up as alpha testing
  - Large circuit
  - Legacy mode will be available in case there is an issue with the circuit

Thank You!