

# FAA AIRFIELD LIGHTING STANDARDS UPDATE

IES ALC – Government Contacts  
Subcommittee Meeting  
Washington, DC  
April 7, 2015

Tom Mai  
FAA  
Office of Safety and Standards  
Airport Engineering Division (AAS-100)



Federal Aviation  
Administration



# AGENDA

- FAA Airfield Lighting Equipment Draft Advisory Circulars (AC's) & Engineering Briefs (EB's) Published in FY2016
- Stroboscopic Project
- Q & A



# AC's (150's Series) Published In FY 2016

- AC 5345-44K, Specification for Runway and Taxiway Signs (10/8/15)
- AC 5345-42H, Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories (11/6/15)
- AC 5345-46E, Specification for Runway and Taxiway Light Fixtures (3/2/16)
- AC 5345-53C Airport Lighting Equipment Certification Program (Addendum is updated monthly)



# AC 150/5345-44K, Specification for Runway and Taxiway Signs- Principal Changes

- Paragraph 1.1, reference to dot matrix signs removed.
- Paragraph 1.2.1, the Note about a black outline for the letter “M” is removed from and moved to Appendix I, Figure 19.
- Paragraph 1.2.4e – sign shipping and storage temperature requirements are removed because they are stated in paragraph 3.2.1, Sign Temperature Requirements.
- Paragraph 1.2.6 – message array, sign array, and sign frame definitions are added.
- Paragraph 3.2.1 – a reference to the appropriate testing paragraph is added. Sign temperature requirements are modified to accommodate LEDs.
- Paragraph 3.2.5.1 – stake mounted signs are deleted within lighted sign requirements.
- Paragraph 3.2.5.2 – message element spacing is added for sign sizes.
- Paragraph 3.2.5.4b & 3.2.6.2 are updated to be inclusive of all applicable requirements in the ASTM 4956, Standard Specification for Retroreflective Sheeting for Traffic Control.



# AC 150/5345-44K, Specification for Runway and Taxiway Signs –Principal Changes (Cont.)

- Paragraph 3.2.6.11 Sign maintenance instructions are added
- Paragraph 4.1.1.2, Note 4 is updated to better define testing requirements for curved sign faces.
- Paragraph 4.1.1.3.3, L-858B and L858H signs are removed from photometry tests.
- Paragraph 4.1.1.9 is updated for power factor test conditions that are consistent with other ACs.
- Section 6, Dot Matrix Signage, is removed along with all references throughout the AC.
- Figure 17, an additional note is added to clarify the sign face.
- All references and any associated Uniform Resource Locators (URLs) are updated.



# 150/5345-42H, Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories

## Principal Changes

- Para 3.2.3.1, elevated light base plates are removed from AC 150/5345-46, Specification for Runway and Taxiway Light Fixtures, and added to this AC to facilitate common hardware in one AC.
- Para 3.2.3.1.1 through 3.2.3.1.4 are added to describe elevated light base plate requirements.
- Para 3.2.3.2 is added to include elevated light fixture mounting stakes with common hardware.
- Para 3.2.3.2.1 through 3.2.3.2.6 are added to describe elevated light mounting stake requirements.
- Para 4.2.8 is added to provide test procedures for elevated light base plates.
- Figures 6 & 7 “AAA” dimension and is changed in both figures for manufacturing uniformity among one piece and sectional light bases.
- Figure 7 – AAA dimension tolerance is changed to match the tolerance in Figure 6 for better uniformity.



# 150/5345-46E, Specification for Runway and Taxiway Light Fixtures

## Principal Changes

- Para 3.4.1.2d is changed to allow deeper throat projection of light fixtures. This solves potential issues with light fixtures not fitting through the bottom flange cutout of existing extensions and sectional light bases.
- Para 3.4.2.2, Base Mounting, Elevated light fixture base mountings are removed from the AC and placed in AC 150/5345-42H, Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories, to consolidate all light bases into a common document.
- Para 3.4.2.3, Stake Mounting, Elevated light stake mountings are removed from the AC and placed in AC 150/5345-42H
- Para 3.10.1.1 is rewritten to clarify the requirement for light fixture internal hardware. The requirement for black oxide coatings is removed. A note is added about in-pavement light fixture bolts and bolt torque requirements.



# DRAFT AC's (150's Series) & EB's in FY 2016

- AC 5345-43H, Specification For Obstruction Lighting Equipment
- AC 5345-49D, Specification L-854, Radio Control Equipment
- AC 5340-18G, Standards for Airport Sign Systems
- AC 5340-30J, Design and Installation Details for Airport Visual Aids
- EB No. 92A, Light Spacing Guidance for New Taxiway Fillet Geometry
- EB No. 93, Guidance for the Assembly and Installation of Temporary Orange Signs
- EB No. xx PAPI

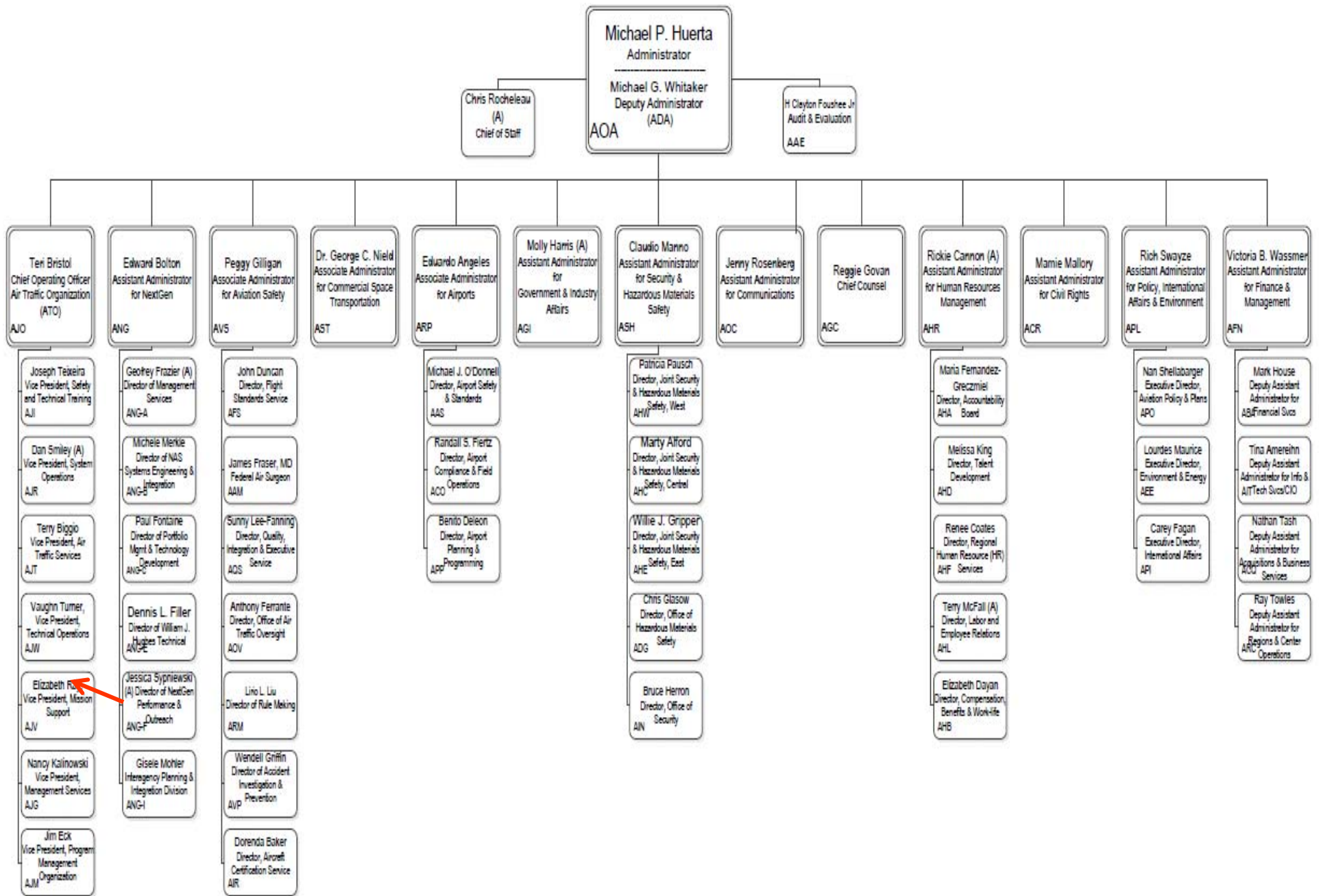




# **DRAFT AC 150/5345-43H, Specification For Obstruction Lighting Equipment**



Federal Aviation  
Administration



## FLASHING L-810 REQUIREMENTS IN AC 70/7460-1L, OBSTRUCTION MARKING & LIGHTING

- Apply to the intermediate levels only on Poles, Towers, and Similar Skeletal Structures between 151ft to 350ft (Para 5.4.2.b)
  - Flashing Lights (L-810). For structures exceeding 151 feet (46 m) but not more than 350 feet (107 m) at intermediate levels, two or more flashing (L-810) lights should be mounted outside at diagonally opposite positions of intermediate levels. These lights should be configured to flash simultaneously with the L-864 flashing light on the top of the structure at a rate of 30 flashes per minute (fpm) ( $\pm 3$  fpm).
- Configuration A1 (Figure A-6)
- Configuration E1 (Figure A-10)
- Wind Turbines above 699ft (Fig A-23 & A-24)



Fig A-6

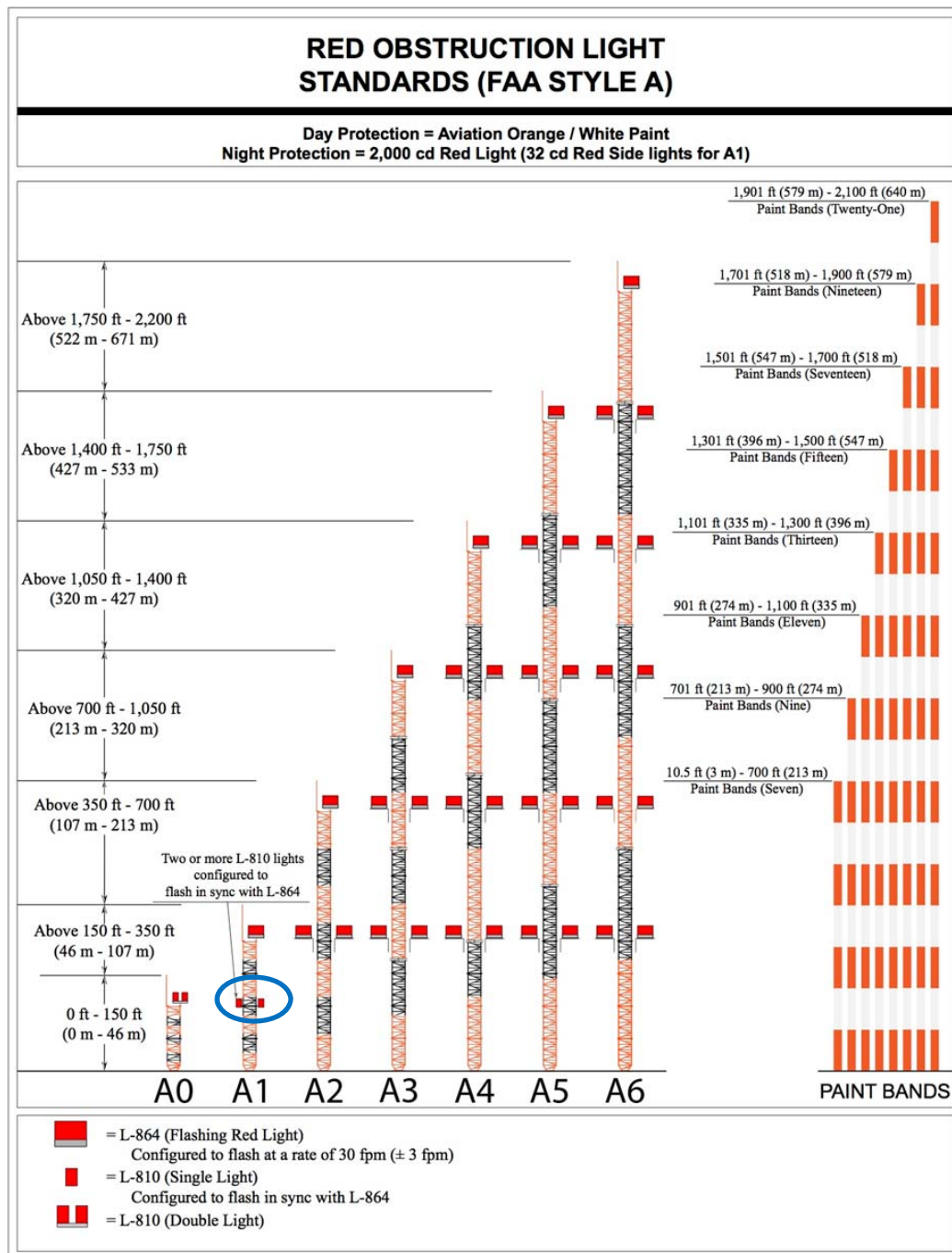


Fig A-10

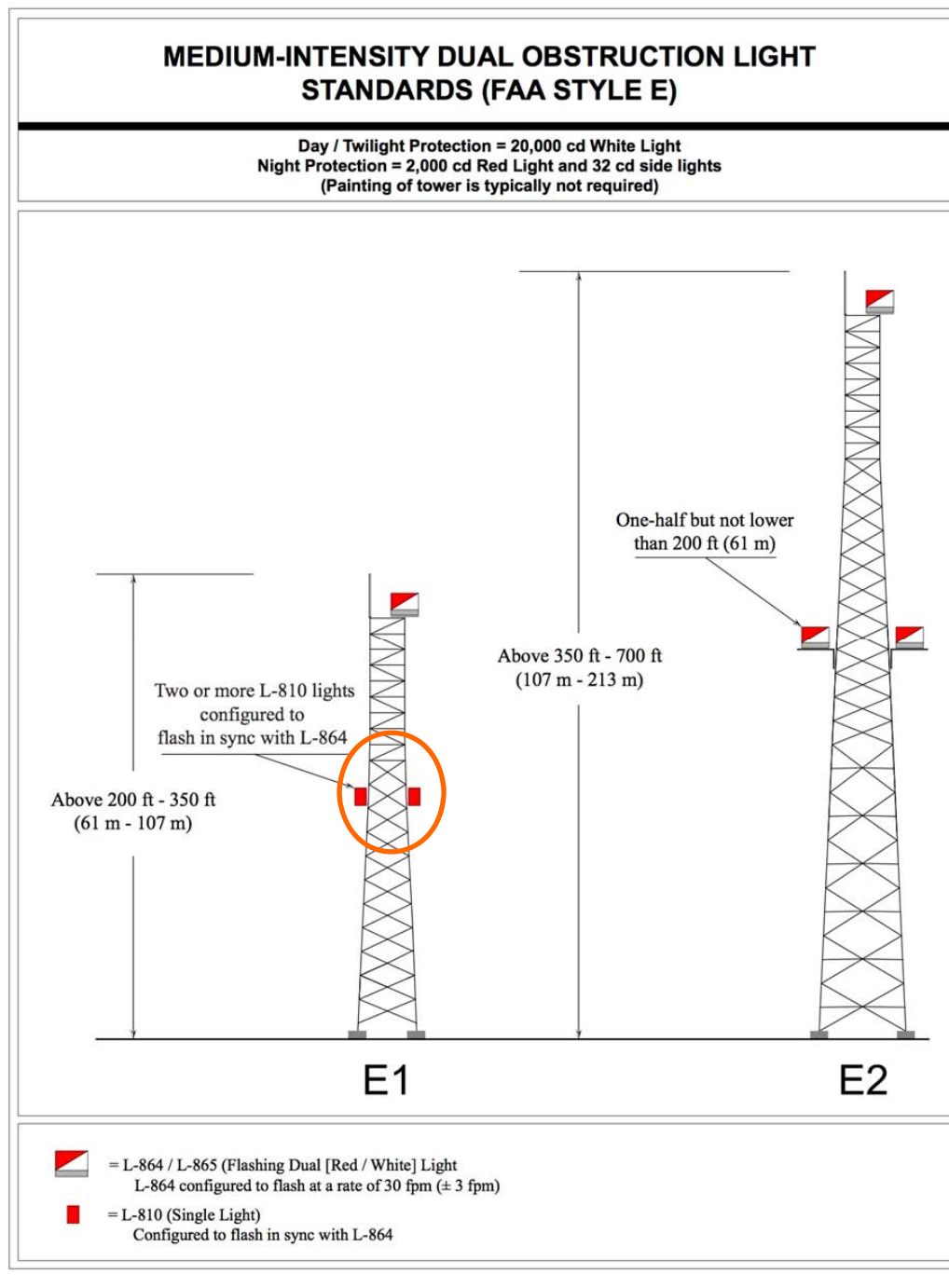


Fig A-23

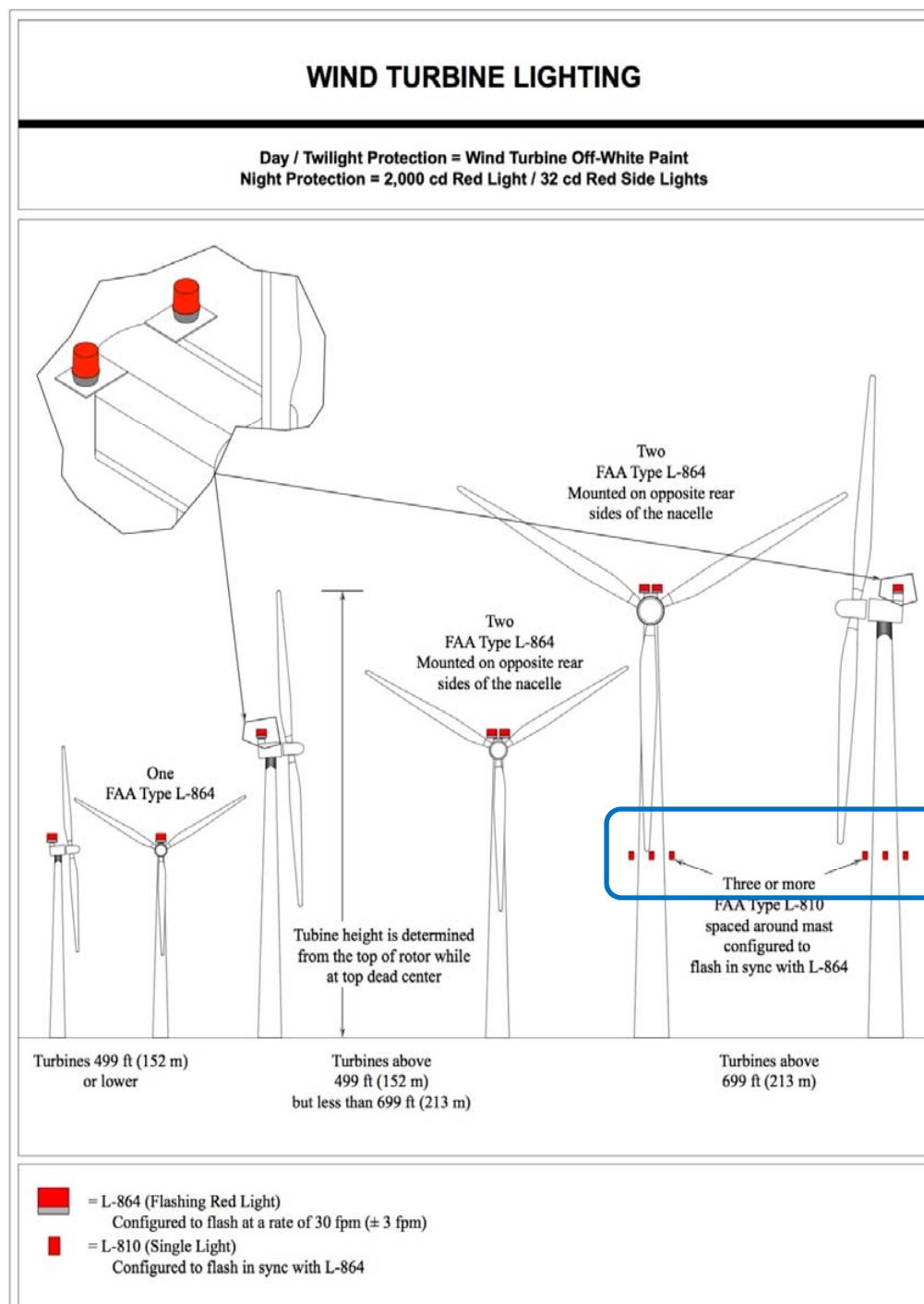
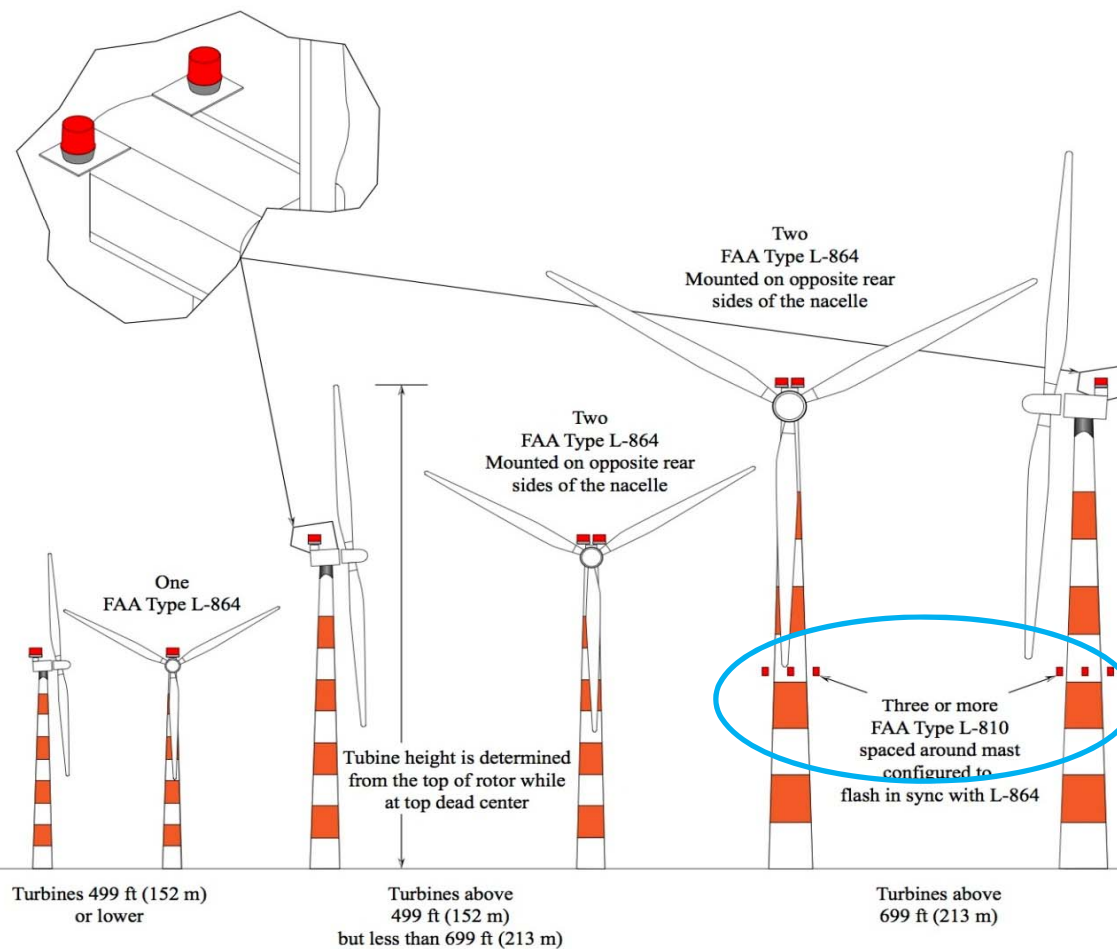




Fig A-24

## LIGHTING AND MARKING OF WIND TURBINES IN SNOW PRONE AREAS (OPTIONAL)

Day / Twilight Protection = Aviation Orange and Wind Turbine Off-White Paint  
Night Protection = 2,000 cd Red Lights / 32 cd Red Side Lights



- = L-864 (Flashing Red Light)  
Configured to flash at a rate of 30 fpm ( $\pm 3$  fpm)
- = L-810 (Single Light)  
Configured to flash in sync with L-864

## FLASHING L-810 REQUIREMENTS IN AC 70/7460-1L, OBSTRUCTION MARKING & LIGHTING (Cont.)

- 10.3.2. Flash Sequence and Duration. The flash sequence for catenary wire support structures should be middle, top, and bottom with all lights on the same level flashing simultaneously. This pattern of flashes is designed to present a unique signal that pilots should interpret as a warning that catenary wires are in the vicinity of the lights. The time intervals for the sequence and duration of the flash pattern are outlined in FAA AC 150/5345-43, Specification for Obstruction Lighting Equipment. If Light-Emitting Diode (LED) obstruction light fixtures are used to light catenary wires, a slower flash rate of 40 fpm is allowed to enable each light fixture to make a well-defined flash so that the middle-top-bottom flash pattern will be easily recognized. Field experience has shown that LED fixtures flashing at 60 fpm, as specified in AC 150/5345-43, do not have enough time to turn off in between flash cycles, and appear as if they are steady-burning. Slowing the flash rate to 40 fpm promotes a cleaner, crisper presentation for the pilot to recognize. In the event there are only two levels of lights, the lights should simply alternate at the same flash rate/duration as if there were three lights.





# DRAFT AC 150/5345-43H, Specification For Obstruction Lighting Equipment

- Update to include new “Flashing” L-810 to meet new requirements in the AC 70/7460-1L



# Principal changes in Draft AC 150/5345-43H

- Section 1.2 – L810(F) light is added.
- Section 3.3.4 is added for obstruction light mounting provisions.
- Section 3.3.4.2 is added to better describe L-810 and L-810(F) mountings.
- Section 3.3.5.2d is modified to describe requirements for L-810(F) and L-864 lights with a controller.
- Section 3.3.5.2e is added to state L-810 lights do not need to be certified with a controller.
- Section 3.4.1.2.1 is added to include a new flashing L-810(F) light to this AC.
- Table 4 is modified to include L-810(F) flash characteristics. Manufacturers should note change to 30 fpm ( $\pm 3$  FPM) for L-864 lights. Also note change to flash duration for L-864.
- Section 3.4.3.1 - L-810(F) lights are added to Simultaneous Flashing Systems.
- Section 4.2.10 – L-810 lights are excluded from the system operational test requirements.
- Section 4.2.10f – L810(F) flashing lights are added the maximum nameplate rated cable length requirements.



# Issues with new requirements in Draft AC 150/5345-43H

- Expecting a 32.5 cd effective intensity from any LED-810's currently available is unrealistic within the L-864 simultaneous flash requirement. Most if not all designs on the market and installed will need to have approximately 2 seconds on time to reach 32.5 effective candela. At 30 fpm, the flash duration cannot exceed 1.333 seconds according to table 4 and thus will not be able to meet this output without significant redesign. LED technology (EB 67) has also made a shorter (100ms) L-864 flash possible, reducing energy and public nuisance. Flash durations will likely need to increase if effective candela and simultaneous flashing of the L-864/L-810 is required. This will have a negative impact on energy consumption, produce more light pollution for the community, and the increased on-time is counterproductive to the intention of avian safety.
- This recommendation is that L-810s not be measured in effective candela but as steady candela. Flashing simultaneously with the L-864 will result in a lower effective candela but will provide the same conspicuity effect of the evaluation of new obstruction lighting techniques to reduce avian fatalities study conducted by Jim Patterson and utilized on hundreds of sites that have been granted a lighting deviation during the "determination of no hazard," process between 2012 and 2015.
- Is it 32.5 cd throughout the 10 degree beam spread or just a peak somewhere within?
- Clarify the definition of "simultaneously". Does this imply that the flashes need to start and stop at the same time or just start?



# Issues with new requirements in Draft AC 150/5345-43H (Cont.)

- What tests will be required to recertify existing L-864 lights to new requirements?
- The flash rate for L-866 and L-885 is inconsistent with AC 70/7460-1L, para. 10.3(2).
- Specifying a minimum flash duration for L-864 is unnecessary due to Blondel-Rey Law.
- Need a confirmation from TC on test/measuring flashing L-810 at 30fpm, its effective intensity
- Need a confirmation on actual flight tests to ensure the level of safety with a new effective intensity, and ensure the pilots can see it in all weather conditions (snow/rain et al)
- What's the recommended effective intensity from TC?



# AC 150/5345-49D DRAFT, Specification L-854, Radio Control Equipment

- Change low end of environmental temperature range from -67° F (-55° C) to -40° F (-40° C) for better parts availability.
- Paragraph 3.4.3b(1) – delete operation of the Type II Receiver at 450 – 512 MHz due to no currently certified manufacturers.
- FAA Spectrum Management currently deliberating with NTIA about 450 -512 MHz band use.



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

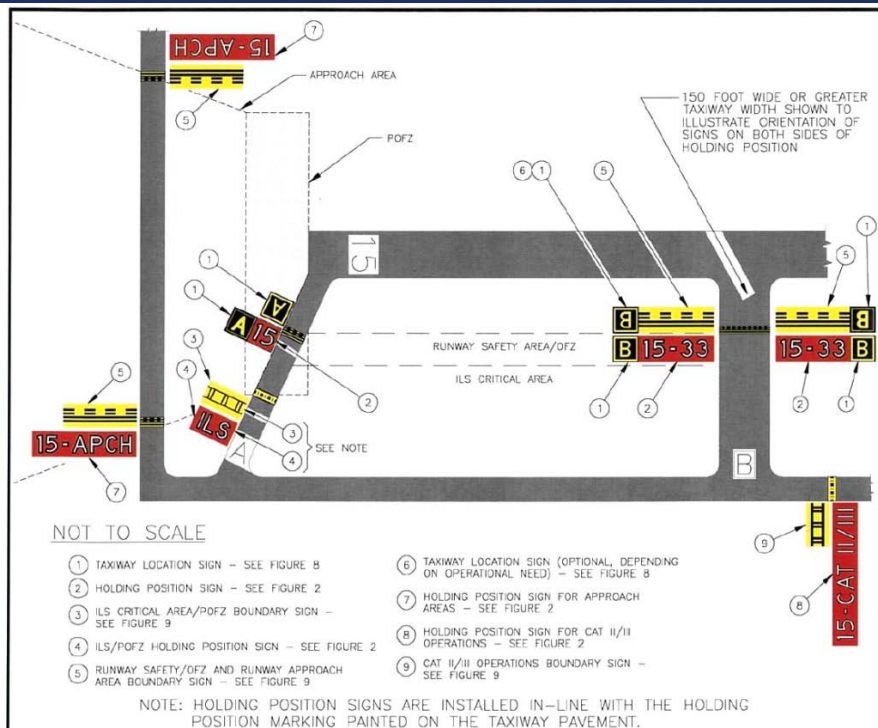
- Incorporate EB 89, Clarifications of Taxiway Nomenclature
- Introduce new “Approach” signs
- Introduce “new” Orange Construction signs
- Update drawings
- Clarifications with examples



# Current

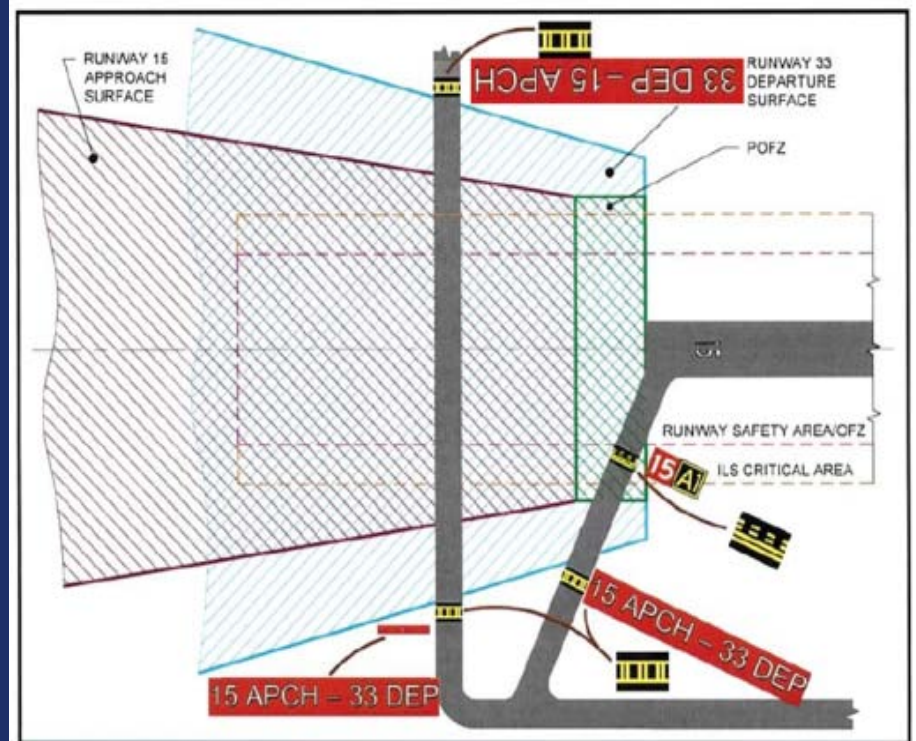
# Proposed

Figure 3. Application Examples for Holding Position Signs.



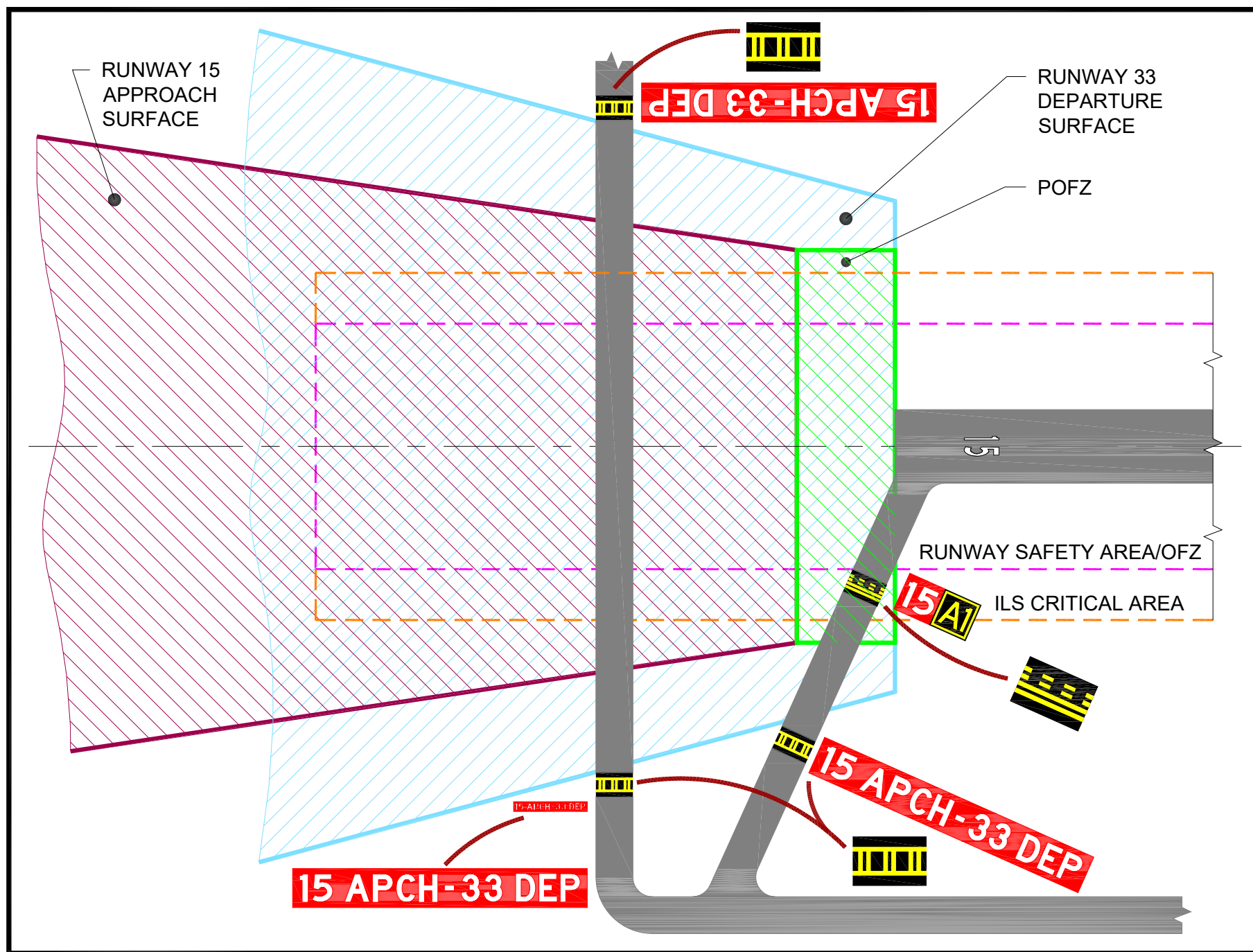
08/16/2010

AC/150/5340-18F



Federal Aviation  
Administration







# Draft AC 5340-18G- New Proposed Signs



Figure 13. Construction Ahead Signs



Figure 14. Construction on Ramp

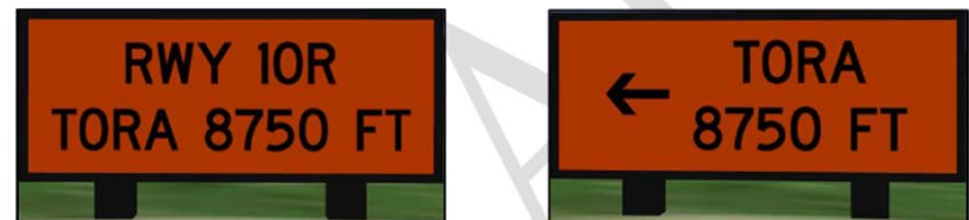


Figure 15. Take-Off Run Available Signs



# Draft AC 150/5340-30J, Design and Installation Details for Airport Visual Aids

- Clarification for power for obstruction light mounted on wind cone.
- Update/check all referenced documents in the AC.
- Clarifications several criteria
- Update some figures
- Update to new 2017 NEC
- Burial depths for conduits according to 5340-30 and 150/5370-10 and IEC
- Consider arc-flash study requirements within the airfield lighting vaults



## UPDATE Wind Cone and L-810 Issue FAA AC 150/5340-30H, Par. 6.7.2.e

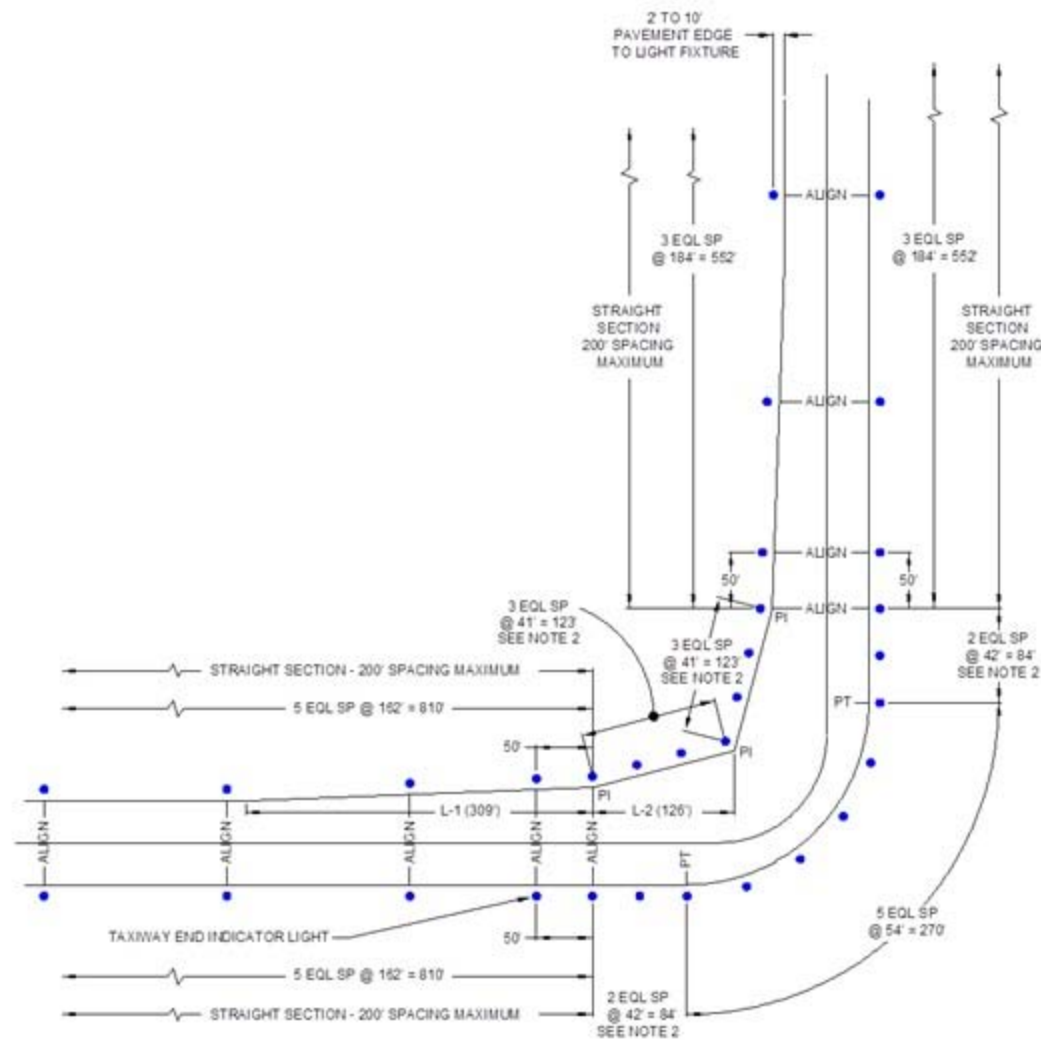
- Propose the following clarification in the next -30
- “The intent of the Note in Paragraph 6.7.2.e in AC 150/5340-30H is that the obstruction lights on top of the wind cone must be lighted even if the runway edge lights are shut down. The obstruction lights can be powered from a dedicated circuit, or shared with another circuit such as a runway sign circuit as long as the obstruction lights have power available even if the runway lights are shut down.”
- For clarification, we will revise the Note in the next revision of AC 150/5340-30J to read as below:
- “Note: Power for obstruction lights mounted on wind cone structures must be on a circuit not shared with runway lights or other circuits that maybe shut down for operational closures. This assures continued lighting of the obstruction in the event of a runway lighting shutdown during closure or maintenance.”



# Draft EB No. 92A, Light Spacing Guidance for New Taxiway Fillet Geometry Per AC 150/5300-13A, Change 1, Airport Design.

- This EB introduces guidance and new requirements for edge lighting the new taxiway fillet geometries designed for cockpit over centerline rather than the judgmental over steer currently used throughout the NAS. The EB provides proposed design examples that show proposed edge light layouts.





NOTES:

1. L-1, L-2 AND L-3 DIMENSIONS ARE FOR TDG-4 AND ARE USED ONLY AS AN EXAMPLE.
2. SINGLE STRAIGHT REQUIRED, MAXIMUM 50' SPACING.
3. PI = POINT OF INTERSECTION.

90° TAXIWAY TURN

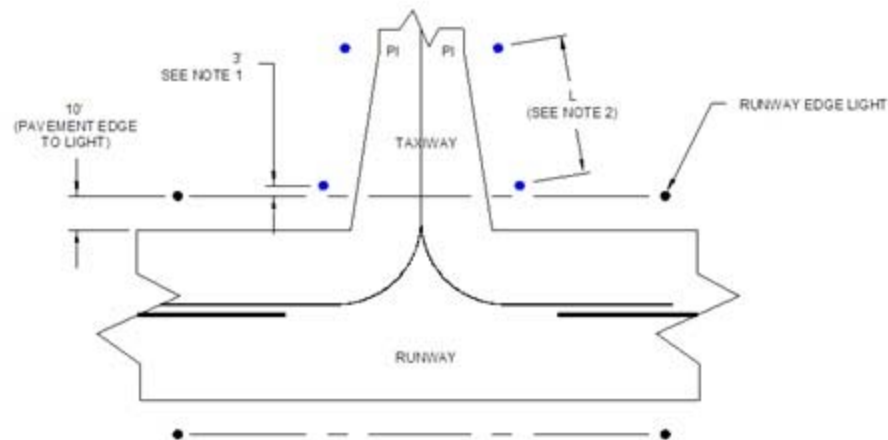


FIGURE 2A. SAMPLE LAYOUT FOR RUNWAY AND TAXIWAY INTERSECTION  
( $L = 3' \leq L < 10'$ )

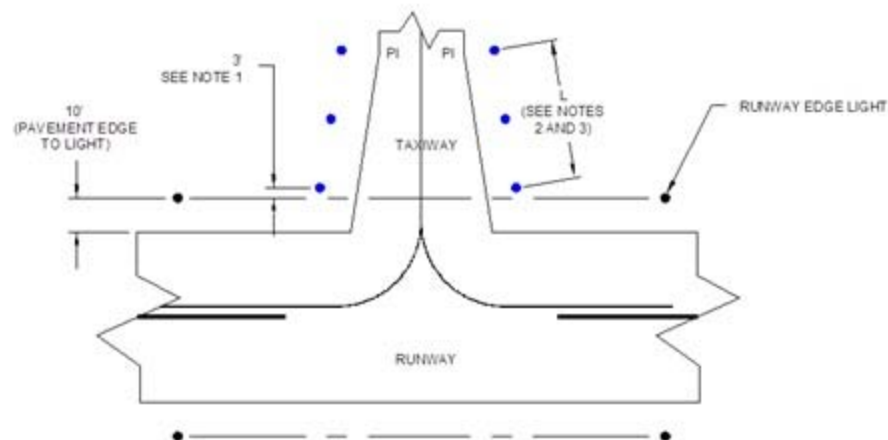


FIGURE 2B. SAMPLE LAYOUT FOR RUNWAY AND TAXIWAY INTERSECTION  
( $L = 10' \leq L \leq 40'$ )

TABLE 1			
SECTION LENGTH (L)	NUMBER, EDGE LIGHTS (N) PER SIDE	MAXIMUM SPACING	SPACING
$L < 3'$	1	N/A	N/A
$3' \leq L < 10'$	2	10'	L
$10' \leq L \leq 40'$	3	20'	$L / 2$
$L > 40'$	$[(L/\text{MAX}) + 1]^*$	20'	$L / (N-1)$

\* ROUND VALUE UP TO THE NEXT WHOLE NUMBER

SPACING NOTES:

1. THE LAST TAXIWAY EDGE LIGHT AT A RUNWAY/TAXIWAY INTERSECTION MUST BE PLACED AT AN ADDITIONAL 3 FEET FROM THE RUNWAY EDGE LIGHT OFFSET LINE. THE OFFSET IS NECESSARY TO MINIMIZE ANY POTENTIAL CONFLICT WITH RUNWAY EDGE LIGHTS.
2. SEE TABLE OPPOSITE FOR SPACING REQUIREMENTS.
3. INSTALL ONLY ONE LIGHT WHERE TAXIWAY AND TAPER INTERSECT WHEN  $L < 3$  FEET.



## ENGINEERING BRIEF No. 93

### Guidance for the Assembly and Installation of Temporary Orange Signs During Construction

- This Engineering Brief (EB) provides guidance about materials, and methods of assembly and installation of temporary orange construction signs.



Figure 13. Construction Ahead Signs



Figure 14. Construction on Ramp



Figure 15. Take-Off Run Available Signs



# Draft EB- PAPI

- **Engineering Brief** - disseminate additional information about how PAPI Obstruction Clearance Surfaces (OCS) are evaluated by FAA Flight Inspection. In addition, provide information about how to deal with obstructions that are outside the 20 degrees PAPI OCS imaginary plane.





# LED Stroboscopic Effect Issues

- Port of Friday Harbor Airport (KFR)
- NASA ASRS Report at ATL
- LED OFTG Recommendation



Federal Aviation  
Administration

# LED Stroboscopic Effect at KFR

- Pilot report at Port of Friday Harbor Airport (KFR) LED Medium Intensity Runway Edge Lights (MIRLs)
  - “Strobing” effect has been observed at times when the MIRLs are viewed thru the propeller of single-engine planes with 3-bladed propellers.
  - “Strobing” effect was noticeable when the lights were on 10% or 30% brightness but not at 100% brightness.
- Study conducted by KFR’s consultant determine that the stroboscopic effect created by PWM LED MILR when “shuttered” by the rotating propeller. (Note: study doesn’t include twin- or jet-engine aircraft because pilot doesn’t look at the lights thru the propeller)



Federal Aviation  
Administration

# LED Stroboscopic Effect at ATL

## NASA ASRS Report

- NASA Aviation Safety Reporting System (ASRS)  
3/24/15 ATL LED Runway Lights Propeller Strobe Effect
- Aircraft: Cessna 210 Centurion / Turbo Centurion 210C, 210D
- C210 pilot experiences flashing runway edge and centerline lights during a night visual approach to Runway 26R at ATL. When propeller RPM is varied the strobe effect is varied and it is decided that the effect is caused by propeller interaction with the LED lights which are apparently flashing at a high rate.



Federal Aviation  
Administration

# FAA/Industry LED OFTG Recommendation

- LED Operational Flight Test Group (OFTG) engaged ERAU and addressed “Blinking, strobing, and almost complete disappearance of LED lights have been reported by three-bladed propeller airplane pilots while looking through the propeller disk on approach. This has been tentatively identified as being related to the existence of a resonance frequency between the propeller blade configuration and rpm, and the pulse width modulation frequency of the LED runway edge lights. Much more data is needed to identify the various potential blade configurations and rpm ranges at risk, as well as the various types of LED airfield lighting affected. “



Federal Aviation  
Administration

# What we know....

- RPI presented a paper “UNDERSTANDING FLICKER IN AIRFIELD LIGHTING APPLICATIONS” at 2014 FAA Worldwide Airport Technology Transfer Conference
- “Flicker Parameters for Reducing Stroboscopic Effects from Solid-state Lighting System” RPI, Volume 11, Issue 1, May 2012
- EB 67D, Para. 2.15 Light Fixture Flicker - All light fixtures that use pulse width modulation (PWM) to facilitate LED brightness changes must not cause perceptible flicker to a moving human observer (example: pilot in an aircraft) throughout the range of brightness steps.



Federal Aviation  
Administration

# Friday Harbor LED-Propeller Interaction Review

- There was a report of LED L-861 runway edge light flickering seen by a pilot flying a Cessna 207 that has a 3-blade propeller when landing at Friday Harbor airport in Washington state
- A test was set up to identify if higher PWM frequencies would resolve the issue

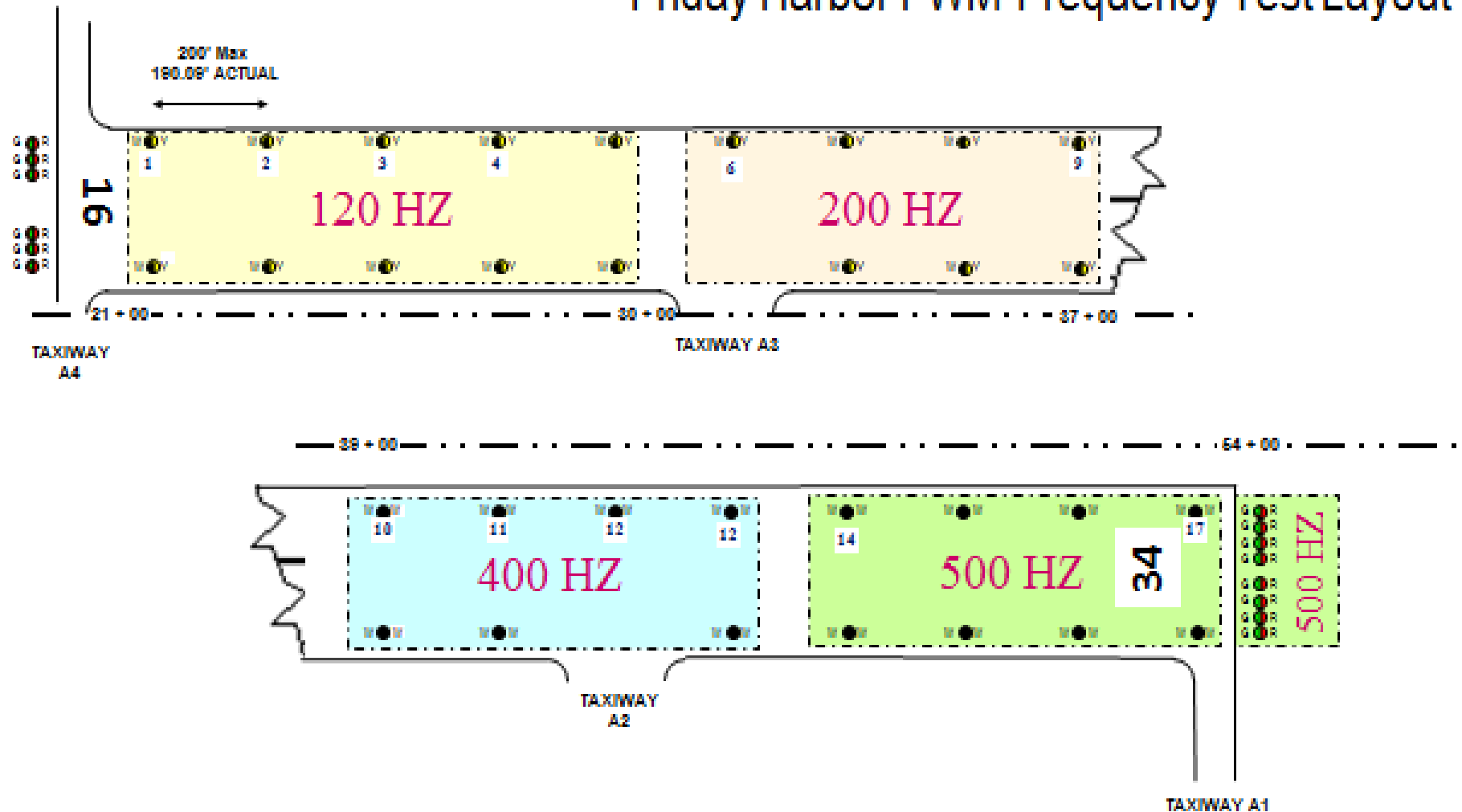


**Friday**



Federal Aviation  
Administration

# Friday Harbor PWM Frequency Test Layout



Federal Aviation  
Administration

# Friday Harbor LED-Propeller Interaction Review

- Flight tests occurred the night of January 20, 2016
- Some noticeable pulsing of the lights were seen at 120Hz (as opposed to actual flickering)
- The lights were seen as steady at the higher 400Hz and 500 Hz frequencies
- All lights were later set to 500Hz
- A pilot survey has been sent out to collect longer term data



Federal Aviation  
Administration



# Q & A



Federal Aviation  
Administration

***Thank You!***



Federal Aviation  
Administration