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Evaluation of an Updated Design of an Internally Lighted Wind Cone

Eric S. Katz

August 1989

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16. Abstract

The purpose of this project was to evaluate an updated version of an 18-inch internally lighted wind cone. The original model was evaluated at the Federal Aviation Administration (FAA) Technical Center. The results of that evaluation, as detailed in Technical Note DOT/FAA/CT-TN85/4 (February 1985), revealed that the original model of the internally lighted wind cone did not provide adequate wind direction and speed information under low velocity (10 knots or less) wind conditions. The new model was installed in close proximity to the standard externally lighted wind cone at the Atlantic City International Airport, NJ, to permit a comparative evaluation by FAA and general aviation pilots. Results of the testing, accomplished during taxi and flight operations under wind conditions of 10 knots or less, revealed that the updated model still does not provide adequate wind direction and speed information. Participating pilots preferred the standard externally lighted wind cone.

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EXECUTIVE SUMMARY

The purpose of this project was to evaluate an updated version of an 18-inch internally lighted wind cone. This new model includes two design features that were not included in the original design that was evaluated at the Federal Aviation Administration (FAA) Technical Center in 1985: The new model includes an obstruction light that was not present in the original model. In addition, there are two internally mounted lights in the new model, as opposed to only one internal light in the original model. The new model differs from the standard L-807 wind cone in having two lights mounted internally within the sock rather than having four overhead floodlights similar to the standard externally lighted unit. This evaluation was undertaken in response to a request from the Engineering and Specifications Division, AAS-200, submitted through the Airport Technology and Advanced Systems Branch, ADS-240. The work was accomplished under Technical Center Project Number T19-03N, "Airport and Heliport Lighting and Marking."

For comparative testing, the new internally lighted wind cone was installed approximately 300 feet from the standard externally lighted wind cone at the Atlantic City International Airport (FAA Technical Center). Pilots were asked to evaluate the internally lighted wind cone during ground taxi operations and while overflying the airport in the local traffic pattern at an altitude of 800 to 1000 feet above ground level (AGL). Upon completion of each evaluation session, pilots were required to complete a post-flight questionnaire.

Test results indicated that pilots felt that the internally lighted wind cone was adequate during ground taxi operations. However, during the airborne traffic pattern phase of the evaluation, the vast majority of pilots found the internally lighted wind cone to be inadequate. The entire evaluation was conducted under wind conditions of 10 knots or less, since it was under these conditions that the original internally lighted wind cone proved inadequate. When asked to rate the internally lighted wind cone in comparison with the standard externally lighted unit, the pilots preferred the externally lighted wind cone by a greater than 3 to 1 ratio. Pilots stated that the externally lighted wind cone was easier to interpret than the internally lighted wind cone.

From the results of this evaluation, it is concluded that:

1. The internal light-mounting technique does not restrict motion or deployment of the wind cone to any perceptible degree, nor does it result in any perceptible amount of heat buildup that might result in a shortened sock life.

2. The internally lighted wind cone does not provide effective wind direction and speed information under low velocity wind conditions (10 knots or less). Adequate wind direction information is essential to pilots under all wind conditions, especially at smaller airports where runway length may be critical.

INTRODUCTION

PURPOSE.

The purpose of this project was to evaluate an updated version of an 18-inch internally lighted wind cone. The evaluation was undertaken in response to a request from the Engineering and Specifications Division, AAS-200, submitted through the Airport Technology and Advanced Systems Branch, ADS-240. The work was accomplished under Technical Center project number T19-03N, "Airport and Heliport Lighting and Marking." The technical project manager is Eric S. Katz.

DISCUSSION

In order to evaluate the recently modified internally lighted 18-inch wind cone design, a unit was obtained from the manufacturer, Hughey and Phillips, Inc. The original design was evaluated at the Federal Aviation Administration (FAA) Technical Center in 1985. The results of that evaluation revealed that the internally lighted wind cone was adequate only under higher wind velocity conditions (10 knots or more) and did not provide effective wind direction and speed information during low velocity wind conditions. In an attempt to provide an internally lighted wind cone that would be effective under all wind conditions, the new unit incorporated two design features not included in the original model:

1. The addition of a 116-watt red obstruction light mounted directly on top of the wind cone's support pole. Without this light, there is no visual reference for determining which way the wind cone is pointing under the lower wind velocity conditions.

2. The single PAR-38, 150-watt spotlight that provided the internal illumination for the original model was replaced by two PAR-38, 75-watt floodlights. If one of the two floodlights were to fail, the new model would still be of some use at night. Failure of the single lamp in the original unit would have rendered it totally ineffective at night.

Details of the new model's construction are shown in figures 1 and 2.

The internally lighted wind cone differs from the standard L-807 wind cone which is described in the Federal Aviation Administration (FAA) Advisory Circular AC 150/5345-27A. The standard externally lighted wind cone uses four PAR-38, 150-watt floodlights to illuminate the wind cone assembly from above (figure 3).

TEST PROCEDURES.

For comparative purposes, the internally lighted wind cone was installed at a distance of approximately 300 feet from the standard externally lighted L-807 wind cone at the Atlantic City International Airport (FAA Technical Center). During the first test session, it was determined that the 116-watt obstruction light was much too bright. When viewing the wind cone from pattern altitude, the brightness of the obstruction light itself exceeded the wind cone's level of illumination, making it very difficult to interpret. The FAA and the manufacturer agreed that the 116-watt light should be replaced with a 69-watt obstruction light, and that the 69-watt light should be used for the duration of the evaluation period.

FIGURE 1. INTERNALLY LIGHTED WIND CONE

FIGURE 2. INTERNALLY LIGHTED WIND CONE DETAILS

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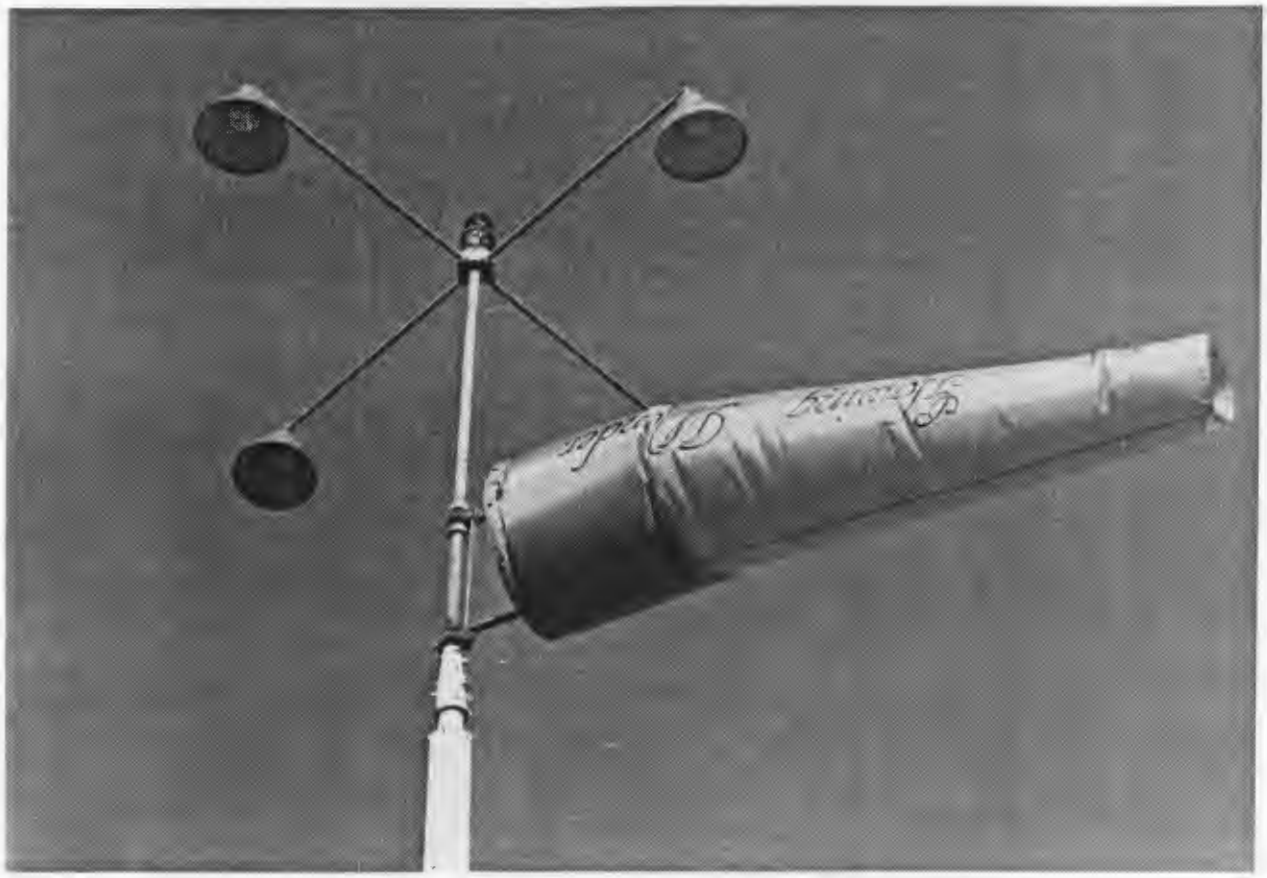

FIGURE 3. EXTERNALLY LIGHTED WIND CONE STANDARD

The internally lighted wind cone was energized using a portable 120-volt generator. A variac was initially incorporated into the circuit to enable subject pilots to view the wind cone at various lighting intensities. Three voltage levels (120, 100, 80) were tested to determine if the wind cone's brightness had a direct impact on its effectiveness. Although the wind cone direction seemed to be slightly more easily interpreted with an input of 80 volts, the improvement was not significant and it was decided to conduct the evaluation at the design voltage of 120 volts.

Pilots were asked to evaluate effectiveness of the internally lighted wind cone during ground taxi operations and while overflying the airport in the local traffic pattern at an altitude of 800 to 1000 feet AGL. They were asked to render an opinion as to the adequacy of the wind cone for both types of operations and also to compare it for effectiveness with the standard externally lighted wind cone located nearby. Pilots were provided with the opportunity of viewing both wind cones from varying angles. Upon completion of each evaluation session, the pilots were required to complete a post-flight questionnaire. An Aero-Commander (light twin engine), a Cessna 172 and a Piper Arrow (light single engines) were used during the test.

While testing was in progress, numerous ground observations were made to determine how faithfully the internally lighted wind cone responded to existing wind conditions, and to what extent these indications agreed with those of the adjacent externally lighted wind cone. This was to determine whether the two PAR-38 lamps mounted in the throat of the wind cone assembly might affect, in any way, the cone's response to wind direction and velocity.

TEST RESULTS.

Twelve post-flight questionnaires were collected from the participating pilots during the evaluation period. Nine of the pilots were FAA Technical Center test pilots and three were locally based general aviation pilots. All test sessions were conducted under nighttime conditions with reported wind velocities varying from 0-10 knots.

A summary of pilot responses is shown as figure 4, and pilot comments are contained in appendix A.

Ten favorable responses (83 percent) indicated that the pilots felt that the internally lighted wind cone was adequate, when viewed while taxiing, for determining the existing wind conditions. The remaining two negative responses indicated that these pilots did not consider the performance of the wind cone adequate under the existing conditions. After viewing the wind cone from the local traffic pattern altitude (800 to 1000 feet AGL), four pilots (33 percent) indicated satisfaction with the wind cone performance, while the remaining eight responses (67 percent) were negative. Many pilots commented that the unit was not discernable as a wind cone, but rather appeared only as a bright "blob" of orange light. There were also several comments concerning the obstruction light. While some pilots stated that the obstruction light was necessary for determining the direction of the wind sock, others felt that the obstruction light only added to the "glowing" effect of the cone, making it even more difficult to interpret.

SUMMARY SHEET

INTERNALLY LIGHTED WIND CONE - PILOT QUESTIONNAIRE

Pilot 12 Total Reported Winds 0-10 knots Date _____

1. Was the internally lighted wind cone adequate for determining the existing wind direction and relative speed?

   On Ground Taxi: Yes 10 (83%) No 2 (17%)

   Comments: _____

   Airborne Traffic Pattern: Yes 4 (33%) No 8 (67%)

   Comments: _____

2. How would you rate the internally lighted wind cone against the standard externally lighted wind cone?

   Internally Lighted Better 2 (17%)

   Both Equal 3 (25%)

   Externally Lighted Better 7 (58%)

3. Comments: _____

THANK YOU!

FIGURE 4. SUMMARY OF QUESTIONNAIRE RESPONSES

When asked to rate the internally lighted wind cone in comparison with the standard externally lighted wind cone, the pilots stated that they preferred the standard device by a greater than 3 to 1 ratio. Pilot comments reflected that it was easier to determine wind information from the externally lighted wind cone, and that it was very difficult to identify the internally lighted unit as a wind cone.

Observations made during the various wind conditions verified that the internally lighted wind cone responded as well as the externally lighted unit to changes in wind speed and direction. It appears that mounting the internal lamps at the throat of the wind cone has no adverse affect upon performance.

CONCLUSIONS

From the results of the evaluation, it is concluded that:

1. The internal light mounting technique does not restrict motion or deployment of the wind cone to any perceptible degree.

2. The internal light mounting technique does not result in any perceptible amount of heat buildup that might result in a shortened sock life.

3. The new internally lighted wind cone design does not provide adequate wind direction and speed information during low velocity wind conditions (0-10 knots).

APPENDIX A - SUMMARY OF PILOTS' COMMENTS

Pilots' comments, as recorded on their post-flight questionnaire forms, are shown below in order of decreasing number of occurrences. The excerpts, while not necessarily quotes of individual pilots, reflect the general nature of the written comments. Noted prior to each comment are the prevailing wind conditions for the flight periods.

1. Comments concerning the internally lighted wind cone, as viewed during ground taxi operations:

(4-10 knots)	Adequate only at certain viewing angles.	(4 pilots)
(4-9 knots)	The wind direction could only be determined when the aircraft was close to the wind cone.	(3 pilots)
(0-5 knots)	The "limp" part (tail) of the wind cone was not visible.	(2 pilots)
(4 knots)	The design voltage (120 volts) creates a glowing effect.	(2 pilots)
(0-4 knots)	The wind cone is marginally adequate at best.	(1 pilot)
(4 knots)	The wind cone is marginally adequate at reduced intensity (80 volts).	(1 pilot)

2. Comments concerning the internally lighted wind cone, as viewed during flight operations:

(0-10 knots)	The wind cone appeared as a bright orange/red ball and did not provide adequate wind information.	(5 pilots)
(9-10 knots)	The wind cone was adequate only at certain viewing angles.	(2 pilots)
(4 knots)	The obstruction light is needed to help interpret the wind direction.	(2 pilots)
(9 knots)	Unable to determine wind direction from either wind cone.	(1 pilot)
(10 knots)	If the aircraft is flying near the wind cone, the wind cone is very good.	(1 pilot)
(4 knots)	The wind cone is marginally adequate at reduced intensity (80 volts).	(1 pilot)
(4 knots)	The design voltage (120 volts) creates a glowing effect.	(1 pilot)

3. Comments concerning comparison of internally and externally lighted wind cones:

(4-9 knots)	The externally lighted wind cone is easier to interpret than the internally lighted wind cone.	(3 pilots)
(0-5 knots)	The internally lighted wind cone is inadequate in performing its intended function.	(2 pilots)
(4-9 knots)	A "halo" appears to surround the internally lighted wind cone.	(2 pilots)
(4 knots)	The internally lighted wind cone is not satisfactory at 120 volts and only barely adequate with reduced voltage.	(1 pilot)
(4 knots)	Raising the internally lighted wind cone's obstruction light might lessen the "halo" effect.	(1 pilot)
(9 knots)	Could not get much significant information from either wind cone unless aircraft was close by and aligned parallel to the direction of the extended cone.	(1 pilot)
(4 knots)	Although the internally lighted wind cone was acquired at a greater distance than the externally lighted wind cone, it was not necessarily interpreted any sooner. The internally lighted wind cone appeared too bright at short range. Lowering the voltage helped to cut down on the glowing effect.	(1 pilot)
(0-4 knots)	The tail of the internally lighted wind cone disappears during low wind conditions.	(1 pilot)
(0-4 knots)	The four overhead lamps of the externally lighted wind cone provide visual cues (illuminated support pole and ground surface beneath the wind cone) which helped to determine wind speed and direction and also helped to identify the unit as a wind cone.	(1 pilot)