

Airport Safety Technology R&D

Research in Standards for Internally Lighted Wind Cone Assemblies

Presented to: IESALC

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Federal Aviation
Administration



Standards for Internally Lighted Wind cone

- AC 150/5345-27D, FAA Specification for Wind Cone Assemblies, dated 06/02/04, contains a specification for wind cone assemblies used to provide wind information to pilots.
- The AC covers two types of wind cones, **L-806** and **L-807**. In this AC, the **internally-lighted windsock** applies only to the **L-807**.
- However, **manufacturers and airports** have also **installed internally-lighted L-806** wind cones. FAA is concerned that the **internally-lighted L-806** wind cone **may pose a safety hazard** by presenting **confusing information** to pilots.

Wind Cone Evaluation History

- DOT/FAA/CT-TN/85/4 “Evaluation of an Internally Lighted Wind Cone”, 1985, where pilots were asked to compare the standard externally lighted wind cone to the smaller internally lighted wind cone.
- DOT/FAA/CT-TN89/45 “Evaluation of an Updated Design of an Internally Lighted Wind Cone”, 1989, where pilots were asked to compare the standard externally lighted wind cone to the smaller internally lighted wind cone at low wind velocities below 10 knts.

Phased Approach

- Literature Review
- Controlled Testing
- Field Evaluation – 8 and 12 foot LED internally lighted wind cones
- Field Evaluation – 8 foot internally and externally lighted wind cones

Phase 1 - Wind Cone Literature Review

- A literature review was conducted to compare the current FAA standards for wind cones to international standards.

FAA and ICAO Certified Internally Lighted L-807 12' Wind Cone



FAA Certified Externally Lighted L-806 8' Supplemental Wind Cone



Uncertified Internally Lighted L-806 8' Supplemental Wind Cone



Wind Cone Literature Review







- The wind cone sock shall extend fully when subjected to a wind of 15 knots (28 km/hr or 17 mph).
- Compared wind cone sock extension requirements of the FAA and Transport Canada.

Wind Cone Sock Extension			
Wind Speeds	15 knts	10 knts	5 knts
FAA	full extension	not defined	not defined
Transport Canada	full extension	no more than 5° below the horizontal	no more than 30° below the horizontal

Phase 2 - Controlled Testing

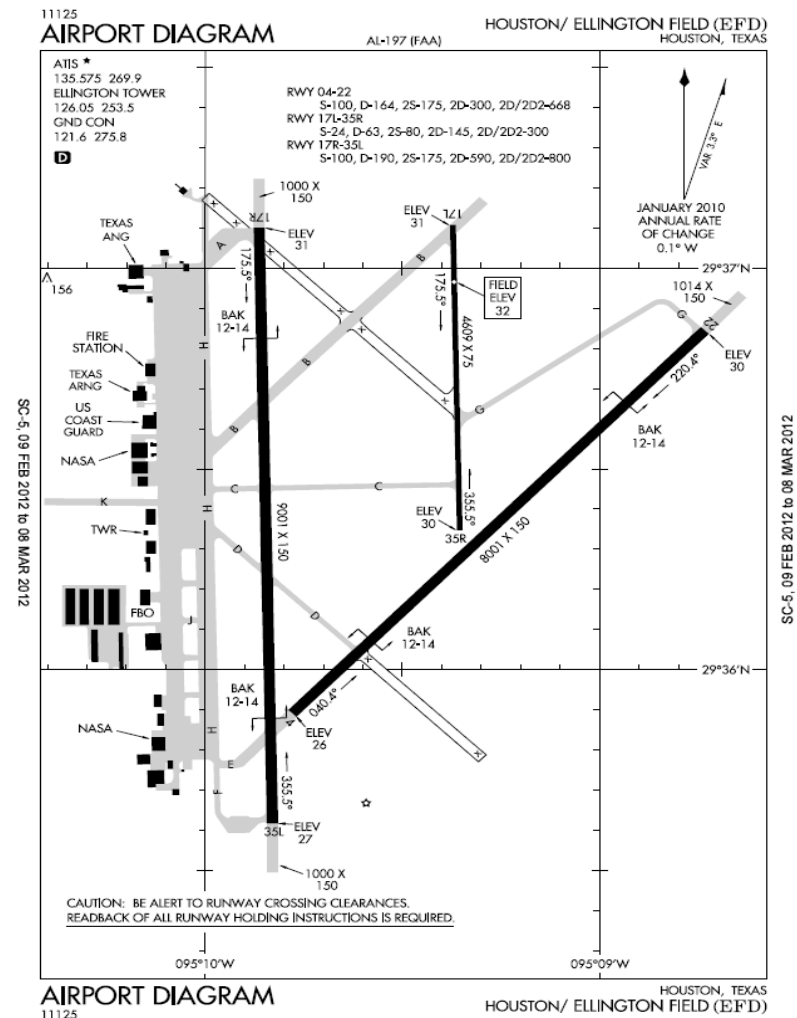
- A series of test will continue to be done on several commercially available internally lighted wind cones to determine how the market measures up to both FAA and International standards for wind cone movement and wind cone sock extension.

Wind Cone Sock Extension Test

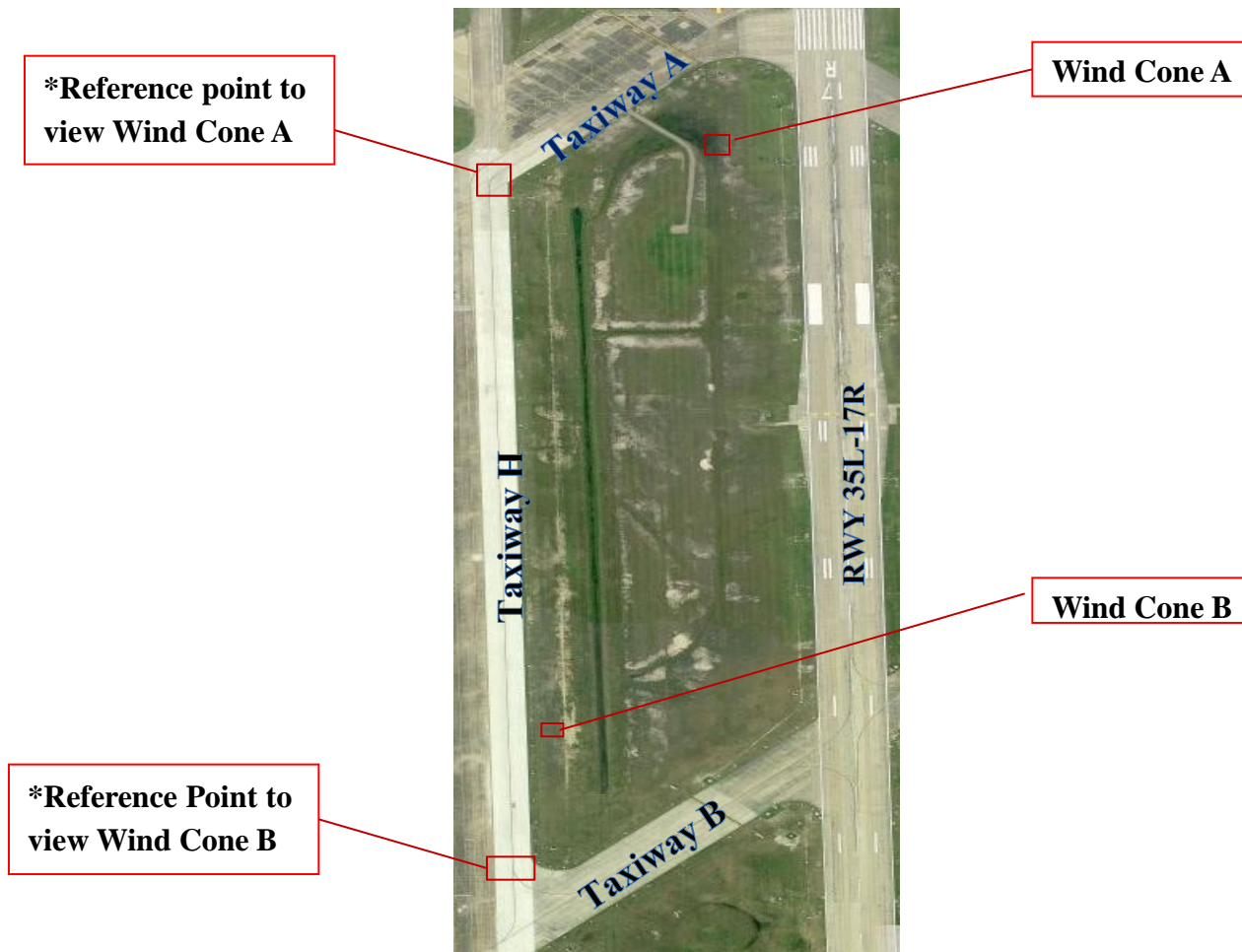
Wind Speeds	0 knts	3 knts	5 knts	10 knts	15 knts	20 knts
FAA	not defined	not defined	not defined	not defined	full extension	full extension
Transport Canada	not defined	not defined	no more than 30° below the horizontal	no more than 5° below the horizontal	full extension	full extension
Test Photos						

Phase 3 - Field Evaluation

- **Agreement reached with Ellington International Airport and their local flight schools Aerosim Flight Academy and Flying Tigers.**
- **Installed at Ellington International Airport are both 12 foot internally lighted wind cones as well as 8 foot internally**
- **Instructors and trainees will complete questionnaires to evaluate if the 8 foot internally lighted wind cone and the 12 foot internally light wind cone both give an adequate indication of the reported wind speed and wind direction conditions.**



Field Evaluation at Ellington International Airport (EFD)



Questionnaire

PILOT PREFLIGHT INFORMATION (Weather information taken from ATIS)

HOURS OF FLIGHT
EXPERIENCE: _____

WIND DIRECTION &
SPEED: _____

CEILING: _____

PILOT
RATINGS: _____

VISIBILITY: _____

DEPARTING
RUNWAY: _____

DATE & TIME: _____

WEATHER
PHENOMENA: _____

**Reference points should be used when viewing Wind Cones 5 & 23 from the ground when completing the pilot wind cone and pilot comparative evaluation sections. Refer to airport map on opposite page.*

PILOT WIND CONE EVALUATION

To what level do you agree that under the following circumstances the wind cone provides an accurate indication of the current wind conditions as reported by ATIS?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Comments
WDI RWY 5 when viewed from the ground:						_____
WDI RWY 23 when viewed from the ground:						_____
WDI RWY 5 when viewed if in pattern at 800ft - 1,000ft AGL:						_____
WDI RWY 23 when viewed if in pattern at 800ft - 1,000ft AGL:						_____
WDI RWY 5 when viewed if on approach:						_____
WDI RWY 23 when viewed if on approach:						_____

PILOT COMPARITIVE EVALUATION

Have you had the chance to evaluate both wind cones A and B during this flight? ☐ Yes ☐ No
If yes, please check the box next to how you would rate the two wind cones compared against each other?

Comments

Wind cone A is better.

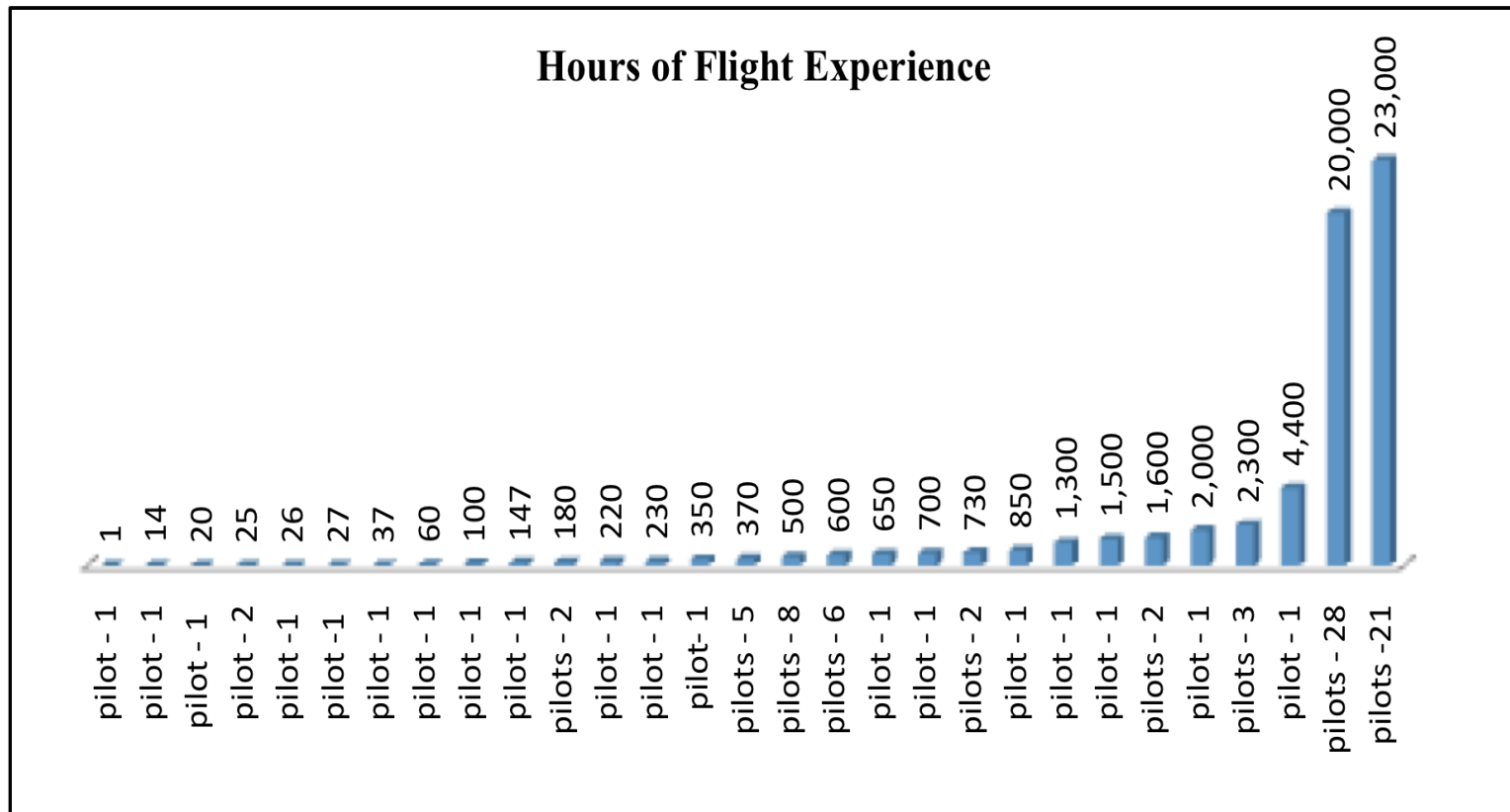
Both are equal.

Wind cone B is better.

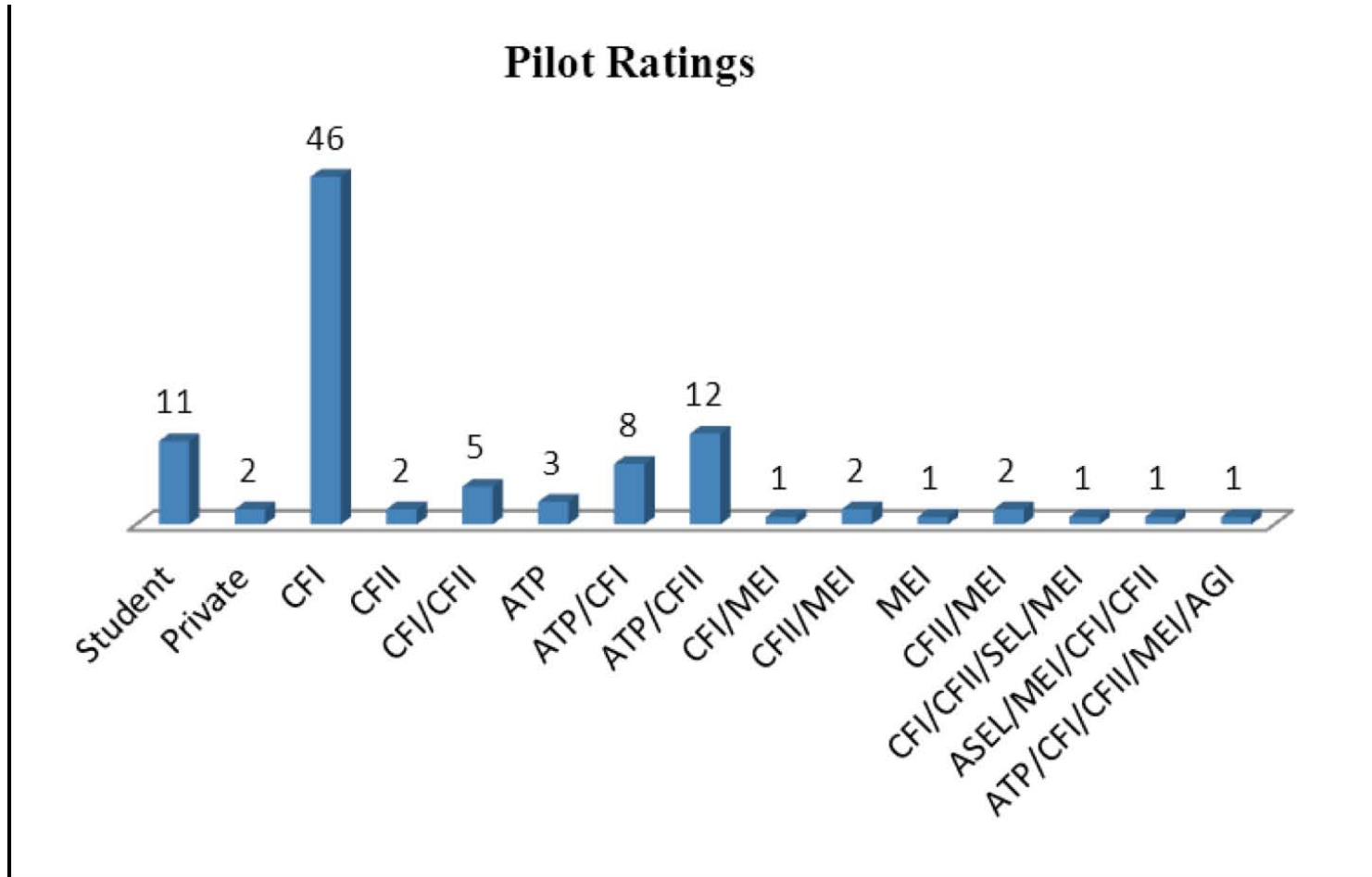
Phase 3 Results

- 98 questionnaires completed
- Each question was broken down further low and high wind velocity conditions
- 81 subjects reported low wind velocity conditions
- 17 subjects reported high wind velocity conditions
- 12 foot internally lighted LED wind cone was perceived by 73% of the respondents as better than the 8 foot internally lighted LED wind cone under low velocity wind conditions

Hours of Flight Experience



Pilot Ratings



Compilation of Phase 3 Results

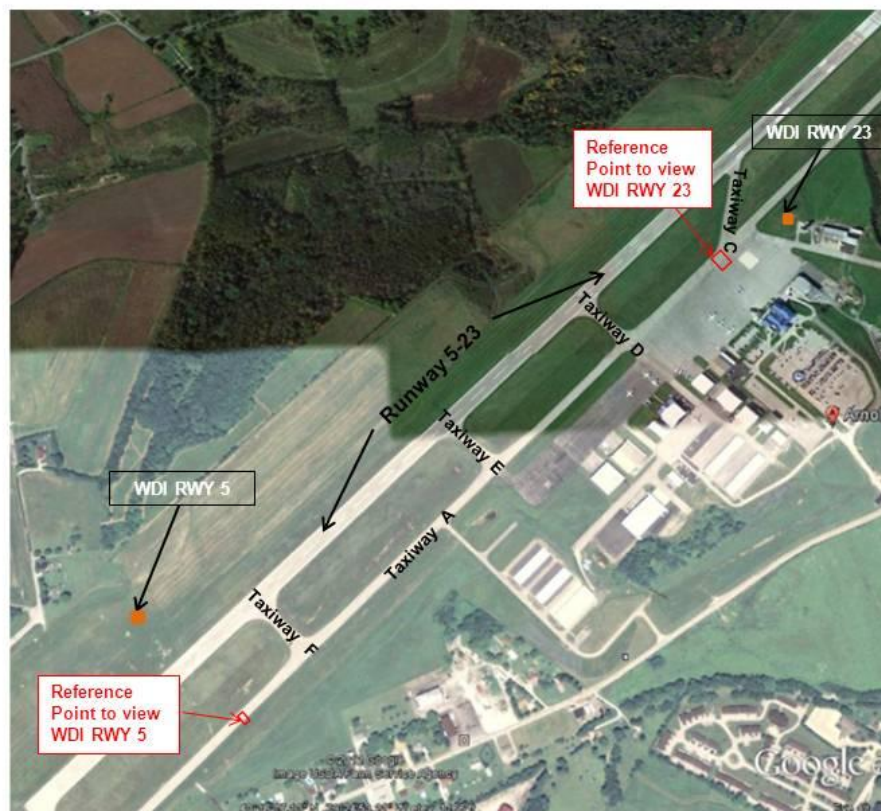
- Question: How do you rate the two wind cones compared against each other?

	Wind cone 'A' is better	Both are equal	Wind cone 'B' is better
How do you rate the wind cones against each other? Overall	3%	21%	76%
Low wind velocity conditions	4%	23%	73%
High wind velocity conditions	0%	12%	88%

Phase 4 – Continued Field Evaluation

- Agreement with Arnold Palmer Regional Airport and Hanscom Field Airport and their local flight schools and FBOs: Westmoreland Aviation Flight School and Vee Neal Aviation; Executive Flyers Aviation and Jet Aviation
- Installed are both an 8 foot internally lighted wind cone as well as 8 foot externally lighted wind cone
- Instructors, trainees and pilots will complete questionnaires to evaluate if while under the same ambient conditions the 8 foot internally lighted wind cone and the 8 foot externally light wind cone both give an adequate indication of the reported wind speed and wind direction conditions

Field Evaluation at Arnold Palmer Regional Airport (LBE)



LBE Wind Cone Locations



RWY 5 near TWY F



TWY A east of TWY C

Field Evaluation at L.G. Hanscom Field Airport (BED)



BED Wind Cone Locations



TWY M and RWY 5



TWY G and RWY 23

Samples of Completed Online Questionnaires

1. Pilot Preflight Information: Hours of Flight Experience, Pilot Ratings, Date & Time

13,000 ATP LR-Jet, CE-650, B-737, CL-600, CL604, G-IV, & G-V

2. Provide weather information taken from ATIS (wind direction & speed, visibility, weather phenomena, ceiling and departing runway.) Please note any wind advisories from ATC

9900, 1 3/4, 1 ovc, RW 11

3. To what level do you agree under the following circumstances the wind cone provides an accurate indication of the current wind condition reported by ATIS for the following 6 questions?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. WDI RWY 5 when viewed from the ground:				X	
2. WDI RWY 23 when viewed from the ground:				X	
3. WDI RWY 5 when viewed if in pattern at 800ft-1,000ft AGL:				X	
4. WDI RWY 23 when viewed if in pattern at 800ft-1,000ft AGL:				X	
5. WDI RWY 5 when viewed if on approach:				X	
6. WDI RWY 23 when viewed if on approach:				X	

Provide any comments you may have for sections 1-6 in the space below: Aren't most operations performed on RW 11/29?

4. Pilot Comparative Evaluation: Have you had the chance to evaluate WDI RWY 5 & 23 during this flight?

No

5. If you answered yes to question 3, check the box next to how you would rate the two wind cones compared against each other.

No Response

Samples of Completed Online Questionnaires Cont.

1. Pilot Preflight Information: Hours of Flight Experience, Pilot Ratings, Date & Time

4100 hrs exp; SEL Inst; 10/6/12 15:30Z;

2. Provide weather information taken from ATIS (wind direction & speed, visibility, weather phenomena, ceiling and departing runway.) Please note any wind advisories from ATC

wind 220 12 G22; vis 10; wx clear; C 200 sct; dep rwy 23

3. To what level do you agree under the following circumstances the wind cone provides an accurate indication of the current wind condition reported by ATIS for the following 6 questions?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. WDI RWY 5 when viewed from the ground:	X				
2. WDI RWY 23 when viewed from the ground:	X				
3. WDI RWY 5 when viewed if in pattern at 800ft-1,000ft AGL:	X				
4. WDI RWY 23 when viewed if in pattern at 800ft-1,000ft AGL:	X				
5. WDI RWY 5 when viewed if on approach:					
6. WDI RWY 23 when viewed if on approach:	X				

Provide any comments you may have for sections 1-6 in the space below.: WDI rwy 5 not observed on approach

4. Pilot Comparative Evaluation: Have you had the chance to evaluate WDI RWY 5 & 23 during this flight?

Yes

5. If you answered yes to question 3, check the box next to how you would rate the two wind cones compared against each other.

Both are equal.

none

Samples of Completed Online Questionnaires Cont.

1. Pilot Preflight Information: Hours of Flight Experience, Pilot Ratings, Date & Time

7810 hours, ATP, CFI, CFII, MEI, 10/5/12

2. Provide weather information taken from ATIS (wind direction & speed, visibility, weather phenomena, ceiling and departing runway.) Please note any wind advisories from ATC

Wind 300 deg at 7, Clear, Vis 10, departed 29

3. To what level do you agree under the following circumstances the wind cone provides an accurate indication of the current wind condition reported by ATIS for the following 6 questions?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. WDI RWY 5 when viewed from the ground:		X			
2. WDI RWY 23 when viewed from the ground:		X			
3. WDI RWY 5 when viewed if in pattern at 800ft-1,000ft AGL:		X			
4. WDI RWY 23 when viewed if in pattern at 800ft-1,000ft AGL:		X			
5. WDI RWY 5 when viewed if on approach:		X			
6. WDI RWY 23 when viewed if on approach:		X			

Provide any comments you may have for sections 1-6 in the space below: Need to depart and land on 5 or 23 to better evaluate, but believe both ends will be fine.

4. Pilot Comparative Evaluation: Have you had the chance to evaluate WDI RWY 5 & 23 during this flight?

Yes

5. If you answered yes to question 3, check the box next to how you would rate the two wind cones compared against each other.

Both are equal

Schedule

Literature Review	08/2011
Laboratory Test	10/11/2011 - 10/14/2011
Field Evaluation (EFD)	3/12/2012 - 5/1/2012
Field Evaluation (LBE and BED)	9/21/2012 – 10/25/2012
Final Report	01/2013