Light Tech Frontier advancing Lighting Technology

Reflector Lens™ Test Program Project – DEEP, Office of the Attorney General at 110 Sherman Street, Hartford CT, EST – ETP-TESTPROG-2015-006

TEST RESULTS REPORT by the Design Office of Lighting Technology, East Hartford CT

1. Executive Summary

a. The purpose of this test program is to validate the effectiveness of the ReflectorLens™ in reducing energy usage and costs or reducing dependence on fossil fuels or greenhouse gas emissions at the designated Test Program Project Location.

b. The Test Plan includes the following steps:

STEP 1: In advance of the Test Date, Lighting Technology will establish and provide to DEEP and DAS the expected baseline conditions for the test program, including, but not limited to, the personnel involved, the time-of-day the test would be conducted, the duration for completion of Steps 5 through 11, the data to be collected, identification of the specific locations where data would be measured and collected, the equipment to be used in conducting measurements; and any other pertinent conditions, subject to review and approval by DEEP and DAS.

STEP 2: In advance of the Test Date, Lighting Technology will provide DEEP and DAS with the methods, formulae, and any assumptions that will be employed for calculating energy usage, energy costs, the cost recovery period, lighting levels, and, if applicable, the reduction of fossil fuel use and greenhouse gas emissions, subject to review and approval by DEEP and DAS. Calculations toward energy costs and the cost recovery period shall use the Rate 30 (Small General Electric Service) tariff in effect for Eversource.

STEP 3: In advance of the Test Date, DEEP and DAS will determine and agree upon a method for receiving feedback from the occupants of the office space, as set forth in Step 12.

STEP 4: DAS will assign one or more representatives, on behalf of DAS and DEEP, to enable access to the office space, to observe the performance of Steps 5 through 11, and to collect and store the thirteen (13) T8 bulbs that will be removed by EST from the fixtures. The assigned representative(s) is otherwise restricted from assisting in the fulfillment of Steps 5 through 11.

STEP 5: On the Test Date, Lighting Technology will record the pertinent baseline conditions at the test bed location, including any changes from the expected baseline conditions established in Step 1.

STEP 6: With the existing thirteen (13) fixtures unchanged, Lighting Technology will establish an illumination baseline by measuring and recording the illumination throughout the entire room at the specific locations identified in Step 1. Lighting Technology will explicitly mark each location temporarily to ensure consistent placement of the measuring equipment.

STEP 7: After completion of Step 6, EST will remove all diffuser panels from the thirteen (13) lighting fixtures. Lighting Technology will establish a separate illumination baseline by measuring and recording the illumination throughout the entire room at the specific locations marked in Step 6.

STEP 8: After completion of Step 7, EST will remove one (1) T8 bulb and insert three (3) ReflectorLens™ over the remaining three (3) T8 bulbs into each of the thirteen (13) lighting fixtures.

STEP 9: EST will re-install all diffuser panels to the thirteen (13) lighting fixtures. After completion of Step 8, Lighting Technology will measure and record the illumination throughout the entire room at the marked locations.

STEP 10: After completion of Step 9, EST will remove all diffuser panels from the thirteen (13) lighting fixtures. Lighting Technology will measure and record the illumination throughout the entire room at the marked locations.

STEP 11: After completion of Step 10, EST will re-install all diffuser panels to the thirteen (13) lighting fixtures.

STEP 12: A period of five (5) business days immediately following the Test Date will be utilized to receive feedback from the occupants of the office space relative to the ReflectorLens™ having been installed throughout the room, in accordance with the method determine by Step 3.

STEP 13: Lighting Technology will perform its calculations of energy usage, energy costs, lighting levels, and, if applicable, the reduction of fossil fuel use and greenhouse gas emissions relative to Steps 6 and 9 (with the diffuser panels on) and Steps 7 and 10 (with the diffuser panels off), using the methods, formulae and assumptions approved by DEEP and DAS as a result of Step 2. Lighting Technology will perform its analyses of these calculations.

STEP 14: Lighting Technology will prepare the Test Results Report, which shall incorporate and include the details, information, calculations, analyses and feedback requested and/or required by Steps 1, 2, 5, 6, 7, 9, 10, 12 and 13 of this Test Plan.

STEP 15: Lighting Technology will submit the Test Results Report to DEEP, DAS and EST within twenty-one (21) days of the Test Date.

c. Independence and fairness of fulfilling the requirements of the Test Plan steps: We reviewed the Illuminating Engineering Society photometrics (tested lighting capability) of typical 2 ft. x 4ft. fluorescent lensed fixtures popularly employed in offices to develop data points of their task effectiveness. Task effectiveness is the measure of a lighting fixture's delivered brightness to the intended area. By developing appropriate task data points from the typical fixture tests, we were able to establish identical data points applicable to the Test Plan existing fixture testing. All assimilated data and analysis provided by Lighting Technology is a direct result of light-meter readings at the developed data points (used at each existing fixture).
d. How the above testing was conducted: The above tests were conducted by placing masking tape at the location of each data point, below each fixture at each task height. For each fixture there were twenty (20) possible data points. The time allotted for this testing was pre-specified. To meet the time allotment in the offices we measured one quadrant of the task area, five (5) data points, as each quadrant is essentially identical in relation to its fixture. For the passageway (hall) we used 20 data points, as its task was throughout the floor. In the office areas, major tasks are at desktop height, (2 ft.-6 in.). In the passageway (hall) the task area is floor level (0 ft.-0 in.). Measurements were taken at or above the masking tape data points.
e. The actual conditions within the testing environment: The condition within the testing environment were not ideal. Penetrating light from sunlight was primarily a concern which could significantly alter true data. Therefore, we predetermined it was necessary to conduct tests only in the evening after dark. The placing of masking tape, the accumulation of data, and the movement of ladders, needed to create Test Steps, often interfered with one another creating a time problem, so the time was extended by one hour. Existing furniture, files and desks were sometimes obstructions. In some cases we used different (whole) quadrants for office readings. In the passageway all walls were not identically spaced. We determined any reading difference would be very marginal. Therefore, we used identical data points for each passageway fixture. The cooperation from property management was excellent. No condition impacted appropriate testing, only time consumed.
f. The data collection methodology: The methodology of data collection involved the accuracy of using the prepared data points. The reading of each data point had to be accurately in accord with the typical data

points developed from similar typical office fixtures. All data points were related to each fixture centerpoint by using a plumb bob to identify the exact centerpoint on the associated task area or floor. Other data points were measured individually to assure data readings related accurately to the associated fixture. As individual light-meter readings were determined each was recorded on a separate form for individual fixtures. This enable the appropriate transmission of the data to organized Excel sheets, enabling schematized analysis.

g. Measures taken to assure the accuracy of the data collected. The measures taken to assure accuracy initially involved preparation. Preparation included the study of suitable similar fluorescent fixtures having recorded qualified test results which facilitated our procedures for accomplishing the Test Plan. This further allowed us to prepare data accumulation sheets, one for each fixture, assuring accurate data recognition and transferable exactness. With this accurate data, correctly applied to Excel sheets, the appropriateness of analysis was assured.

h. A brief summary of test results: The test results clearly indicate that there is an insignificant difference with ReflectorLens™ when they are used alone compared to when they are used with clean, non-yellowed, undamaged previous lenses. It is acceptable to conclude ReflectorLens™ does not noticeably reduce, and often increases fixture illumination when the number of bulbs per fixture is reduced by 25% to 50%. It may be estimated that ReflectorLens™ can, on the average, reduce energy consumption by 33%.

2. Report Reference

a. Test Plan steps 6, 7, 9, and 10 involve Lighting Technology light-meter measurements.

b. Step 6 addresses the existing fixtures as is. Step 7 addresses the existing fixtures with their diffusing panels removed. Thus the step 6 lensed bare fluorescent bulbs were exposed.

c. The comparative tests of steps 6 and 7 indicate a 5% increase of task illumination for office areas, and a 22% decrease in illumination for the passageway (hall).

d. The overall illumination, including both the office areas and the passageway calculated to a decrease of 10%.

e. Step 9 re-addresses the existing office fixtures with their diffussing panels back on, but with only three (3) fluorescent bulbs (one had been removed in step 8). Each of those three (3) fluorescent bulbs were equipped with a ReflectorLens™ in step 8. In the same manner the existing passageway fixtures were outfitted with only two (2) bulbs with ReflectorLens™. Thus, step 9 was tested as if the original fixtures were originally outfitted with ReflectorLens™, but with less bulbs.

f. The comparative tests of steps 6 and 9 indicate a 8% increase of task illumination for office areas, and a 20% decrease of task illumination for the passageway. This resulted in an appropriate 0% increase/decrease overall, regardless of the significant decrease in the number of fluorescent bulbs installed.

g. Step 10 re-addresses the existing office and passageway fixtures with their diffusing panels removed, leaving only the diffusing of each the previously installed ReflectorLens™ in action.

h. The comparative tests of steps 6 and 10 indicate a 12% increase of task illumination for office areas, and a 12% decrease of task illumination for the passageway. This resulted in a 4% increase overall, regardless of the significant decrease in the number of fluorescent bulbs installed.

i. Considering the comparative testing data of each office area with Illuminating Engineering Society (IES) recommendations, all office areas met or exceeded IES recommendations except the office area fixtures we identified as D and E. The office areas illuminated by fixtures D and E are overlit with ReflectorLens™ due to the closeness to one another of these two fixtures. Removing more lamps and their associated ReflectorLens™ would solve over-lighting conditions. All passageway data comparative data with IES recommendations identifies over-lighting, which also is correctable by removing more lamps and their associated ReflectorLens™.

3. Original Test Results Report

a. Methodology:

Lighting Technology reviewed photometrics of typical 2x4 fluorescent recessed lensed fixtures popularly employed in offices to develop appropriate data points of their task effectiveness. Such data points are

found within the illuminated area defined as not less than 50% of a lamp or fixture centerpoint illumination. Twenty equally-spaced such data points were identified. It is those data points I replicated at appropriate task heights (2ft-6in AFF in offices, 0ft-0in AFF in Hall/passageway) for testing. For each Office Fixture we utilized one quadrant (5 data points) plus ¼ of the fixture centerpoint data (projected). Only 25% of centerpoint data affects a quadrant in the office areas. The Hall data points included, by necessity, 100% of centerpoint data, as its data point and the 5 others were wholly within the area of task effectiveness. Data points were marked with removable masking tape rather than initially intended chalk.

1) Steps 6, 7, 9, and 10 were defined by ATTACHMENT A of the TEST PLAN.
2) Step portions 1, 2, 3, 4. 5, 6, and 7 are the data point readings applicable.
3) Data point diagrams are attached.
4) The squares referenced below are each in the same quadrant.
5) Office Fixtures
   1 - Centerpoint (neglect)
   2 - 25% of the centerpoint
   3 - The opposite corner of a 1ft x 1ft square drawn from the centerpoint
   4 and 6 - The adjacent corners of a 2ft x 2ft square drawn from data point 3
   5 and 7 - The adjacent corners of a 2ft x 2ft square drawn from data point 4
6) Hall Fixtures
   1 - Centerpoint
   2 - 25% of the centerpoint (neglect)
   3 and 7 - 1ft-10in from the centerpoint on opposite sides, perpendicular and close to the side partitions
   4 and 6 - 2ft-0in from the centerpoint on opposite sides, parallel to the side partitions
   5 - Half-way between associated centerpoints, parallel to the side partitions
      (3 and 7dimensions are limited by the distance between sidewalls)
      (Distances were kept equal where partitions varied)
      (5 - of Fixture F is equal-distant from centerpoint as 5 of Fixture G)
      (The extra reading of Fixture I is equal-distant from centerpoint as reading 5)

b. Data Calculations and Notes of Compliance or Variation Thereof

These calculations use the collected data directly.

All conditions of the Plan Steps intent were met except as varied herein by noted necessities required for the appropriate completion of those steps.

Step 6 markings proved to be more time consuming than planned due to pre-existing owner obstructions. Measuring method adjustments assured appropriate data readings and consistency throughout each succeeding Step.

Step 7 became limited with the shortage of time. One Office and one Hall/walkway fixture as provided were fully tested. All other Steps were completed in full.

Step 8. I noted 2 Reflector Lens with lamps were inserted into each of the 4 Hall fixtures, and 3 were inserted into each of the 9 Office Fixtures. Any other Step, observations, calculations or analyses herein took this into effect.

Step 13. Lighting Technology's calculations clearly identify lighting levels in footcandles and relative energy usage in Watts. Lamps are rated 24 Watts, connected load. Watts is proportional to energy usage, fossil fuel use, greenhouse gas emissions, etc. As variables such as changing rates, electric generation costs, generation source availability, non-fossil generation, power factor, demand charges, and actual hours of lighting use affect all calculations beyond our Watts analysis, Lighting Technology's up-to-date ability is limited.

When the following formula is used, the comparisons of Step Data would be complete. Energy Saving Technologies and DEEP/DAS can concur on the variables they wish to consider effective for any valuable extended analysis.

Watts/1000 x Hrs of Use per Year x $Cost/KWh = Energy Cost per Yr

c. Footcandle Preferences

IES derived:

For offices, 15 to 30fc @2.5ft AFF

For circulating corridors/adjacency passageways, 3fc, Ave/Min @ 0ft AFF

Lighting Technology practice:

For common modern office work, 20fc average is adequate

For interior passageways, 5 to 7 fc is preferred

d. Data Collection and Calculations

Step 6. Fulfilled.

Step 7. Sufficient, but limited data obtained.

Step 8. Fulfilled, but there were only 2 bulbs with Reflector Lens in the 4 Hall Fixtures

Step 9. Fulfilled as herein noted.

Step 10. Fulfilled as herein noted.

Step 13. See below.

Step 14. Performed as included herein.

Step 15. Completed and being transmitted within 21 working days after data collection of 7/14-7/15/17.

Based on the available data as collected the following recognizes: the existing bulb wattage was 13 Fixtures with 4 bulbs each, 13 x 4 x 25 Watts/bulb, 1300 Watts total; the bare bulb test wattage, adjusted for the procedures as below, was 9 Fixtures with 3 bulbs each, plus 4 Fixtures with 2 bulbs each, (9 x 3 x 25) + (4 x 2 x 25), 875 Watts total.
Therefore, a 33% wattage reduction was able to be reasonably considered, in addition to a parallel conservative estimate based on testing if 4 bulbs were in each bare bulb test. This approach is from our computerized relative simulation of the Test Plan requirement.

Comparing Office Fixture B data with (using 4 bulbs) and without lenses (using 3 bulbs) indicates a 9% drop in fc.
Adding a fourth bulb would indicate about 20 x 1.15* = 23 fc potential, an approximate 5% fc increase in task illumination, considering the 5 selected data points.
Adding a fourth bulb would indicate about 20 x 1.16* = 23 fc potential, an approximate 5% fc increase in task illumination, considering only the 4 selected data points meeting the 50% of centerpoint criteria.
Each approaches confirms the other, suggesting appropriateness.

Comparing Hall Fixture G data with (using 4 bulbs) and without lenses (using 2 bulbs) indicates a 41% drop in fc.
Adding 2 bulbs would indicate about 20 x 1.50* = 30 fc potential, an approximate 10% fc decrease, considering the 5 selected data points.
Adding 2 bulbs would indicate about 20 x 1.00* = 20 fc potential, an approximate 0% fc difference, considering none selected data points met the 50% of centerpoint criteria.
Neither approach confirms the other, suggesting appropriateness might exist at about 25 fc, a 22% decrease in task illumination.

*There are generally diminishing returns when bulbs are added within the same reflective optics.

4. Supporting Documents

The Collected Data Points

Fixture	**A**	**B**	**C**	**D**	**E**	**F-hall**	**G-hall**	**H-hall**	**I-hall**	**J**	**K**	**L**	**M**

As Exists													
Step 6-1	41	32	31	39	49	27	29	25	23	40	37	39	32
Step 6-2	10	8	8	10	12	7	7	6	6	10	9	10	8
Step 6-3	33	31	25	41	47	25	31	24	24	34	39	37	29
Step 6-4	28	28	22	37	40	21	27	24	23	29	31	22	21
Step 6-5	21	19	15	30	28	16	38	30	22	23	22	20	15
Step 6-6	30	24	22	45	46	36	35	24	24	19	33	31	25
Step 6-7	24	19	15	39	36	27	32	26	20	21	28	24	19
									20				
Ave fc	**24**	**22**	**18**	**34**	**35**	**25**	**32**	**26**	**22**	**23**	**27**	**24**	**20**
Ave fc of all 13 fixtures:	**25**				**Ave fc of 9 office fixtures:**	**25**				**Ave fc of 4 hall fixtures:**	**26**		
BareBulbs													
Step 7-1		30					16						
Step 7-2		7.5					4						
Step 7-3		29					19						
Step 7-4		25					18						
Step 7-5		19					22						
Step 7-6		22					21						
Step 7-7		19					19						
Ave fc		**20**					**19**						
Ave fc of these 2 fixtures:	**19.5**				**Ave fc of office fixture:**	**20**		**20**		**Ave fc of hall fixture:**	**19**		
Fixture	**A**	**B**	**C**	**D**	**E**	**F-hall**	**G-hall**	**H-hall**	**I-hall**	**J**	**K**	**L**	**M**
RL w/Lens													
Step 9-1	37	42	37	42	49	22	24	23	19	39		37	33
Step 9-2	9	10	9	10	12	5.5	6	6	5	10		9	8
Step 9-3	36	39	33	46	51	19	24	23	19	33	38	35	30
Step 9-4	29	30	28	40	40	17	24	24	15	25	36	32	25
Step 9-5	22	20	19	31	33	12	26	26	19	18	27	30	18
Step 9-6	28	31	30	47	43	31	25	23	19	23	31	26	23
Step 9-7	22	26	22	42	39	20	24	24	19	18	18	25	22
									17				
Ave fc	**24**	**26**	**24**	**36**	**36**	**20**	**25**	**24**	**18**	**21**	**30**	**26**	**21**
Ave fc of all 13 fixtures:	**25**				**Ave fc of 9 office fixtures:**	**27**				**Ave fc of 4 hall fixtures:**	**22**		

RL only													
Step 10-1	39	40	35	45	46	25	25	24	20	41	39	39	34
Step 10-2	10	10	9	11	7.5	6	6	6	5	10	10	10	8.5
Step 10-3	35	37	32	46	46	20	25	25	20	34	37	37	33
Step 10-4	30	31	27	29	42	20	24	24	22	28	31	35	27
Step 10-5	23	23	21	32	35	15	27	28	22	21	22	34	21
Step 10-6	30	29	29	45	44	33	29	24	21	25	34	30	26
Step 10-7	24	25	23	39	41	21	23	25	16	20	30	29	23
									21				
Ave fc	**25**	**26**	**24**	**34**	**36**	**22**	**26**	**25**	**20**	**23**	**27**	**29**	**23**
Ave fc of					**Ave fc of**					**Ave fc of**			
all 13					**9 office**					**4 hall**			
fixtures:	**26**				**fixtures:**	**28**				**fixtures:**	**23**		

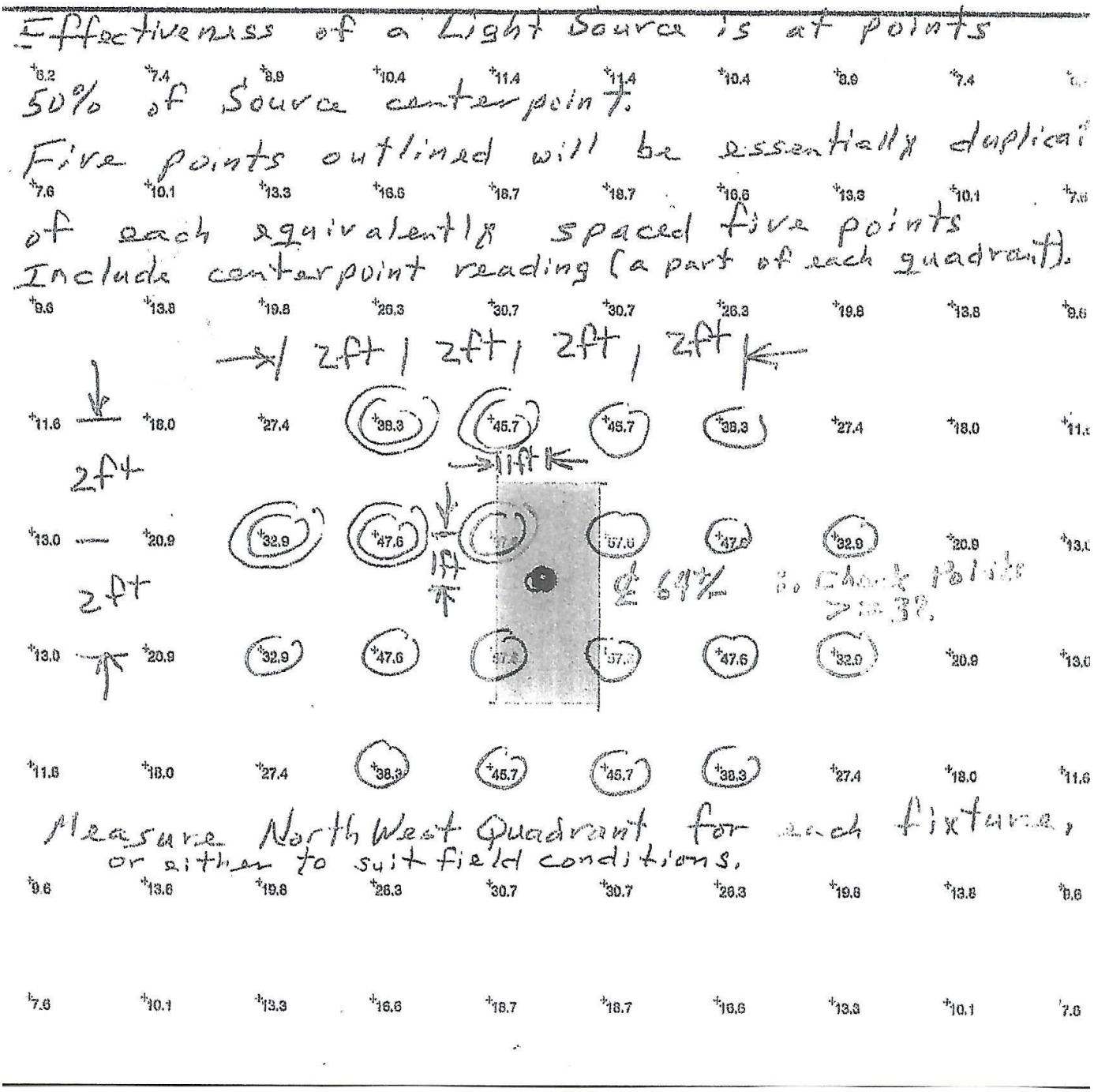
DATA POINT NOTES:

a. Office Fixture test task areas were predetermined by IES photometrics of similar prevalent fixtures. Five points were chosen and marked to represent the best arrangement within the appropriate fixture task area.
b. All Steps '-1' recorded for office fixtures, A B C D E J K L M, were excluded from Ave fc, as Steps '-2' (1/4 of Step 1, calculated,) represented that point for the task area test data.
c. All Steps '-2' recorded for hall fixtures, F G H I, were excluded from Ave fc, as Steps '-1' represented hall floor test data.
d. We measured Step 7, BareBulbs, test data for the B and G fixtures as shown above. B had three (3) bulbs. G had two (2) bulbs. Other options were not available due to time constraints.

DATA POINT OBSERVATIONS:

a. The Step 6 'As Exists' and Step 9 'RL w/Lens' fc results for the 13 Fixtures were surprisingly similar.
b. An approx. 8% improvement in Office Fixture Task fc occurred testing Step 9 ('RL w/Lens' + 25% bulb reduction).
c. An approx.15% decline in Hall Fixture Task fc occurred testing Step 9 ('RL w/Lens' + 50% bulb reduction).
d. An approx. 28% decline occurred for the Step 7 ('BareBulbs' + bulb reduction) 2 Fixtures tested.
e. An approx. decline of 9% in Office Fixture Task fc occurred testing Step 7 ('BareBulbs' + bulb reduction).
f. An approx. decline of 41% in Hall Fixture Task fc occurred testing Step 7 ('BareBulbs' + bulb reduction).
g. The Step 6 'As Exists' and Step 10 'RL0nly' fc results for the 13 Fixtures indicated an approx. 4% improvement.
h. An approx. 12% improvement in Office Fixture Task fc occurred testing Step 10 ('RL0nly'' + 25% bulb reduction).
i. An approx. 12% decline in Hall Fixture Task fc occurred testing Step 10 ('RL0nly'' + 50% bulb reduction).

Computer generated diagram identifying the general Data Points associated with the Office Fixture task area. The Hall Fixtures required similar Data Points rearranged to suit its geometric proportions.



5. Conclusions and/or Recommendations

Our conclusions regarding the outcome of each comparative test are as follows:

When we compared Steps 6 and 7 -

Bare bulb data indicated Office Fixtures experience a 5% fc increase of task area illumination without lenses.

Bare bulb data indicated Hall Fixtures experience a 22% fc decrease of task area illumination without lenses.

This calculates to a 10% decrease overall.

When we compared Steps 6 and 9 -

Using ReflectorLens with existing Lenses indicated a 8% increase of task area illumination in office areas, a 20% decrease of task area illumination in the hall. This calculates to a 0% increase/decrease overall.

When we compared Steps 6 and 10 -

Using ReflectorLens without existing Lens indicated a 12% increase of task area illumination in office areas, a 12% decrease of task area illumination in the hall. This calculates to a 4% increase overall.

When we compared IES derived illumination suggestions with the data -

All office area fixture data was acceptable except D and E. D and E task areas were overlit due to the closeness of the two fixtures.

All hall area fixture data identified excess illumination.

It is safe to reduce D and E fixture task illumination by 40%, and passageway (hall) area illumination by 70%.

Our effective comparison of the illumination Test Plan results is as follows:

When ReflectorLens™ were used during testing three (3) bulbs were used in the office fixtures, and two (2) bulbs were used in the passageway (hall) fixtures, rather than the four (4) bulbs used in each without ReflectorLens™.

The test results indicate a 8% increase when ReflectorLens™ is used combined with the existing office fixture lenses, and a 12% increase when ReflectorLens™ is used without the existing office fixture lenses.

The test results indicate a 15% decrease when is used combined with the existing passageway (hall) fixture lenses, and a 12% decrease when ReflectorLens™ is used without the existing passageway (hall) fixture lenses.

The no ReflectorLens™ test results indicate a 8% decrease when bare bulbs are used without the existing office fixture lenses, and a 27% decrease without the existing passageway (hall) fixture lenses.

The effectiveness of ReflectorLens™ considering the above, is:

It enhances task illumination while significantly reducing electricity consumption about 33%.

It allows further reduction of electricity consumption, about 30%, by correcting excess illumination.

Through ReflectorLens™ enhancement the 1300 Watt connected load is reduced to 875 Watts.

By eliminating excess illumination the 875 Watt connected load might be reduced to 600 Watts.

As a result -

Lighting energy costs would be reduced about 33%.

The dependence on fossil fuels and their greenhouse gas emissions would be proportionally reduced, depending on the proportion purchased from non-fossil sources.

The true cost of this product, weighing projected and potential savings against the cost of retrofitting existing fixtures, is based on this applicable formula, Watts/1000 x Hrs of Use per Year x $Cost/KWh = Energy Cost per Yr.

The following describes the variables:

Watts varies between the existing fixtures, those fixtures fitted with ReflectorLens™, and those fixtures fitted with ReflectorLens™ as modified to IES (Illumination Engineering Society) recommendations.

The estimated Hrs of Use vary with actual project use. The selected conservative estimate will be 8 hrs/day, 5 days/week, 52 weeks/year, not considering maintenance and custodial use, totaling 2080 hrs/year.

The estimated average cost of electricity we use will be $0.16/KWh.

All variables would subject to the existing variables of each proposed project.

The cost of electricity per year for existing fixtures is:

1300Watts/1000 x 2080Hrs x $0.16/KWh $434

The cost of electricity per year for existing fixtures fitted for with ReflectorLens™ is:

875Watts/1000 x 2080Hrs x $0.16/KWh $291

The cost of electricity per year for existing fixtures fitted to suit IES (Illumination Engineering Society) recommendations with ReflectorLens™ is:

600Watts/1000 x 2080Hrs x $0.16/KWh $200

The respective annual savings would be $143, and $234.

There are 13 total fixtures in the Test Plan Area. The total cost of retrofitting those fixtures with ReflectorLens™ is $980.

We therefore conclude it is quite reasonable to retrofit with ReflectorLens™, whether or not the space is considered for being fitted to suit IES (Illumination Engineering Society) recommendations.

The life cost of this product is essentially without cost to the user.

The ReflectorLens™ is covered against manufacturing defects by the manufacturer's five year warranty.

The ReflectorLens™ requires no electrical connections or electrical retrofit of any kind. Therefore it neither adds nor necessitates electrical power except that to the existing fixtures.

Simple payback is the cost of the product divided by the reduced operating cost of the product.

Current CL&P incentives are 40% for this product, and are deducted as shown below.

The payback for existing fixtures fitted for with ReflectorLens™ is: $980-$392, divided by $143, 4 years 1 month.

The payback for existing fixtures fitted to suit IES (Illumination Engineering Society) recommendations with ReflectorLens™ is: $980-$392 divided by $234, 2 years 6 months.

Not considered are the following additional savings:

Light bulb purchases are reduced by 33%.

Light bulb recycling costs are reduced by 33%.

Task orientated lighting increases operating proficiency much more than 1%, depending on tasks performed.

Following are my professional recommendations regarding the viability of this product and its suitable variations.

Finally, there is a lighting retrofit product installable without electrical fixture changes.

This is not a product suitable for new buildings, or gutted building re-design.

It is quite suitable for buildings being retrofitted or remodeled.

It is also ideally suits buildings needing lighting upgrades or redesigns.

The highpoint of ReflectorLens™ - it is impressively suited for limited budgets.

Property managers, facility managers, and building owners finally have a choice for fixing older building lighting systems economically, without fuss or nuisance, especially as older buildings sometimes have yellowed or broken, sometimes irreplaceable, lenses.

ReflectorLens, as it name implies, is a retrofit combination reflector and lens capable of totally replacing both the reflector and lens of an existing fluorescent fixture (its total optics).

DOE stated on March 8, 2017, "A [retrofit] product using the existing luminaire's [lighting fixture's] optical system will have a lower efficiency than when it's tested by itself."

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