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A few notes on the validity of Photometric Data (IES) files.

There are two major reasons that customers seek photometric testing, one is to validate performance parameters for a product and the other is to obtain photometric data that can be used for design purposes. Typically this is via a photometric data file such as IES or ELUMDAT and from here on I'll refer to these as IES files.

Over the years we have helped many customers with issues of photometric data quality and usability within their lighting design program and the question really comes down to a matter of trust - can the customer trust the IES file data they are using in a lighting design? This is important as there is a great responsibility on the designer to provide a lighting solution that meets the specifications for the design, not only performance but regulatory and to also to provide a documentary trail of evidence.

We have all heard of the saying 'junk in junk out' and this is particularly true in lighting calculations, using an incorrect IES file will lead to incorrect calculations which may not be picked up until after the system is installed hence not validating the IES file can have consequences. Given this situation we feel it is vital that users validate photometric data before use in designs. Here are some methods.

1. Comparison of the data against a Photometric Test Report

It is common for various energy efficiency programs (eg. DLC¹/VEET²) to require that photometric data be from an accredited (eg. NVLAP³/NATA⁴) laboratory so it needs to be noted that although test reports can be marked as accredited IES files cannot. This is because they are plain ASCII text files that can be opened and edited at will whereas a photometric report is a formal signed document.

All IES files should be derived from a photometric test on a *physical product* and if so the IES file will mention the Test Report No. in the header data of the file. Open the .IES file (notepad is fine) and look for it among the keywords [square brackets] and then seek a copy of that report from the supplier.

Example extract from an IES file header:

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[TEST] LL12345  
[TESTLAB] LightLab International
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There have been many instances where the IES file has been produced from an optical design program (sometimes called virtual photometry) and so the IES file itself is just a prediction of the performance, it is not its *actual* measured performance. In this case there is no test report and no formally measured proof of performance along with its commensurate traceability back to a national standard.

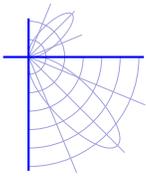
Once a photometric report is available here's a short list of items to look at :

- Total lumen output, compare this to the lumen output as indicated in the lighting design program (eg. AGi32⁵) or in a photometric data program (eg. Photometric Toolbox - PTB⁶). Is it the the same as in the report?
- Watts. The watts should be the total circuit watts of the luminaire including any gear losses, match what is displayed in the lighting program after the IES file loaded ?
- Does the description, cat. number, no. of lamps (LEDs) etc. align with the actual product? Is the IES file for the same product that was actually tested? Many IES files are clones of an original with data modified such as lumen output, candela multipliers and text entries. Note that it is normal for a supplier to edit description fields in IES files so that the text aligns with the company's marketing terminology
- For LED luminaires is the Lumen Output field set to -1 ? LEDs are tested using absolute photometry and having the Lumen Output field set to -1 is a formal requirement of the Standard that defines IES Files, LM-63⁷. Here's an extract :

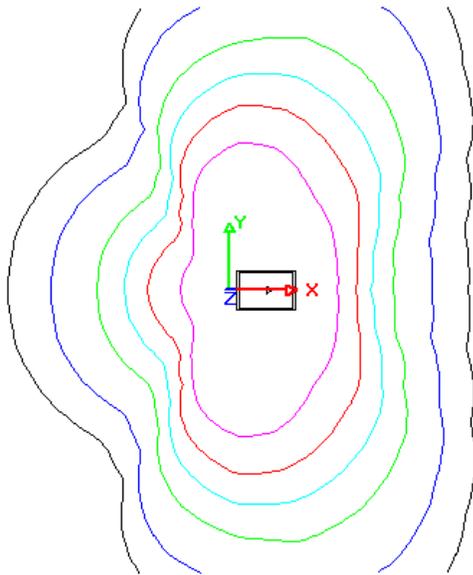
5.5 <lumens per lamp>
This field shall contain a number indicating the lumens per lamp on which the photometric test is based. In the case of absolute photometry, where the lumens per lamp are not the basis for the photometric data, enter negative one (-1).

The Lumen Output Field being set to -1 is used as a flag within the lighting design program to prevent the user from altering the lumen output of the luminaire and calculating incorrect values. If the lighting program you are using allows the lumen output to be modified for LEDs then this field in the IES file has a +ve value which is incorrect. The lumen output field is the second number following the TILT= keyword in the IES file. Note the -1 in the example below.

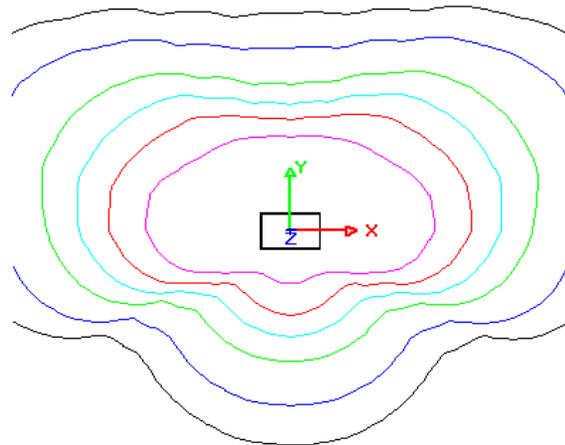
TILT=NONE
768 -1 1 361 19 1 2 0.192 0.005 0.192



- Does the beam formation in the report agree with what is observed when using the IES file in a lighting program? More often than you might think the beam, or actually the luminaire photometry, is rotated 90 degrees. Uplights might be reported as downlights as well. Use of a simple isolux diagram that can be printed off, initialed as correct, and filed is a really a minimum effort to ensure this does not present design issues later. The last page of this document shows an example.

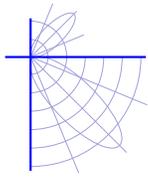


Street light luminaire with photometry oriented correctly (across the street is +X)



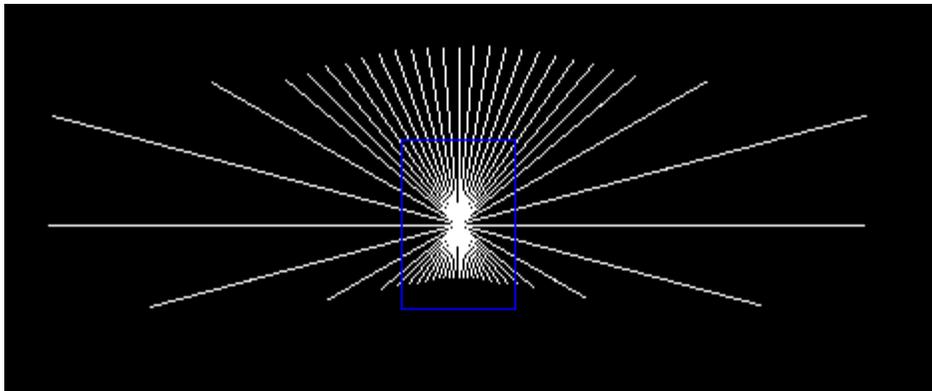
This file has the photometry rotated 90 degrees so any tilt/upcast applied would be along the street (the luminaire would be “twisted sideways” and not tilted).

- Looking at the photometric test report was the luminaire tested in its normal operating position? This is a requirement for photometric tests conducted in accordance with LM-79 as operating the luminaire in other positions can and will change the thermal characteristics and hence the light output. The report must state (Section 14 item h. in LM-79⁸) in what operating position the luminaire was tested and the IES file needs to align with that. eg. if the luminaire is wall mount then after it is loaded into the lighting program, without any tilt ,the isolux plot must demonstrate it is wall mounted.

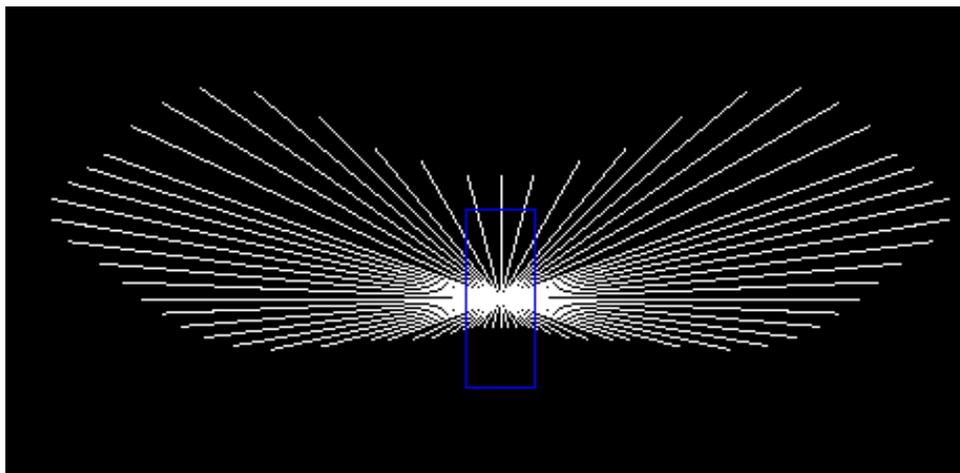


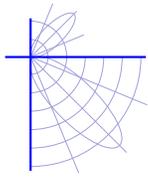
- For beam forming luminaires such as floodlights and streetlights do the concentration of measured c-planes align with the beam ? Accurate calculations of a beam requires sufficient measurements points within the beam to fully describe it and certain standards (eg. AS1158^{9.2} 4.3.3) require a minimum set of c-plane angles to be measured during photometry. This can usually only be checked using a photometric manager program such as PTB.

Plan view - The beam on this streetlight luminaire runs left/right (along the road) yet the c-planes have a large angular spacing there - this luminaire was tested 90 degrees out of alignment horizontally so the c-plane candela data does not accurately map the beam.



A good example - notice that the c-planes are concentrated where the beam is - left/right.

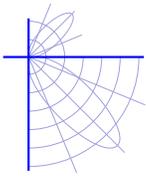




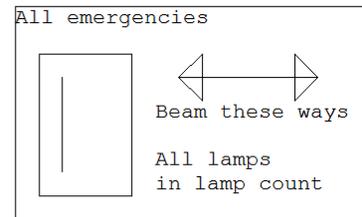
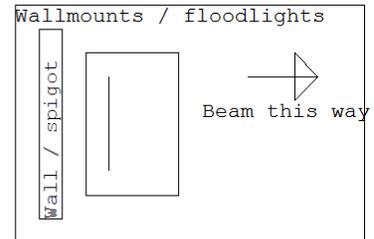
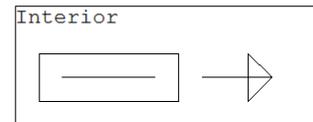
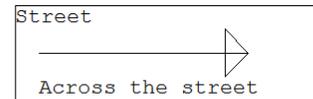
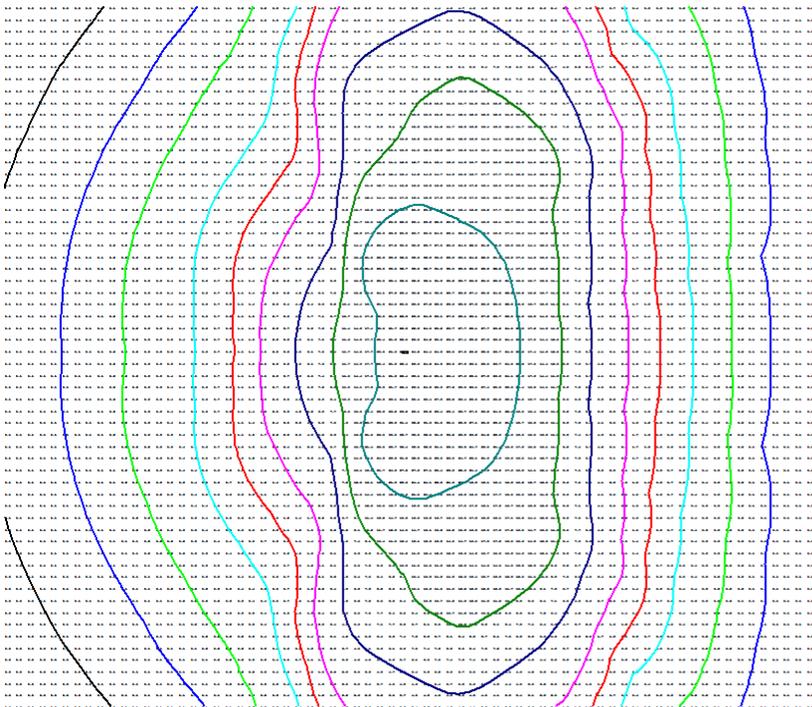
- Does the report have light emitted from the luminaire at angles not supported by the luminaire optics? Example would be a fully recessed downlight which would not have any useful light above the horizontal. Does the IES file have candela values above 90 ? If so then these values will be noise or what is called stray light and which can be particularly problematic when the luminaire is specified as full cutoff - the light above the cut-off line will make photometric analysis programs report it as non-cutoff or uplight $<>0$ in the BUG¹⁰ rating. Look for intensity values at zenith (gamma 180) or above the full cutoff line for if the luminaire optics do not support light being emitted at these angles, yet the report has that, then chances are the IES file will too. This is far more common than you might think and can be a real problem for computations where stray light might cause issues - eg obtrusive light, emergency lighting and of course BUG ratings. Looking after these seemingly small details are the hallmarks of long standing, quality driven, photometric laboratories.

2. When the Photometric Report isn't available

- Consider alternatives as there is no defensible way of validating the data and any calculations using the file have no traceability back to a national measurement standard.
- Some manufacturers may have scaled the data from another tested product and this is happening more and more with LEDs. Scaling is appropriate in certain situations or within certain product groups so check with the supplier on the scaling and have them supply in writing the method they have used. Keep this as evidence of your validation process as it demonstrates a measure of due diligence. If the supplier cannot offer their method in a written form, or it doesn't make technical sense, then that goes to the lack of validity of the IES file.
- Run the IES file through a lighting design or photometric utility program and cross-check that the lumen output, watts, efficacy (lm/W), beam distribution and beam rotation is actually what you expect. Again refer to the last page is an example for use as a guide in making up your own. This is a confidence builder only and does not provide any form of traceability with calculations but it is the bare minimum you should do.
- Look out for IES files for LEDs where the lumen output is changeable within your lighting program, if this can be done then the IES file might be scaled. If you can change the lumen output don't without validation from the supplier.



IES file check template - Copyright 2016 LightLab International.



Revision 1.8 (5 Jul 14)

Luminaire Schedule						
Symbol	Label	Lum. Watts	No. Lamps	Dimensions ok?	[LUMCAT]	BUG Rating
	Example Only	45	40		Sample LED Streetlight	B1-U0-G1

References :

1. Design Lights Consortium (www.designlights.org)
2. Victorian Energy Efficiency Target (www.veet.vic.gov.au)
3. National Voluntary Laboratory Accreditation Program (www.nist.gov/nvlap)
4. National Association of Testing Authorities, Australia (www.nata.com.au)
5. Agi32 Lighting Design Software (www.agi32.com)
6. Photometric ToolBox (www.agi32.com)
7. LM-63 IES LM 63:2002 (R2008) Standard File Format For Electronic Transfer Of Photometric Data, Illuminating Engineering Society (www.ies.org)
8. LM 79:2008 Electrical And Photometric Measurements Of Solid-state Lighting Products, Illuminating Engineering Society (www.ies.org)
9. AS/NZS 1158.2:2005 Lighting for roads and public spaces - Computer procedures for the calculation of light technical parameters for Category V and Category P lighting, Standards Australia (www.standards.org.au)
10. IES TM-15-11 Luminaire Classification System for Outdoor Luminaires, Illuminating Engineering Society (www.ies.org)