Instructions for participants in the 2025 AERC inter-laboratory comparison for measurements of optical properties of shading materials

Introduction

Laboratories that submit data to the Complex Glazing Database (CGDB) for use by the Attachment Rating Energy Council (AERC) rating program have to participate in an inter-laboratory comparison (ILC). This a procedure that allow both contributors and database maintainers to confirm that the measurement capabilities of the laboratories are of high quality.

This is the second time the procedures in AERC 1.1 is used in an ILC and the samples have been selected to exercise some of the refinements that happened since the 2017 ILC.

The box

Each box is labeled on the outside with its number, e.g. Box 04. All reports will use this number as identifier rather than the name of the individual laboratories.

The 2025 shading material ILC consists of 5 samples that are chosen to cover a range of properties and measurement procedures:

1. White and gray roller shade with horizontal weave, lighter on the front than back.
2. Organic straw-looking weave with large area inhomogeneity.
3. Cellular shade wall fabric with fluorescence.
4. Ensemble of 6 dark shade screens for sample variability test AERC 1.1 Appendix B
5. Generic White blind slat with curved surface

Each sample have a sticker defining the front side and up side of the sample. When measuring the transmittance and reflectance of the front side, light should be incident on that surface. If the sticker has fallen off, please use photographs in this document to identify sample number and orientation. The sticker also has a number on it showing which sample it is, prefixed by the box number (e.g. 14-2 is sample 2 in box 14).

Handling and storage recommendation

Try to not touch the samples in the area where the properties are measured. Saving the samples allow for you to remeasure them in the future if you get a new instrument or move your instrument and are worried about the alignment.

General measurement instructions

Specific instructions for measurement and reporting for each sample is given in the next section, here we cover basic directions that hold true for all samples.

UV/Vis/NIR

The UV/Vis/NIR range is defined as 300-2500 nm. The data interval must be equal to, or lower than, 5 nm.

The samples have labels stuck on the side that is defined as front, while also marking the up orientation.

Emissivity and TIR

AERC 1.1 appendix E describes the use of an emissometer to get a single integrated value for thermal IR emissivity and transmittance (TIR) and integrated values can be reported. If an FTIR with integrating sphere is used, the IR range is defined as 5-25 μm with a data interval of smaller than or equal to 1 μm steps.

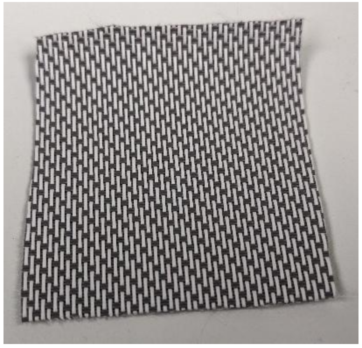
Reporting

Use the interim CGDB text file format to submit your results, except for sample 4 where the AERC tolerance spreadsheet should be used.

Specific measurement instructions

Here are the details for each sample where the relevant parts of AERC 1.1 are referenced. Note that if these instructions contradict AERC 1.1, these instructions are poorly worded and you should contact the author for clarification.

Sample 1



This sample represents a case of double-sided fabric where the inhomogeneity is much smaller than the illuminated area (AERC 1.1 appendix C section 4.2.1). To minimize the effect of the inhomogeneity you are to try to create as much mismatch between the hole pattern and your beam as possible. The most common case is to rotate a rectangular pattern 45 degrees with respect to a rectangular light beam. Orientation could matter even if the beam of your instrument is circular, as any polarizing effects of the weave could amplified by the polarization of the grating monochromator. N.B. this is not the angle of incidence.

This sample has to be measure on both the front and the back.

Sample 2

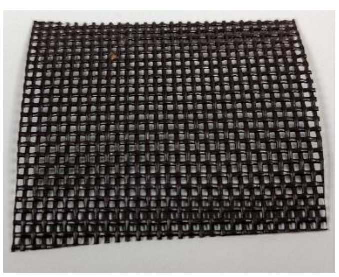
This sample represents the case of intermediate inhomogeneity described in AERC1.1 appendix C section 4.2.3. You have to measure the product in at least three positions. Calculate standard deviation after three measurements and unless it is below a 0.02 you have to perform more measurements and recalculate the standard deviation after each additional measurement until your average has high enough confidence.

While the back is different from the front for this sample you may consider it as identical and only measure the front properties and use those for the back properties as well (this is purely to save time, had this been a real submission both sides should have been measured following the process needed for samples with intermediate inhomogeneity.). N.B. the text file still need values for the back side, but they can be identical to the front side values.

Sample 3

This sample represents the case where the sample is homogeneous but exhibit fluorescence. For scanning spectrophotometers where the monochromator is situated prior to the sample there is a way to process the data described in AERC1.1 appendix C section 4.6. The simple model is to perform linear interpolation between the points where it seems like there is no impact from the fluorescence.

The front and back of this material is considered identical for this exercise so you only have to measure one side. N.B. the text file still need values for the back side, but they can be identical to the front side values.



Sample 4

You have been provided with 18 pieces of this fabric. Each piece is marked box-4-sample#. The exercise is to perform the material tolerance testing described in AERC 1.1 section 5.1.1.2-4 (see also example in AERC 1.1 appendix B). This exercise expects use of a multi-channel instrument that reports integrated visible values. It is possible to qualify for full measurements even if you do not participate in this part.

Note that this sample has intermediate size inhomogeneity relative to a lot of spectrophotometer light beams. Unless you measure each sample multiple times you will most likely report incorrect tolerance as

Sample 5

Curved sample might cause issues, try your best to flatten the sample. The properties should be measured for the flat material. Note that the back has brush strokes that might generate a diffracted reflection. It might be helpful to set the instrument to a visible wavelength (or white) and see how the material reflects the light to the sphere wall, ideally you want to avoid the direct reflection to fall on ports or detectors. The front and back of this material is considered identical for this exercise so you only have to measure one side. N.B. the text file still need values for the back side, but they can be identical to the front side values.

Comments on emissivity measurements using different backing materials

The emissivity should be reported in the text files for samples 1, 2, 3, and 5, do not report emissivity of sample 4.
When using an emissometer to characterize samples with TIR > 0 it is common practice to measure with two different backing materials, one with high and one with low emissivity and calculate T and E based on those measurements. In 2017 this had a lot of issues in the first round of measurements so a workbook was prepared to improve agreement between labs. Part of that exercise required participants to submit the workbook, this time it is only provided for you as a tool and the data should be reported in the text files.

Due to the calculation of emissivity and transmittance from the measurements on different backing being difficult for small values of transmittance it might need some judgment to decide a sample is TIR 0 even though you might not have identical values with both backings (which would theoretically happen and if you measure enough times). It is a tall order trying to find T^2 e.g. order of 0.0001 for a 1% transmittance sample in measured values when precision of 0.001 for my D&S AE1. So use your judgement for if the calculated TIR is more reasonable than TIR = 0 rather than blindly trusting the spreadsheet. The comments below are verbatim from 2017 and provided for additional context.

2017 original instructions for the emissivity workbook

The results for solar-optical measurements were in better agreement than expected but the emissivity results are not as good as expected. Some submitters had TIR =0 for all samples which should not be the case, however, only correcting that would not resolve all the variation.
After doing internal tests at LBNL I believe that requiring the emissivity measurements to follow the procedure used for solar-optical properties of sample 3, i.e. measure at least 3 times, calculate standard deviation, and if not good enough, measure more times. The workbook is set up for you to fill out the measured apparent emissivities, and for now this is what we will have to use for the standard deviation calculation. I am worried that for samples with very low TIR, the variation in TIR is much higher than the variation in

In addition to adding more columns for measurements, I have also created separate lines depending on which backing material the sample was measured on. This was specified in AERC 1.1 appendix E and I was hoping that this would be followed and that the reported value would be the solution of equation (2) in section 2.1.2. The backing materials should ideally have high thermal conductivity and be flat, personally I use the calibration discs that come with the D&S AE1.

In hindsight I should have included a homogenous material, but I realized that the lid of the box that the samples came in should be uniform, so I added that as an extra sample to measure.
I have prepared a new workbook and attached it. I expect you to fill out cells B1 to B4 in the information sheet, B1 to B2 and D5 to at least F18 in the raw data sheet. Note that I filled out values just to verify that the calculations seem reasonable.

Simon Vidanovic wrote a numeric solver, and I included that in the workbook. You can see how it gets the raw data, iterates for a solution of the equation system and comes up with an answer. In theory you should not have to enter anything into the “Solve*”-sheets, but if there is no convergence, you can go in and try to change the default starting values (Es_ini, Ts_ini). As shown in the attached powerpoint, I should ideally have calculated TIR and Es for each combination of Ea1 and Ea2 to get a more interesting value of the standard deviation to track. If you are good at Excel and remakes the workbook to show that, I would be very happy to get a copy of it.

Reporting instructions

Checklist of files for your submission

- Excel workbook named Workbook_AERCILC2025_boxNN.xls, where you replace NN with your box number (please use leading 0 if your number is less than 10) filled out with information about your lab and instruments (no data in here).
- Text files with wavelength and 8 columns of data for samples 1, 2, 3, and 5, for a total of four text files. These should be named boxNN_x.txt where NN is your box number as above, and x is the sample number.
- Excel workbook boxNN_4.xls with data for the partial tolerance testing of sample 4. Note that this file has been modified to work for partial tolerance tests, do not use this file as a template for a full tolerance test with 18 samples.

Please do not add or remove rows and columns from the spreadsheet templates and please pay attention to the naming of the file as it greatly helps the automated processing of the data.

Example: Participant with box 1 is expected to submit the following 6 files:

Workbook_AERCILC2025_box01.xls
box01_1.txt
box01_2.txt
box01_3.txt
box01_4.xls
box01_5.txt

Template files available at https://windows.lbl.gov/cgdb-interlaboratory-comparison and that web page will also be used to keep updated documents and I will try to upload answers to general questions there as well.

The files should be emailed to jcjonsson@lbl.gov by May 30, 2025. Participants that do not submit by that date will not end up in the report and will not be approved for submissions to the CGDB until data is sent in and approved.

Data format

Please enter measured reflectance, transmittance, and emissivity in values between 0 and 1 rather than as %-values between 0 and 100.

Instrument information

The first (and only) tab in the workbook contains information about your instrument, please fill that out with your information to the best of your capabilities.

Goal

The goal of the ILC is to make sure the submitting laboratories populate the CGDB with accurate data as well as educate participants on the methods in AERC 1.1 and the data format used for CGDB. In past ILCs, LBNL has been working with outliers trying to make sure they measure accurately and that is still our mission for this exercise.

Questions

There is a balance writing this kind of instruction set, too short and it is not useful, too long and crucial details get hidden from what looks like normal language. I try to err on the side of too short with the understanding that you will contact me for clarification.

For any questions please contact jcjonsson@lbl.gov or igdb@lbl.gov.

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