Diffuse glazing task group – September 2017

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Scope

- *Find a way to obtain spectral data for diffuse glazing products in a manner that would allow WINDOW calculations of IGUs. Determine best practice how to obtain data and verify the accuracy of these practices.*

Agenda

- Quick summary for people in the room about progress since the spring meeting
- Discussion about standards pertaining to diffuse IR measurements for emissivity measurements of materials with surface roughness
- Update on the research proposal
- Interrupt with questions as needed

Balloted 300-series documents

- We are only trying to clean up these documents so that we have a clean version to add the diffuse changes – no change in simulated values
- One negative that came in spring was the ASTM standard referenced for the ILC. Looking into the available ASTM documents it was concluded that they don't sufficiently describe some intricacies of our process so language was added to describe what is going on

Emissivity of diffuse glazing

- Glass is opaque, so rough surface is the most likely scenario, but thin polymers with embedded pigments are also of interest
- Dan Wacek at Viracon did measurements with emissometer of fritted glass with low-e coatings
  - Results look reasonable, but not conclusive
  - But how do we know the response is accurate for rough surfaces as well as for specular?
  - How do we get a calibrated reference with known low emissivity that is scattering?

IR properties of rough samples

- Comparison of emissometer and FTIR for fritted glass with coatings
- Need to include IR sphere
- True value?

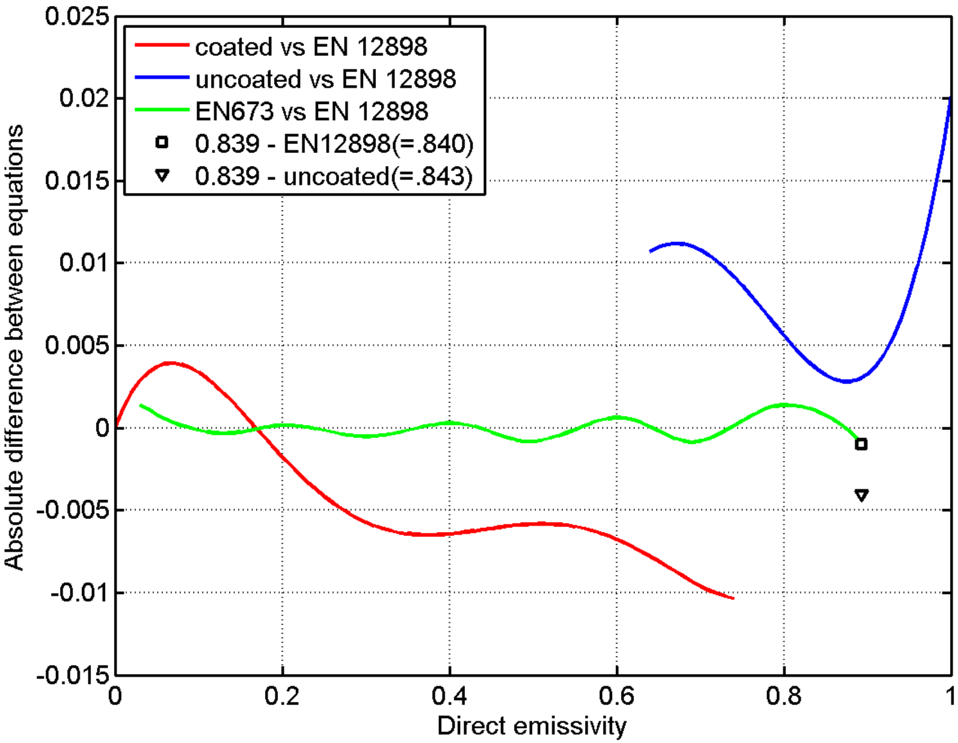
#	Sample Description	Side	Gloss*	Emissometer Reading	FTIR Emissivity	Decrease when mov	
1	Uncoated V175	No Frit	74	0.827	0.846	0.019	
	(White)	Frit	64	0.81	0.836	0.026	
	Decrease as frit is added			0.017	0.01	0.036	<-moving
2	Uncoated V907	No Frit	75	0.822	0.846	0.024	
	(Black)	Frit	67	0.813	0.84	0.027	
				0.009	0.006	0.033	
3	V175 with VE-85	No Frit	64	0.096	0.089	-0.007	
	(White)	Frit	24	0.109	0.31	0.201	
				-0.013	-0.221	-0.02	
4	V907 with VE-85	No Frit	64	0.095	0.088	-0.007	
	(Black)	Frit	31	0.12	0.25	0.13	
				-0.025	-0.162	-0.032	
5	V175 with VE-2M	No Frit	56	0.043	0.038	-0.005	
	(White)	Frit	22	0.053	0.307	0.254	
				-0.01	-0.269	-0.015	
6	V907 with VE-2M	No Frit	56	0.042	0.037	-0.005	
	(Black)	Frit	33	0.055	0.183	0.128	
				-0.013	-0.146	-0.018	
7	V175 with VNE-63	No Frit	79	0.03	0.025	-0.005	
	(White)	Frit	43	0.036	0.263	0.227	
				-0.006	-0.238	-0.011	
8	V907 with VNE-63	No Frit	82	0.03	0.026	-0.004	
	(Black)	Frit	51	0.046	0.231	0.185	
				-0.016	-0.205	-0.02	

List of standards

#	Standard #	Reapproved	TITLE	Method	Comments
1	ASTM E 408-71	1990, 2013	Standard Test Methods for Total Emittance of Surfaces Using Inspection-Meter Techniques (A & B methods)	Emis-Reflect	Based on 1960's tech papers from NASA
2	ASTM C 1371-98	2015	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers	Emissometer	Glass needs to be less than 1 mm thick to conduct to heat-sink. Scope of standard states that it is for highly conductie materials.
3	ASTM E 1585-93	NO	Measuring and Calculating Emittance of Architectural Flat Glass Using Spectrometric Measurements	Spectrometer	Replaced by NFRC 301 which is essentially a direct copy
4	NFRC 301-1997	2014	Standard Test Method for Emittance of Specular Surfaces Using Spectrometric Measurements	Spectrometer	Designed for architectural Low-E coatings on float glass
5	EN 12898: 2001	2001	Glass in Building - Determination of the emissivity	Spectrometer	Designed for architectural Low-E coatings on float glass
6	EN 15976: 2011	2011	Flexible sheets for waterproofing. Determination of emissivity	Emissometer	Designed for IR reflecting coatings on thin films
7	ASTM E 1933-96	2014	Standard Practice for Measuring and Compensating for Emissivity Using Infrared Imaging Radiometers	Radiometer	
8	ASTM E 1862-96	2014	Standard Practice for Measuring and Compensating for Reflected Temperature Using Infrared Imaging Radiometers	Radiometer	

Standards purely focused on specular measurements

- NFRC 301 (not for long)
- EN12898 – different blackbody temp (283) and different dir->hem correlation
- EN15976 – not confirmed, but targeting IR reflecting films
- Migth work with FTIR combined with sphere



Emissometers

- E.g. D&S AE1, Surface Optics ET100
- Requires known reference samples, ideally with values close to the studied sample. E408 – “This error (…) emittance can be as large as 10% on certain types of specimens (such as specular metal surfaces). Since the angular response is unknown, ε_N values must rely on reference samples that have been calibrated for ε_N”
- Avoid sample overheating. C1371 “For example, if the specimen material is glass, with a thermal conductivity of about 1.0 W/m·K, then the specimen thickness shall be less than 0.91 mm.”

Radiometers

- IR cameras
- E1933 Require the sample to be >10C higher than ambient temperature
- E1862 is about compensation for back ground radiation, an angle-dependent specular measurement.

Resource for standards

- Leonard Hanssen at NIST
- https://www.nist.gov/programs-projects/infrared-optical-properties-materials-and-components
- https://www.nist.gov/calibrations/optical-properties-materials-calibrations

Research proposal

- Full proposal written and will be balloted for spring in parallel with diffuse updates to 300-series
- Will have to be adjusted to reflect what is decided regarding IR measurements (e.g cost of NIST measurements)