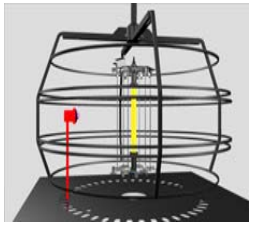
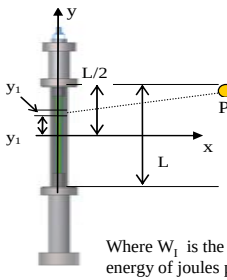
Faster and Adaptable Accelerated Solar PV/Thermal Durability Testing Solution

ATLAS MATERIAL TESTING SOLUTIONS



Atlas Weather-Ometer® equipped with a xenon arc lamp



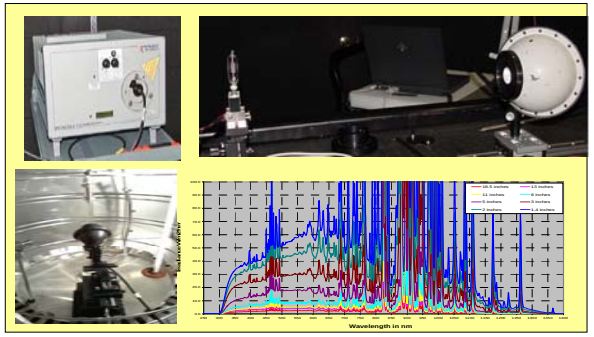
$$I = \frac{W_I}{4\pi L}\int_{-L/2}^{L/2} \frac{1}{x^2 + (y - y_1)^2}\, dy_1$$

$$y = \sqrt{\frac{L^2}{4} + \frac{xL}{\tan(cx)} - x^2}$$

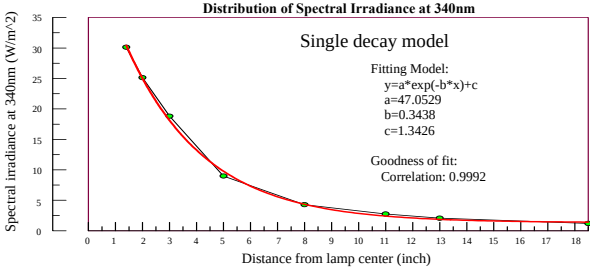
$$c = \frac{4\pi L I}{W_I}$$

Where W_I is the radiant flux of the lamp in terms of radiant energy of joules per unit time

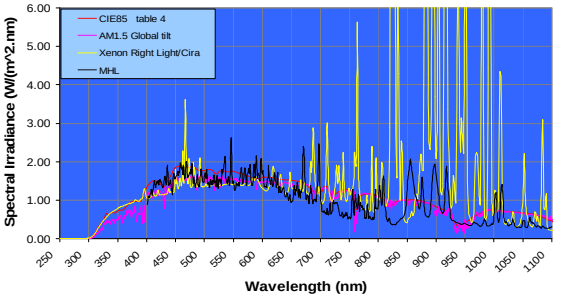
Modeling of light source



NIST-traceable irradiance calibration and measurement capability



Modeling of acceleration factor matches experimental data

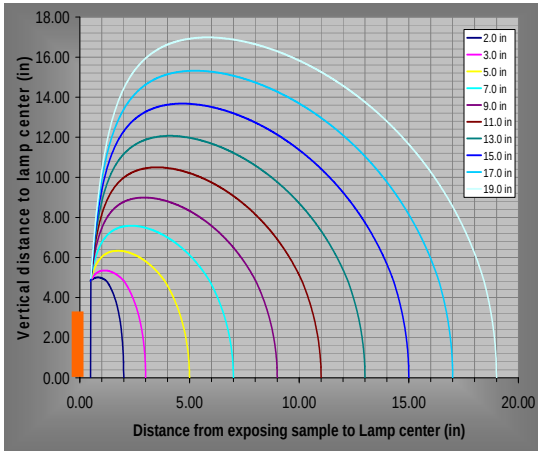


Comparison of Spectral Power Distribution of Atlas light sources and two prevalent references

Xenon lamp provides: Spectral match (with filter option): Class A –IEC 60904-9

Uniformity: <=2% on designated areas

Temporal instability - STI: up to 0.5%; LTI: up to 1%

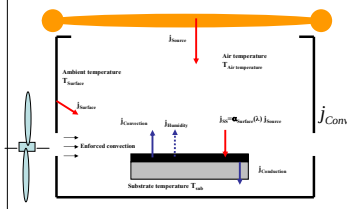


Equal irradiance lobes for various lamp geometry define sample mounting scheme to achieve the optimal uniformity

Temperature Control (Left: EVA as encapsulation in PV module is mounted in cold plate. Middle: direct air cooling on EVA. Right: use auxiliary refrigeration unit to reduce the air temperature)

Determine the Sample Surface Temperature

Theoretical consideration



$$j_{SS} = a_{surface(\lambda)} \cdot \int_{\lambda_0}^{\lambda_1} E_{e\lambda} \cdot d\lambda$$

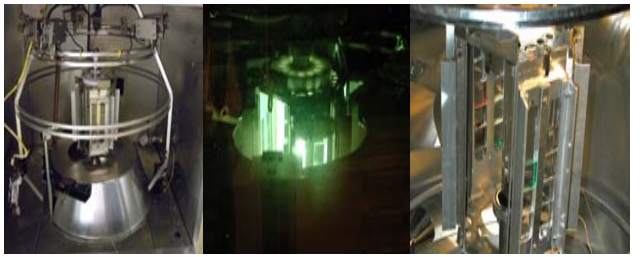
$$j_{IR} = \alpha_{Surface} \cdot \sigma \cdot \left(T^4_{Ambience} - T^4_{Surface}\right)$$

$$j_{Convection} = \alpha_{Convection} \cdot \left(T_{Surface} - T_{Air-temperature}\right)$$

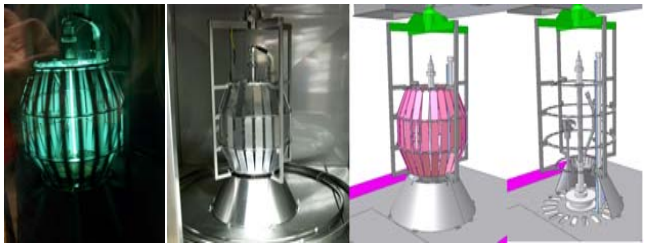
$$j_{Conduction} = \lambda \cdot \frac{\left(T_{Surface} - Tsub\right)}{d}$$

$$j_{stored} = j_{SS} + j_{IR} - j_{Convection} - j_{Conduction} - j_{Humidity}$$

$j_{(source)}$ = Energy flux density of source (radiant, conduction, convection, etc.)



Customized testing instrument using an Atlas xenon Weather-Ometer for high-flux stress test of encapsulants for medium-concentration concentrating photovoltaic (CPV) system at National Renewable Energy Laboratory (NREL)



A customized interior instrument design on 12kW xenon lamp for accelerated materials durability test

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PV Module Reliability Workshop (NREL), February 18-19, 2010. Golden, Colorado