Newport Corp
Stratford, CT

6/6/08

REPORT OF CALIBRATION
of One Standard of Spectral Irradiance (250 - 2400 nm)

Oriel Part# 63358 **Lamp Serial Number: 7~1803**

1. Material

One 45 watt, quartz halogen, tungsten filament lamp with designation 7~1803

2. Calibration Procedures

The lamp was pre-treated and calibrated using custom designed equipment in Oriel's calibration facility and modeled on the equipment and procedures described in the NBS Special Publication 250-20.

3. Calibration Reference

The working standards used as reference were 7~1535 and 7~1536 which, in turn, were calibrated using F766 standard traceble to NIST reference standard: F-525.

4. Results

The spectral irradiance produced by Standard 7~1803 at a distance of 0.5 m when operated at the calibration current is provided in a number of formats to facilitate the use of this tool. Irradiance levels at wavelengths for which NIST provides data,
are provided for best traceability to NIST. A fitting formula is provided, found using NIST suggested method, slightly modified for faster convergence when using commercial algorithms, is listed with the data. Irradiance values, calculated using this formula, are tabulated on the attached sheets in 10 nm increments and are included in an ASCII format in 1 nm increments on the PC format diskette included with this product.

Calibrated by:Bob Fusaris

Date:
6/6/08

OPERATION OF THE IRRADIANCE STANDARD

Safety Considerations

There are three hazards associated with operation of this lamp.

1. Ultraviolet Radiation
2. Heat
3. Electrical

1. Ultraviolet radiation

These lamps emit low levels of ultraviolet radiation, UVA, UVB and UVC. Since these are potentially hazardous to the eyes and the skin, we recommend that you wear UV goggles and limit exposure of the skin. You will find a discussion on ultraviolet safety on page 1-191 of Oriel Volume II catalog. This page also shows the current recommended Threshold Limit Values for occupational exposure to ultraviolet. You should use the irradiance data and the radiation square law to estimate whether UV will be a problem. Obviously it depends how close you work to the lamp, how long you operate the lamp etc. UV goggles and glasses are available from Oriel. To limit skin exposure in an open laboratory environment we recommend you fabricate shields to enclose the lamp. These should be large enough (at least 0.5 m from the lamp) to ensure the lamp is effectively in the open air. Small enclosures will change the thermal and optical operating conditions of the lamp and hence the calibration.

2. Heat

The surface of the lamp is hot enough to burn skin or ignite combustible materials. Additionally, dark combustible materials close to the lamp may ignite.

3. Electrical hazard

The lamp operates at 6.5 A and approximately 7 V. Under certain conditions these are considered hazardous current and voltage levels and we recommend that you post appropriate warning signs since "live terminals" can be exposed.

Mounting the lamp

The irradiance standard is intended for vertical operation in the open air. The lamp should be held in an Oriel Model 63365 Lamp Mount or similar. All calibration and life data available refers to this form of operation. Different types of operation, for example horizontal operation or operation in an enclose will result in different irradiation and may shorten the useful life.

Power source

The lamps require a source of well regulated constant current such as the Oriel 68831 Radiometric Power Supply. The current source needs to be accurately calibrated to reproduce the calibration current. Deviations from the calibration value result in changes in the irradiance produced with the highest discrepancies in the ultraviolet region of the spectrum.

Lamp life

Studies at NIST of the 1kW type of tungsten halogen show different drift rates with time for lamps tested. While the drift (in % per 100 operating hours) was worst at 250 nm, the values (at 250 nm) for the lamps tested varied from 0.5 % to 4.8 %. We reproduce the NIST data for your information.

Lamp # 7~1803

Wavelength	Lamp#			
(nm)	1	2	3	4
250	0.50	4.3	4.0	4.8
350	0.45	3.4	2.9	3.35
450	0.40	2.90	2.30	2.55
555	0.40	2.55	1.90	2.00
654.6	0.40	2.35	1.60	1.65
800	0.40	2.1	1.35	1.3
1300	0.35	1.7	0.8	0.65
1600	0.35	1.6	0.75	0.5

Please note that these drift rates are for constant operation of the lamp. We expect worse data when the lamp is run for short periods as the filament is subjected to thermal shock each time the lamp is started. Oriel DC power supplies for these lamps have a "soft start" and "soft shutdown" features to mitigate this problem. Gradual increase to the operating current over a period of about a minute should allow you to approach the drift rates above when you operate the standard lamp for shortened periods.

It is recommended that the lamp be recalibrated after 50 hours of use.

NIST Results

The principal set of results is provided at NIST specified wavelength data points. Estimated Transfer Uncertainty (2δ) is as follows. The NIST Uncertainty of Reported Values for the F-525 standard lamp with respect to SI units are listed for information.

Wavelength (nm):	250	350	654.6	900	1300	1600	2000	2400
NIST Uncertainty	2.23	1.35	1.01	1.34	1.42	1.89	3.29	6.50
F766 Uncertainty	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Oriel Transfer Uncertainty	2.0	1.5	1.5	1.5	1.5	2.0	2.0	2.0
Total (SQRT of Quadrature sum)	**3.6**	**2.8**	**2.7**	**2.8**	**2.9**	**3.4**	**4.3**	**7.1**

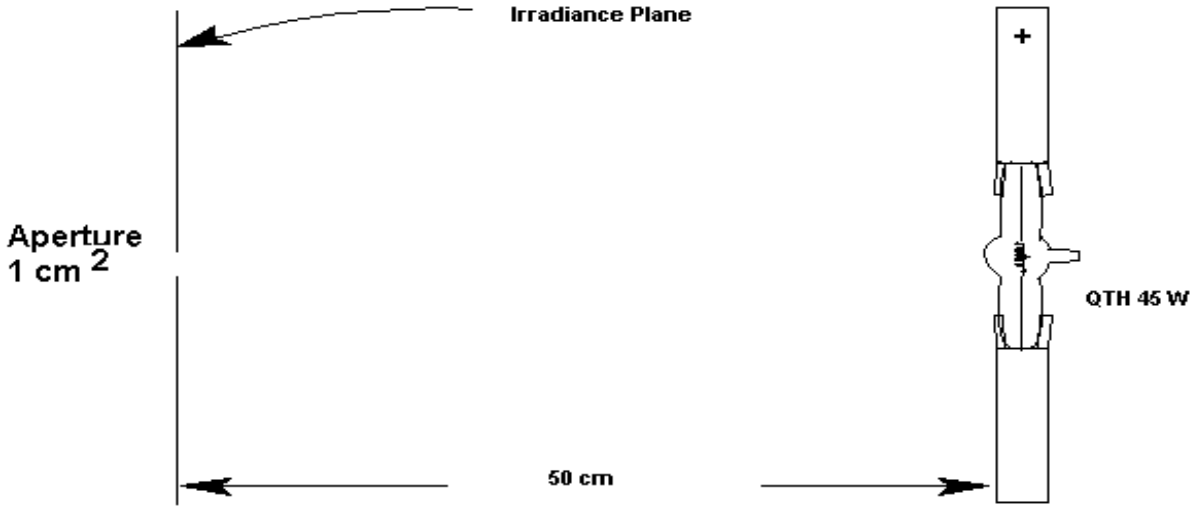

Fig. 1 Reference points for the 50 cm (500 mm) calibration distance

CALIBRATION RESULTS

Model No. 63358 Quartz Tungsten Halogen lamp

Lamp Serial No.: 7~1803

Spectral Range: 250-2400nm

Lamp Current: 6.50 Amps

Voltage (ref. Only) = 7 V

Room Temperature: 25 C

Fitting equation for non-NIST wavelengths (divide values by 10 to obtain results in $\mu W/cm^2$ nm):

$$\textbf{Irradiance } (mW/m^2 \text{ nm}) = \lambda^{-5} * \exp(A + B/\lambda) * (C + D/\lambda + E/\lambda^2 + F/\lambda^3 + G/\lambda^4 + H/\lambda^5)$$

Where:

A= 41.7915090488591
B=-4838.98137717923
C=0.778641040863826
D=543.460937982459
E=-426311.782126541
F=127392931.174736
G=-13902811647.7036
H=0