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Status Report

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Development of a Stable Ultraviolet Source and Techniques for Accurate Radiometry

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High Pressure Plasma Arc as a Useful Ultraviolet Standard

A. Comparison of the radiation characteristics for mechanically similar units.

Two arcs were assembled from parts manufactured according to specifications. When used at 15 atm pressure and 50 amperes, the spectral radiance at 2800 A differed by about 14%. The reason for this discrepancy is not known. However, the difference appears to be correlated with the difference in measured half-width of the arc to a standard deviation of 2%. The correlation will be investigated under a wide range of operating conditions.

B. Effect of changing plate spacing upon arc spectral radiance.

The sensivity of the spectral radiance of the portable arc relative to the plate spacing in the observation chamber was determined. The results of 77 measurements for spacings ranging from about 1 to 2 millimeters, indicate a maximum change of 3% in spectral radiance for a 40% change in spacing. Using the expected assembly tolerance, this effect would amount to about 1% in spectral radiance. Moreover, the spectral radiance is a maximum at a particular spacing and when operating at or near this spacing the effect would be much less than 1%.

C. End-on observations with the portable arc.

Since the argon arc, observed perpendicular to its axis, is optically thin; the radiance should increase approximately linearly with any increase in arc depth. This was accomplished by modifying the arc so it could be used end-on. The cathode was "split" into two electrodes which were positioned off the axis so that observations could be made along the axis of the arc. "End-on" use of the arc is almost as reproducible (~ 2.5%) as "side-on" use. Comparison of a 50 ampere, 15 atmosphere arc used "side-on" and "end-on" is shown on the following page.

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Wavelength	Radiance Temperature Side-On	End-On
2200 A	5190 °K	7354 °K
2300	5172	7314
2400	5171	7266
2500	5060	7179
2600	4966	7086
2700	4894	7019
2800	5007	6966
2900	4737	6903
3000	4684	6855
3100	4644	6852

Even a 5 atm, 30 ampere end-on arc using a relatively low power input of about 2 KW has a radiance temperature ranging from 6030 °K at 2200 A to about 5600 °K at 3100 A. Moreover it is conceivable that such an arc could be reduced in size to that of an ordinary flashlight.

Standards and Techniques for Accurate Radiometry.

A. Graphite Arc

Measurements on the graphite arc have been virtually completed. The spectral radiance from 2000 A to 8000 A has been determined for 4 more graphite and 2 carbon electrodes. The contribution of the arc stream at wavelengths longer than 2600 A was obtained. In particular the atomic and molecular spectral lines were examined with relatively high resolving power (~25 000) in order to determine more accurately the wavelength regions for which the arc is a useful standard.

B. Irradiance Measurement

In order to determine the consistancy of our spectral radiance standards and the spectral irradiance standards maintained by the Radiometry Laboratory of NBS, a spectral irradiance calibration at about 6500 A was performed on a lamp previously calibrated by the Radiometry Laboratory. The result obtained was about 6% lower than the value reported by that laboratory. The difference is slightly larger than the combined reported uncertainties of the two calibrations. An effort will be made to resolve this difference.

The irradiance measurement emphasized the need for large uniform sources or normal size sources with a very high spectral radiance with which to determine the reflectance of integrating spheres. The high pressure argon arc might be very useful in this respect, especially below 3500 A.