Table 1 Relative radiation heat fluxes

Filter model	Transmission region, μ	Arc current, amp	R_m	R_t[7]
G-772-3900	0.37–3.0	240	0.789	0.775
G-772-4750	0.44–3.0	240	0.722	0.680
G-772-5400	0.52–3.0	240	0.689	0.614
G-772-6300	0.60–3.0	240	0.623	0.559
G-772-7000	0.67–3.0	240	0.603	0.520
G-776-7100	0.25–0.95	240	0.255	0.370
G-772-3900	0.37–3.0	100	0.810	0.816
G-772-4750	0.44–3.0	100	0.755	0.759
G-772-5400	0.52–3.0	100	0.729	0.738
G-772-6300	0.60–3.0	100	0.686	0.697
G-772-7000	0.67–3.0	100	0.655	0.656
G-776-7100	0.25–0.95	100	0.222	0.309
G-776-3900	0.37–3.0	50	0.849	0.854
G-772-4750	0.44–3.0	50	0.806	0.814
G-772-5400	0.52–3.0	50	0.787	0.789
G-772-6300	0.60–3.0	50	0.764	0.765
G-772-7000	0.67–3.0	50	0.727	0.733
G-776-7100	0.25–0.95	50	0.200	0.222

of interest and varies linearly with the magnitude of the radiation flux.

The arc source used for the measurements is described by Lukens.[6] An argon (Ar) gas was used in the laminar mode of operation at arc currents of 50,100 and 240 amp, and the arc pressure and diameter were maintained at 1 atm and 10^{-2} m, respectively. The radiation assembly was installed in the asymptotic region of the arc column, where plasma properties are axially invariant. For a prescribed set of arc operating conditions, a test run consisted of first obtaining a detector reading with the shutter open and no filter in the adaptor. This reading provided the maximum possible detector output for the prescribed arc conditions. Readings were then obtained with the various filters in place, and the results were normalized with respect to the maximum value. All results were found to be reproducible to within $\pm 2\%$.

Values of the normalized radiation measurements are listed under the heading R_m in Table 1. Results determined theoretically by Lee[7] are listed under the heading R_t and are presented for comparison. The theoretical results account for the effects of self-absorption in the arc, as well as the contribution of both line and continuum emission to the spectral distribution of radiation from the arc. For purposes of comparison, the transmission characteristics of the various windows and filters have been applied to the theoretical results. These results are normalized with respect to the predicted total radiation ($0 \leqq \lambda \leqq \infty$) from the arc, with provision made for attenuation by the windows.

With the exception of the filter for which transmission is in the spectral region between 0.25 and 0.95μ, the agreement between the theoretical and experimental results is excellent. The disagreement associated with the one filter is attributed to uncertainties in the theoretical model which increase with decreasing wavelength. The uncertainties are associated with evaluation of the radiative recombination parameters required to determine the continuum radiation.[7]

Although the experimental results offer limited resolution, it is possible to make several observations concerning the spectral distribution of radiation from the arc. By subtracting the experimental ratio obtained for the filter with the 0.67μ lower wavelength cutoff from that obtained for the filter with the 0.37μ cutoff, it is evident that, depending upon current, from 12 to 19% of the total arc radiation lies in the visible from 0.37 to 0.67μ. Moreover, when this result is compared with the ratios obtained for the G-776-7100 filter, it appears that, at most, a few percent of the total radiation is in the region $\lambda < 0.37\mu$. Hence, depending upon current, approximately 80 to 85% of the total radiation falls in the spectral region below 3μ, with the remaining 20% lying in the medium and far infrared.

References

[1] Barzelay, M. E., "Continuum Radiation from Partially Ionized Argon," *AIAA Journal*, Vol. 4, No. 5, May 1966, pp. 815–822.

[2] Lukens, L. A. and Incropera, F. P., "A Technique for Delineating Convective and Radiative Wall Heat Flux," *AIAA Journal*, Vol. 10, No. 3, March 1972, pp. 359–361.

[3] Bott, J. F., "The Spectroscopic Measurement of Temperatures in an Argon Plasma Arc," *The Physics of Fluids*, Vol. 9, No. 8, Aug. 1966, pp. 1540–1547.

[4] Giannaris, R. J. and Incropera, F. P., "Nonequilibrium Effects in an Atmospheric Argon Arc Plasma," *Journal of Quantitative Spectroscopy and Radiative Transfer*, Vol. 11, No. 2, Feb. 1971, pp. 291–307.

[5] Morris, J. C. and Yos, J. M., "Radiation Studies of Arc Heated Plasmas," ARL 71-0317, Dec. 1971, Aerospace Research Labs., Wright-Patterson Air Force Base, Ohio.

[6] Lukens, L. A., "An Experimental Investigation of Electric Field Intensity and Wall Heat Transfer for the Heating Region of a Constricted Arc Plasma," Ph.D. thesis, 1971, Mechanical Engineering Dept., Purdue Univ., Lafayette, Ind.

[7] Lee, J. B., "The Cascade Arc Plasma as a Radiation Source: Determination of Spectral Properties," Ph.D. thesis, 1973, Mechanical Engineering Dept., Purdue Univ., Lafayette, Ind.

Errata

Accelerating One-Dimensional Searches

IVAN L. JOHNSON JR.
NASA Johnson Space Center, Houston, Texas

AND

JAMES L. KAMM
Analytical Menchanics Associates Inc., Jericho, N.Y.

[AIAA J. **11**, 757–759 (1973)]

EQUATION (7) should read

$$a_2 = 2\gamma_1^{-2}\gamma_2^{-2}\{[\gamma_2^3 f(\gamma_1) - \gamma_1^3 f(\gamma_2)](\gamma_2-\gamma_1)^{-1} - (\gamma_2^2+\gamma_1\gamma_2+\gamma_1^2)f(0) - \gamma_1\gamma_2(\gamma_2+\gamma_1)f'(0)\}$$

$$a_3 = 6\gamma_1^{-2}\gamma_2^{-2}\{[\gamma_1^2 f(\gamma_2) - \gamma_2^2 f(\gamma_1)](\gamma_2-\gamma_1)^{-1} + (\gamma_2+\gamma_1)f(0) + \gamma_1\gamma_2 f'(0)\} \quad (7)$$

The authors regret this editing oversight on their part.

Received June 8, 1973.

Index categories: Aircraft Performance; Spacecraft Attitude Dynamics and Control.