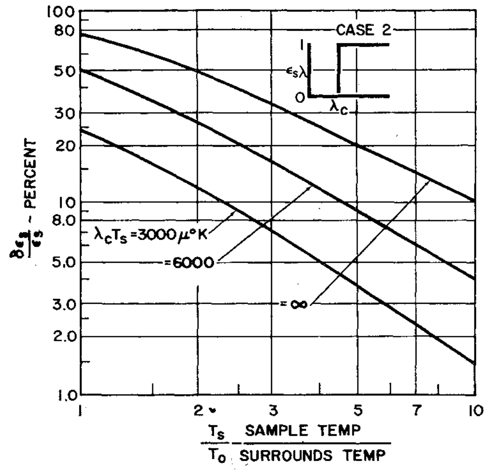

Fig. 2 Nongray error for selective emitter-type material.

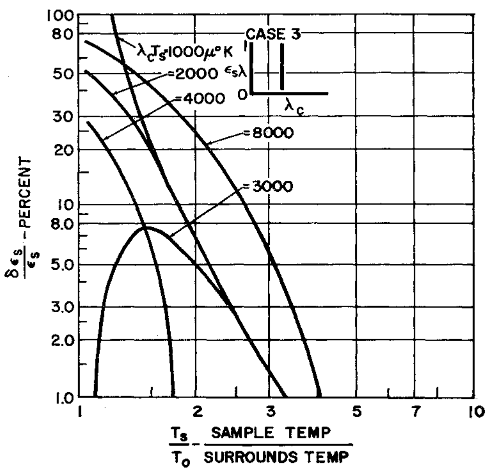

Fig. 3 Nongray error for spike emitter-type material.

"spike" or single emittance line. Edwards and Nelson[1] presented partial results for case 1.

Making the substitutions

$$F(Z) = C_1Z^{-5}/\{[\exp(C_2/Z)] - 1\} = T^{-5}E(\lambda,T) \quad (10a)$$

$$Z = \lambda T \quad (10b)$$

$$T^* = T_s/T_0 \quad (10c)$$

in Eq. (8) and applying the limits from Eq. (9), the nongray error for the cases considered becomes

Case 1

$$\frac{\delta\epsilon_s}{\epsilon_s} \geq \frac{1}{[(T^*)^4 - 1]}\left[\int_{\lambda_cT_0}^{\lambda_cT_0T^*} F(Z)dZ \Big/ \int_0^{\lambda_cT_0T^*} F(Z)dZ\right] \quad (11a)$$

Case 2

$$\frac{\delta\epsilon_s}{\epsilon_s} \geq \frac{1}{[(T^*)^4 - 1]}\left[\int_{\lambda_cT_0}^{\lambda_cT_0T^*} F(Z)dZ \Big/ \int_{\lambda_cT_0T^*}^{\infty} F(Z)dZ\right] \quad (11b)$$

Case 3

$$\frac{\delta\epsilon_s}{\epsilon_s} \geq \frac{1}{[(T^*)^4 - 1]} \frac{F(\lambda_cT_0) - T^*F(\lambda_c,T_0,T^*)}{T^*F(\lambda_c,T_0,T^*)} \quad (11c)$$

The results of numerical computation of Eq. (11) are shown in Figs. 1–3 for a range of T_s^* and λ_cT_s. If λ_cT_s is equal to 3000, the material has an emittance of 0.27 if it is a case 1 material and 0.73 if it is a case 2 material; if the value of λ_cT_s is 6000, the corresponding emittances are 0.73 and 0.27, respectively. The extremes of λ_cT_s cannot be ignored, however. For both case 1 and 2 materials, the extremes of λ_cT_s are highly reflective materials, and these extremes indicate the possible effect of a surface film that is transparent through almost all of the wavelengths involved in the emission. The nongray error can be minimized by maintaining a large value of T_s^* in the instance of case 1 or 3. The error for case 2 is significant for values of T_s^* as large as 5–10.

Reference

[1] Edwards, D. K. and Nelson, K. E., "Maximum error in total emissivity measurements due to nongrayness of samples," ARS J. **31**, 1021–1022 (1961).

Erratum: "Electrical Discharge Across a Supersonic Jet of Plasma in Transverse Magnetic Field"

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[AIAA J. 1, 234 (1963)]

LINE 7 of the above paper should read "... at a velocity of approximately 3×10^3," rather than "... 3×10^4." The value was correct in galley proof, but the error occurred in making another correction in this paragraph in page proof.

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Moment of Momentum by Direction Cosines

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THE equation relating the sum of the moments acting on a rigid body to the time rate of change of its moment of momentum can be written

$$\mathbf{M} = [C_{01}][\dot{C}_{10}][I]_1([C_{01}][\dot{C}_{10}]) + [I]_1([\dot{C}_{01}][\dot{C}_{10}] + [C_{01}][\ddot{C}_{10}]) + m\,\mathbf{r}_1 \times \mathbf{a} \quad (1)$$

where $X_0Y_0Z_0$ is an inertial Cartesian coordinate system and $X_1Y_1Z_1$ is *any* coordinate system fixed in the body. Its origin is 0_1.

$[C_{01}]$ is the direction cosine matrix taken from the transformation matrix that transforms the coordinates of a point *from* system 0 *to* system 1. $[C_{10}] = [C_{01}]'$, the transpose of $[C_{01}]$. $[I]_1$ is the inertia tensor of the body computed in system 1. $\mathbf{r}_1$ is the position vector of the center of mass of the body measured from 0_1, and $\mathbf{a}$ is the acceleration of 0_1 relative to $X_0Y_0Z_0$.

$\mathbf{M}$ is the sum of the moments, about 0_1, of all the external forces acting on the body. Equation (1) gives its components in system 1.

The curved brackets denote the operation of forming (either manually or by computer program), a column matrix

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