

Grooves for Emissivity and Absorptivity Enhancement in High Performance Cavity Sources and Radiometers

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Abstract The emissivity of a flat emitting plate, and similarly the absorptivity of a flat absorbing plate, are well known to be enhanced by machining grooves into the flat surface. In addition to minimising retroreflection from cavities with flat end plates, grooves increase the number of absorbing surfaces a typical ray hits before exiting such a cavity. However two factors, generally overlooked in groove design, may become important for the design of ultrahigh emissivity or absorptivity cavities: (1) axial rays intersect the grooved surface off-normal, where the surface reflectivity is potentially much higher than at normal incidence, and (2) the groove angle may be difficult to define accurately, especially after the application of absorbing paint. This paper will describe ray tracing work showing that small changes in the groove angle can lead to dramatic changes in cavity emissivity or absorptivity (up to several percent) for relatively highly reflecting surface coatings. While this is not normally a problem for common black coatings and for radiation within the visible and IR spectrum below 100 microns, it may become an important correction for longer wavelengths where many common coatings become more highly reflecting and specular, especially at off-normal incidence. Since a room temperature thermal source has a significant fraction of emission at these long wavelengths, this may lead to an overall correction at the 1 – 100 ppm level when measuring the radiance of such sources.

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