Effect of Mixture Ratio on UV, Visible and Infrared Radiation from Exhaust Plumes

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Abstract: The development of infrared plume generators for aerial targets with the design goals of approximating threat aircraft/missile signatures required the identification of major physical and chemical parameters which affect the radiation characteristics (spectral and spatial intensity) of **jet** aircraft and missile exhaust **plumes**. Investigations have been carried out to determine the spectral distributions of general hydrocarbon exhaust and combustion between 0.3 and 14 microns. Gaseous, liquid and solid propellants, including pyrophorics, have been studied in the laboratory at static altitudes up to 18.3 kilometers (60,000 feet). The data show all hydrocarbons to have common major radiating species. In the infrared, the predominant radiating species at any oxidizer to fuel (O/F) ratio are always CO2 and H2O. In the ultraviolet and visible, the radicals of C2, CH, and OH are the primary contributors to radiation from low O/ F ratios to beyond stoichiometry. Band radiation at high mixture ratios is mainly due to OH. C3 radiation is apparent at very fuel-rich conditions, although continuum, or graybody radiation, is the primary emission mode. One major parameter, O/F ratio, has been found to be the dominant factor affecting radiation at any wavelength. The data indicate propellant chemistry to have a relatively minor effect on infrared radiation levels.

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