PASSIVE THERMAL CONTROL AND PROTECTION

Passive thermal control is a means of controlling spacecraft and its component temperatures without using equipment such as fluid loops or other active components. Rather, the focus is on using insulations, judicious material selection with attention to properties such as density, specific heat and conductivity, interface conductance, thermo-optical coatings and quite often, geometry and spacecraft orientation to control the inflow and outflow of heat. Passive thermal engineers necessarily rely on the environmental conditions exploiting natural heating sources such as incoming solar flux, reflected solar flux (albedo) and planetary infrared heating. Cooling is accomplished via radiation to the space sink environment which is very close to absolute zero.

Passive thermal engineers work seamlessly with those focused on active thermal control. The boundary between these two disciplines is often organizational and not technical. There is some overlap between these two focus areas in that passive thermal engineers often rely on some active or semi-active components such as heaters and heat pipes and active thermal engineers rely on environment, thermo-optical properties and other passive tools.

Thermal protection focuses primarily on high temperature, high heating type environments often found during ascent and atmospheric reentry. Whereas active and passive thermal practitioners focus on temperatures ranging from hundreds of degrees below zero (F) to, perhaps, a few hundred degrees above zero (F), thermal protection specialists focus on temperatures from many hundreds of degrees (F) to thousands of degrees (F). Through use of reusable thermal protection materials such as silica tiles and quartz blankets, high temperature seals as well as ablative materials, thermal protection engineers ensure the spacecraft structure, key spacecraft components and, of course, crew are protected from the harsh ascent and entry heating environments. Of special interest is the area of hot structures, such as the reinforced carbon-carbon found on the Space Shuttle Orbiter. This material is not an insulator. Rather, it is material that is designed to survive temperatures in excess of 3000 F, sustain aerodynamic load and be used over and over again.

Source: NASA Engineering Network. (2010). *Passive Thermal Control and Protection: FAQ.* Retrieved on February 9, 2010 from http://nen.nasa.gov/portal/site/llis/community/PT/FAQ/