HEAT PIPES

cience for the 21st Century ***will include work in the area of heat pipes***

Heat pipes are pencil-sized metal tubes that move heat from one end of the tube to the other without the aid of a pump. Within the heat pipe, heat vaporizes a small amount of fluid at the pipe's hot end, the fluid travels to the other, slightly cooler end and condenses before returning to the hot end through a capillary wick, where it repeats the process. The device efficiently transfers large quantities of heat.

Being studied for future space-age travel, heat-pipe technology was borrowed from rudimentary heat-conducting pipes used by English bakers100 years ago. Heat pipes vary greatly in size, depending upon their particular use. Some are the size of hypodermic needles, while larger versions stretch to 24 feet. Modern applications of this technology include miniature heat pipes that cool the chips inside most laptop computers. Heat pipes work efficiently in a zero-gravity environment; commercially developed heat pipes are now routinely used to cool electronics in communications satellites.

Modern heat pipe technology was first developed at Los Alamos nearly 40 years ago. Engineer George Grover, who did much of the pioneering and theoretical work on heat pipes at Los Alamos, demonstrated the first heat pipe in 1963.

Early Los Alamos heat pipes contained water or sodium. Now they often use lithium, a soft silver-white chemical element that is the lightest known metal. When placed inside a molybdenum pipe, which can operate at white-hot temperatures approaching 2,200 degrees Fahrenheit, the lithium vaporizes and carries heat down the length of the pipe. A lithium heat pipe developed at Los Alamos in the mid-1980s transferred heat energy at a power density of 23 kilowatts per square centimeter. To put this figure in perspective, heat is emitted from the sun's surface at six kilowatts per square centimeter.

In 1996, three Los Alamos heat pipes, prototypes of liquid-metal heat pipes to be used in advanced spacecraft, were flown and tested aboard the space shuttle Endeavor. The pipes operated at temperatures exceeding 900 degrees Fahrenheit and performed flawlessly. Today Los Alamos is working with NASA's Marshall Space Flight Center in Huntsville, Ala., to develop heat pipes for use in generating electricity and propulsion of spacecraft journeying to the solar system's outer limits.

Los Alamos researchers are developing heat pipes for other applications as well as they take their research to the next level and are interacting with potential collaborators on problems that can be solved using this technology. Scientists recently worked with NASA Langley Research Center in Hampton, Va., in the design of a futuristic hypersonic aerospace plane, a 10,000-mile-an-hour aircraft that would take off from a runway like a jet, but then complete most of its flight in low-Earth orbit. Heat pipes cooling the leading edges of the wings and engine ducts of such a plane could open the door to two-hour New York-to-Tokyo flights.

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