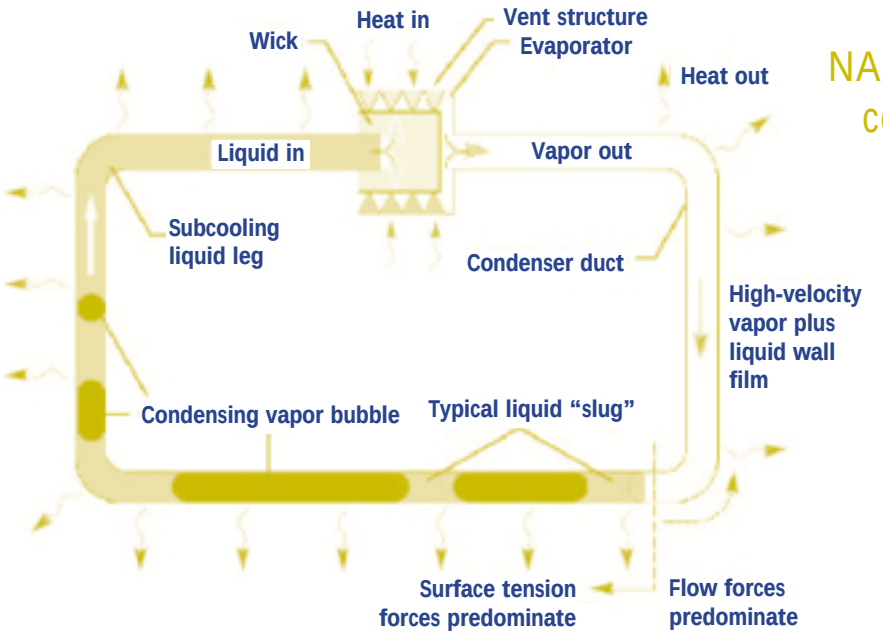
Capillary Pumped Loop Body Warmer



NASA offers companies the opportunity to jointly develop and license this innovative thermal control system.

Originally developed at NASA Goddard Space Flight Center for spacecraft thermal control, this capillary pumped loop (CPL) system can be used to regulate the temperature of the human body's extremities. The CPL redistributes heat using a capillary wick structure rather than an external mechanical pump. This design eliminates the need for an external power source. GSFC has built working prototypes of CPLs for glove heating.

Benefits

- Reduced insulation requirements can make clothing less bulky and restrictive.
- Application to hand warming allows improved dexterity and tactility.
- Elimination of mechanical pumps to distribute the fluid will result in lighter weight themal control systems.

Heating Applications

- Heated handwear for cold environments (e.g., ski gloves) and people with Raynaud's disease
- Cold environment extra-vehicular activity (EVA) by astronauts
- Arctic expedition gear
- Cold water scuba diving equipment

Cooling Applications

- Hazardous material control garments
- The Army's stand-alone, man-portable microclimate cooling system
- Protective garments for firefighters; racecar drivers; and workers in mines, foundries, power plants, and glass works
- Cooling garments for medical conditions such as multiple sclerosis

National Aeronautics and Space Administration

The Technology

NASA Goddard Space Flight Center's capillary pumped loop technology is a two-phase heat transfer system that uses the latent heat of vaporization/condensation of a working fluid. The basic CPL consists of an evaporator section with a capillary wick structure, a pair of smooth-walled tubes (one for the liquid supply; the other, the evaporator return), and a condenser section. Heat is absorbed by evaporation of a refrigerant at the evaporator section and transported via a vapor in tubing to the condenser. This phenomenon permits the transfer of relatively large quantities of heat by small amounts of fluid across small temperature drops.

A variety of refrigerants, including ammonia, water, alcohols, and several freons, are suitable working fluids. Capillary pumping provides the driving mechanical force for the system.

When applied to the human body, CPLs can be used either to warm or cool specific parts (e.g., feet, hands, ears, face) by transferring excess heat from warmer areas (e.g., behind the knee, elbow, armpit, groin, trunk). This effect may be accomplished either with or without the assistance of an external pump. In addition, it is possible to connect the CPL to an external heat source or sink so that it functions as the secondary heat transfer loop to distribute heat to or from the body.

Although CPLs are inherently self-regulating, physiological experiments will be required to assess heat transfer rates to/from skin, available excess heat at various locations on the body, and heat loss rate through clothing as well as to determine actual performance and practicality for various applications. The principal development issues relate to the heat transfer interface with the human body. CPLs can be made as discrete components from inexpensive materials. Goddard's technology is a relatively easy adaptation of existing technology.

Partnering Opportunities

This technology is part of NASA's technology transfer program. The program seeks to stimulate commercial use of NASA-developed technologies. Working prototypes of this technology for glove warming have been built and undergone some testing. More extensive test data are being acquired, and a patent application has been filed. NASA invites commercial companies to consider partnering with Goddard to develop an application-specific system and pursue commercial applications.

For More Information

If you are interested in pursuing commercialization of this technology, or if you would like more information, please contact:

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