

REFRIGERATION TECHNOLOGY TRANSFERAL JPL/NASA

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JPL has long been involved with developing cryogenic refrigeration systems for the cooling of infrared sensors used by both NASA and the US Defense Department. In 1989, JPL began spinning off this technology to provide commercial refrigeration and air conditioning. In one area of technology, mixed fluids had been used to cool missile-seeking infrared detectors for the Defense Department. This same technology has now been used to provide a family of refrigerant mixtures to replace ozone-depleting Freon 12. Tests at JPL have shown that these mixtures have similar properties to Freon 12, are more azeotropic (less change with evaporative losses) than previous mixture substitutes, and yet have substantially better lubrication properties than **R134a**, the leading single fluid candidate to replace Freon 12.

In another area of refrigeration technology, solid adsorption cooling systems were used to provide cooling of infrared detectors for long life outer planet missions, as well as for earth-orbiting surveillance missions. Sorption compressors operate by sorbing a low pressure refrigerant onto solid powders, typically near room temperature, and exhausting the refrigerant at high pressures when the powder is heated an addition 100-200°C. When the high pressure refrigerant is **pre-cooled** and expanded, it provides net refrigeration. Thus, simple heating and cooling of the powders provides a basically solid-state cooling system with essentially no wear-related moving parts.

This technology has now been spun off and is being licensed by **Aerojet** General to provide air conditioning for a Los Angeles County subway car. For this application, the entire compressor heater power will be derived from the subway train's **electro-resistive** brake waste heat. The estimated date of installation for the subway car system is 1996. This same technology will also be evaluated by **Aerojet** to provide high-efficiency air conditioning systems for home and commercial applications.

Another area of technology spinoff is in the area of small, multi-unit and small, mobile liquid absorption systems. Southern California Gas Company and Ford Automotive have funded JPL to develop low cost, lightweight liquid absorption air conditioning systems that can serve as gas-powered, window air conditioning units or exhaust-heat powered, automobile air conditioning systems. A laboratory prototype of this system is planned for 1995.