Potential Use of Nano Technology in MIL-STD ECUs

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Military Standard (MIL-STD) Environmental Control Units (ECUs) have unique requirements that make them different from commercial air conditioners. They are designed to meet both high stress and environmental extremes. They must be ruggedized to meet vibration and impact requirements that result from military off-road transport and rail transport requirements. A special coating must be applied to components to allow for highly corrosive environments. MIL-STD ECUs are rated for performance at a 120°F condenser ambient and 90°F, 50% relative humidity evaporator ambient. Thus the condenser must be capable of rejecting more heat than a commercial condenser of the same size rating that operates under lower condenser ambient temperature. MIL-STD ECUs do not operate as heat pumps because R-22 heat pumps have poor performance at low ambient temperatures. Military systems are mobile and the primary design concerns are ECU weight and size. This constrains the system to have smaller coils. Heavier fan assemblies are required to handle the increased pressure drop that results from the smaller coils and to provide additional airflow. The ECUs are designed to minimize the power draw. As a result they are not optimized for efficiency over the range of operating conditions.

Nanotechnology can be beneficial in reducing the size, weight, and power consumption of these units. Nanotechnology can reduce the size of the heat exchangers and increase heat transfer. The pressure drop of the heat exchangers can be reduced, which reduces the size and power consumption of the fan assemblies. Reduced power consumption means less fuel to transport to the field and smaller generators to power the ECU.