Air-Conditioning and Refrigeration Technology Institute

Project Summary

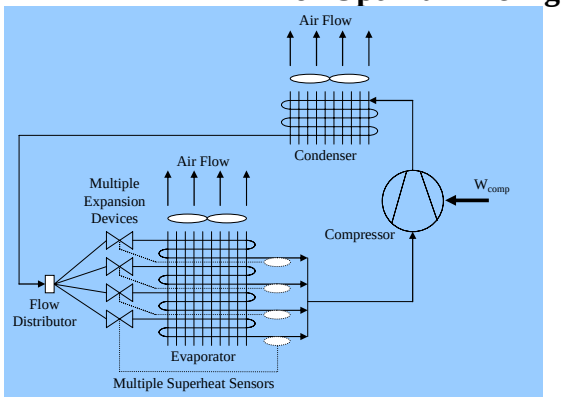
Optimizing Refrigerant Distribution in Evaporators

Growing concern for global warming supports an increasing need for methods to reduce emissions of greenhouse gases. The release of carbon dioxide during the generation of electrical power with fossil fuels is a major source of greenhouse gases. Hence, any improvement in the energy efficiency performance of air conditioning or refrigerant equipment will reduce the consumption of electricity and simultaneously reduce emissions of greenhouse gases.

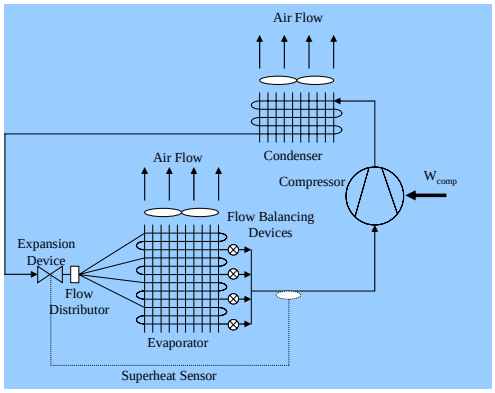
Loss of air conditioning and refrigeration evaporator performance frequently results from a mal distribution of refrigerant flow through the sections of the evaporator. The cause might result from a poor coil design, improper installation of the evaporator, non-uniform airflow, a dirty coil, coil icing, and refrigerant or oil logging in the evaporator.

A previous ARTI project by Payne and Domanski, *Potential Benefits of Smart Refrigerant Distributors*, studied the potential benefits of using smart distributors in controlling refrigerant flow. The modeling program was used to determine the savings in evaporator core volume possible if refrigerant distribution was optimized and controlled by a smart distributor. In extreme cases, savings in core volume could be as much as 40%. The study also found that insertion of individual needle valves in each circuit could recover the up to 7% loss in cooling capacity from non-uniform air flow.

Possible Systems Configurations
For Optimum Refrigerant Distribution



Individual Superheat Control



Overall Superheat Control and Flow Balancing

This project did model and confirm that the Individual Superheat Control (above left) with the upstream valves can recover the loss of cooling capacity from non-uniform air flow – it also found that the Overall Superheat Control and Flow Balancing downstream valves (above right) were not effective in recovering cooling capacity. They also discovered that individual upstream control can effect reduction in coil size (e.g. - 16 percent reduction at 0.8 non-uniform air flow factor). A follow-on phase will test two types of valves to determine which is most promising.

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