

Cool solutions to thermal problems.

Rocky  
Research

COMMERCIAL | INDUSTRIAL | DEFENSE

## HVAC&R Solutions: Refrigerant Flow Control

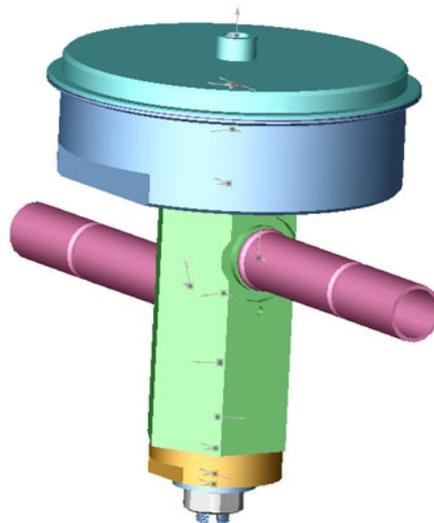
Rocky Research combines an uncommon amount of expertise in thermal management with a focus on energy efficiency to develop dynamic solutions for the HVAC&R industry. From overall heating & cooling systems to flow control valves and operational controls management, our engineers, chemists, scientists and technicians have the experience and know-how to develop an HVAC&R solution for you.

### Advances Thermostatic Expansion Valve for Domestic Refrigerators, Air Conditioners, and Automotive Applications

Rocky Research's novel mechanical thermostatic expansion valve (TXV) is designed for use with:

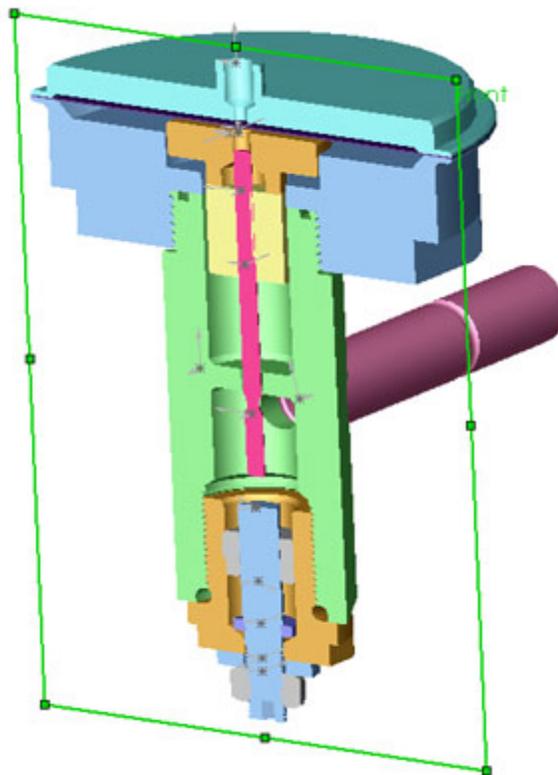
- Refrigeration systems of cooling capacities from 10W to several Kilowatts.
- Residential and commercial air conditioning systems: Rocky Research is currently investigating use of its pulsing TXV instead of conventional modulating TXVs. Results show improvements in superheat control and energy efficiency.
- Automotive applications where the pulsing TXV can improve the cool-down period and overall efficiency of an automotive air conditioner at different driving conditions.

The subject mechanical TXV can control evaporator conditions nearly as well as an electronic expansion valve, but at a lower cost and without the need of electrical wiring and harnessing. Specific advantages include:



1. Faster pull down to operating conditions because the evaporator is kept full during the pull down period. This can also mean a smaller compressor for equivalent pull down to a capillary system.
2. Reduced energy consumption of constant-speed compressor systems.
3. Operation of variable speed compressors for further efficiency gains.
4. Optimized operation over a broader range of ambient temperatures than is possible with capillary systems.
5. Elimination of capillary plugging problems without costly shop floor quality control.
6. Avoidance of “hunting” resulting in evaporator flooding or refrigerant starving as experienced with conventional TXVs
7. In some cases a reduction in refrigerant charge.

Operation of the new valve is similar to that of conventional mechanical TXVs, except the valve pulses to control flow, rather than modulating the degree of plug opening. When the bulb pressure calls for refrigerant flow, the diaphragm opens the inlet port and the valve cavity is pressurized. An outlet restriction causes cavity pressure to rise above evaporator pressure, and the valve immediately re-closes. The valve continuously pulses in this manner until the evaporator cools and the bulb pressure decreases to the point where the diaphragm no longer opens the valve. Like any TXV, superheat is adjustable by changing spring pressure and/or bulb charge. The outlet restriction is several times the diameter of a capillary or orifice sized for the same application, and is large enough to be immune from plugging.



## 1. Design

Rocky Research completed the valve design to the degree of cost effective manufacturability.

## 2. Prototyping

Rocky Research built and operated dozens of prototype valves to verify functionality.

## 3. Operability Demonstration

Rocky Research demonstrated and verified operability with refrigeration and air conditioning systems between 12 watts and 17.5 kW of capacity and has seen improvements in efficiency up to 50% and pulldown up to 350% depending on the type of system tested.

## 4. Reliability Testing

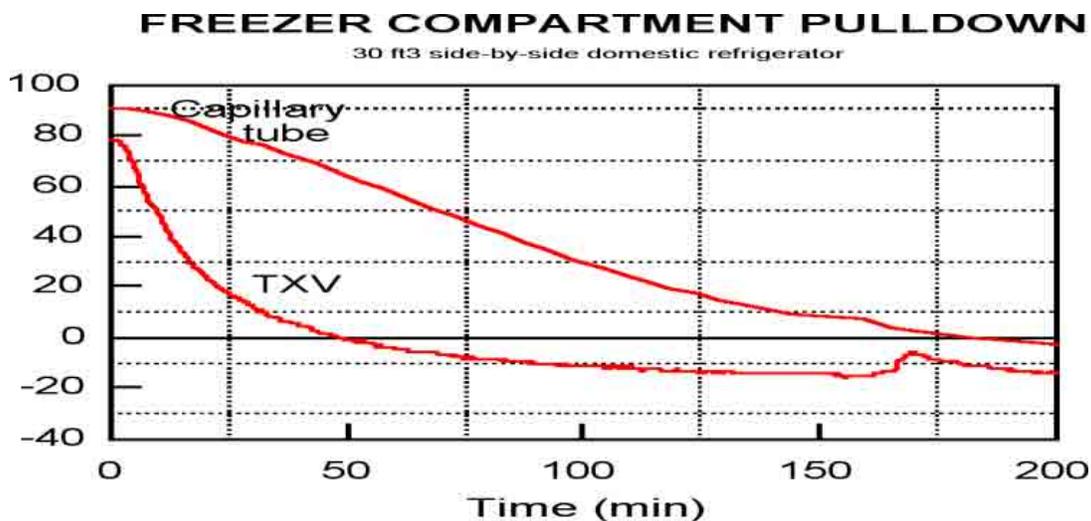
Several durability tests have been conducted with more than 100 million cycles logged on the diaphragm and thermal assembly without any failure.

## 5. Intellectual Property Protection

Rocky Research obtained a US patent 5,675,982 with the U.S. Patent and Trademark office, foreign counterpart applications are pending along with a second US application.

## 6. Manufacturer Selection and Training

Rocky Research selected, tooled and trained a US manufacturer, which can and is available to provide cost effective and high quality products to Rocky Research and Rocky research licensees, if desired.



Rocky Research is prepared to provide sample valves, contract manufactured by the above mentioned US company, on a loan basis for the purpose of performance verification. Rocky Research prefers to test and “optimize” the valve on a cooling/refrigeration system at its test facilities before shipping the sample. Should a shipment of multiple valves be necessary, we are

prepared to provide such shipments at our cost. In addition, we are prepared to provide additional design information upon specific request.