



Carrier Case Study

If you want to understand today, you have to search yesterday.
~Pearl Buck

This was especially true for Carrier Corporation, a company with a long, rich history. After decades in the industry, Carrier Corporation management realized that they were using three different manufacturing methods in the same plant. While each individual manufacturing decision had made sense at the time, it was time to take a fresh look at the company's production processes.

History

In an industry invented by Willis Carrier, the Carrier Corporation still leads the way by bringing innovation to their customers. This tradition started in 1902, when just one year after receiving his degree in mechanical engineering, Willis Carrier completed the design of the world's first mechanical refrigeration system. With his focus on creating new technology—and even new terminology—Carrier used the technology of his era to support his new ideas and inventions.

One example of this existing technology is the Schrader valve. As bicycles began to use pneumatic tires in the 1890s, inventor August Schrader designed his most popular invention, the eponymous valve, to provide a way to fill tires. The success of this valve can be seen on cars and bicycles still today. Used in early Carrier designs, Schrader type valves are still used as production and service access ports on many refrigeration systems.

Although there have been some improvements to the Schrader valve, today's design is very similar to the 1890 version. Originally designed for low pressure applications where small leaks and limited flow rates were not a concern, Schrader valves may not be the ideal valve for today's high pressure, highly engineered refrigeration systems. Pursuing the challenging quest of increasing A/C system performance, improving system quality and extending life expectancy, all while driving the price to the customer down, has led Carrier to examine the decades old "state of the art" process port.

Challenge

One of the biggest challenges for manufacturers is finding a way to create a high quality product while shortening the time it takes to evacuate contaminants and fill the system. Schrader valves are too restrictive to provide the flow rates needed. To solve this problem, Carrier replaced the Schrader valve with a valve featuring a larger diameter, allowing for a higher flow rate. However, the existing service tools used by refrigeration technicians were incompatible, presenting field service access issues.

Not wishing to create a problem in the field, Carrier chose to provide a Schrader valve for access to the system in the field and use the high flow valve only for processing in the manufacturing plant. This meant that two types of valves were included on each system:

one for manufacturing and one for service. Manufacturing flow rates increased, but only with the added expense of an extra valve.

Another approach Carrier has used involved avoiding the valve altogether. Carrier chose to evacuate and fill the refrigeration system through a process tube during manufacturing. With this system, a special connector grips and seals onto the tube, allowing much higher flow for processing. Again, access valves for field service must be provided. While fast, this method has shortcomings when, at the end of charging the system, the tube is pinched and brazed to seal it. This step takes time, and it is difficult to make the brazed joint reliably leak-free. The result is that processing flow is increased with the added costs of tubing, along with an extra production station to pinch and braise the tube closed. Plus, a service-only valve was still required for field access.

Perhaps the largest cost associated with the process tube approach, however, is due to leaking joints. Unlike all of the other joints in the system, this joint is made after the system has been evacuated and charged with refrigerant. To correct a leak at this point, the refrigerant must be reclaimed and the joint re-brazed. The system is then charged with refrigerant once again. Clearly, the costs of a bad joint are high.

Always evolving, Carrier has over time implemented all of these methods to provide the required access to the refrigeration system, both on the manufacturing floor and in the field.

“Each manufacturing method made sense at the time it was implemented, but over time we were using different methods for evacuating and charging our systems—all in the, same plant. Surely, there had to be one, single ‘best practice,’” said Charlie Haynes Engineering Manager with Carrier’s Tyler, Texas manufacturing plant. “On some systems, we were processing through Schrader valves. On larger systems, we were processing through a separate Eaton high flow valve, while on other systems we were using process tubes.”

“And now, with the mandated conversion from ozone depleting CFC refrigerants, such as R-22, to environmentally friendly non-CFC refrigerants, such as Puron, the evacuation process becomes even more critical,” Haynes added. “The increased water absorption of the HFC compatible oils used to lubricate the system puts even more pressure on the evacuation cycle to remove contaminating water molecules from the system.”

A Better Way

During this search for the optimal manufacturing method, a FasTest supplier contacted Carrier and offered a simple solution. FasTest had recently developed the CoreMax® family of processing tools with a new patented high flow access valve. Overcoming the shortcomings of past high flow valves, CoreMax is also compatible with existing service side connections.

“We were looking for a better way to ‘skin the cat,’ and the introduction of the FasTest valves gave us exactly what we were searching for—a cost-effective, manufacturing friendly system providing high evacuation and charge rates coupled with improved reliability,” Haynes said.

The CoreMax valve offers both high flow rate and compatibility. The valve side that inserts into the refrigerant system has a much larger core diameter than the Schrader style valve. On the service side, however, the CoreMax valve looks just like the Schrader style valve. It has the same thread, pitch, and actuating pin, which means service technicians can use their existing gauge sets and connection tooling to service the system.

“The beauty of the CoreMax System is that it allows the manufacturer to customize their process with the various production ready tooling available while centering on our CoreMax high flow valve,” said Chuck Ingram, Vice President of Sales and Marketing for FasTest. “Manufacturers can realize true productivity gains by improving their vacuum flow rates equal to or beyond that of process tubes while maintaining service accessibility in the field. It’s a win-win for both the process engineer and the service technician.”

“We worked diligently with the Carrier Reliability engineers, along with the Engineering Teams at the Morrison, Tenn. and Tyler, Texas manufacturing facilities, ensuring our valve was reliable and designed to handle today’s higher pressure refrigerants and synthetic oils,” Ingram added.

“We knew that there had to be a better way than using a 100 year old valve design,” said Rob Danielson, Vice President of Engineering for FasTest. “And we knew it was going to be a challenge, but we also knew how much it would benefit our customers. Being a manufacturer of tools allowed us to take a systems approach to the design, matching tools to the valve and delivering a complete solution.”

“CoreMax gave us the opportunity to consolidate our various manufacturing methods into one,” said Christian Cornejo, Carrier Project Engineer. “Depending on the previous processing method, CoreMax provided different benefits. In one case, the benefit was dramatically higher flow rates. In another case, it was a cost reduction, and in another it was immediate and significantly reduced rework issues,” Cornejo said.

An added benefit was the positive reaction of the line personnel.

“Having one processing method that uses snap-on, snap-off connectors has made the job on the line much easier,” Cornejo continued. “We do not have to change setups for different products and the connections are very easy to make.”

Continuing Improvement

In an industry Willis Carrier invented, Carrier Corporation continues a tradition of innovation that began over 100 years ago. Always innovating and never satisfied, Carrier engineers strive to provide the best products to the most people for the best value. To

learn more about the history of air conditioning, visit www.Carrier.com and click on the modern air-conditioning interactive timeline.

To learn more about the CoreMax System from FasTest, visit www.fastestinc.com.

Table 1

	Pros	Cons
Schrader Style valves	Many service tools available	Limited flow diameter providing approximately 1 scfm of vacuum flow increasing the time required to pull a consistent base evacuation Limited production tools available
Process Tubes Pinch tubes Flow tubes	These straight tube process ports allow for greater flow than Schrader style valves, approximately 3 to over 8 scfm of vacuum flow depending on implementation	Special connectors required to grip and seal on the straight tube increasing tooling and maintenance cost. Additional process step to pinch and braze the tube closed. Difficult to maintain a leak free joint. Additional valve port (Schrader style) needed for field service
Specialty High Flow (Eaton, Stove Pipe, Automotive) valves	Flow rates comparable to process tubes, approximately 3 to 5 scfm of vacuum flow	Not compatible with existing service connections, gauge and tools sets. Additional valve port (Schrader style) needed for field service.
CoreMax® System	Higher flow rates approximately 3 to over 12 scfm of vacuum flow depending on implementation Compatible with existing service and gauge set connections. Flexible processing methods tailored to meet vacuum requirements	Proprietary system