



Turn to the experts

## Carrier AHRI Approved Laboratory



## Precision Chiller Performance Testing





## Charlotte Manufacturing Facility

World-class, award-winning, quality-driven, safety superiority and strategic operating objectives all define Carrier's Charlotte manufacturing facility.

The current 350,000 ft<sup>2</sup> state-of-the-art building — in operation since 1999 — produces water-cooled chillers which range from 16 to 5,500 tons (56.3 – 19,343 kW) capacity and ships our products globally.

- Certified to ISO 9001: 2015
- LEED EB Certified
- ASME Certified Manufacturing Facility
- *Industry Week* "Best Plants" Past Award Winner



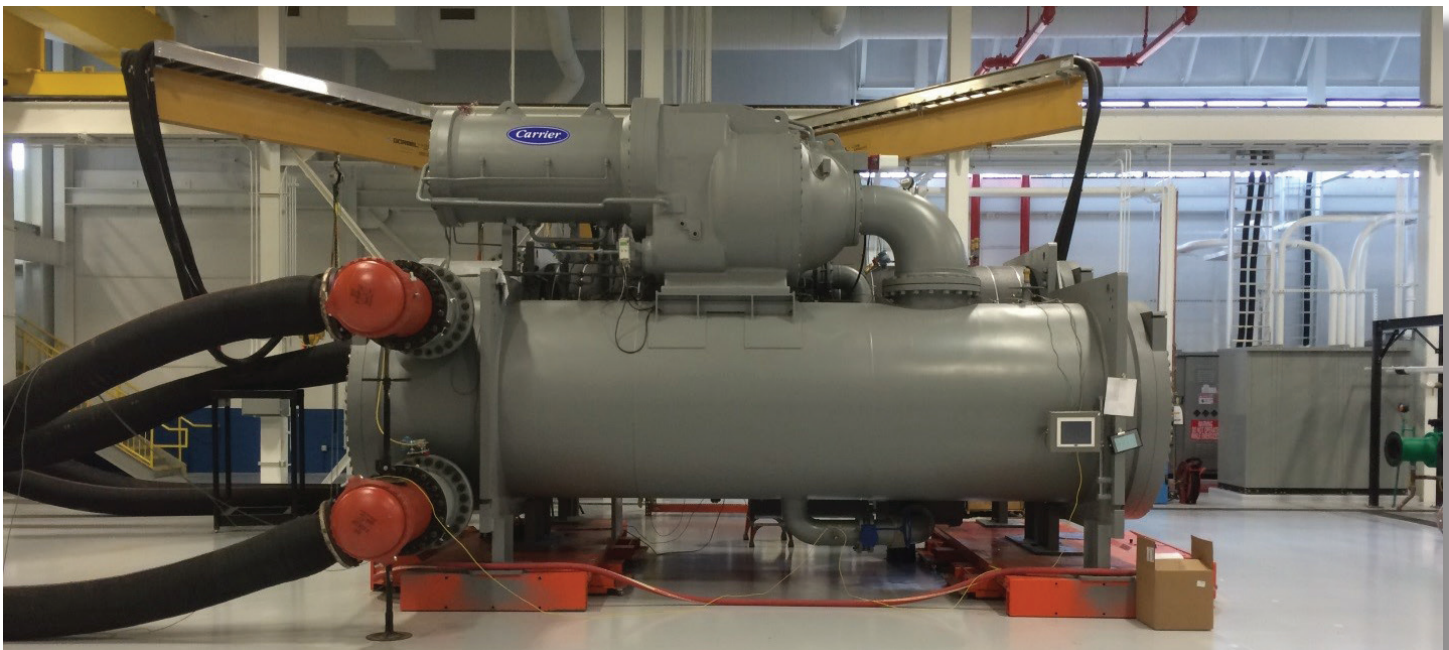
## Water-Cooled Chiller Test Facilities

Carrier maintains multiple AHRI approved water-cooled test loops in the Charlotte facility. These test loops enable Carrier to confirm a range of performance from 80 tons through 3,400 tons refrigeration capacity (281 – 11,957 kW). These tests can be run at full- or part-load over a wide range of temperature and flow conditions, all while maintaining the tolerances specified in the latest AHRI standard.

Voltages from 230V – 13,800V at 50/60 Hz supply frequency can be accommodated. Carrier tests a broad range of chiller sizes at various load points in both customer witness or non-witness format.

The Charlotte facility provides a wide variety of chiller customer experiences such as performance and testing observation, relevant equipment and technical presentations and manufacturing facility tours.

During the actual testing procedures, chiller performance will be evaluated against the approved data which was submitted at time of order.



*Shown above is a 19XR water-cooled centrifugal chiller undergoing rigorous testing procedures on an AHRI approved test stand located in Carrier's state-of-the-art Charlotte, NC facility.*

# AHRI Certification Program

Carrier participates in the AHRI performance certification program as defined in the water-cooled chiller certification manual, which allows us to affix the AHRI logo to all equipment documents and nameplates. This program stringently defines the

rating conditions for chillers and conducts random performance audits throughout the year. These audits must be performed in an AHRI approved laboratory with strict adherence to all test parameters.

## AHRI Instrumentation:

AHRI defines the acceptable tolerances for performance tests. Test conditions must match the design conditions within the following AHRI tolerances:

- Entering condenser water temperature  $\pm 0.5^\circ \text{F}$  ( $0.28^\circ \text{C}$ )
- Leaving chilled water temperature  $\pm 0.5^\circ \text{F}$  ( $0.28^\circ \text{C}$ )
- Water flow rates  $\pm 5$  percent
- Supply voltage  $\pm 10$  percent
- Supply frequency  $\pm 1$  percent
- Water pressure drop to  $\leq 15$  percent or listed differential pressure + 2ft. (whichever is greater)

## Instrument Calibrations:

All instruments are calibrated on an annual basis in accordance with AHRI 550/590 and AHRI 551/591 (latest edition) and submitted to AHRI for facility approvals. In many cases, redundant instrumentation is maintained to provide confirmation of specific measurements.



*Calibration certificates can be provided upon request.*

## Operational Envelope of Facility

- Maximum Capacity<sup>1</sup>: 3,400+ tons (11,957+ kW)
- Minimum leaving chilled water temperature: 36°F (2.22°C)
- Maximum leaving condenser water temperature: 115°F (46.1°C)
- Maximum evaporator flow<sup>2</sup>: 9,000 GPM (567.81 L/s)
- Maximum condenser flow<sup>2</sup>: 10,500 GPM (662.45 L/s)
- Available frequencies: 50 Hz, 60 Hz
- Available voltages: 208 – 13,800 V
- Available cooling medium: Fresh water is used for all test loops. Applications for brine can be simulated by water temperature adjustments within the operating envelopes of the test loops in order to match the lift conditions of the brine application.

## Test Preparations

- Chillers are placed in position within the lab and factory technicians connect and support the laboratory power cables.
- Direct hose connections are joined to the heat exchanger water boxes. Pressure taps near the manifolds are used to measure waterside differential pressures.
- The chiller is then charged with the designated refrigerant.
- Proper instrumentation transformers for the motor rating and standard electrical instrumentation are selected and connected to the measuring station.
- A preliminary test is conducted to ensure that the chiller and lab systems are operating within allowable specifications in order to complete customer test.

## Test Report

A performance data report is provided upon completion of the test. Performance data is recorded per AHRI 550/590 or AHRI 551/591 (latest edition). This report will contain the following information:

- Cover/sign-off Sheet
- Unit identification by model and serial number
- Date and Time of Test
- Water Temperatures – condenser and evaporator
- Water Flow Rates
- Capacity
- Chiller Voltage
- Chiller Power – Kilowatts
- Power Supply Frequency
- Overall ikW/ton and Energy Balance
- Waterside Differential Pressure

<sup>1</sup>AHRI Standard 550/590 & 551/591 only applies up to 3,000 tons (10,551 kW).

<sup>2</sup>Can be enhanced as required.

*The ability to meet all operating conditions is not guaranteed as there are limitations on laboratory capabilities especially under certain weather conditions.*

## Carrier Testing and Verification Options

**Certified Performance Test:** Certified performance tests are the most commonly requested type of test. This option provides the customer with a full performance test report available at the time of chiller shipment. Test reports are available in Imperial or SI units.

**On-Site or Virtual Customer Witness Tests:** These options give customers the ability to witness a chiller performance test, either on-site at the Charlotte facility or virtually from any location. With either, customers interact with chiller lab personnel and observe relevant presentations. Facility tours are conducted as either on-site walk-throughs or virtual via a conference call.

**Maximum Capacity:** With Carrier's patented variable orifice refrigerant metering design, more refrigerant can be circulated through the chiller's refrigerant circuit during "off-design" conditions. Often times a chiller will be capable of producing capacities which exceed the design value which allows end users to maximize available cooling capacity per square foot of mechanical room space.

**Stability Demonstration Tests:** The AHRI 550/590 and AHRI 551/591 standards govern chiller performance requirements down to a minimum of 25 percent operating capacity. In real-world applications, chillers must often run below 25 percent load in order to satisfy the requirements of a given application. Carrier's chillers are designed to accommodate a variety of "off-peak" conditions including low load/high lift (no condenser water relief) as well as low load/low lift (condenser water relief). This helps to ensure reliable and efficient operation across a wide operating envelope.

**Free Cooling\*:** Free cooling capability allows the chiller to produce useful cooling tons when ambient conditions permit, without running the compressor. This provides the potential to eliminate costly plate-frame heat exchangers, associated pumps and piping and may also help in complying with the ASHRAE 90.1 Standard for water economizers.

**Series-Counterflow\*:** By reducing the lift imparted on each chiller, series-counterflow arrangements have the ability to provide substantial efficiency gains versus a traditional parallel configuration.

**Variable-Primary Flow:** Often times variable evaporator flow designs are implemented as a means to save energy on chilled water pump operation. Carrier's AHRI approved test lab can demonstrate the chiller's turndown capability in response to varying load and flow conditions.

**Acoustic Demonstration Test:** Acoustic tests are conducted in accordance with AHRI Standard 575 (latest edition). Note: acoustic tests do not demonstrate exact sound data because of the presence of factory background noise. Sound test points are for informational purposes only and Carrier will not accept any liability associated with sound test results which may differ from the acoustical data generated by the Carrier chiller selection software. Acoustic tests do not include any sound attenuation options that may have been selected for the chiller.

**Inverted Start:** An inverted start occurs when the water flowing through the chiller's condenser is colder than the water flowing through its evaporator. Achieving a successful chiller startup during these conditions is vital to plant operation and overall system robustness. Carrier's ability to demonstrate this scenario in a lab setting instills confidence that Carrier's equipment can be relied upon even in the most demanding conditions.

**Zero Tolerance Testing:** The AHRI 550/590 and AHRI 551/591 standards define specific tolerances within which chillers must operate to account for uncertainties associated with measurement, test facilities and manufacturing. By removing these tolerances, it guarantees that the chiller will deliver the capacity and efficiency that customers demand. Carrier's ability to conduct zero tolerance performance tests provide peace of mind by demonstrating that the chiller will perform as expected even under the most stringent conditions.

**Capacity Recovery:** Unexpected losses of power in critical applications can have detrimental effects on chilled water systems. A chiller's ability not only to restart quickly, but to get back up and running to the required load can help reduce overall plant down-time when it matters the most.

**Long Duration Tests:** The AHRI 550/590 and AHRI 551/591 standards require that a particular test point be run at uniform time intervals until a minimum of 30 data point measurements can be collected and recorded. This typically takes less than one (1) hour. Often times it is desired to demonstrate how a chiller will operate over a longer period of time, particularly at "off-design" conditions. Long duration tests demonstrate the chiller's capabilities during periods of sustained operation.

*\*On applicable models*



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