Thermal Performance Testing Information

Preferred Test Codes: SPX Cooling Technologies (SPX Cooling) supports the use of the thermal test code ATC-105 published by the Cooling Technology Institute (CTI). A very similar alternative is PTC-23 published by The American Society of Mechanical Engineers. All discussion of testing assumes that one of these two codes will be followed during the test. Customers may reserve the right to specify and use modifications to these codes or elect to use another procedure. In the case of exceptions to ATC-105 or PTC-23, it is suggested that SPX Cooling Technologies be consulted.

Third party test agencies: Where customers want to use the services of third party agencies to conduct the testing, SPX Cooling supports the use of CTI Licensed Agencies. If guaranteed performance compliance is to be determined by a test, SPX Cooling will consider other agencies but reserves the right of approval. SPX Cooling reserves the right to witness any testing where contract compliance is the issue.

Types of tests: Currently, it is common to refer to tests as either Class A or B. In general, a Class A test is one conducted using mercury-in-glass thermometers and grade level psychrometers. A Class B test uses a data acquisition system and usually finds the psychrometers hung in an array over the air inlet face of the tower. This does not mean that a data acquisition system cannot be used in conjunction with grade level psychrometers. It is common to call the air temperature measurement device used in cooling tower tests a psychrometer. This is technically incorrect as a psychrometer measures the wet bulb and dry bulb temperatures while those instruments widely used today measure only a single temperature. Depending on how the "cooling tower" psychrometers are assembled, they may be used to measure either a wet or dry bulb temperature.

It is also very important to recognize the difference between an ambient and entering wet bulb test. Both ASME and CTI recommend that towers be sized and tested based on entering wet bulb temperatures. SPX Cooling also recommends that entering wet bulb temperatures be used. This consideration can affect the size of the tower selected and the results of thermal tests. An ambient wet bulb is defined as the temperature of the air mass entering the tower less any influence of the hot, moist discharge air from the tower in question (recirculation). Normally, for an ambient test at least 3 wet bulb instruments are located 50 to 100 feet upwind of the tower. It is also necessary to measure or otherwise account for the temperature and quantity of any other air streams (interference) entering the tower other than its own recirculation. This interference can come from any other source including other cooling towers. This can be very difficult to impossible in some situations. The entering wet bulb temperature attempts to measure the average temperature of all the air entering the tower regardless of its source. While this is easier than trying to separate the influence of several air masses, it still requires careful analysis by the test staff to ensure that the number of instruments and their locations are adequate.

The Typical Test: Most testing done today is conducted using data acquisition systems to measure the temperatures. This discussion assumes this type of system is used. Should mercury-in-glass thermometers be utilized, the major difference is that less data will be taken and the parameters will typically be measured sequentially.

The first order of business to conduct a test is to inspect the tower to ensure it is ready for the test and identify points of measurement for the various parameters. While the third party test agencies may consider the tower condition, it is really not their obligation to clean, balance, or otherwise adjust the tower. The customer is expected to maintain the condition of the tower and prepare it for the test. In the case of an acceptance test, the manufacturer will normally be much more thorough in this area to ensure the tower's full potential is measured. Once this is complete and all parties are satisfied, instruments are deployed and the testing begins. This process can take from a couple of hours to one or more days usually depending on the size of the tower.

To begin the testing process, the test engineers begin taking data. Usually, the thermal data is started and monitored for a brief period. If any problems with instrumentation or conditions are noted, efforts will be made to correct them. Once this process is underway, the test staff will continue to monitor the system, and measure the water flow rate and fan power. The codes offer recommendations on deviation from design conditions for the test parameters. While it is preferable to comply with all these limitations, it is not always possible. CTI Agencies report on the deviations from recommended parameters and their history indicates only 25 - 30% of all tests find all parameters within the guidelines. Recognizing this, the codes allow for deviation provided all parties agree. If at any time during the process, it is determined a parameter is outside the recommended limitations, all parties must review the situation and reach a unanimous solution. This can result in data being discarded and restarts required. For mechanical draft towers, the actual testing process is usually one day or two days. Weather and operating conditions can sometimes increase this. For natural draft towers multiple tests over a minimum of 2 days is recommended. Due to the complex nature of natural draft tower testing, this process usually takes 3 to 5 days.

To measure the water flow rate, a pitot tube traverse of the piping carrying water to the tower is the preferred method. A wattmeter is used to measure fan input power on mechanical draft tower systems up to 600 volts. Above 600 volts alternate means must be identified. Temperatures are measure with thermometers, RTDs, or thermistors. The following parameters must always be measured: water flow rate, hot water temperature, cold water temperature, wet bulb temperature, fan power (mechanical draft towers), dry bulb temperature (natural draft towers), and wind speed. In addition, any other factor affecting the towers operation or the data taken must be accounted for. Examples may include pump discharge pressure, make-up flow and temperature, blow-down flow and temperature, auxiliary streams entering the collection basin, etc.

The hot water temperature is normally taken in the distribution basin (crossflow towers) or in a tap in the piping carrying water to the tower. The tap may be the pitot taps, but there are times when separate taps are required. An example of this might be if the pitot taps are in underground piping and a flowing well could cause problems.

The cold water temperature is normally taken at taps on the discharge side of the pumps. In most cases, installations have pressure gauges at this location. The gauges are often replaced with flowing wells for temperature measurement. If this is not possible, separate taps need to be provided. On some towers, especially once through (helper) towers, the cold water temperature can be difficult to impossible to measure accurately. If the water discharges directly from the tower to large flumes, a lake, or a river, special consideration and instrumentation may be required. In some cases, the installation may not lend itself to accurate testing.

The codes have defined the instrumentation and procedures very clearly. Unfortunately, the many installation variations and test circumstances provide multiple obstacles. This can cause even the best of test engineers problems and increased uncertainty of results. The straightforward process alone does not protect against completely meaningless results. For this reason, the CTI carefully tests those individuals licensed by CTI to lead tests and inspects and approves their test equipment. Manufacturers also have highly skilled and trained engineers to participate in the testing process to help ensure the products are properly evaluated. Even in the case of CTI licensed test engineers, variation in the quality of work and attention to detail may be noticed.