

# Motor insulation tests avoid costly equipment breakdowns

## Application Note

In the warm summer season, cooling equipment operates at near peak capacity. If that equipment is used for critical building functions, any equipment downtime for whatever reason is unacceptable.

At the most sensitive end of the spectrum, hospitals rely on their central cooling systems for critical patient care areas, such as operating and emergency rooms. If cooling is lost, subpar environmental conditions could threaten patient health and either prevent procedures from being scheduled or create potential liability.

More commonly, many commercial and light-manufacturing buildings now have in-house data centers full of servers. These servers might be responsible for critical information, such as personal information, real-time financial transactions or airplane tickets. These servers also generate large amounts of heat, which must be either dissipated or offset with cool air. A loss of chilled water cooling capacity for even a few minutes can cause a server room to shut down.

In the vast majority of hospital and data center systems, the cooling is provided by a number

of water chillers, pumps and cooling towers. The water chillers might be centrifugal, screw or scroll construction. Most commonly, a number of centrifugal chillers provide redundancy and step capacity.

Chillers, pumps and tower fans all utilize three-phase motors to move water, move air, or compress refrigerant. The failure of any of these motors can threaten the operation of the entire chiller system. It is very important that ALL motors are thoroughly checked out before being put in service for the cooling season. While emergency service is available on these machines, it is enormously

expensive. Rates of \$250/hour/person on nights and weekends are not unheard of, with transportation and parts costs adding a large additional expense.

While there are a number of diagnostic tests that can and should be run on chiller plants before seasonal start up, none is more important than checking the motor resistance with an insulation tester. The insulation tester will pass a high voltage through the individual motor windings while measuring the winding resistance. A low resistance indicates that the winding is deteriorated and might fail after the device is placed into service.



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The insulation and windings on cooling tower fan motors must be tested.

In general, using an insulation tester involves the following steps:

1. Wear personal protective equipment (PPE) and obey safety rules at all times. Place safety glasses over eyes. Disconnect and remove all power sources to the motor before attempting any type of repair. Follow lock out-tag out procedures. Double-check by using your multimeter to ensure that all power is shut off.
2. Remove the screws that hold the wire connection cover in place from the motor, and set aside. Detach the power wires from the motor wires; you might have to identify the pairs with labels or numbers so you can maintain proper rotation, especially in three-phase motors. Commonly, the device must be at room temperature for a minimum of 24 hours before you run the test. Also, make sure that the motor is not in a vacuum when the insulation testing is done, as this might destroy the motor.
3. Attach one lead of the insulation tester to one of the motor wires and the other to the motor ground or metal case. Turn on the meter or crank the handle. The meter's manufacturer should have reference readings for each meter. Generally a reading above 20 to 30 megohms should be sufficient to run most motors. All new motors should read greater than 999 megohms; any reading less than this will indicate deterioration of the winding insulation.
4. Test each motor winding in turn and record each set of windings, per the megohm reading. Better insulation tester will have the ability to log the data to a laptop for future reference. If one of the legs has a very low reading the motor should be replaced. This will also result in a high amperage draw or constant blown fuses. Many manufacturers will provide a chart with the proper readings.

As always, follow all device and meter manufacturer's recommendations for use.

Which motors in the chiller plant should be tested? The answer is all of them, or as many as possible. This of course will include the chiller and pump motors at a minimum. It also should include chiller oil pump motor and cooling tower fan motors. If either one of these motors fail they may very well end up causing the entire chiller system to fail as well.

The bottom line is that testing motor insulation will identify problems in time to fix them, while they're still repairable.



The pump is one of three components of a modern chiller plant.

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