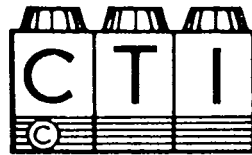


COOLING TOWER MANUAL



CHAPTER 11

ELECTRICAL COMPONENTS FOR COOLING TOWERS

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Approved by the CTI Executive Board

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11.2

Chapter 11

ELECTRICAL COMPONENTS FOR COOLING TOWERS

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11.3

11.1 SCOPE

The electrical components for a cooling tower are of primary importance and must be given serious consideration for selection of proper motors, enclosures, wire sizes, grounding and lightning protection. Emphasis should be placed on high operating efficiencies.

11.2 DEFINITIONS

AFBMA	-	Anti-Friction Bearing Manufacturers Association
DPDT	-	Double Pole, Double Throw Electrical Switch
HP	-	Horse Power
NEC	-	National Electric Code
NEMA	-	National Electrical Manufacturer's Association
PF	-	Power Factor
RTD'S	-	Resistance Temperature Detector
TEFC	-	Total Enclosed Fan Cooled Electric Motor

11.3 MOTOR EFFICIENCIES

Motors purchased with packaged systems should be evaluated for efficiency and cost of operation. The motor manufacturer should define the nominal operating efficiency at full load, 3/4 load, and its power factor. This data is needed to determine the real cost of a motor. Real cost of a motor can be evaluated by the following:

$$\text{Price Quoted} + \text{Efficiency Related cost} = \text{Real Cost of Motor}$$

New motor name plate will have the nominal efficiency at full load, NEMA Standard MG1-12.53b list the minimum efficiency associated with the nominal efficiency.

11.4 MOTOR OPERATIONS AND DESCRIPTIONS

During cold weather, tower fan horsepower will increase substantially, as shown by the curves on Figure 11.4. Fan Power is proportional to the product of air flow and head, and since flow is constant while pressure head varies with density, horsepower will vary with air density. Whereas the curves assume horsepower varies as exit air density, actual horsepower change will be slightly different as the density effect on static should recognize coincidental density change on all elements contributing to the total static.

11.4

Critical to a motor is not horsepower but operating or winding temperature. Higher horsepower is only significant in that it means higher winding temperature rise, approximately equal to the square of the horsepower change (motor current varies as horsepower and most of the heating is a resistance or an I^2R loss). High horsepower becomes critical only when the higher temperature rise, when added to the temperature of the air cooling the motor, nets a winding temperature higher than the design temperature of the winding insulation. Insulation thermal life is cut in half for every 10°C rise in temperature. Therefore it is important that the total temperature rating not be exceeded. The following example illustrates this.

Insulation Type	B	F	H
Measured Temperatures rise (resistance method)	80	105	125
Hot spot allowance	10	10	15
Ambient	40	40	40
Total temperature	130°C	155°C	180°C
@125% load			
Insulation Type	B	F	H
Measured temperature rise	125	164	195
Hot spot allowance	15	18	22
Ambient	-10	-27	-37
Total temperature	130°C	155°C	180°C

Since high winter horsepower does not truly "overload" the motors, switchgear must be designed to accept higher winter current while meeting the intent of the National Electrical Code. Changing fan pitch and overload heaters for summer and winter operation will not be considered here as viable alternatives. Typical code requirements for overload protection are: It shall trip at not more than the following percent of full load current:

- 15% overcurrent with 1.0 service factor motors.
- 25% overcurrent with 1.15 service factor.
- 40% maximum with winding thermal detectors as primary protection.

Every motor starter should have an overload selection table inside the cover that was determined by the temperature rise in that enclosure. If the starter is installed at a location that is at a different ambient than the motor it is controlling, adjustments will have to be made in the selection of the overloads. Exposure to direct rays of the sun or a location in a hot or cold room are two things that will affect overload selection.

The overload tables are set up so that a properly selected overload operating at 40°C ambient will trip at between 107 and 115% of full load current on a 1.0 service factor motor or between 115 and 125% of full load current on 1.15 service factor motor. Same overloads can be adjusted to trip between $\pm 15\%$ of the normal trip point.

The following summarizes common practice in overload protection, with comments where extreme winters are expected: