

## Test tools and troubleshooting electric motors

### Application Note

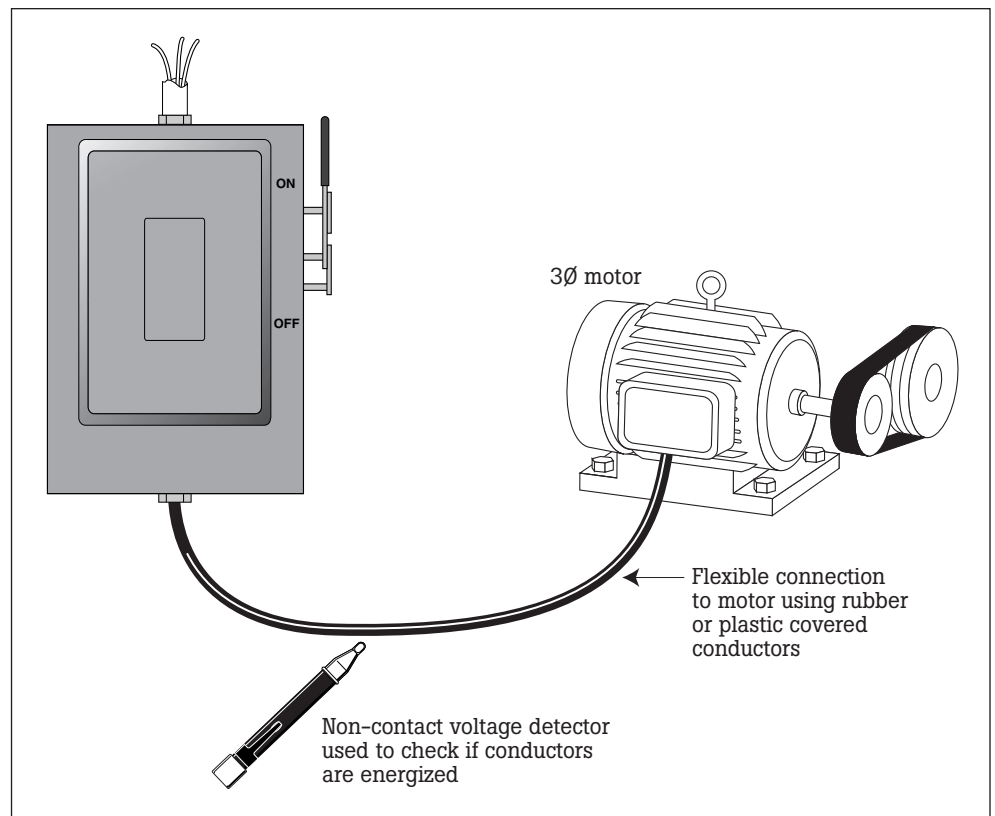
Troubleshooting is the systematic elimination of various parts of a system, process, or piece of equipment to locate a malfunctioning part. To locate and correct a motor malfunction quickly, troubleshooting is best performed using the proper test tools. Different types of test tools are used depending on which part of the system is being tested and what information is required to isolate the fault. For example, when troubleshooting a motor and motor control circuit the following test tools can be used:

- Non-contact voltage detector is used to determine if conductors or any non-grounded metal parts are energized before touching them.
- Digital multimeter (DMM) is used to take basic resistance, voltage, and current measurements.
- Clamp-on ammeter is used to take current measurements without opening the circuit.
- Megohmmeter is used to detect insulation deterioration.
- Non-contact thermometer is used to measure temperature in order to determine circuit overloading, poor connections, or undersized conductors.
- Power quality analyzer is used to measure for harmonics on the line, transients, power interruptions and other circuit conditions that can cause component and system faults.

#### Non-contact voltage detector

A non-contact voltage detector is a test tool that gives a visual indication when voltage is present in a conductor, or other metal parts. The tester glows red if voltage is present. The red glow

can be used to indicate if voltage is present in an insulated conductor, or that a non-insulated metal part is energized (hot, live) by a hot conductor touching an improperly grounded system or part. Touching an energized metal part can cause an electrical shock.

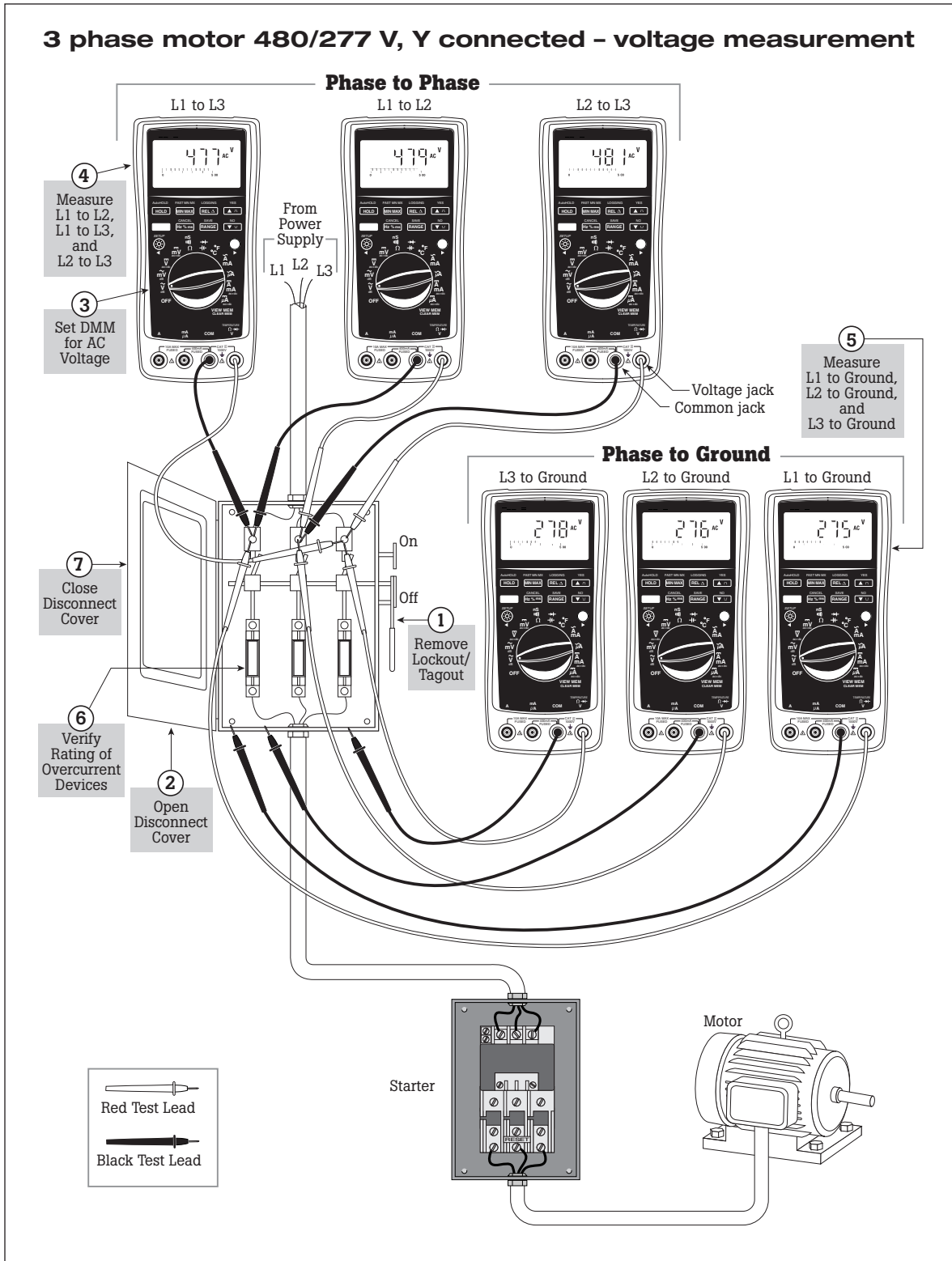


**Digital multimeter (DMM)**

A DMM is a test tool that measures several different electrical quantities, such as voltage, resistance, or current. Some

models also include special features for taking minimum/maximum, and relative measurements and/or testing diodes and capacitors. A DMM is required when performing troubleshooting tasks

such as testing for power loss from blown fuses, excessive current levels from overloaded circuits, and improper resistance from damaged insulation or equipment.



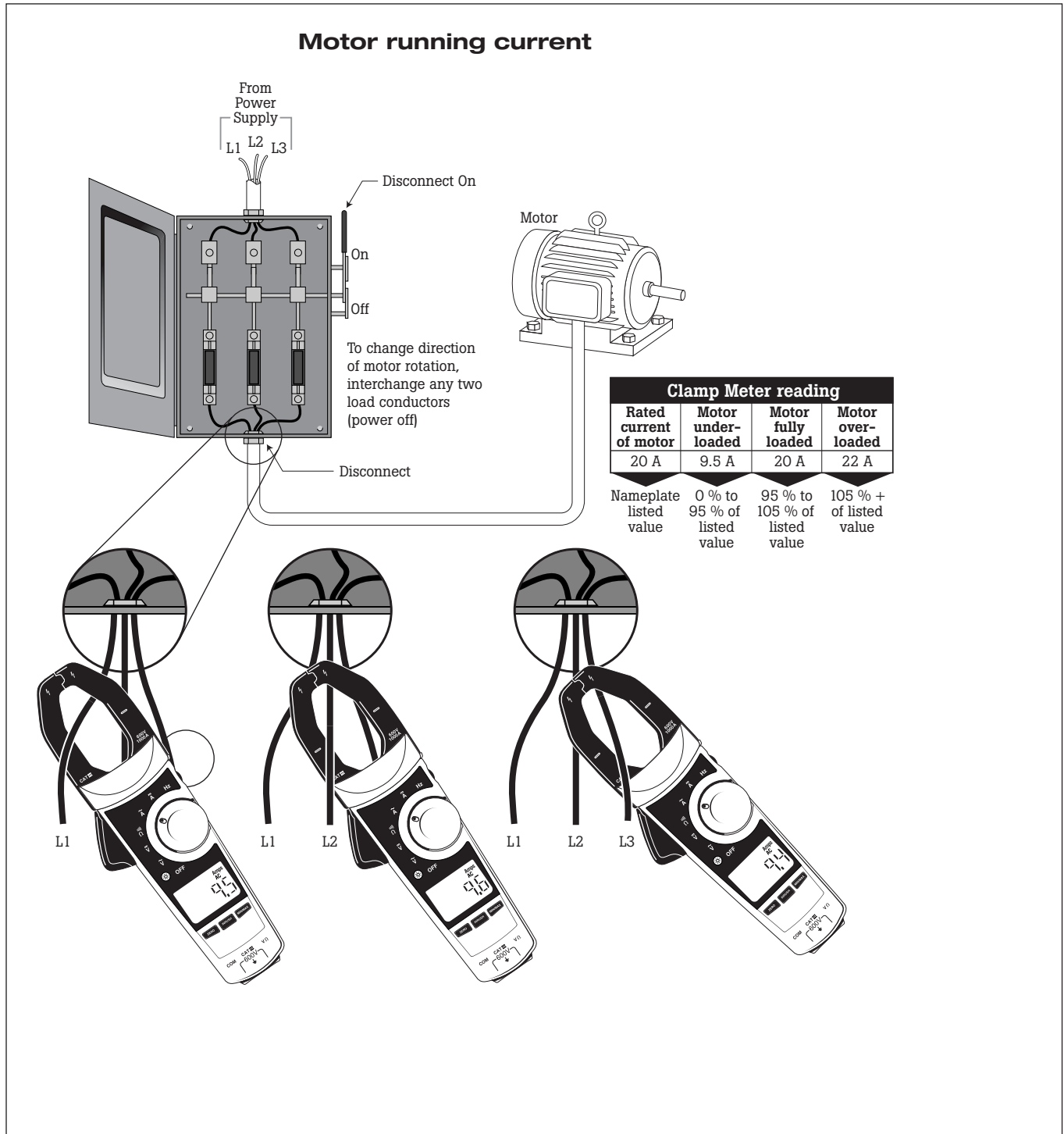
**Clamp-on ammeter**

A clamp-on ammeter is a test tool that measures current in a circuit by measuring the strength of the magnetic field around a

conductor. Most clamp-on ammeters measure AC, others can measure both AC and DC. The clamp-on ammeter allows current measurements without opening a circuit. The jaws of a

clamp-on ammeter are opened and enclose the conductor under test. The measurement displayed indicates the amount of current drawn by loads connected to the conductor.

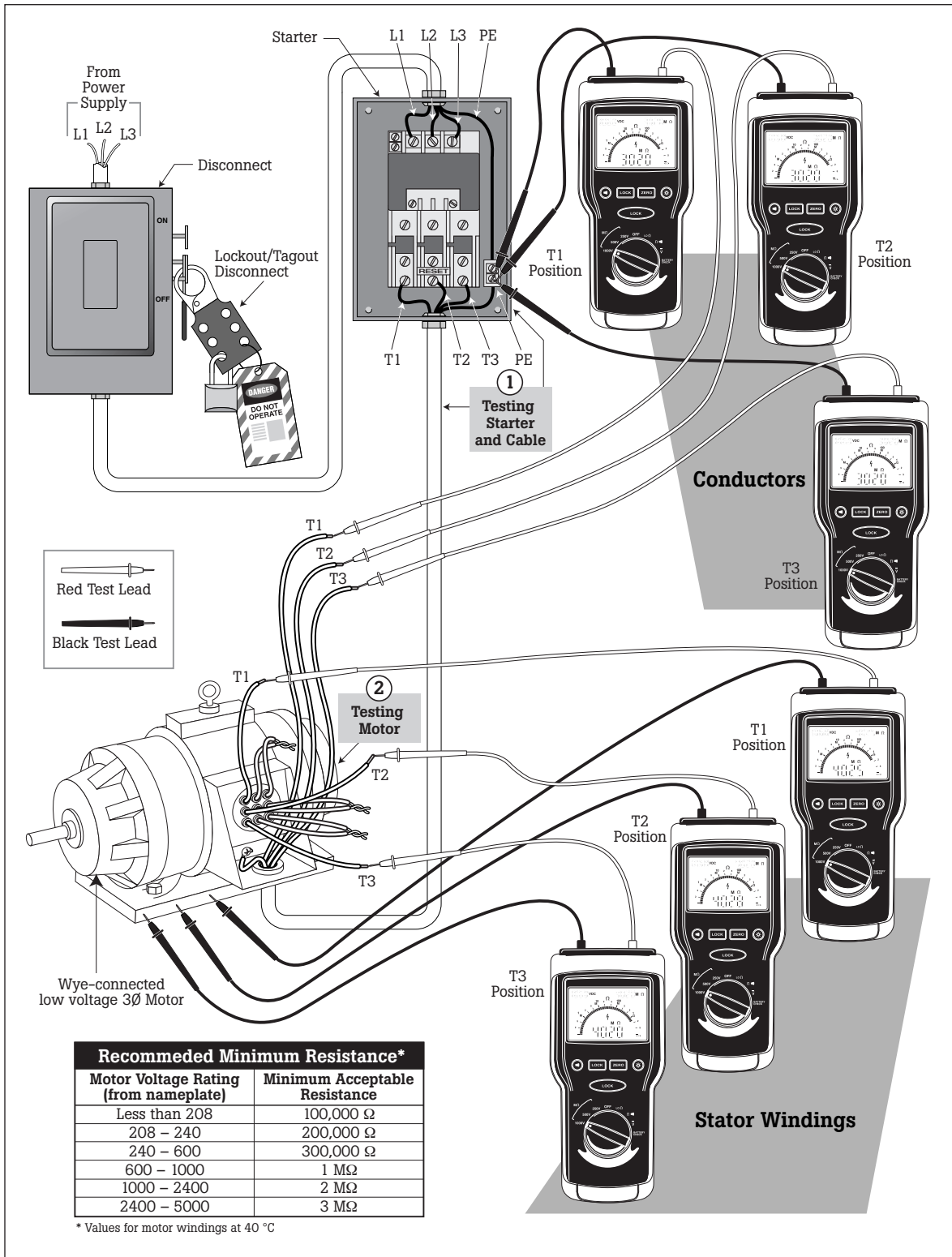
**Motor running current**



### Megohmmeter

A megohmmeter is a test tool that detects insulation deterioration by measuring high resistance values under high voltage

conditions. A megohmmeter detects insulation failure or potential failure of insulation caused by excessive moisture, dirt, heat, cold, corrosive vapors or solids, vibration, and aging.



**Non-contact thermometer**

A non-contact thermometer is a test tool that measures temperature at a single point. Temperature is measured when troubleshooting because the resistance of most materials change as the temperature of the material changes. An increase in temperature decreases the performance of electrical equipment and destroys insulation.

Loose, corroded, or dirty electrical connections generate unwanted resistance and heat. The temperature rise at a connection depends on the current flowing through the connection and the resistance of the connection. A temperature rise of 85 °F above ambient temperature indicates a fault that requires routine maintenance. Routine maintenance is performed so that the problem is fixed before it

causes damage. A 100 °F increase requires immediate action. Immediate action involves immediate shutting down of a system and repairing the fault. Resistance in a normal circuit occurs at the load. Resistance in a circuit that has poor connections, corrosion, or other high resistance paths occurs at points other than the load. Infrared meter temperature measurements prevent problems by locating unwanted heat.

**Finding Temperature Reading**

What is the temperature reading if the temperature of an area is 145 °F and the ambient temperature is 60 °F?

1.  $T = \text{Temperature reading} - \text{Ambient reading}$   
 $T = 145 - 60$

**T = 85 °F**  
**(Schedule routine maintenance)**

Take temperature reading of areas above ambient temperature

On  
Off

Aim meter at area to be measured

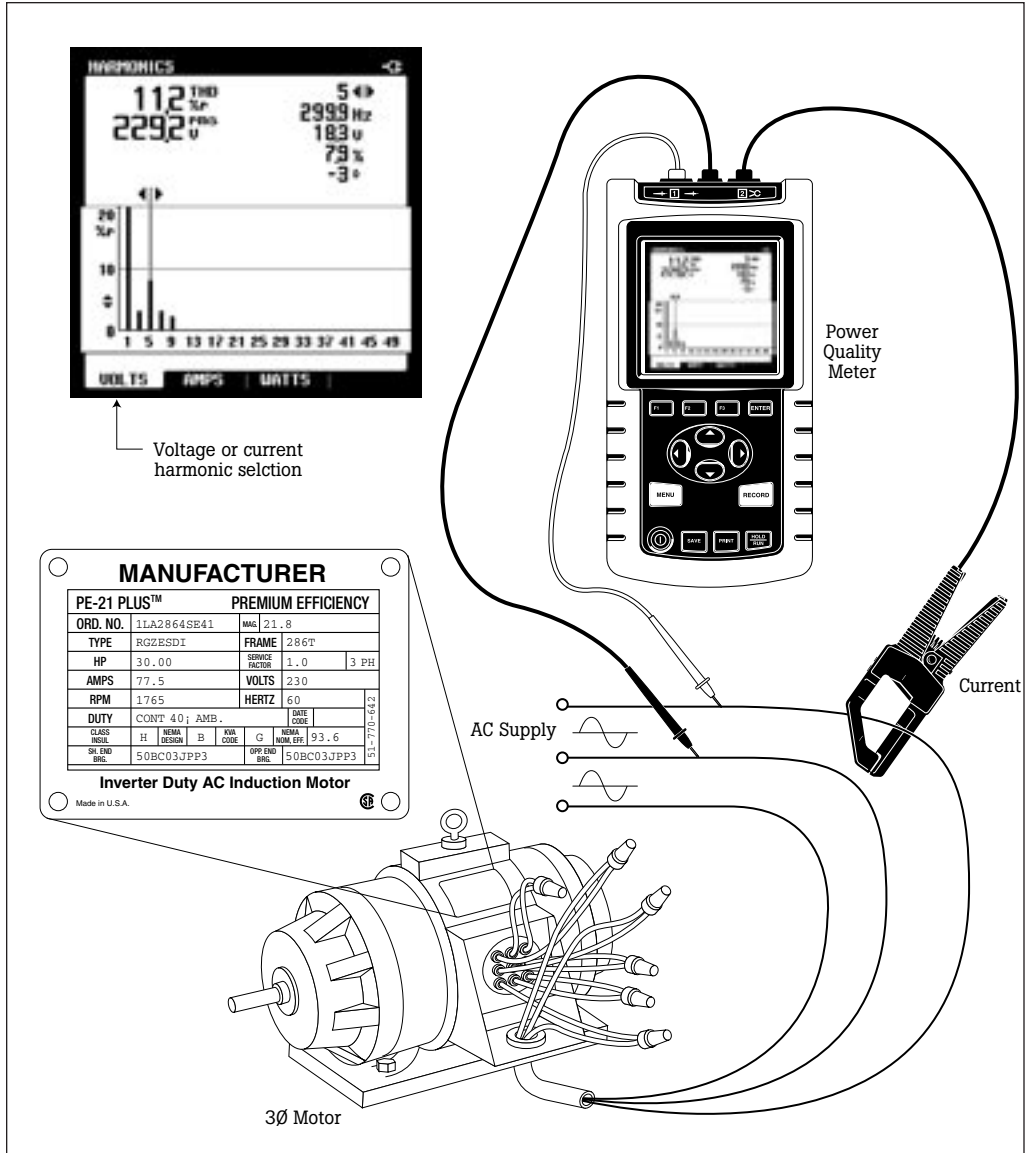
Equipment Condition	
Temperature Difference*	Indication
45	Light load on circuit
60	Heavy load on circuit
85	Possible problem. Schedule routine maintenance
100	Dangerous problem.

Take ambient temperature reading for reference

\* In ° F

**Power quality analyzer**

A power quality analyzer is a test tool used to obtain and record more valuable troubleshooting data. They can take all the basic measurements that a DMM can take, and also measure harmonics, transients, power, and other electrical quantities and problems.



This article is based on material excerpted from *Electric Motor Drive Installation and Troubleshooting, Troubleshooting Electric/Electronic Systems*, 2nd Edition, *Power Quality*

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