FLUKE®

Three-phase motors

Application Note

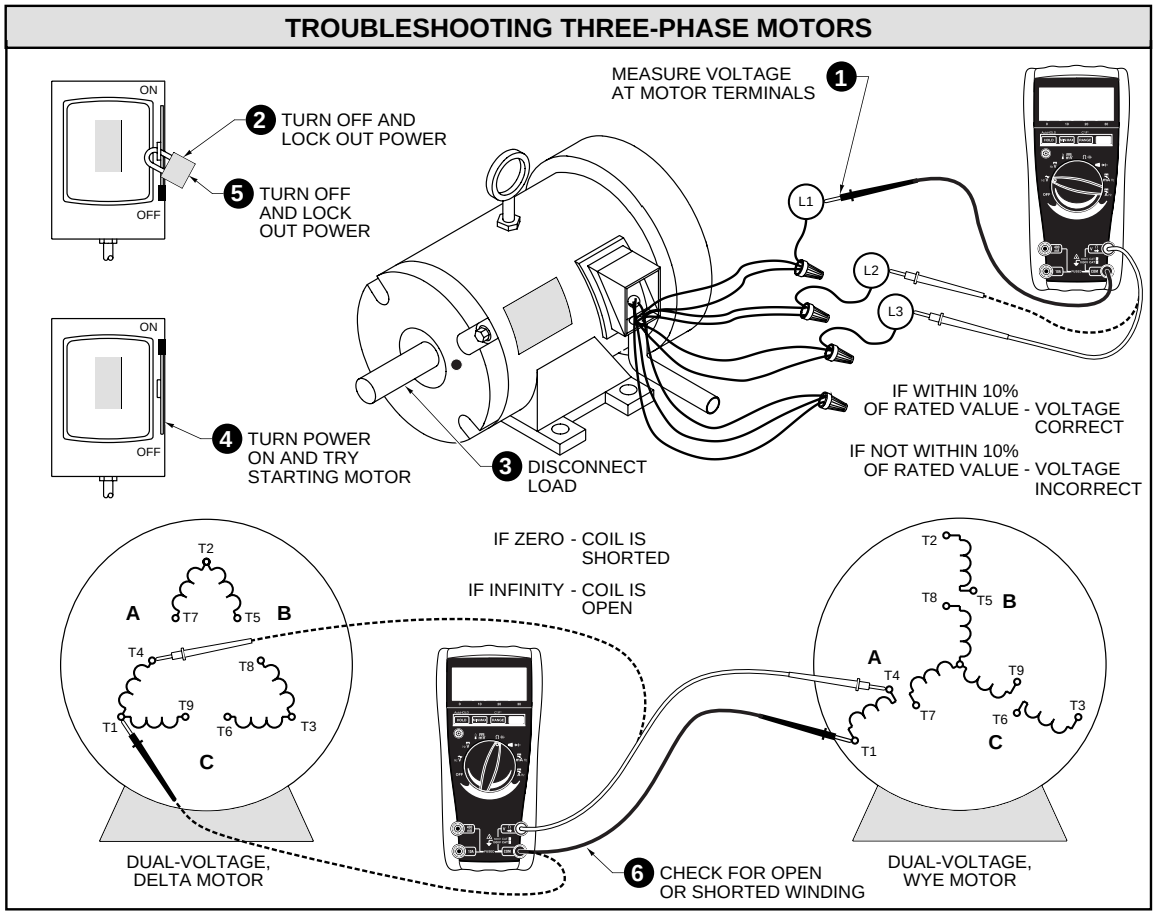


Figure 1. Troubleshoot three-phase motors with an ohmmeter.

Three-phase motors have fewer components that may malfunction than other motor types. Therefore, 3ø motors usually operate for many years without any problems.

If a 3ø motor is the problem, the motor is serviced or replaced. Servicing usually requires that the motor be sent to a motor repair shop for rewinding. If the motor is less than 1 HP and more than 5 years old, it is replaced. If the motor is more than 1 HP, but less than 5 HP, it may be serviced or replaced. If the motor is more than 5 HP, it is usually serviced.

Troubleshooting three-phase motors

The extent of troubleshooting a 3ø motor is dependent upon the motor's application. If the motor is used in an application that is critical to the operation or production, testing is usually limited to checking the voltage at the motor. If the voltage is present and correct, the motor is assumed to be the problem. Unless it is very large, the motor is usually replaced at this time so production can be resumed. If time is not a critical factor, further tests can be made in order to determine the exact problem.

See Figure 1. To troubleshoot a three-phase motor, apply the following procedure:

1. Using a voltmeter, measure the voltage at the motor terminals. If the voltage is present and at the correct level on all three phases, the motor must be checked. If the voltage is not present on all three phases, the incoming power supply must be checked.
2. If voltage is present but the motor is not operating, turn the handle of the safety switch or combination starter OFF. Lock out and tag the starting mechanism per company policy.

3. Disconnect the motor from the load.
4. After the load is disconnected, turn power ON to try restarting the motor. If the motor starts, check the load.
5. If the motor does not start, turn it OFF and lock out the power.
6. With an ohmmeter, check the motor windings for any opens or shorts. Take a resistance reading of the T1–T4 coil. This coil must have a resistance reading. If the reading is zero, the coil is shorted. If the reading is infinity, the coil is opened. Since the coil winding is made of wire only, the resistance is low. However, there is resistance on a good coil winding. The larger the motor, the smaller the resistance reading.

After the resistance of one coil has been found, the basic electrical laws of series and parallel circuits are applied. When measuring the resistance of two coils in series, the total resistance is twice the resistance of one coil. When measuring the resistance of two coils in parallel, the total resistance is one half the resistance of one coil.

Troubleshooting guides

Troubleshooting guides for motors state a problem, its possible cause(s), and corrective action(s) that may be taken. These easy-to-reference guides, while general in nature, may be used to quickly determine potential problems and possible courses of action. See Figure 2.

Troubleshooting Guide for Three-Phase Motors

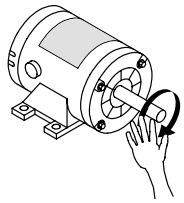
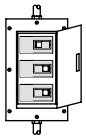
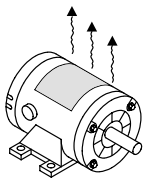
Problem	Possible Cause	Suggested Test Tool	Corrective Action
Motor will not start 	Wrong motor connections		Most three-phase motors are dual-voltage. Check for proper motor connections.
	Blown fuse or open CB	Basic electrical tester, DMM , clamp meter, or megohmmeter	Test the OCPD. If voltage is present at the input, but not the output of the OCPD, the fuse is blown or the CB is open. Check the rating of the OCPD. It should be at least 125 % of the motor's FLC.
	Motor overload on starter tripped		Allow overloads to cool. Reset overloads. If reset overloads do not start the motor, test the starter.
	Low or no voltage applied to motor	Basic electrical tester, DMM or clamp meter	Check the voltage at the motor terminals. The voltage must be present and within 10 % of the motor nameplate voltage. If voltage is present at the motor but the motor is not operating, remove the motor from the load the motor is driving. Reapply power to the motor. If the motor runs, the problem is with the load. If the motor does not run, the problem is with the motor. Replace or service the motor.
	Open control circuit between incoming power and motor	Basic electrical tester, DMM or clamp meter	Check for cleanliness, tightness, and breaks. Test the circuit starting with the incoming power and moving to the motor terminals. Voltage generally stops at the problem area.
Fuse, CB, or overloads retrip after service 	Power not applied to all three lines	Basic electrical tester, DMM or clamp meter	Measure voltage at each power line. Correct any power supply problems.
	Blown fuse or open CB	Basic electrical tester, DMM , clamp meter, or megohmmeter	Test the OCPD. If voltage is present at the input, but not the output of the OCPD, the fuse is blown or the CB is open. Check the rating of the OCPD. It should be at least 125 % of the motor's FLC.
	Motor overload on starter tripped		Allow overloads to cool. Reset overloads. If reset overloads do not start the motor, test the starter.
	Low or no voltage applied to motor	Basic electrical tester, DMM or clamp meter	Check the voltage at the motor terminals. The voltage must be present and within 10 % of the motor nameplate voltage. If voltage is present at the motor but the motor is not operating, remove the motor from the load the motor is driving. Reapply power to the motor. If the motor runs, the problem is with the load. If the motor does not run, the problem is with the motor. Replace or service the motor.
	Open control circuit between incoming power and motor	Basic electrical tester, DMM or clamp meter	Check for cleanliness, tightness, and breaks. Test the circuit starting with the incoming power and moving to the motor terminals. Voltage generally stops at the problem area.
	Motor shaft does not turn		Disconnect the motor from the load. If the motor shaft still does not turn, the bearings are frozen. Replace or service the motor.
Motor overheats 	Motor is single phasing	Basic electrical tester, DMM or clamp meter	Check each of the three-phase power lines for correct voltage.
	Improper ventilation	Infrared temperature	Clean all ventilation openings. Vacuum or blow dirt out of motor with low-pressure, dry, compressed air.
	Motor is overloaded	Basic electrical tester, clamp meter or DMM with clamp accessory	Check the load for binding. Check shaft straightness. Measure motor current under operating conditions. If the current is above the listed current rating, remove the motor. Remeasure the current under no-load conditions. If the current is excessive under load but not when unloaded, check the load. If the motor draws excessive current when disconnected, replace or service the motor.
	Excessive harmonics	Power quality analyzer	Check for the presence of harmonics in the feeder supplying the motor, especially 5th harmonic which can generate heat rise.

Figure 2. Troubleshooting guides are used to determine problems and possible courses of action.

This article is based on material excerpted from *Electric Motor Drive Installation and Troubleshooting*, *Troubleshooting Electric/Electronic Systems*, 2nd Edition, *Power Quality Measurement and Troubleshooting*, and *Electrical Motor Controls*, 2nd Edition published by American Technical Publishers, Inc. To obtain information on related training products, visit the American Tech web site at www.go2atp.com.

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