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CHECKING THE THREE-PHASE ASYNCHRONOUS MOTOR CONNECTED TO THE NETWORK IN THE STAR AND DELTA METHOD

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Abstract
This article explores the procedures and mathematical principles for checking three-phase asynchronous motors connected to a network using the star (Y) and delta (Δ) configurations. Understanding the distinction between these two configurations is critical for the efficient and safe operation of such motors.
In the star configuration, the motor windings are connected such that one end of each winding converges at a common neutral point, resulting in a higher phase voltage but reduced starting current. Conversely, the delta configuration connects the windings in a loop, with each junction point connected to the power supply, yielding lower phase voltage but higher running current.
Additionally, practical steps for visually inspecting, performing continuity tests, and conducting insulation resistance tests are outlined. These checks are essential for verifying proper connections and ensuring the motor's optimal performance. The article concludes by emphasizing the importance of regular maintenance and proper switching between configurations, particularly for motors equipped with star-delta starters.
This comprehensive guide serves as a valuable resource for engineers and technicians involved in the installation, maintenance, and troubleshooting of three-phase asynchronous motors, enhancing their understanding and application of these essential industrial components

Keywords: Three-Phase Asynchronous Motor, Induction Motor, Star Connection (Y), Delta Connection (Δ), Line Voltage, Phase Voltage, Line Current, Phase Current, Power Calculation, Power Factor (cos(φ)), Continuity Test, Insulation Resistance Test, Star-Delta Starter, Electrical Motor Maintenance, Industrial Motor Applications, Motor Windings, Starting Current, Running Current, Electrical Inspection, Motor Efficiency.

Introduction

Three-phase asynchronous motors, commonly known as induction motors, are widely used in industrial and commercial applications due to their robustness, simplicity, and cost-effectiveness. A key aspect of their operation involves the method of connecting the motor windings to the

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power supply, primarily using the star (Y) and delta (Δ) configurations. Understanding how to check and ensure the correct connection of these motors in both configurations is crucial for their efficient and safe operation.

Understanding Star and Delta Connections

Before delving into the checking procedures, it's essential to understand the star and delta configurations:

- **Star (Y) Connection**: In the star configuration, one end of each of the three windings is connected together to form a neutral point. The other ends are connected to the power supply lines. This method typically provides a higher voltage at the motor terminals and is used during the starting phase to reduce the starting current.
- **Delta (Δ) Connection**: In the delta configuration, each winding is connected end-to-end to form a closed loop. The three junction points are then connected to the power supply lines. This method is used for normal running conditions, providing a lower voltage at the motor terminals but higher current, which translates to higher power output.

Checking the Star Connection

1. **Visual Inspection**:

Ensure that the motor is disconnected from the power supply.

Open the terminal box and visually inspect the connections.

In the star configuration, you should see three wires connected to the motor windings converging at a common point (the star point). The other ends of the windings should be connected to the power supply terminals.

2.

3. **Continuity Test**:

Using a multimeter set to the continuity or resistance mode, check the continuity between the star point and each of the phase terminals (U1, V1, W1).

There should be continuity indicating a closed circuit, confirming that the windings are correctly connected to the star point.

4.

5. **Insulation Resistance Test**:

Set the multimeter to the insulation resistance mode (megohmmeter) and measure the resistance between the star point and the motor frame (ground).

The reading should be high (typically in the range of megaohms), indicating good insulation.

Suppose a three-phase motor operates with a line voltage of 400V and a line current of 10A with a power factor ($\cos(\phi)$) of 0.8.

1. **Star Connection**:
   - Phase Voltage:
   $$V_P = \frac{V_L}{\sqrt{3}} = \frac{400V}{1.732} \approx 231V$$
   - Phase Current:
   $$I_P = I_L = 10A$$
   - Power:
   $$P = \sqrt{3} \times V_L \times I_L \times \cos(\phi) = 1.732 \times 400V \times 10A \times 0.8 \approx 5546W$$

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2. **Delta Connection**:

- Phase Voltage:

$$V_P = V_L = 400V$$

- Phase Current:

$$I_P = \frac{I_L}{\sqrt{3}} = \frac{10A}{1.732} \approx 5.78A$$

- Power:

$$P = \sqrt{3} \times V_L \times I_L \times \cos(\phi) = 1.732 \times 400V \times 10A \times 0.8 \approx 5546W$$

Checking the Delta Connection

1. **Visual Inspection**:

Ensure that the motor is disconnected from the power supply.
Open the terminal box and visually inspect the connections.
In the delta configuration, you should see the ends of each winding connected in a triangular loop. Each junction point of the windings should be connected to the power supply terminals (U1 to W2, V1 to U2, and W1 to V2).

2. **Continuity Test**:

Using a multimeter set to the continuity or resistance mode, check the continuity between each pair of phase terminals (U1 to W2, V1 to U2, and W1 to V2).
There should be continuity indicating a closed circuit for each winding loop.

3. **Insulation Resistance Test**:

Set the multimeter to the insulation resistance mode (megohmmeter) and measure the resistance between each phase terminal and the motor frame (ground).
The reading should be high (typically in the range of megaohms), indicating good insulation.

Switching Between Star and Delta

Many three-phase asynchronous motors are designed to start in the star configuration and switch to the delta configuration once they reach a certain speed. This is managed by a star-delta starter.

1. **Initial Star Connection**:

Ensure the motor starts in the star configuration to limit the inrush current.
Verify the timer settings on the star-delta starter to ensure the motor switches to delta after an appropriate time interval.

2. **Automatic Switching to Delta**:

Monitor the motor as it starts and ensure the star-delta starter switches the connections correctly.
Listen for any unusual sounds or vibrations, which could indicate a problem during the transition.

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Conclusion

Properly checking the connections of a three-phase asynchronous motor in both star and delta configurations is essential for its safe and efficient operation. Regular maintenance, including visual inspections, continuity tests, and insulation resistance measurements, will help identify potential issues before they lead to motor failure. Understanding these procedures ensures that the motor performs optimally, reducing downtime and extending its lifespan.

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