

## HECO Knows Rotor Bars

Nobody does electric rotor bar testing & repair as well as HECO

# Cracked Rotor Bars in Electric Motors

Cracked rotor bars or cracked rotor bar shorting ring connections are a major source of problems for many electric motors, and detecting them can require the use of specialized rotor testing equipment. If you think your motor has cracked rotor bars, you don't want to waste time and money on ineffective tests -- you need your motors operating at peak performance right away. That's why it is so important to understand not only what causes **induction rotor bars** to crack, but how professionals can detect them.

## Why Do Rotor Bars Crack?

There are **three interacting phenomena** that lead to cracked rotor bars:

1. Repeated starting
2. Thermal expansion
3. Centrifugal forces

Let's take a look at each of these in more detail.

### Repeating Starting

When an electric motor starts, the rotating magnetic stator field is going to apply alternating forces very rapidly to each rotor bar (and the forces diminish as the rotor accelerates). This is referred to as a cyclic force, and will eventually result in fatigue failure. In fatigue failure, a component can fail under a load much smaller than its typical strength.

## Thermal Expansion

The laminations are made of steel, while the rotor bar is made of copper. As the motor heats up, the copper bar expands more quickly than the steel laminations. Its change in dimension is primarily lengthwise and will cause movement of the ends of the bar in the slots. This repeated scraping over time will eventually result in a loose fit.

## Centrifugal Forces

As the rotors in a motor spin, they experience centrifugal forces that are strong enough that retainer rings must be shrunk onto copper shorting rings to keep them in place. In order to prevent the rotors from causing balance problems or from becoming bowed, clearance must be included to account for thermal expansion. When centrifugal forces are combined with thermal expansion, the bars will likely bend at the rotor slot and result in another cyclic force that can result, over time, in a broken rotor bar.

## How Do You Detect a Cracked Rotor Bar?

A basic visual inspection is not the only way to **detect a cracked rotor bar**. There are actually several different ways, most of which must be performed in an electric motor repair shop and some of which require specialized rotor testing equipment.

### Growler Test for Rotor Bars

The **Growler test** looks for discontinuities in the current flow through the rotor. In this test, the heated rotor is removed from the stator and current flow is induced via a laminated core wrapped with wire. The core is placed near the stator and iron filings (or sometimes a hacksaw blade) are used to visually detect current discontinuities. This is a low-tech method that detects problems with the rotors. A sub-test of this is the hot growler test. It is essentially the same test but you warm up the rotor prior to performing the test to see if it opens up any welds to identify shorts that are only present when the rotor is warm.

## Single-Phase Rotor Test

Another test for detecting a cracked rotor bar is the single-phase rotor test, and for this test the motor remains assembled. Single phase power is applied to the motor, the rotor rotates slowly, and an analog meter is used to monitor one phase looking for fluctuations in amp draw. Such fluctuations are indicative of a cracked rotor bar.

## High Current Rotor Test

The high current rotor test involves applying high current through the shaft of the rotor after it has been removed from the stator. An infrared or thermoscan camera scans the surface of the rotor in search of localized hot spots. These hot spots are the result of shortened laminations and can cause the rotor to bow, go out of balance, and eventually suffer premature failure.

## Induction Motor Current Analysis (aka, Current Spectrum Test)

The most accurate and reliable test for cracked rotor bars would be the induction motor current analysis, also known as the current spectrum test. In this test, the motor is placed under 50 - 100% load. The rotor will induce currents, appearing as side bands around the 60 Hz supply line frequency, back in the stator windings. These sidebands are a function of how many poles the motor has and the slip frequency. Comparing the amplitude of these sidebands allows the technician to estimate how many rotor bars are broken.

## Vibration Spectrum Test

The vibration of an electric motor under load will modulate at a rate equal to the number of poles x slip frequency. If a rotor bar is broken, the amplitude of the beat increases with load. In addition, a cracked rotor will lead to a localized increase in temperature, which in turn causes bowing and uneven expansion. This results in imbalance, additional vibration, and side bands that are related to slip frequency. These signs of a cracked rotor bar can be revealed through vibration spectrum analysis.

## HECO Knows Cracked Rotor Bars

When it comes to detecting and repair of cracked rotor bars, HECO knows what it is doing. We have the state-of-the-art equipment and skill set to perform the right test to detect cracked rotor bars in your motor -- including induction motor current analysis and vibration spectrum analysis. In addition, our technicians have the experience to interpret those results in order to get your induction motor working as it should. We don't call a rotor shop to come in and look at it, we ARE a rotor shop! If you suspect cracked rotor bars are the problem with your electric motor, **contact us today**.