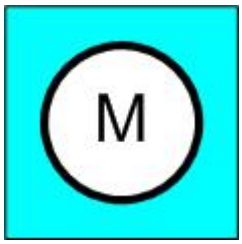


# Electric Motor Connection Issues

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## Introduction

In this series, we have mentioned that the electric motor acts as a very effective, but very expensive, fuse. The average life of electric motors in a facility should be 20 years, when properly applied and maintained. When failures do occur, it is usually the result of improper selection, installation, maintenance or some other identifiable defect that could be avoided. When it relates to any of these issues, a little up-front work will usually avoid problems and provide an almost trouble-free system.

An area that is rarely considered during installation, with the exception of medium to high voltage machines, is the connections of the motor. It is odd that such an important point can turn into an issue as it is one of the 'weak points' in the motor circuit as, with any connection point, expansion, contraction and electrical and mechanical vibration can cause looseness or, worse, wear insulation off connection points.

In this article, we are going to discuss some of the issues with motor connections and a few basic case studies. In the January article, we will discuss the proper method of insulating and treating motor connections. Of particular interest is that proper connections are usually far easier than the efforts we go through to install improper connections!

## Issue #1: Crimped Connections

In this first case, an electric motor in a commercial building would occasionally trip both when the motor was started and during motor operation. When tested using Motor Circuit Analysis, no problems could be detected and insulation to ground issues were not identified. Following the

tests, the motor was re-started and the motor immediately tripped. In an effort to identify the cause of the problem, the connection box was opened up and testing was going to be performed at that point. However, it was immediately identified that the tip of one of the supply leads had been forced out of the tip of the crimped connection (Figure 1).

Figure 1: Crimped Connections (1)

While this does not appear as if it is severe, it only took this small amount of insulation to have broken down over time to cause the motor to arc to the inside of the connection box (Figure 2).

Figure 2: Connection Box Fault Point

The initial consideration in this fault was that the nuisance tripping might have been caused by a pinhole short in the insulation system, as it was a variable frequency drive application. If the technician had decided to swap out the motor, and the connection had been cut without noticing

the fault point, the replacement motor would have operated correctly and it would be assumed that an otherwise good motor was either rewound or junked.

Issue #2: Crimped Connections Strike Again

In our second case, this motor would not start and the circuit breaker would trip immediately when the motor was energized every time. The motor had been in place for many years before it started failing so it was determined that it was most likely a rewind as it had less than one megohm to ground in a standard insulation to ground test. However, Motor Circuit Analysis determined that the only issue was straight to ground while the rest of the circuit tested balanced. The only two things that could cause this particular issue was if the short was outside the motor or in the connections.

Figure 3: Defective Crimp Connection (a)

Figure 4: Defective Crimp Connection (b)

In this case, it was obvious that the insulation was damaged during the crimping procedure. If a crimped connection must be used, proper application techniques must be followed.

Issue #3: Electrical Tape Connection

Often times short cuts are taken, such as in this case. When making connections, electrical tape alone will not suffice. It does not afford protection when vibration, contaminants or moisture get into the tape and generate a path to ground. The result is the same as what occurred in both issues 1 and 2 above. In this case, you will also note the less than professional taping job.

Figure 5: The Results of Electrical Tape Only

Issue #4: Making Those Connections Fit In the Connection Box!

There are times when the proper materials are used to insulate the connections. However, due to high levels of mechanical vibration and insulated connections being forced into the connection box, the insulation can be worn away over time. This is a combination of the leads being a little long, the connection box being undersized and too much insulation on the connections.

Figure 6: Too Much in the Connection Box

Figure 7: Blow Spot

Figure 8: Connection Box Point of Failure

## Issue #5: The Infamous Wire Nuts

As a general observation, another issue that can occur in connections is the infamous wire nuts. These are the hardware store-type wire nuts that are twisted on to wire to make your connections that tend to be used in home wiring and smaller electric motors. The common issues that occur with these devices include: Just plain falling off the connection; The outer hard plastic insulation fractures and comes apart; Bare wire exposed at the base of the connection; and, Loose connections.

## Conclusion

If you are making connections as outlined in the five issues discussed in this article are you doing something wrong? Not really, other than when performed incorrectly you can end up with these results. In each case, the maintenance technicians who installed the connections had the right idea in mind, but had not properly prepared or followed the processes to accomplish the proper methods. The results can be a real nuisance.

The good news is that these situations can usually be corrected, as they were in these five cases. The means and methods to ensure motor connection excellence are not that difficult and in our next article we will discuss how to achieve long lead life and properly apply insulation to the lead wire in motors under 600 volts.

## About the Authors

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Performance Evaluation has been testing electrical equipment for the past 22 years with an assortment of test equipment. Performance has used both static and dynamic tests to help prevent unscheduled downtime. The testing includes AC/ DC motors of all sizes and transformers". Performance contact is Richard Borge, www.performancetdr.com, 888-484-7564, perfeval@aol.com and 973-661-4281 (fax).