BJM CORP ALL-TEST™ Tech Note: Motor01

- ⇒ Basic Knowledge
- ❑ Problem Example
- ❑ Improvement Example

Theme: Motor Testing – 3-Phase Fault Detection Example

Description

This Tech Note supplements information found within the 3-Phase Motor Troubleshooting Guidebook concerning stator and rotor fault detection. This example will describe the basic steps in determining motor, rotor or no fault detection in assembled 3-phase design B, single speed, electric motors.

It is important to note that a "perfect" 3-phase motor is very difficult to find based upon manufacturing tolerances, etc. In other instances, motors may have a particular difference in design in order to meet special applications. In both cases, with the rotor mounted in the motor, it is necessary to perform additional steps to isolate rotor or stator faults.

Initial Readings

In a few cases, some motors may exhibit unusual levels of unbalance. This could occur for a number of reasons, including: 1) stator pole to rotor bar ratio and position; 2) stator winding design (lap versus concentric coil); 3) other tolerance-related issues including rotor casting voids. If a series of unusual readings are detected with the ALL-TEST IV PRO, there are several ways of isolating the cause. One method requires the use of an ALL-TEST III in concert with the ALL-TEST IV PRO, the other method involves a short series of additional tests using the ALL-TEST IV PRO.

Sample Initial Readings

Reading	T1-T2	T1-T3	T2-T3
Resistance	.272	.273	.272
Impedance	47	53	58
Inductance	9	10	11
Phase Angle	73	72	71
I/F	-43	-42	-41

Based upon these readings, the motor should be exhibiting failure signs such as electrical noise or a lack of torque. Following we will provide two examples of how to determine if and what type of fault exists.

ALL-TEST III and ALL-TEST IV PRO Tandem Method

One method of separating the stator from the rotor when troubleshooting is to use an ALL-TEST III in concert with your ALL-TEST IV PRO:

1. Connect the ALL-TEST III to your first set of windings (T1-T2) and rotate the shaft until the highest reading is obtained.
2. Take your first ALL-TEST IV PRO reading (first winding) then stop.
3. Connect the ALL-TEST III to your second set of windings (T1-T3) and rotate the shaft until the highest reading is obtained.
4. Take your second ALL-TEST IV PRO reading (second winding) then stop.

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5. Repeat for your third winding. If the final results still show an unbalance, the stator should be suspect, if they are balanced, the rotor should be checked using the rotor testing steps for either the ALL-TEST III or ALL-TEST IV PRO. If both the stator and rotor test good, then the unbalance is due to the motor design and should be noted.

ALL-TEST IV PRO Method

Using the ALL-TEST IV PRO, a short series of tests may be performed in order to determine whether the unbalanced readings are due to the rotor, stator or design. The steps are straightforward:

1. Note the position of the rotor after saving the original readings. Move the rotor 90 degrees from its original position and retake the readings in the same order that they were originally taken.
2. Reference the previous reading and note if the unbalance has shifted with the rotor movement. If it has, or if you are uncertain, retake the measurements at 180 degrees from the original position.
3. If the readings remain unbalanced in the original position, the stator windings are most likely faulted, if the readings shift with the rotor position, perform a rotor test as outlined in the motor troubleshooting guide.

Shifting Readings Example

	T1-T2	T1-T3	T2-T3
Impedance 0 deg	47	53	58
Inductance 0 deg	9	10	11
Impedance 90 deg	53	58	47
Inductance 90 deg	10	11	9
Impedance 180 deg	58	47	53
Inductance 180 deg	11	9	10

Note: The readings will not be exact, this is just an example

Maintained Readings Example

	T1-T2	T1-T3	T2-T3
Impedance 0 deg	47	53	58
Inductance 0 deg	9	10	11
Impedance 90 deg	47	53	58
Inductance 90 deg	9	10	11
Impedance 180 deg	47	53	58
Inductance 180 deg	9	10	11

Note: The readings will not be exact, this is just an example

General Notes

Note 1: In few cases do large unbalances relate to original design. In most instances, these unbalances can be related to defects due to operation or manufacture. The motor may seem to operate OK, but have a large number of casting voids or high resistant rotor bars that will reduce the effectiveness of the motor to produce torque.

Note 2: An accurate assembled impedance unbalance may be obtained, for energy and reliability purposes, by taking 4 to 12 rotor positions then measuring impedance at each position. Average the readings and determine the average phase unbalance. This can be used in conjunction with BJM CORP's Impedance Unbalance Calculator or "Motor Circuit Analysis for Energy, Reliability and Production Cost Improvements"[1] to determine annual costs. It may also be used in MotorMaster+ Version 3.02 Enhanced for determining repair versus replace cost benefits.

[1] Penrose, Dr. Howard W., Western Energy Magazine, September/October 2000 Edition

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