BJM CORP ALL-TEST™ Tech Note: Motor02

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

Theme: Motor Testing – DC Motor Testing

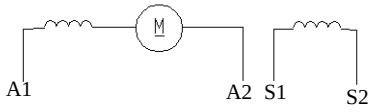
Description

This Tech Note describes the basic steps necessary to test and troubleshoot DC electric motors using the ALL-TEST IV ***Pro***™ 2000. The DC motors discussed include: series connected, shunt wound and compound wound standard DC motors that have access to brushes and visual access to the commutator. This Tech Note assumes an understanding of the construction, nomenclature and general operation of DC motors by the user.

Winding Types

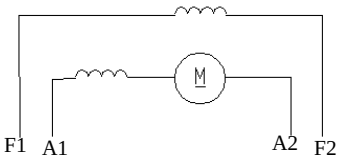
There are three basic winding types for DC motors:

1. Series Motor



Series motors consist of interpole and armature windings and a series winding. The winding resistance is generally very low and the motor requires a load when it operates or it will "run-away." The windings are marked A1 and A2 for the interpole(s) and armature leads and S1 and S2 for the series coil. These are high-torque motors normally used as traction and locomotive drives.

2. Shunt Motor



The shunt motor has a winding in parallel to the armature winding and interpoles. This type of motor has good speed regulation and reasonable starting torque. The interpoles and armature windings are usually low-resistance while the shunt winding has many turns of smaller wire giving it a relatively high resistance. The field windings are normally labeled F1 and F2 for single voltage and F1-F2 and F3-F4 for dual voltage.

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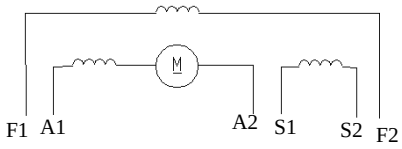
3. Compound Motor



The compound motor combines the strengths of both the series and shunt motors. The leads are normally labeled as shown in the previous descriptions.

Testing DC Motors

Following are the types of testing available for each motor:

1. Series Connected DC motor: The true method for testing this type of motor is by trending, looking for changes, particularly in I/F and phase angle (which are not as temperature dependant as the other readings) from reading to reading. A bar-bar armature test can be performed using either the ATF11 armature fixture or the existing brushes.
2. Shunt Connected DC motor, single voltage: Same testing as for the series connected DC motor (see 1).
3. Shunt Connected DC motor, dual voltage: In this case, a comparison test can be performed using F1 and F2 as the first winding compared to F3 and F4 as the second winding, then A1 to A2 as the third winding. The bar to bar test may be performed, as well.
4. Compound Connected DC motor: Combines the testing methods shown in 1, 2 and 3. In addition, a continuity check using impedance should be performed between the series coils and the field coils to make sure that there are no shorts between the two.

Testing Steps – Trending

For trending purposes, the auto mode of the ALL-TEST IV ***Pro***™ 2000 can be used.

1. From the drive or at the motor terminals, select Auto Mode.
2. Test the Available Field Windings (F1-F2, or F1,F3 – F2,F4, or F1-F4, as appropriate). If possible, split the winding (if 4-field leads are available) in order to provide comparative readings, as winding 1 and winding 2 in the ALL-TEST.
3. Test the series winding, as appropriate. If only one field winding is available, use winding 2 (if it is a series winding, use winding 1, of course) and test S1-S2. If testing using winding 3, test S1 to A2, as appropriate (that will take a reading of the armature and series windings).
4. Test the armature through A1-A2, and store in winding 3.
5. Store and compare to future readings. Resistance, inductance and impedance will vary based upon winding temperature. Ensure to take readings at the appropriate repeatable times, such as just after operation or after a cool-down period (room temperature).

Testing Steps – Troubleshooting Field and Series Windings

1. Separate all leads.
2. If possible, compare F1 and F2 to F3 and F4 in shunt and compound motors. There should be no more than a 3% difference in resistance, impedance or inductance, with the phase angle being within 1 degree and the I/F being no more than 2-digits from each other.
3. Test the Series field looking to see if the I/F is greater than "-50" and compare to previous readings, if possible.

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4. If it is a compound motor, test between the series and shunt fields. If there is any continuity, the windings have failed.

Armature Test – Bar to Bar

The key to testing the armature is a bar to bar measurement of impedance. There are two basic methods. If there is good access to the commutator, use the ATF11 armature fixture. Set the ATF11 to cross as many bars as possible, lift all brushes, then perform the test covering all of the commutator bars 360 degrees around the commutator. If unable to access the commutator with the ATF11, lift all but two brushes 90 degrees from each other (use both brushes if it is a two –brush motor) and clip the ALL-TEST leads to the connections for these brushes.

1. Visually inspect the brushes and commutator looking for evidence of overheating, burning, contamination, excessive wear, etc.
2. Mark the first bar being tested using a non-conductive marking. If the ATF11 is being used, select either the right or left point as the start. If brushes are being used, use the leading edge of one of the two brushes as the reference point. In many cases, the brush will cross multiple bars. As you progress around the commutator, the ATF11 will move one bar at a time, or the leading edge of the reference brush will move to the edge of one commutator bar at a time.
3. Use the manual mode of the ALL-TEST and select "Z" (impedance). As each set of bars are tested, use the "remeasure" selection in the "Z-test." Write down each result watching for impedance, and changes in frequency (shown on the right side of the screen – test frequency may change if a short is detected).
4. Look for a pattern that may result in a flat line or a gradually increasing then decreasing set of readings. This can be done visually or by entering the data into Excel and graphing it. Readings that deviate more than 3% from the pattern may indicate shorted turns or bad connections in the commutator.

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