Requirements for Testing

A factory test system for DC motors should:

- Be suitable for motors with linear and non-linear torque characteristics
- Be suitable for fast manual and automatic loading of the test station
- Have test times in the seconds range
- Test the motor without connecting any speed sensor to the motor shaft
- Show the significant motor characteristics over the full speed range
- Allow introduction of tolerance limits either for the whole speed range or singular, selected points
- Automatically indicate PASS or FAIL for all criteria tested
- Detect the direction of rotation
- Have an excellent repeatability
- Save details of the test in a data bank
- Allow combination with other test systems like HV testing or others as required
- Be cost effective
- Have short delivery time
- Have low fault susceptibility

The Solution of M.E.A. Testing Systems Ltd.

M.E.A. has developed a new factory test system fulfilling above requirements based on a mathematical model combined with the well-proven classical M.E.A. method with speed measurement for calibration.

- Step 1: The motor is run from stall to no load and using the mathematical model. A preliminary torque curve is received as first approach.
- Step 2: With the same hardware as used for the first step plus an additional sensor, the real torque curves of several motors of this type are determined by the M.E.A. standard method, and an average is calculated.
- Step 3: Now the first torque curve and various other motor parameters are fitted to the second curve point by point.
- Step 4: This third curve thus obtained is the Master Curve for the test. Tolerance limits have to be introduced into the software, and they can be used to test all motors of this type.
- The Master Curve with its tolerances will be saved in a data bank and recalled and loaded when the same motor type has to be tested.
- If another new motor type shall be tested, Steps 1 to 4 have to be executed for this new motor.
- Instead of motor data obtained in Step 2 by the M.E.A. System, also existing test data from other sources may be used.
**Benefits of the M.E.A. Solution**

- The Master Curve used as basis for the test corresponds to the reality.
- The test is not only based on a mathematical model, but also on correct measurements. False assumptions cannot be made.
- DC motors with linear and non-linear torque characteristics are covered with high accuracy.
- For the actual factory testing, speed measurement is not needed.
- From a list, the parameters to be checked can be selected. Available are: **Test voltage, Current, Input power, Output power, Torque, Efficiency, Friction torque Direction of rotation**
- Not shown parameters will nevertheless be saved and are available in case of failure analysis.
- Tolerances can be defined at load points or in the complete or partial areas of the speed range between stall and no load.
- The test results are well repeatable, for example in 50 measurements of the same motor, with a deviation from the measured average of +/- 0.5 %.
- The testing time for a smaller motor of 200 W, for example, is 6 s (depending on the motor’s acceleration and deceleration time), though a certain pre-run may be required to allow the motor developing its full and consistent performance.
- The switching of the test procedure is done automatically by the system software, according to the requirement of the specific motor to be tested.
- The hardware necessary contains a power analyzer (19” rack), a laptop (or any PC with Windows XP or higher and USB 2.0), and a sensor, which is only used once for the initial calibration of a new motor type.
- The M.E.A. software fulfils all practical requirements. It can further be customized.

To illustrate the functionality of the CMM method, we will use as an example a DC permanent magnet motor. The following Figures 1 and 2 are final results obtained by the MotorLab module of the MotorLine M-PI:

**Figure 1 - Performance Curves of DCPM motor using CCM**

**Figure 2 - Tabular Data of DCPM motor using CCM**