Multiple Electrical Motor Test Stand

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Abstract: NTS-TSE designed and integrated an automated test system using NI hardware and LabVIEW 8.5 software capable of testing all the AC (400Hz) and DC electrical fans and motors on the Patriot Missile Launch vehicle. The system replaces three individual manual test stations and automates the test processes while allowing the user to modify or develop new test processes, develop electronic data storage and enhance quality control, increase reliability and cost-efficiency.

Introduction: This test facility rebuilds AC & DC electrical motors and Vanaxial fans. The customer has 3 physically separate test stands, all built circa 1980 with manual instruments and cumbersome test processes. Test processes were scattered in several documents and were not centralized. They want to automate the test processes, be able to modify or develop new test processes and develop electronic data storage so they can monitor test results for return rate and repair quality. The motors being tested are four Vanaxial Fans, three AC motors and two DC motors. Traditional dynamometer technology would have required 3-5 variously sized dynamometers (powder core, and eddy current types, requiring liquid cooling systems) to meet the large torque range requirements of the motors to be tested. In addition, the system would require the operator to disassemble the system to perform static and dynamic braking tests.

Tests Include: Torque-Speed curves from no-load speed to stall or near-stall speeds, no-load speeds, brake to stop RPM vs. time, standing brake torque, motor winding hipot, continuity, and vibration tests. Test voltages range from 208Vac 3-phase, 400Hz to 28 Vdc.

Solution: A single integrated test system that is capable of testing all electrical motors and fans from one location that will minimize operator interaction.

Figure 1, Multiple Electric Motor Test Stand

The core dynamometer control system is based on the DynoLAB™ EM by Sakor Technologies, Okemos, MI. The SAKOR DynoLAB™ Test Executive v4.5 software is based on National Instrument's LabVIEW™ version 8.5, and features a proprietary and very user-friendly graphical interface that employs a convenient flowchart method of configuring tests and controlling the system

The user interface developed by NTS provides step-by-step directions for each test sequence. Test sequence programs perform a complete test sequence on each motor built on test process modules. Test process modules isolate tests to basic components and provide a selection from which they can develop new test processes modules or assemble complete new test sequences. The customer can also reconfigure the user displays; add pictures to display cabling and setup configurations, all without learning a traditional programming language.

For testing the AC & DC motors the system used by NTS is centered around a single 16HP air cooled AC motor. This motor can act as a load for performing Torque-Speed tests or as a motive source to test and evaluate motor brake specifications. Motors can be connected to the dynamometer or a free-standing motor mount for operations such as brush seating or RPM-brake tests. Vanaxial fans are secured in a steel frame mounted onto the test bench.

The test bench is a steel custom engineered industrial workbench to provide a safe workspace for high speed motors, fans, and torque tests. Electrical switchgear, controls and storage of all test fixtures and cables are integrated into the test stand. Data Acquisition Instrumentation and the operator interface are housed separately in an industrial 19 inch rack Nema 1 enclosure.

Hardware: Instruments include a GPIB programmed 3-phase AC and DC power analyzer, a multiplexed Digital Multimeter, an RS-232 AC Hipot tester, three GPIB programmable 5kW DC power supplies, and a GPIB programmable 480Vac 45kw AC Power Converter to provide 208Vac 3 Phase, 400Hz AC source. A 16HP, 12,00 RPM, electrical motor will provide 145 in-Lb of torque from stall to 7,000 RPM, with torque tapering to 50 in-lbs at 12,000 RPM. The system power requires a single 480Vac 3-Phase power source.

Data acquisition is performed using a National Instruments PCI Multifunction I/O board and industrial isolation modules. Inputs include AC/DC voltages, DC current shunts, AC current transducers, RTDs for temperature measurements and various Digital I/O modules for relay and power controls.

- *0-16 Hp continuous motoring (brake testing) and braking (load testing)*
- *Maximum speed 12,000 rpm*
- *145 in-lb constant torque from stall to 7,000 rpm*
- *Max continuous torque tapers to 50 in-lb at 12,000 rpm (9.5hp)*
- *150% overload for 30 seconds below base speed*
- *Torque measurement range +/- 300 in-lb*
- *Torque accuracy 0.05% full scale*