MTS

Service Notes

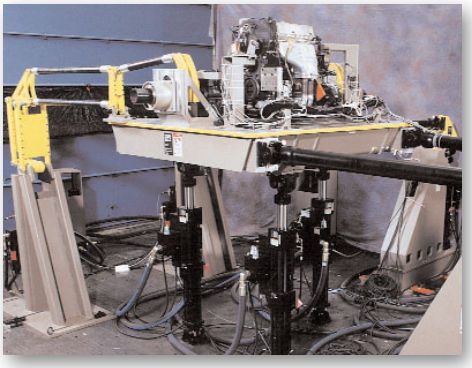
WHAT YOU SHOULD KNOW ABOUT YOUR SYSTEM

The Importance of Calibration:

- **Multi-Axial Simulation Table (MAST™) Systems**
- **Linear Variable Displacement Transducers**
- **LVDTs and Accelerometers**
- **End to End Calibration vs. Factory Re-Calibrations**
- **Data Acquisition – A/D and D/A Calibration**

Multi-Axial Simulation Table systems are often critical elements of the test program of vehicle and component development programs. Critical durability and performance predictions are made based on the results of MAST tests. However, it is not always widely understood that critical calibration determinations must be made to ensure the systems provide accurate test information.

Displacement vs. Acceleration Control



MAST systems have a unique performance characteristic based on the type of control they employ. And, while it is not commonly known, MAST tables operate in displacement control at the lower frequency range. Starting at the mid range, the MAST automatically switches to acceleration control.

This mode of operation is usually seen on the following types of tests:

- High Level Severe Durability
- Low Level Severe Durability
- Squeak and Rattle Integrity
- Dynamic Design Verification Tests
- Time History Reproduction
- Frequency Spectrum Reproduction
- Block Cycles
- Sine Sweep

This switch is employed because LVDTs are not capable of providing the continued accuracy required for displacement control operation at the higher frequencies.

What this means is that both LVDTs and accelerometers are integral components of the control loop of the system at their respective operational frequencies. Since these are measurement instruments at the core of system control loop output, the accuracy of their measurements are vital to the validity of the test being performed.

Furthermore, dynamic verification of the accelerometers through the higher frequency range is critical, because errors are most often observed at higher frequencies – which for a MAST system is 5 Hz and above.

So, although MTS uses measurement instruments of the highest available accuracy, quality and dependability, their accuracy needs to be routinely validated by an established calibration procedure. Of course, the best calibration is that which is performed in your laboratory, under the conditions consistent with those in which your test system must do its job.

LVDT Calibration

Regular calibration of LVDTs establishes the relationship between value indicated by a measuring instrument or measuring system and the corresponding standard or known values derived from the standard

MTS recommends performing annual LVDT calibration using traceable standards. The calibration procedure involves proving that the calibration of the device is within acceptable tolerances as defined by specifications and/or adjusting the device, when necessary, to bring its calibration back within acceptable tolerances.

A critical component of accurate calibration involves environmental conditions. Calibration should be performed with the device in a thermal environment that approximates that which would occur during normal use. LVDTs have built-in temperature compensation and are accurate within a fairly large range.

Other Requirements

In additional to environmental consistency, MTS ensures that other conditions are met before a calibration is performed. For example, the system incorporating the device must be fully functional and the LVDT part of the device should be mounted as it would be in normal use.

Of course, the technician performing the calibration must be fully qualified to operate both the system and the calibration equipment that will be used.

The system LVDT should have been previously calibrated. If a new LVDT, electronic module or range has been added, however, care must be taken to ensure all preliminary calculations and adjustments (including transducer excitation, phase, etc.) have been made.

Naturally, appropriate calibration standards must be available and matched to the operating ranges of the device. Additionally, all the calibration equipment must be NIST traceable and bear stickers showing that the calibration period has not expired.

MTS provides both standards and a fixed procedure to ensure that LVDT calibrations are performed correctly thus assuring you of both the performance and traceability you need..

Accelerometer Calibration

Accelerometer sensitivity at various frequencies of interest can only be achieved through periodic calibration, usually at intervals from six to 12 months. Sensitivity is defined as the ratio of the accelerometer's output signal to the applied motion, expressed as mV/g in voltage mode or pC/g in the charge mode at a given frequency.

Calibration is achieved by comparing the sensitivity of the test accelerometer to another known or standard unit in a back-to-back standard in a test machine developed for accelerometer calibration. Both accelerometers experience the same acceleration in a test. At each frequency of interest the g-level is precisely set by measuring the output of the standard accelerometer. At the same time (or alternately) the output of the test (or unknown) accelerometer is measured and a sensitivity vs. frequency report is generated.

The frequency response tolerance of a typical accelerometer is +/-five percent throughout a specified frequency range. The sensitivity deviation in percent is reference to the sensitivity at 100 Hz. Deviations in excess of +/- five percent may indicate degradation or possible damage.

End-to-End Calibration Provides Superior System Analysis

MTS Field Service Engineers employ the principles and philosophy of end-to-end calibration. Essentially this means that the system-level field calibration practice involves all measurement process elements, including the transducer, cables, conditioners and controllers. By examining a system this way, MTS provides you with a higher quality calibration with a reduced risk of error. The elements of the system are evaluated as a unit, eliminating considerable uncertainty. Thus, you get a more exact evaluation of system performance than you would get if an accelerometer or transducer were removed from the system and calibrated in the factory. While the latter may be more convenient and incrementally less expensive, it leaves something to be desired in an evaluation of the calibration and performance of a complete test system. And after all, it is the complete system that you use to perform tests that are is critical to your laboratory and your company.

Calibration of A/D and D/A Devices

It is critical that readout devices and command sources for testing systems are accurate in both recording data and providing inputs to drive actuators. Thus, an A/D and D/A calibration verifies the ability of a readout device to record all input parameters and command sources to generate the required drive command.

Again, such a calibration should be performed in the environment that approximates the normal operating environment of the calibration subject. And the device should be fully functional.

MTS technicians employ a standard, NIST traceable procedure that ensures an A/D and D/A calibration performs to specifications, providing data and control as indicated in the product specifications.

For More Information

For more information on MTS field calibration services, contact your local MTS field service technician, or contact MTS at (toll free) 800-328-2255.
(Fax) 952-937-4515,
(e-mail) info@mts.com.

100-078-268a ImportCAL Printed in U.S.A. 2/06