ASTM D5026 Dynamic Mechanical Properties (DMA) of Plastics in Tension

TEST METHOD SUMMARY

ASTM D5026 is one of the most commonly used test standards for conducting DMA of Plastics in Tension. The test procedure characterizes the viscoelastic properties of thermoplastic resins, thermosetting resins and composite systems. Using rectangular specimens, ASTM D5026 determines the storage (elastic or E'), loss (viscous or E") and complex (E*) moduli, as well as tan delta (δ), as a function of frequency, temperature, or time. These properties provide insights as to the thermomechanical performance, including glass transition temperature (Tg), damping behavior, and effectiveness of cure.

NOTE: Data accuracy and analysis is particularly critical with polymers, as failures can occur even when loads and stresses are constant over time. This is known as creep failure. Another common failure occurs when polymer life is shortened due to operation in higher temperatures than originally designed for. In accordance with the Williams-Landau-Ferry (WLF) model, the MTS DMA software can perform time-temperature superposition (TTS) algorithms, allowing materials researchers to generate master curves that are critical in predicting long-term life based on short-term test data. Three decades of reliable data is especially important here since small data errors lead to large amounts of error in life estimation.

Solutions for ASTM D5026 typically include these types of components;

LOAD FRAME OPTIONS*

Both the MTS Acumen® and the MTS Landmark® test systems are ideal for conducting dynamic mechanical analysis (DMA) of polymers per ASTM D5026. They offer a variety of force capacities and deliver up to 100 Hz (covering three decades) of precise, frequency controlled test protocols to accommodate a wide variety of DMA and other fatigue testing needs. The compact MTS Acumen systems' electrodynamic actuation consumes less energy than other technologies, and provides a clean, quiet, and cost-effective system operation. The MTS Landmark 100 Hz Elastomer Test System is a tabletop system that features MTS servohydraulic actuation technology, and is the preferred test system when testing requirements demand higher force capacities.

MTS Acumen®
Electrodynamic Test Systems

MTS Landmark®
100 Hz Elastomer Test System

GRIP OPTIONS*

Thumb Screw Grip	3 kN L-Grip

There are several different tensile grips that can be used for ASTM D5026. The easy-to-use, 3 kN Thumb Screw Grip works well for smaller specimens. The MTS Toggle Grip (not pictured) is self-tightening so it maintains the most consistent clamp load throughout the test. The MTS L-Grips are economical and come in both 250 N and 3 kN capacities.

CHAMBER OPTIONS*

651.05F-01 Chamber
To ensure accurate and consistent results, the MTS 651.05F-01 Environmental Chamber has been tested in DMA applications. It is designed to maintain a constant temperature with very little temperature gradient across the specimen. Heating is achieved with electrical heating elements and a motor-driven fan for diffused convection heat. Cooling is accomplished with liquid nitrogen. It also has a built-in temperature controller, all-welded construction, and Fiberglas™ insulation.

SOFTWARE OPTIONS*
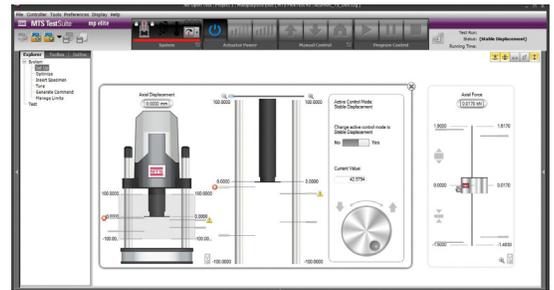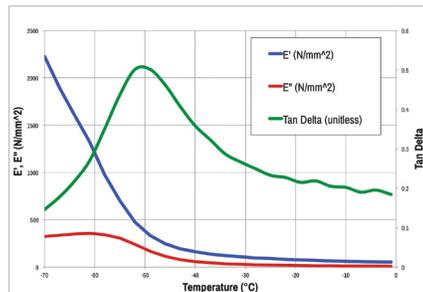
DMA / Dynamic Characterization Application Software	TestSuite™ Software for MTS Acumen® Systems
To test per ASTM D5026, application software MTS Model 793.31 DMA/Dynamic Characterization allows the user to conduct dynamic characterization (leveraging the Kelvin-Voigt model) with up to four channels of control. The DMA application software measures Stiffness (K), Phase Angle, Damping (C), Modulus (E or G), Tan Delta, Glass Transition (Tg), and more. Additional software options include the TTS (time-temperature superposition) Master Curves module, which is commonly used to predict viscoelastic behavior at frequencies outside the range of what is typically achievable with physical testing. And the MTS Model 793.33 for static deflection testing and MTS Elastomer Express (for QA/QC testing).	MTS TestSuite Multipurpose Software delivers the test definition, execution, analysis and reporting capabilities required for dynamic testing. The intuitive user interface is optimized for MTS Acumen systems. The software lets you graphically build and run tensile, compression, bend, fatigue and fracture, multiaxial, block loading and custom profile tests with efficiency. With its easy-to-use interface, you can easily test to specific industry standards or pursue your own interpretation of a standard with customizable "plug-and-play" test methods. The software also captures all setup data and test results, allowing you to quickly repeat tests, analyze data with the stand-alone Analysis Software, and design and create reports with the convenient Excel Add-In.

*NOTE: This technical note is intended to show some of the popular and more common solutions used for this particular application. Most often, additional options are available and necessary to accomplish your more comprehensive test objectives.

APPENDIX - TEST SPECIMEN DETAIL

The guidance provided in ASTM D5026 allows for test specimens to be cut from sheets, plates, or molded shapes, or may even be molded to other desired finished dimensions. Any rectangular specimen that is representative of the material being tested and within the fixturing capabilities of the test equipment, may be used as long as it is clearly described in the test report.