ISO 6721-12 Dynamic Mechanical Properties (DMA) – Compressive Vibration

TEST METHOD SUMMARY

ISO 6721 Part 12 is one of the most commonly used test standards for conducting DMA of materials in Compression, at frequencies typically up to 100 Hz. The test procedure characterizes the viscoelastic properties of thermoplastic resins, thermosetting resins and composite systems. Using cylindrical or right prism specimens, ISO 6721-12 determines the storage (elastic or E'), loss (viscous or E") and complex (E*) moduli, as well as tan delta (tan δ), as a function of frequency, temperature, or time. These properties provide insights into 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 Master Curve software can perform frequency-temperature shift procedures, allowing materials researchers to generate master plots that are critical in predicting long-term life based on short-term test data. Three decades of reliable data is especially important here since data errors lead to large amounts of error in life estimation.

Solutions for ISO 6721-12 typically include these types of components;

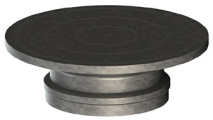
MTS Acumen®
Electrodynamic Test System

LOAD FRAME OPTIONS*

Both the MTS Acumen® and the MTS Landmark® test systems are ideal for conducting dynamic mechanical analysis (DMA) of polymers per ISO 6721-12. 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 other testing requirements demand higher force capacities.

MTS Landmark®
Servohydraulic Test System

COMPRESSION PLATEN OPTIONS*



50 mm Diameter Platen

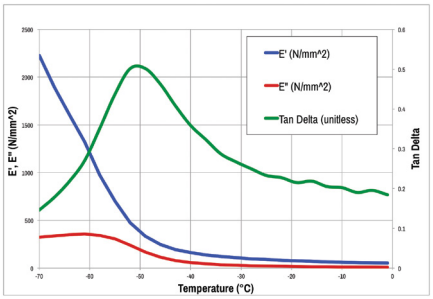
70 mm Diameter Platen

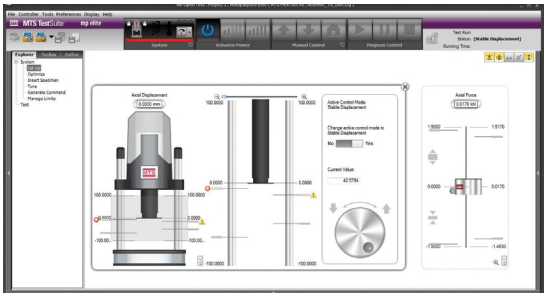
There are two different compression platens that can be used for ISO 6721-12. The MTS 50 mm Diameter Platen has a temperature range of -150°C to 350°C (-238°F to 662°F). The 70 mm Diameter Platen (MTS Model 643.07C) has a temperature range of -40°C to 149°C (-40°F to 300°F) and can accommodate a specimen diameter range of 7.6 mm to 76.2 mm (0.3" to 3").

CHAMBER OPTIONS*

651.05F-01 Chamber	
	The MTS 651.05 Chamber has been tested in DMA applications. It maintains a consistent temperature gradient across the specimen. It has electrical heating elements and a motor-driven fan for diffused convection heat. Cooling is accomplished with liquid nitrogen. ISO 6721-1, a reference test method, states temperature ramp rates of 1-2 °C/min or 2-5 °C step intervals held for 3-5 minutes are generally suitable. Since time to reach equilibrium greatly depends on the mass of the specimen, step intervals are often preferred. Consult our DMA application engineers for recommendations.

SOFTWARE OPTIONS*





DMA / Dynamic Characterization Application Software	TestSuite™ Software for MTS Acumen® Systems
To test per ISO 6721-12, 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

Compression test specimens shall be in the shape of a right prism or cylinder, with preferred specimen sizes of 4 x 4 x 8 mm (prism) or 5 mm diameter x 10 mm length (cylinder). When this is not possible, know that the ratio of length/width (or diameter) of the test specimen has significant influence on the test results.

MTS Systems Corporation
14000 Technology Drive
Eden Prairie, MN 55344-2290 USA
Telephone: 1-952-937-4000
Toll Free: 1-800-328-2255
Fax: 1-952-937-4515
E-mail: info@mts.com
www.mts.com

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