

ASTM D412 Tensile Properties of Vulcanized Rubber and Thermoplastic Elastomers

TEST METHOD SUMMARY

Proper tensile testing of vulcanized (durable) rubber and thermoplastic elastomers per ASTM D412 is quite useful since these compounds are one of the most complex and universally used materials where both elasticity during stretching and recoil upon release are needed. Rubber compounds used in footwear, tires, sports equipment, gaskets and many other applications are formulas that have been optimized with precise amounts of several materials. One simple and common elastomer example, used in many toys, is plasticized PVC. And on the other end of the spectrum in terms of complexity, there are specialty elastomers used in aerospace applications which maintain high performance specifications even in extreme temperature environments.

Tensile testing of vulcanized rubber and thermoplastic elastomers in a universal testing machine evaluates the residual elongation of a test sample after first being stretched and then allowed to relax in a specified procedure. Elongation of these materials consists of both permanent (plastic) and recoverable (elastic) components, so accuracy in the time specified for stretching and recovery is critical. ASTM D412 references two test methods: Method A is for dumbbell (dogbone)-shaped specimens, while Method B is for flat cut ring specimens. The standard calls for samples which have not been pre-stressed to be measured for tensile stress, tensile stress at a given elongation, tensile strength, yield point, and ultimate elongation.

Solutions for ASTM D412 typically include these types of components;

LOAD FRAME OPTIONS*

Both the premium MTS Criterion® and the economical MTS Exceed® universal testing machines are ideal for tensile testing of vulcanized rubber and thermoplastic elastomers per ASTM D412. They both come in a variety of force capacities and frame styles, ranging from 1-column tabletops to larger 2-column floor-standing models. For these high elongation materials, taller frame options are available. The 30kN and 100kN models also have dual-zone test spaces to reduce set-up times if you frequently change test requirements. And as an alternative to a new load frame, you can modernize the software and controls of your old test system with an MTS ReNew™ Upgrade.



MTS Criterion®
 Electromechanical Universal Test Systems



MTS Exceed®
 Electromechanical Universal Test Systems




GRIP OPTIONS*

			
Pneumatic Grips	Manual Wedge Grips	Roller Grips	Scissors Grips
<ul style="list-style-type: none"> » Vise & Wedge style grips provide constant clamping force to minimize slippage » Most commonly used for qa/qc testing » Many different faces and larger specimen opening for universal testing needs » Fast and easy operation 	<ul style="list-style-type: none"> » Spring loaded mechanical wedge grips are self tightening to minimize grip slippage » Versatile grip for many materials » Interchangeable faces available 	<ul style="list-style-type: none"> » Smooth rubber face and smooth compression bar work well for thin films but not for many other applications » Quick and easy to set up » Diamond tip grip faces available for thicker specimens 	<ul style="list-style-type: none"> » Self-tightening grip limited to certain situations since diamond tip grip faces can damage thin samples creating premature break » Good for odd-shaped, non-uniform and thicker specimens

GRIP FACE OPTIONS*

			ASTM D412 Gripping Guidance There are five types of tests in this standard. For test Types A,B,C, and CP, the standard specimen widths are 25 mm (1 in). For test Type T the standard specimen width is 30 mm (1.2 in). For all tests, the grip face width should be wider than the specimen under test.
Flat Rubber	Diamond Tip	Serrated	
<ul style="list-style-type: none"> » Versatile and the most recommended 	<ul style="list-style-type: none"> » Can be used for thicker and more durable specimens 	<ul style="list-style-type: none"> » Often used for thinner, more fragile specimens 	

EXTENSOMETRY OPTIONS*

			Extensometer Guidance Because of the extensibility that rubbers and elastomers exhibit, extensometers are required to accurately measure elongation. As non-contacting extensometers are proving to both effective and reliable, especially for delicate specimens, the AVX has become popular for this and many other applications.
Non-contacting - Video	Contacting - Automatic	Contacting - High Elongation	
» Versatile and the most recommended	» Can be used for thicker and more durable specimens	» Often used for thinner, more fragile specimens	

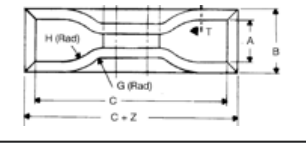
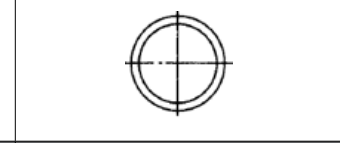
SOFTWARE OPTIONS*



ASTM D412 Tensile Properties of Vulcanized Rubber and Thermoplastic Elastomers	About TestSuite™ TW
To simplify testing to ASTM D412, MTS has developed a TestSuite™ TW test template that will set-up and run the recommended tensile tests. After the test data has been collected, reports can display all of the required calculations including tensile stress, tensile stress at a given elongation, tensile strength, yield point, ultimate elongation, and more. MTS consultants are available to support any of your rubber / elastomer applications, test method set-up, and data collection and integration requirements.	This flexible and versatile software application comes in three versions so that you can choose exactly which one best fits your requirements. Lab managers and test creators like TW Elite since it includes all the test definition capacity and flexibility needed to create and edit custom test sequences while accommodating the specific runtime needs of lab personnel. Test operators prefer the simplicity and intuitive nature of TW Express. This software allows operators to easily execute tests and monitor data or calculated values in runtime views. For QA/QC labs that prefer the MTS Exceed universal test machine, TW Essential will provide both the test creation and test operation capabilities, combining efficiency and productivity in one software application.

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

APPENDIX - TEST SPECIMEN DETAIL

		Straight Specimens Straight specimens may be prepared if it is not practical to cut either a dumbbell or a ring specimen. This may occur in the case of a narrow strip, small tubing or narrow electrical insulation material. Straight specimens tend to break in the grips if normal extension-to-break testing is conducted and should be used only when it is not feasible to prepare another type of specimen. For obtaining non-rupture stress-strain or material modulus properties, straight specimens can be quite useful.
Method A – Dumbbell Shaped Specimens	Method B – Flat Cut Ring Specimens	
Since anisotropy or grain directionality due to flow introduced during processing and preparation may have an influence on tensile properties, dumbbell (and straight) specimens should be cut so the lengthwise direction of the specimen is parallel to the grain direction when this direction is known.	Ring specimens enable elongations to be measured by grip separation, but the elongation across the radial width of the ring specimens is not uniform. To minimize this effect the width of the ring specimens must be small compared to the diameter.	



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 100-332-873 TMTND412 Printed in U.S.A. 09/21