PTM&W Industries, Inc.

10640 S. Painter Ave. Santa Fe Springs, CA 90670
562-946-4511 800-421-1518 FAX: 562-941-4773

Test Terms and Definitions

Test	ASTM Standard	Description
General Tests For Tooling Materials		
Viscosity	D2393	A test to measure the viscosity, in centipoise, of a material with the Brookfield Viscometer Model RVF.
Pot Life	D2471	A test to determine the time from initial mixing of resin and hardener to the time when solidification commences. The standard describes the use of either a wooden probe every 15 seconds, or a mechanical gel time meter, to obtain this information.
Cured Durometer Hardness	D2240	Measure of the indentation hardness of a specimen. It is the extent to which a spring loaded steel indentor protrudes beyond a pressure foot into the material.
Shrinkage, Cast Bar	D2566	Refers to the linear component of the shrinkage of the material during cure. Involves the casting of material to be tested into a properly released, standard configuration mold exactly 10" long and measuring the shrinkage after full cure. Four standard molds are available for use in this test. They vary in depth and therefore volume, to allow the test to most nearly approximate the cross-sectional area that will normally be poured with the material to be tested. The four molds are: Mold #0 - 0.75" deep, 0.017 gallon volume; Mold #1 - 1.125" deep, 0.053 gallon volume; Mold #2 - 2.50" deep, 0.344 gallon volume; and, Mold #3 - 4.50" deep, 1.23 gallon volume;
Specific Gravity	D1475	Specific gravity* is the ratio of the weight of a given volume of material at 23°C to that of an equal volume of water at the same temperature, and is expressed as grams per cubic centimeter.
Density	D792	Density* is the weight per unit volume of material at 23°C, and can be expressed as grams per cubic centimeter, pounds per cubic inch or pounds per gallon. * Although specific gravity and density are frequently used interchangeably, there is a slight difference in their meaning. The discrepancy enters from the fact that water at 23°C has a density slightly less than one.
Specific Volume		Specific volume is calculated from the materials' density, and is the cubic inches of volume a pound of the material will occupy. Useful as a comparative value between products.
TENSILE PROPERTIES:	D638	Determined by subjecting standard dumbell-shaped specimens to tensile stress in appropriate testing machine. A synchronized recorder automatically plots the load as a function of the deformation. From this graph, tensile properties of the specimen can be determined.
Tensile Strength		The maximum tensile stress sustained by the specimen during a tension test. When the maximum stress occurs at the yield point, it is designated Tensile Strength at yield. When the maximum stress occurs at break, it is designated Tensile Strength at Break. Usually reported as Tensile Strength at Break in pounds per square inch.
Elongation		The percentage increase in length of the specimen at its breaking point.
Tensile Modulus		The ratio of stress to corresponding strain below the proportional limit of a material. It is expressed in force per unit area (pounds per square inch).
Flexural Strength	D790	Determines the flexural properties of a material by testing a rectangular cross-section bar specimen in flexure as a simple beam. A 5" long bar rests on two supports and is loaded by means of a loading nose midway between the supports. The specimen is deflected until rupture occurs, and the maximum stress at the moment of rupture is reported in pounds per square inch.
Flexural Modulus	D790	The ratio within the elastic limit of stress to corresponding strain with units of pounds per square inch.
Compressive Strength	D695	Standard test specimens (typically .5" x .5" x 1") are mounted between the platens of a compression testing machine. Compressive stress is transmitted to the specimen through the platens which are machined and polished to a nearly perfect flatness in order to reduce the effects of unequal loading to the specimen. For the same reason, the specimen is prepared so that its faces bearing the load are as nearly parallel as possible. The compressive strength is calculated by dividing the maximum compressive load carried by the specimen during the test by the original minimum cross-sectional area of the specimen. It is reported in pounds per square inch.

General Tests For Tooling Materials, continued

Test	ASTM Standard	Description
Compressive Modulus	D695	(Also modulus of elasticity) The ratio of stress to corresponding strain below the proportional limit of a material. It is expressed in force per unit area (pounds per square inch) based on the average initial cross-sectional area.
Izod Impact Strength	D256	Method for determining behavior of materials subject to shock loading. Specimen supported as a cantilever beam is struck by a weight at the end of a pendulum. Impact strength is determined from the amount of force required to fracture specimen.
Glass Transition Temperature		When a cured material is heated, vast changes in thermal and mechanical properties occur. These changes are particularly large near the glass transition temperature (Tg). Below the Tg, the material is hard and "glassy", above the Tg it has rubbery characteristics. Tg is the transition temperature from a glassy to a rubbery state. At this temperature, tensile strength, hardness, electrical properties and chemical resistance depreciate rapidly, while tensile elongation and flexibility increase markedly. Tg usually occurs over a range of temperature, but for simplicity one temp.is selected as Tg.
DSC Method	D3418	Glass Transition Temp. determined by Differential Scanning Calorimeter.
TMA Method	D3386	Glass Transition Temp. determined by Thermal Mechanical Analyzer.
DMA Method	D4065	Glass Transition Temp. Determined by Dynamic Mechanical Analyzer.
Heat Deflection Temperature(HDT)	D648	A ½ x ½ x 5" specimen is placed on supports 4 inches apart and a load of 66 or 264 psi is placed on the center. The temperature in the chamber is raised at the rate of 2 ± 0.2 °C per minute. The temperature at which the bar has deflected 0.010 inch is reported as "deflection temperature at 66 (or 264) psi fiber stress."
Coefficient of Thermal Expansion	D696	A method to determine the linear thermal expansion of a material. The test is performed over a specified temperature range. Any given material will have a substantially different coefficient of thermal expansion at temperatures above its glass transition temperature (Tg). This can be misleading as to its performance, since service above the Tg is not recommended, therefore, the test is performed at a range of temperatures below Tg, and the linear coefficient of thermal expansion is reported for the range of temperatures used.

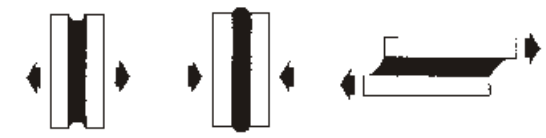
Urethane Tests

TENSILE TESTS:	D412	Dumbell-shaped samples of specific size are cut from thin sheets of cured urethane. The ends of the sample are clamped and separated at a constant speed in opposite directions. The tension or force required to do this is then recorded. The test results are shown as a stress-strain curve, the shape of which provides information about the elastic behavior of the sample.
Ult. Tensile Str.		The tension or force applied at the breaking point of the elastomer.
Modulus		The force per unit of original cross-sectional area required to stretch the specimen to a stated elongation (i.e., 50%, 100%, & 300%). There are only a few cases where parts are strained to more than 100% modulus - most applications have strains in the 20-35% range.
Ult. Elongation		The percentage of increase in length of the elastomer at its breaking point.
Tensile Set		The extension remaining after the sample has been stretched and allowed to recover. It is expressed as a percentage of the original length.
Young's Modulus	D797	A measure of the stiffness of the elastomer. It is defined as the initial slope of the stress-strain curve. The higher the value, the more resistant the material is to being stretched.
Tear Strength	D624	The tensile force necessary to cause tearing over a given length, expressed in pounds per various linear inches (pli). Either a Die "C" or a preslit rectangle are the commonly used specimen shapes to determine tear strength of polyurethanes..
Compression Set	D395	The residual decrease in thickness of a test specimen measured 30 minutes after it has been removed from a suitable fixture in which it had been subjected for a definite period of time to compressive deformation under specified conditions of load applications and temperature.
Bashore Rebound	D2632	To determine Bashore rebound, a standard weight is dropped onto the specimen from a specified height and the height of rebound is observed. A perfectly elastic material has a rebound of 100%, and a perfect absorber has a rebound of 0%.
Taber Abrasion	D4060	A 4" diameter sample is mounted on a rotating turntable. Abrasive wheels are applied to the sample using a fixed weight. For a specified number of cycles, the abrasive wheels wear away the sample. The taber result is calculated by measuring the weight loss per thousand cycles of abrasion.
Water Absorption	D570	Data is obtained by immersion 24 hours or longer in water at 23°C. Upon removal, specimens are dried and weighed immediately. The increase in weight is reported as percentage gained.

Adhesives Tests

Test	ASTM Standard	Description
Tensile Lap Shear	D1002	The most widely used adhesive test. The specimen is prepared with 1 in. aluminum strips bonded in a simple over-lap of 0.5 inch. The test is similar to a tensile strength setup, and the force applied at bond failure is reported as the lap shear value.
Peel Tests: Climbing Drum	D1781	Method for determining peel resistance of the adhesive bond between a relatively flexible and rigid material. In a climbing drum peel test a thin sheet of metal is bonded to a rigid backplate. The thin sheet is clamped to a flanged drum, and the other end of the specimen is attached to the top clamp of the testing machine. The fixture is designed so that when a tensile load is applied by the testing machine, the drum rolls up the specimen, causing the adhesive bond to peel apart. The peel resistance over at least a 6" length of the bond is recorded. The results are determined as the average peeling load required, and this average peel torque is reported in inch-pounds per inch
T Peel	D1876	A test used for metal-to-metal adhesives. The specimen is made from thin sheets 12" long by 1" wide, with 9" bonded and 3" unbonded. The free ends of the specimen are each bent through 90°, clamped in the testing fixture and pulled apart at a constant rate. A record of the load versus distance peeled is made. The units of T Peel are pounds per inch.
90°, or Bell Peel		In this test, a thin sheet of metal is bonded to a thicker backplate in a specimen 10" long by 1" wide, with 8" bonded and 2" unbonded. The free end of the thin sheet is pulled between two 1" rollers which support the thicker backplate. In this test, an attempt is made to control the radius through which the thin sheet is pulled to give more consistent results. The units of peel strength are pounds per inch.
Cleavage	D1062	Tensile load (pounds per inch of width) required to cause separation of a 1 inch long metal-to-metal adhesive bond. This test is made by bonding together two rigid adherends and pulling them apart by means of an external load as in a tensile strength test.
Fatigue Test		A method for determining the behavior of materials under fluctuating loads. A specified mean load and an alternating load are applied to a specimen and the number of cycles required to produce failure is recorded. With adhesives, this test is normally carried out with lap shear specimens.
Creep	D2294	Method for determining creep or stress relaxation behavior. Lap shear specimen is subjected to prolonged constant tension or compression loading at constant temperature. Deformation or relative movement of the adherends is measured at fixed time intervals, and a creep vs time diagram is plotted. Slope of curve at ant point is creep rate. Test may be carried out at various temperatures and under various conditions.
Environmental Tests:		Usually carried out on lap shear specimens, but peel specimens are also used.
Elevated Temperature		Specimens are stored in an air circulating oven, and a specified number are removed for each data point and tested at room temperature and ageing temperature.
Weathering		These tests are usually carried out in four different natural climatic conditions: (1) Tropical Wet (2) Tropical Dry (3) Temperate Wet (4) Temperate Dry These tests often last as long as ten years.
Cycling Tests		Specimens are exposed to a number of cycles of climatic conditions such as hot-wet, cold-wet, ambient dry and hot dry. This test is designed to accelerate the time in which weathering data can be collected.
Salt Spray Tests		Specimens tested after 30 day exposure to a solution of salt in spray form at 75°F.
High Humidity		Specimens tested after exposure to 95-100% relative humidity at 180°F.
Immersion Tests		Specimens tested after immersion in various fluids that may be present in the environment to which the adhesive will be exposed. Test parameters usually specified by customer for specific applications.

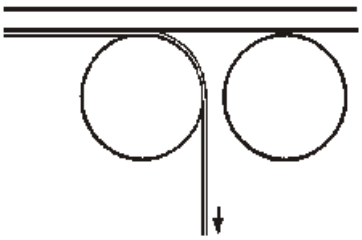
Examples of Adhesive Joint Loading Forces



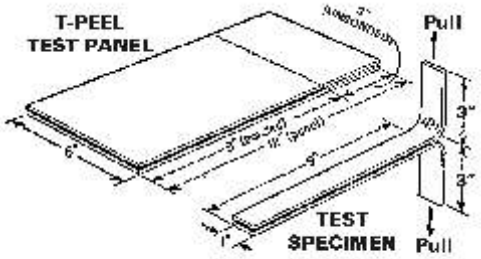
Tension Compression Shear

Cleavage Peel

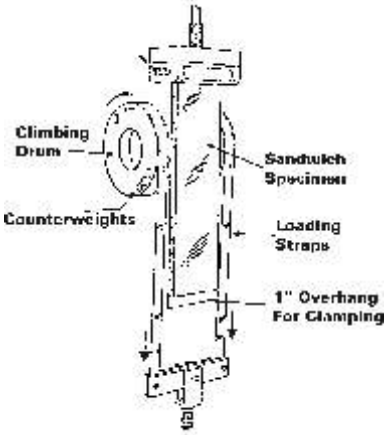
Examples of Selected Test Methods and Fixtures



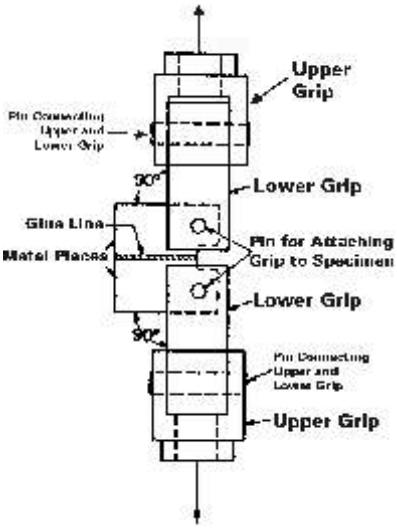
90°, or “Bell” Peel



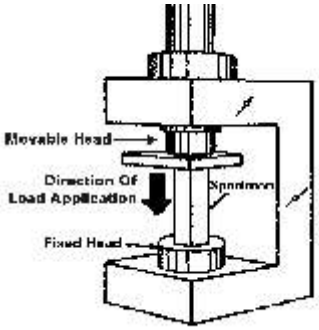
T-Peel



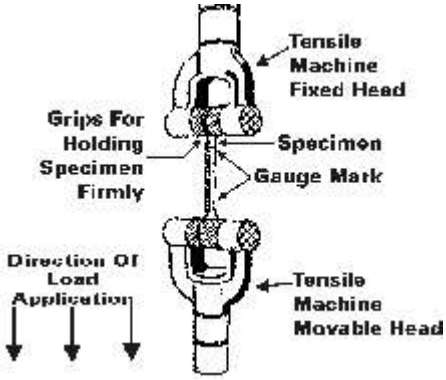
Climbing Drum Peel



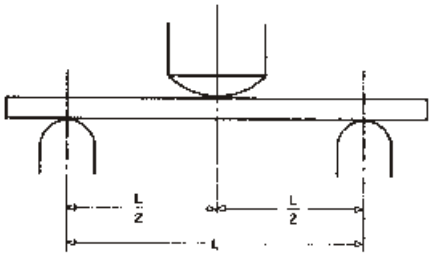
Cleavage Test



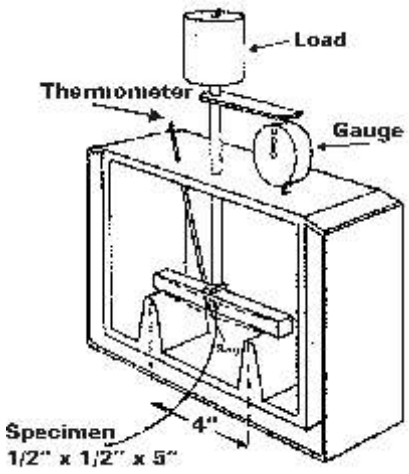
Compression Fixture



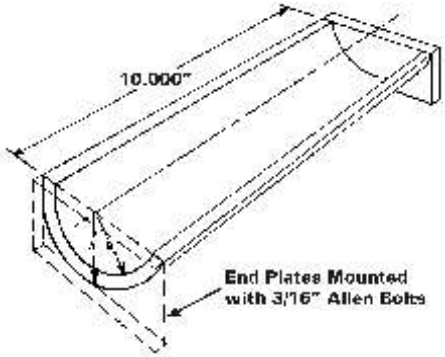
Tensile Test Setup



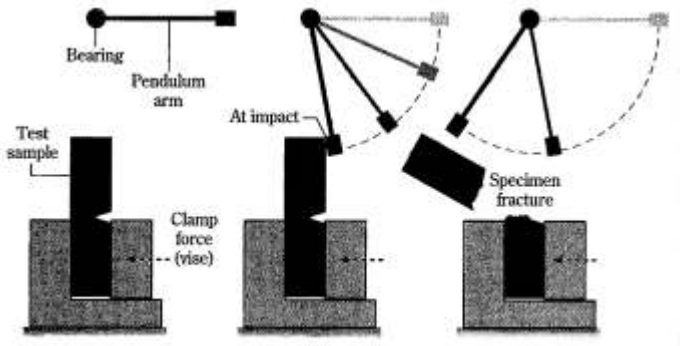
Flexural Test Setup



HDT Test Machine



Shrinkage Test Mold



Izod Impact Test Procedure

Shrink Mold Sizes

Mold #	Depth	Volume
# 0	0.75”	0.017 gallon
# 1	1.125”	0.053 gallon
# 2	2.50”	0.344 gallon
# 3	4.50”	1.23 gallon