RAW MATERIAL TESTING LABORATORY

A key differentiator between a typical injection molder and AGS Technology is our raw material capability and knowledge. When you look at a plastic product data sheet there are multiple physical property tests that help define the performance of the listed plastic. AGS Technology has a complete, in-house raw material testing laboratory that allows it to characterize the properties of incoming regrind and virgin resin in both ASTM and ISO standards. Over the following pages we will discuss some of the physical property tests that AGS Technology conducts on a daily basis to help formulate Injectoblend™ compounds that consistently meet customers performance requirements.

TENSILE STRENGTH — Standard Test: ASTM D638 / ISO 527-1

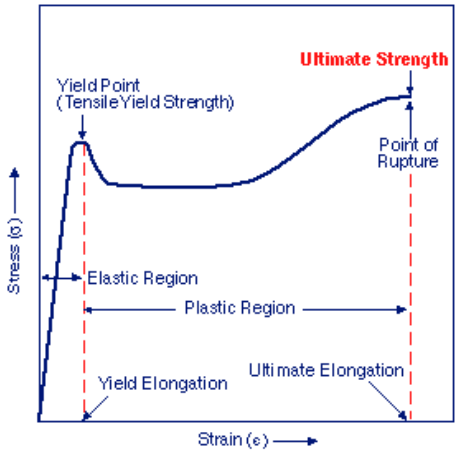
Tensile strength is a measure of a materials ability to resist being pulled apart. Testing is carried out on a universal testing machine using dry as molded test bars. The test bar is gripped between a fixed and moveable crosshead. The moveable crosshead is made to travel at a constant rate until breakage occurs. The testing machine is equipped with sensors to measure the stress being exerted on the specimen. Tensile strength is calculated by dividing the cross sectional area of the test bar by the maximum force recorded by the load cell.

With nylons, tensile strengths can range dramatically depending on the specific grade being tested. With the more flexible nylons (impact modified) results can be as low as 7,000 Psi. (48 Mpa). Where higher strength formulations such as 33% glass filled, can exceed 26,000 Psi. (180 Mpa).

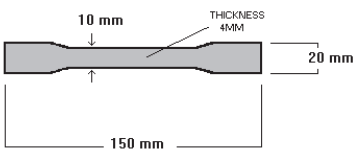
ELONGATION AT BREAK — Standard Test: ASTM D638 / ISO 527-1

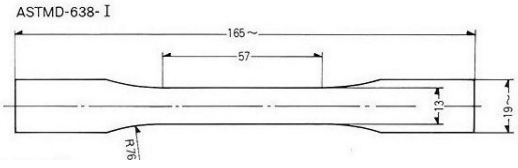
Elongation is the total amount of stretching that occurs during the tensile test until the final breakage point is reached. An extensometer (strain gauge) is attached to the dogbone to record the amount of elongation or strain.

The more flexible nylons will typically register greater then 50% elongation, where the higher strength formulations, on the other hand, may break with less then 5% elongation.



TENSILE TEST BAR -ISO
(dogbone)





FLEXURAL STRENGTH — Standard Test: ASTM D790 / ISO 178

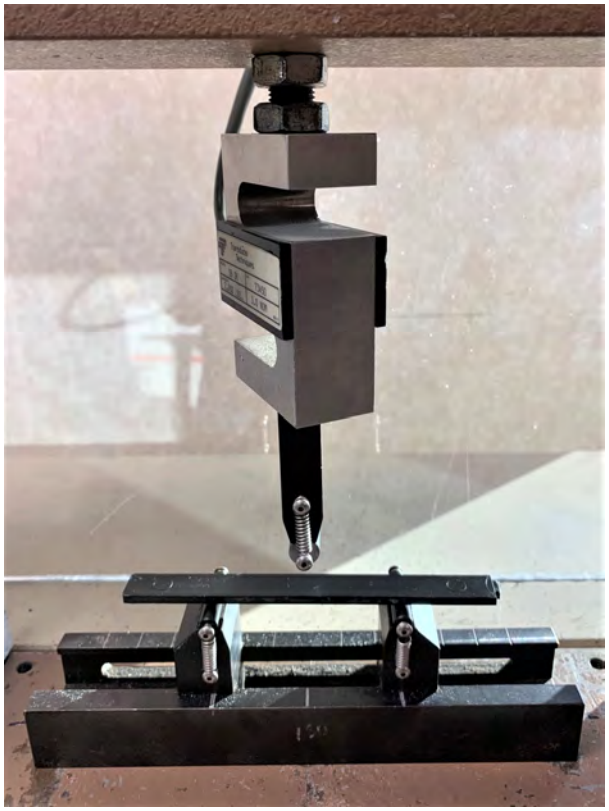
Flexural strength is an indication of "stiffness", and is a measure of how well a material resists bending.

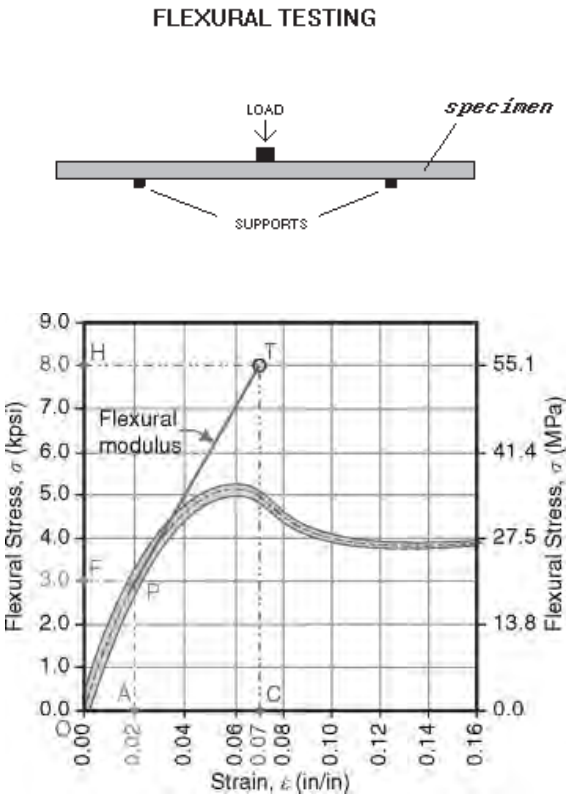
During this test, a dry as molded test specimen is supported at each end, and a load is applied to the middle. The load is forced downward at a constant rate until a break occurs on the outer surface. The maximum stress applied is recorded as the Flexural Strength and is expressed in Psi or MPa.

FLEXURAL MODULUS — Standard Test: ASTM D790 / ISO 178

Secant Modulus: The secant modulus is the ratio of stress to corresponding strain at any given point on the stress-strain curve and is expressed in psi or MPa.

Tangent Modulus: The tangent modulus is the ratio of stress to corresponding strain and is expressed in Psi or MPa. It is calculated by drawing a tangent to the steepest initial straight-line portion of the load-deflection curve.

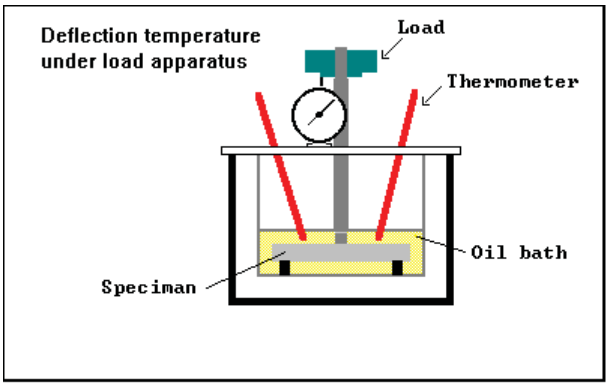




DEFLECTION TEMPERATURE UNDER LOAD Standard Test: ASTM 648 / ISO 75

DTUL , sometimes referred to as Heat Deflection Temperature (HDT) is used as an indication of high temperature performance by measuring how elevated temperatures effect stiffness.

This test is similar to the flexural strength test except the applied load is held constant at the required force. The test specimen is fixtured on edge and is placed in an oil bath. The temperature of the oil is increased at a constant rate until the specified bar deflection is detected. The temperature (degrees F or C) is then recorded as DTUL.



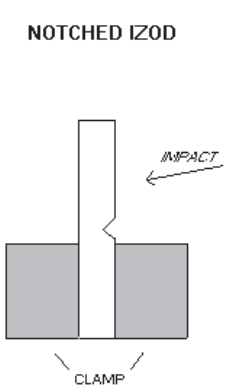
IMPACT STRENGTH

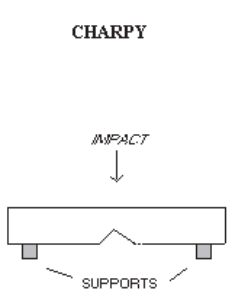
Standard Test: ASTM D256 / ISO 180-1A

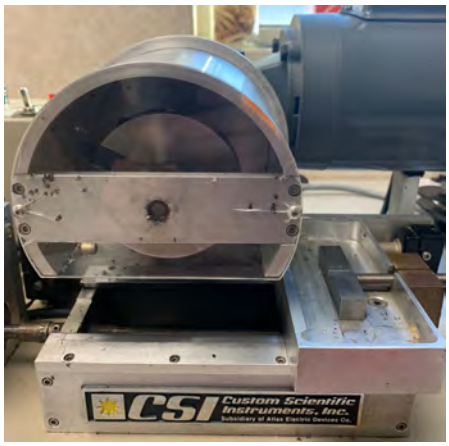
Impact strength is an indication of material "toughness". Impact data can be obtained by a number of different testing methods, but the most common tests used in the U.S. are the IZOD IMPACT and CHARPY IMPACT.

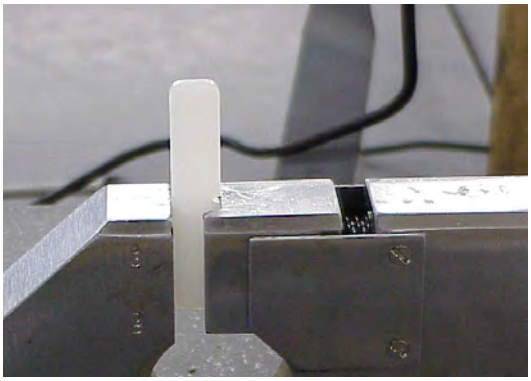
For measuring IZOD IMPACT (ISO 1A method) a test specimen measuring 80 x 10 x 4 (mm) is used. This bar can be tested un-notched or notched with a **"V"** notch cut into the bar with a 0.25 mm radius at the base of the groove. Both tests utilize a swinging pendulum type machine which delivers an impact on the notched (or un-notched) specimen. The machine records the loss of energy, and results are reported in kilojoules per square meter (kJ /m ^{2}) or foot-lbs per square inch (ft-lb /in ^{2}) of specimen width.

Toughened nylons can exceed 80 kJ/m ^{2}, where the more notch sensitive formulations such as mineral filled, can break at less then 3 kJ/m ^{2}.









SPECIFIC GRAVITY

Standard Test: ASTM D792 (A) / ISO 1183-1

Specific Gravity and Density are often times used interchangeably, however, there is a difference between the two.

Density is the measure of mass per unit volume, and is typically expressed as; grams/cm^3 or kg/m ^{3}.

Specific gravity is a dimensionless quantity, and is defined as the ratio of the density of a given material, to the density of water.

$$\textbf{Specific gravity} = \frac{\text{Density of the material}}{\text{Density of water}}$$

Density (g/cm^3) = Specific gravity (23 ^{0} C) X 0.998

AGS performs the test by weighing a small piece cut from a dry as molded tensile bar and then submerging the same piece in 23 ^{0} C water, and then re-weighing while it is submerged. The Density is calculated from the weight difference.

Material suppliers determine Specific Gravity (S.G.) for quality assurance reasons, but it is also used for determining part weight and cost. For example, if you would like to convert material costs ($), to cost in cents/in.^{3}, you could use the following equation:

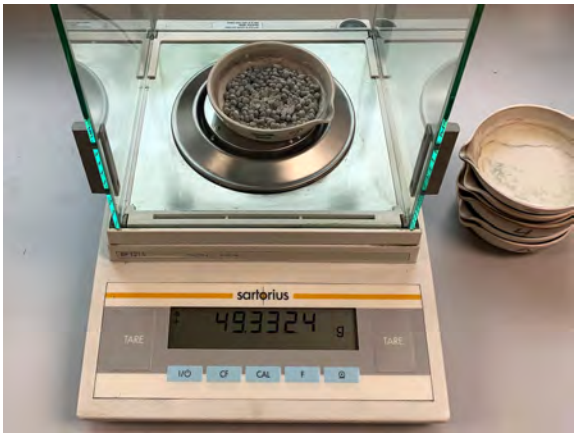
$ / lb. x S.G. x 3.61 = cost in cents / in3

Examples:
ABS @ $1.25/lb x 1.04 x 3.61 = $0.0469/in3
PC+ABS @$1.75/lb x 1.13 x 3.61 = $0.0714/in3
PC @ $2.00/lb x 1.20 x 3.61 = $0.0866/in3

ASH CONTENT

Standard Test: ASTM D2584 / ISO 3451-1

An Ash Content test is used to determine if a material is filled. The test will identify the total filler content. The test involves taking a known amount of sample, placing the weighed sample into a dried / pre-weighed porcelain crucible, burning away the polymer in an air atmosphere at temperatures above 500°C, and weighing the crucible after it is has been cooled to room temperature. Ash residue remaining in the crucible is considered filler as a percentage of the total sample.

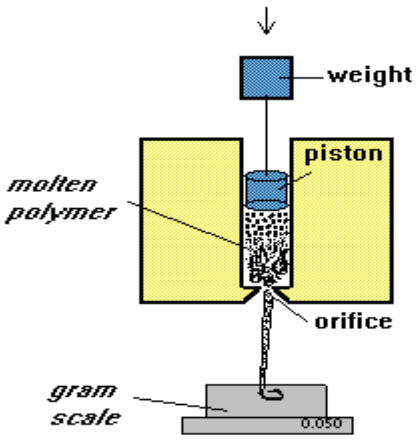


MELT FLOW RATE **Standard Test: ASTM D1238 / ISO 1133**

The melt flow rate test, also referred to as the melt index test measures the amount of polymer flow through an extrusion plastometer.

The test is carried out by feeding the material into a cylinder where it is heated to a specific temperature and then forced down by a weighted piston through a small orifice, where it is timed and weighed. The results are then calculated to reflect what amount (measured in grams) would have been extruded in 10 minutes time.

This test is best suited for quality assurance reasons, such as checking lot consistency, rather than comparing different material types flow or processing characteristics.



EXTRUSION PLASTOMETER