ASTM Test Method

R&D Center

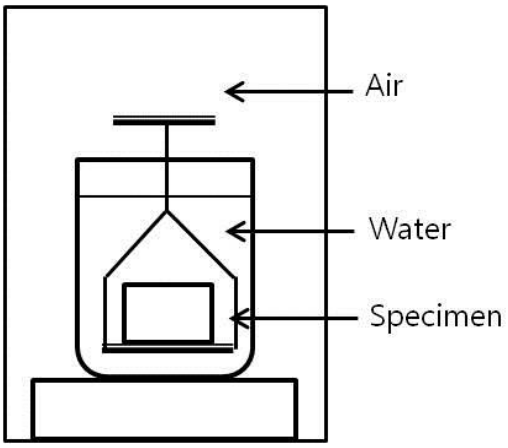
KOREA ENGINEERING PLASTICS CO.,LTD.

Density (ASTM D792, test method A)

1. Definition

(1) Density : ratio of the mass of a sample to its volume expressed in kg/㎥ = 1,000 g/㎤

(2) Specific gravity : the ratio of the mass of a given volume of the impermeable portion of the material at 23°C to the mass of an equal volume of gas-free distilled or de-mineralized water at the same temperature



2. Test condition

(1) Conditioning of the test specimen : over 40 h at (23 ± 2) ℃ and (50 ± 5) % R.H.

(2) Specimen : Its volume shall be not less than 1 cm^3 and its surface and edges shall be made smooth. The thickness of the specimen shall be at least 1 mm for each 1 g of weight. A specimen weighing 1 to 5 g was found to be convenient, but specimens up to approximately 50 g are also acceptable.

3. Calculation

(1) specific gravity 23/23 ℃(sp gr 23/23 ℃) = a/(a + w - b)

a = apparent mass of specimen, without wire or sinker, in air

b = apparent mass of specimen (and of sinker, if used) completely immersed and of the wire partially immersed in liquid

w = apparent mass of totally immersed sinker (if used) and of partially immersed wire.

(2) Density 23 ℃, kg/m^3 = sp gr 23/23 ℃ X 997.5

[Unique density of polymers]

Material	Density (g/㎤)	Material	Density(g/㎤)
ABS	1.05	PPO	1.08
Acetal(POM Co.)	1.41	PPS	1.55
PA6 / PA66	1.14	PE	0.91~0.96
PC	1.20	PP	0.90~0.91
PBT	1.31	PS	1.05
PET	1.36	PTFE	2.14

Tensile properties (ASTM D638)

1. Summary

The test specimen is extended along its major longitudinal axis at a constant speed until the specimen fractures or until the stress (load) or the strain (elongation) reaches some predetermined value. During this procedure, the load sustained by the specimen and the elongation are measured.

2. Test condition

(1) Conditioning : at (23 ± 2) ℃ and (50 ± 5) % R.H., minimum 40 h for specimens 7 mm or under in thickness, 88 h for specimens over 7 mm in thickness

(2) Test speeds : 50 mm/min, 5 mm/min (only to be quoted if strain at break is 10 %), 1 mm/min (modulus)

3. Calculation

(1) Tensile Strength(stress at yield) : stress at the yield strain, $\sigma = F/A$

σ : the stress value in question (MPa)

F : the applied force (N)

A : the initial cross-sectional area of the specimen (mm^2)

(2) Strain, $\varepsilon = \Delta L_0/L_0$

ε : is the strain value in question, expressed as a dimensionless ratio, or as a percentage

L_0 : is the gauge length of the test specimen (mm)

ΔL_0 : is the increase of the specimen length between the gauge marks (mm)

1) Strain at yield : the first occurrence in a tensile test of strain increase without a stress increase

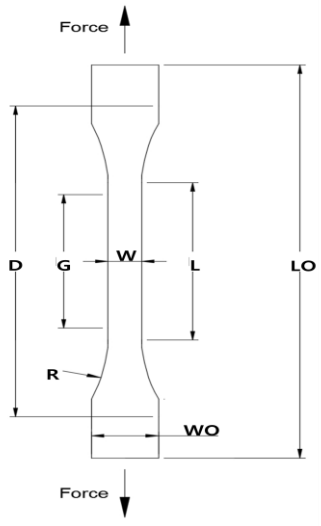
2) Strain at break : strain at which the specimen breaks

(3) Modulus : %, $Et = (\sigma_2-\sigma_1)/(0.0025-0.0005)$

Slope of the stress/strain curve $\sigma(\varepsilon)$ in the strain interval between ε_1 = 0.05 % and ε_2 = 0.25

σ_1 : is the stress measured at the strain value 0.05 %

σ_2. : is the stress measured at the strain value 0.25 %



W—Width of narrow section : 13,
L—Length of narrow section : 57
WO—Width overall : 19
LO—Length overall: 165
G—Gage length : 50
D—Distance between grips : 115
R—Radius of fillet : 76
Specimen thickness: 3.2 (Dimensions : mm)

Flexural properties (ASTM D790)

1. Summary

A test specimen of rectangular cross-section, resting on two supports, is deflected by means of a loading edge acting on the specimen midway between the supports. The test specimen is deflected in this way at a constant rate at midspan until rupture occurs at the outer surface of the specimen or until a maximum strain of 5 % (see 3.8) is reached, whichever occurs first. During this procedure, the force applied to the specimen and the resulting deflection of the specimen at midspan are measured.

2. Test condition

(1) Conditioning : at (23 ± 2) ℃ and (50 ± 5) % R.H., minimum 40 h for specimens 7 mm or under in thickness, 88 h for specimens over 7 mm in thickness

(2) Test speed : 2 mm/min

3. Calculation

(1) Flexural stress, $\sigma_f = 3FL/2bh^2$

σ_f : the flexural-stress

F : the applied force (N)

L : the span (mm)

b : the width (mm)

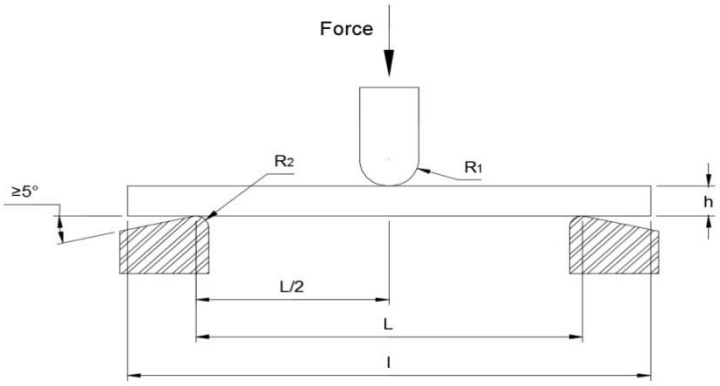
h : the thickness(mm)

(2) Flexural modulus, $E_t = (\sigma_2-\sigma_1) / (0.0025-0.0005)$

slope of the stress/strain curve $\sigma(\varepsilon)$ in the strain interval between ε_1 = 0.05 % and ε_2 = 0.25 %

σ_1 : is the stress measured at the strain value 0.05 %

σ_2. : is the stress measured at the strain value 0.25 %



Length of specimen l = The specimen shall be long enough to allow for overhanging on each end of at least 10 % of the support span.

Width b = less than one fourth of the support span

(thickness h ≥ 3.2)

b = 12.7(h < 3.2)

Length of span between supports L = 16 times the thickness

(Dimensions : mm)

Izod impact strength (ASTM D256)

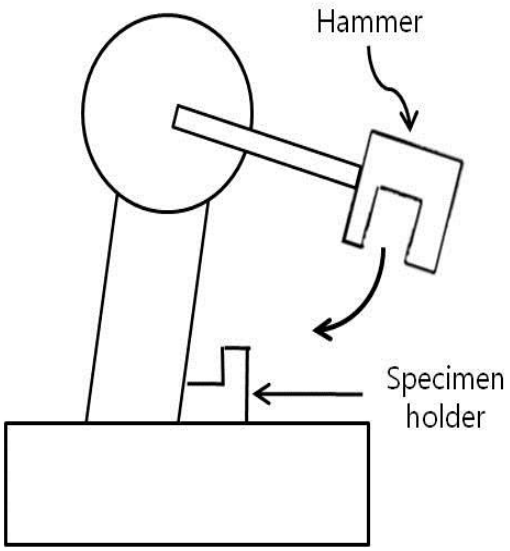
1. Summary

The test is carried out with the specimen notch / un-notched bar. The test specimen, supported as a horizontal cantilever beam, is broken by a single impact of a striker

2. Test condition

(1) Conditioning of the test specimen : over 40 h at (23 ± 2) ℃ and (50 ± 5) % R.H.
for some hygroscopic materials, such as nylons, the material specifications require sealing the specimens in water vapor-impermeable containers as soon as molded and not removing them until ready for testing.

(2) Impact speed : 2.9 m/s



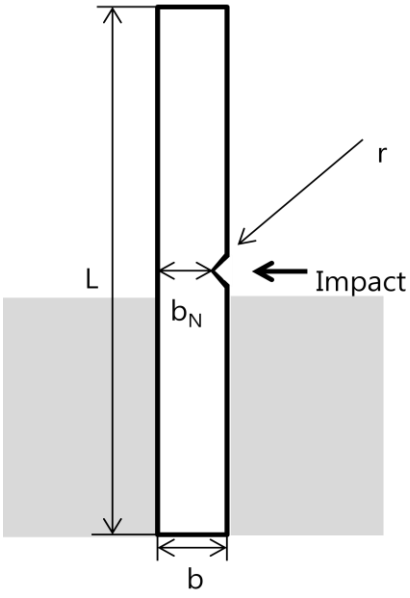
3. Calculation

(1) Impact Strength

$a_{cN} = E_c/h * 10^3$

E_c : the corrected energy absorbed by breaking the test specimen(J)

h : the thickness of the test specimen(mm)



Length l = 63.5 ± 2.0
Width b = 12.70 ± 0.20
Thickness h = 3.2 or 6.4 ± 0.2
Remaining width at notch base b_N = 10.16 ± 0.05
Radius of notch base r_N = (0.25 ± 0.05)
(Dimensions : mm)
Angle of notch base 45° ± 1°

Melt index (ASTM D1238)

1. Summary

Melt index is calculated by measuring rate of extrusion of a molten resin through a die of specified length and diameter under prescribed conditions of temperature, load and piston position in the cylinder of an extrusion plastometer, the rate being determined as the mass extruded over a specified time. We can find out the rheological behavior of resin with melt index.

2. Test condition

(1) Conditioning of the test specimen

1) Many thermoplastic materials, except materials which contain volatile components, are chemically reactive or have other special characteristics, do not require conditioning prior to testing.

(2) Test temperature and load

Material	Temperature	Load
POM	190 ℃	2.16 kg
PA 6	235 ℃	2.16 kg
PA 66	275 ℃	2.16 kg
PET	290 ℃	2.16 kg
PBT	250 ℃	2.16 kg
PPA	340 ℃	2.16 kg
PA.MXD6	270 ℃	2.16 kg

(3) The pre-heat period shall last for (7.0 ± 0.5) min from the completion of the charge unless otherwise stated in the materials specification.

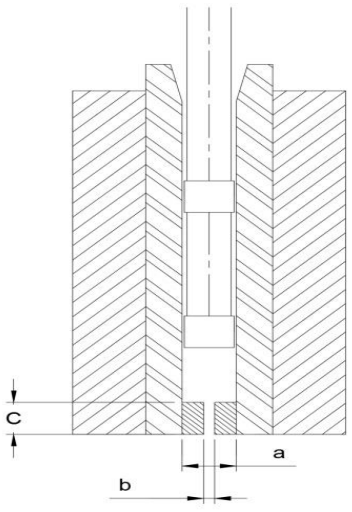
3. Calculation, MFR(T, m_{nom}) = 600 x m / t

m_{nom} : is the mass, exerting the nominal load (kg)

600 : is the factor used to convert grams per second into grams per 10 min (600 s)

m : is the average mass of the cut-offs (g)

t : is the cut-off time-interval (s)



a = 9.5504 ± 0.0076, Cylinder radius
b = 2.095 ± 0.005, Orifice radius
c = 8.000 ± 0.025, Orifice length
(dimensions : mm)

Melting point (ASTM D3418)

1. Summary

(1) DSC(Differential Scanning Calorimetry) measures the temperature of solid-liquid phase change and the temperature is defined as melting temperature.

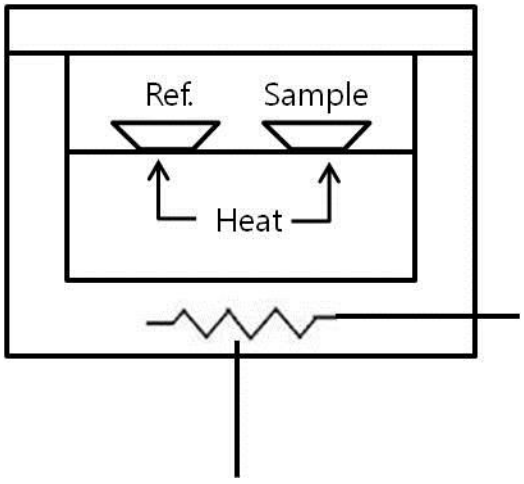
(2) DSC can give information of not only melting temperature but also glass transition temperature, crystallization temperature, enthalpy of fusion, etc., by measuring difference in heat flow between reference and sample.

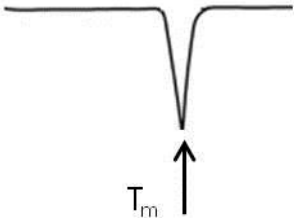
2. Test condition

(1) Specimen : In most cases a 5-mg specimen mass is satisfactory.

(2) Test Procedure

1) Heat the cell to 30 ℃ above Tm at a rate of 10 ℃/min or 20 ℃/min
2) Hold the temperature for 5 minutes.
3) Cool the cell to 50 ℃ below Tc at a same rate of number 1
4) Hold the temperature for 5 minutes.
5) Heat the cell to 30 ℃ above Tm at a same rate of number 1





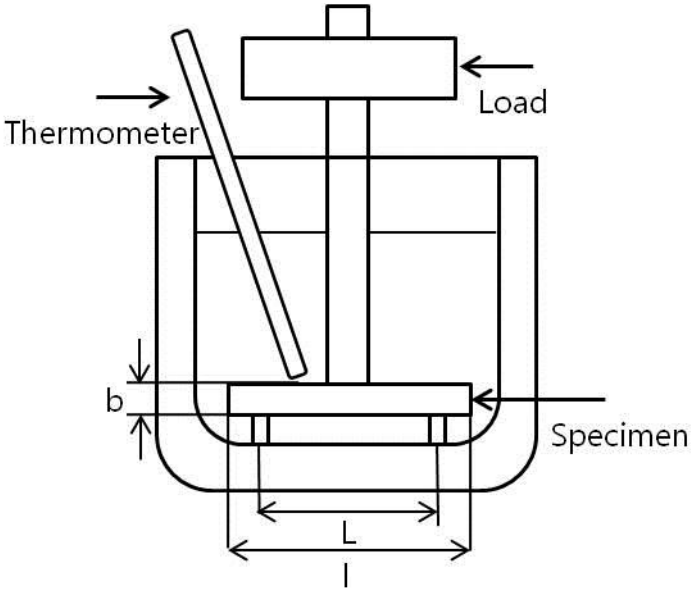
Heat deflection temperature (ASTM D648)

1. Summary

HDT is the temperature at which the deformation amount of the test specimen reaches regular standard value at elevated temperature under load at a specified rate of temperature increase. We can determine the heat stability of resin with HDT.

2. Test condition

(1) Conditioning of the test specimen : over 40 h at (23 ± 2) ℃ and (50 ± 5) % R.H.
(2) Edgewise test
(3) Scan condition : The rate of temperature increase is (2 ± 0.2) ℃/min from under 27 ℃
(4) Load : 0.45 MPa, 1.80 MPa
(5) Measure the temperature at which the deformation amount of the test sample reaches 0.34 mm.



Length l = 127 ± 0.13
Width b = 13.0 ± 0.13
Thickness h = 3 ~ 13 ± 0.13 (Dimensions : mm)

Rockwell Hardness (ASTM D785)

1. Summary

Rockwell Hardness is related to indention hardness of plastics. A Rockwell Hardness number represents the hardness of the material.

2. Test condition

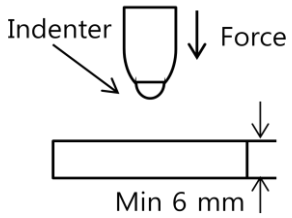
(1) Conditioning of the test specimen : over 40 h at (23 ± 2) ℃ and (50 ± 5) % R.H.
(2) Specimen type : The standard test specimen shall have a minimum thickness of 6 mm
(3) Rockwell Hardness scales

Rockwell Hardness Scale	Minor Load(kg)	Major Load(kg)	Indenter Diameter(mm)
R	10	60	12.700 ± 0.0025
M	10	100	6.350 ± 0.0025

3. Calculation

$$HR = 130 - e$$

HR = the Rockwell Hardness number, and
e = the depth of impression after removal of the major load, in units of 0.002 mm.



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