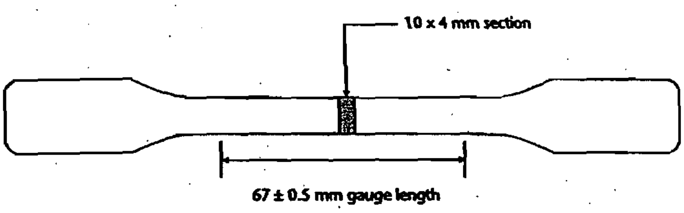
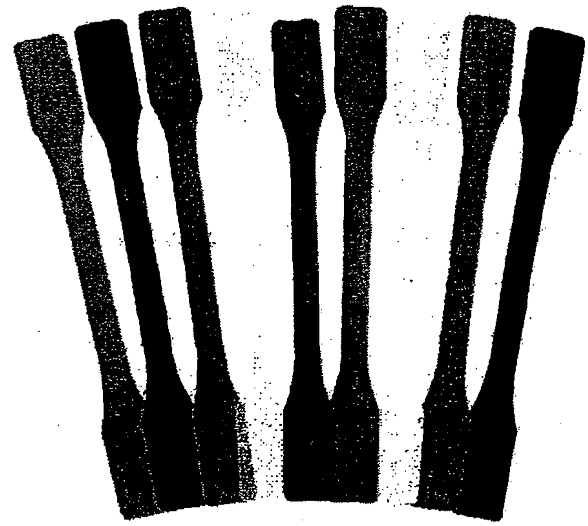


Cross-sectional area 40 mm^2



Introduction

One of the essential requirements for studying strength and properties of materials is an understanding of the way in which materials behave under load and conditions of stress.

The range of test specimens offers differing heat treatments and chemical compositions, carefully selected to enable the student to examine and compare properties of a wide variety of engineering materials.

A fundamental requirement of a standard specimen is that results should be predictable and repeatable. This range of test specimens meets this requirement.

The plastic series of specimens described in this datasheet is suitable for use with the Monsanto (Hounsfield) tensometer or similar.

Plastic Specimens of Low and High Density Polyethylene

Codes PL1, PL3

The low density polyethylene (PL3) has branched polymer chains and therefore the structure of this grade of polyethylene is largely amorphous. It has a density of approximately 0.92 and a melting temperature of 115°C. The merits of the polymer are its low cost, flexibility at temperatures down to –120°C, high toughness and chemical inertness to a wide range of liquids and solids. The major applications of low density polyethylene are therefore in packaging, toys, housewares and insulation for electrical cables.

High density polyethylene (PL1) has a higher degree of crystallinity than the low density grade, resulting in improved strength and stiffness. The density is approximately 0.96 and melting temperature 135°C. The improved mechanical properties, coupled with chemical inertness and resistance to permeation, make this type of polymer ideal for blow-moulded containers, dustbins, milk crates, tissue film, pipe and structural panels.

Tensometer Metric Specimen
Gauge width: 10.0 mm
Gauge thickness: 4.0 mm
Gauge length: 67.0 mm
Cross sectional area: 40 mm^2
Colour: PL1 (red), PL3 (yellow)

Tensometer variables
Chuck: Quick Grip
Beam: 1.2 kN
Magnification (automatic recorder): 1:1
Extension rate: 26 mm/min

Plastic Specimens of Polystyrene and Toughened Polystyrene

Codes PL2, PL4

Polystyrene (PL4) is a glassy, brittle polymer with low toughness and a softening temperature of only 100°C. Its advantage over other polymers is the ease with which it can be processed by extrusion, injection and vacuum forming. Polystyrene is therefore used for a wide range of cheap products like trays, boxes and toys.

The brittle characteristics of polystyrene can be relieved by the incorporation of around 5% butadiene rubber into the microstructure (PL2). The rubber exists as second-phase particles of approximately 1 mm diameter and these increase the toughness of polystyrene by an order of magnitude.

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Tensometer metric specimen
Gauge width: 10.0 mm
Gauge thickness: 4.0 mm
Gauge length: 67.0 mm
Cross sectional area: 40 mm^2
Colour: PL2 (blue), PL4 (clear)

Tensometer variables
Chuck: Quick Grip
Beam: 2.5 kN
Magnification (automatic recorder): 1:1
Extension rate: 26 mm/min

Plastic Specimens of Nylon and Glass Filled Nylon

Codes PL5, PL6

Nylon 66 (PL5) is a tough, semi-crystalline polymer that is widely used in all branches of industry for load-bearing applications. In particular, its abrasion resistance and low surface friction make it suitable for gears, cams and bearings. In the automative industry it is employed in door locks, filters, ball joints, bearings in suspension and steering systems. Domestic applications include curtain rail fittings, door fumiture, food mixers and vacuum cleaners.

Glass fibres can be added to Nylon 66 (PL6) to increase the strength and stiffness, but at the expense of elongation and toughness. The glass addition also improves dimensional stability. The users of glass-filled nylon are similar to those of the unfilled grade but with the added capabiltiy of being operated at higher stress levels, or under conditions where creep resistance is required.

Tensometer metric specimen
Gauge width 10.0 mm
Gauge thickness 4.0 mm
Gauge length 67.0 mm
Cross sectional area 40 mm^2
Colour: PL5 (white), PL6 (black)

Tensometer variables
Chuck: Quick Grip
Beam: 10 kN
Magnification (automatic recorder): 1:1
Extension rate: 26mm/min

Plastic Specimens of Polycarbonate

Code PL7

Polycarbonate (PL7) is a very tough, glassy polymer. It has good mechanical properties down to -90°C and up to 130°C, excellent dimensional stability, good weather and chemical resistance, transparency to light and resitance to buming. This combination of properties enables the polymer to be used for crash-helmet visors and transparent roof panels. Domestic applications include sterilizable babies' feeding bottles, hair curlers and hair dryers.

Tensometer metric specimen
Gauge width: 10.0 mm
Gauge thickness: 4.0 mm
Gauge length: 67.0 mm
Cross sectional area: 40 mm^2
Colour: PL7 (green)

Tensometer variables
Chuck: Quick Grip
Beam: 5 kN
Magnification (automatic recorder): 1:1
Extension rate: 26 mm/min

Plastic Specimens of Polypropylene

Code PL8

Polypropylene (PL8) has higher strength and stiffness than polyethylene and better heat resistance (melting temperature approx. 160°C) so it can be used in applications where contact with hot water and steam may be involved, e.g. hospital and laboratory equipment, car radiator reservoirs and washing machine/dishwasher componenets. Polypropylene sheet is fabricated into chemically-resistant tanks, and filaments are used for rope and netting. The disadvantages of polypropylene are its loss of flexibility at temperatures below 0°C and it is more permeable to gases than is high-density polyethylene due to its lower degree of crystallinity.

Tensometer metric specimen
Gauge width: 10.0 mm
Gauge thickness: 4.0 mm
Gauge length: 67.0 mm
Cross sectional area: 40 mm^2
Colour: PL8 (brown)

Tensometer variables
Chuck: Quick Grip
Beam: 2.5 kN
Magnification (automatic recorder): 1:1
Extension rate: 26 mm/min

Plastic Specimens of Acrylic Polymer

Code PL9

The samples of acrylic polymer (PL9) supplied are of polymethyl methacrylate, which is a glass material a little tougher than polystyrene. In its pure form it is completely transparent and resistant to outdoor weathering. The polymer is therefore widely used as a replacement for glass in applications like lights, signs, lenses, aircraft windows and traffic control lights. The breaking resistance of acrylic sheet is approximately ten times that of window glass.

Tensometer metric specimen
Gauge width: 10.0 mm
Gauge diameter: 4.0 mm
Gauge length: 67.0 mm
Cross sectional area: 40 mm^2
Colour: PL9 (amber)

Tensometer variables
Chuck: Quick Grip
Beam: 5kN
Magnification (automatic recorder): 1:1
Extension rate: 26 mm/min

Ordering Information

Plastic specimens each availiable in boxes of 10.
Please quote only order ref and quantity when ordering.

Order Ref	Code	Colour	Material
TN1410	PL1	Red	High-density polyethylene
TN1420	PL2	Blue	Toughened polystyrene
TN1430	PL3	Yellow	Low-density polyethylene
TN1440	PL4	Transparent	Polystyrene
TN1450	PL5	White	Nylon 66 unfilled
TN1460	PL6	Black	Nylon 66 glass filled
TN1470	PL7	Green	Polycarbonate
TN1480	PL8	Brown	Polypropylene
TN1490	PL9	Amber	Acrylic polymer

Specifications

	PL1	PL2	PL3	PL4	PL5	PL6	PL7	PL8	PL9
Limit of proportionality (N/mm^2)	15	20	5	40	60	125	35	20	70
Maximum strength (N/mm^2)	25	30	10	40	70	125	65	30	70
Elongation (%)	>100	10	40	0	20	0	>50	>100	0

Further experiments using these plastic specimens can be found in the TQ laboratory manual entitled *Tensile and Impact Properties of Metals and Polymers.*

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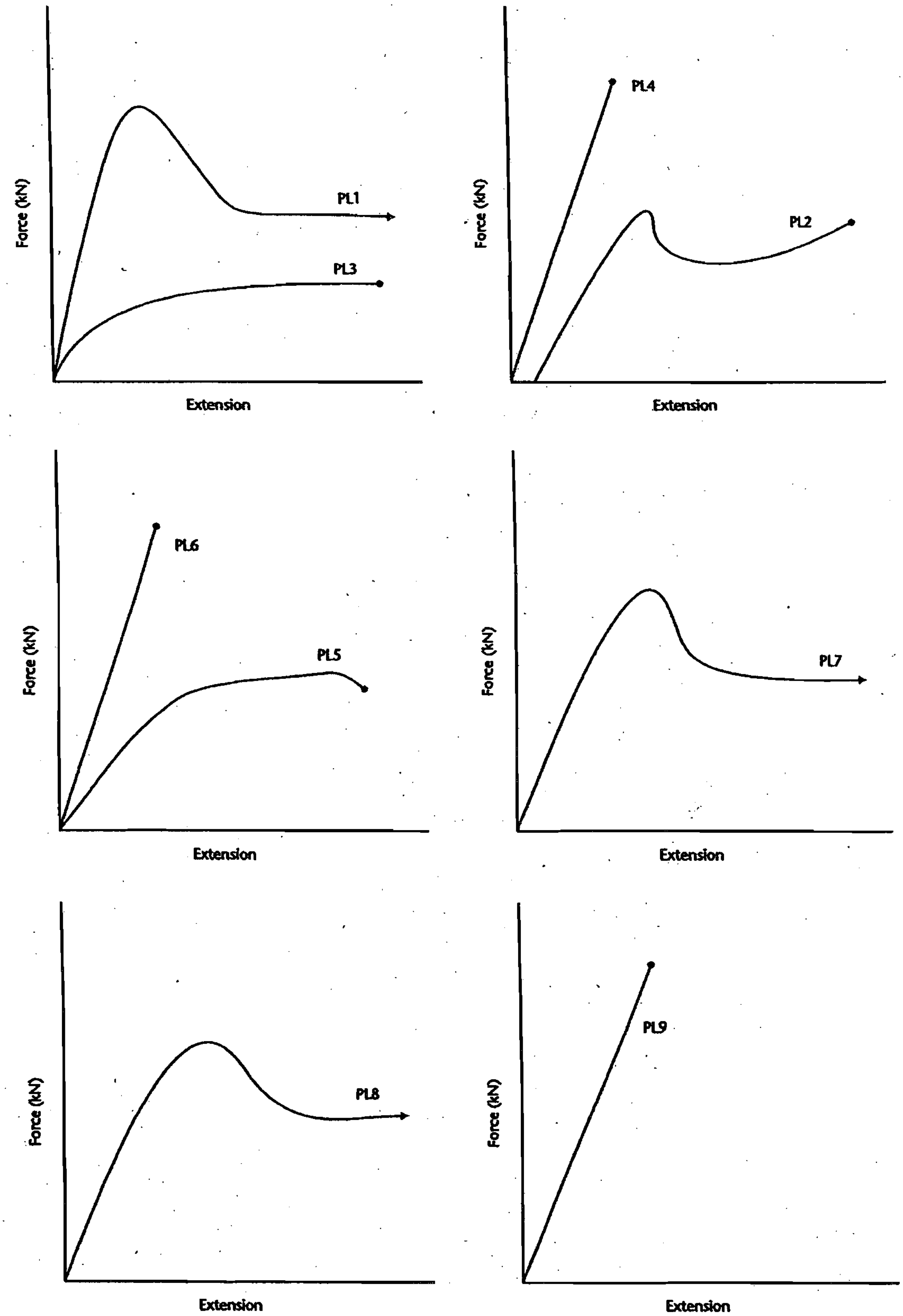
ES0104

Tensile test curves (Not to be used for detailed comparison between the six major groups.)



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