A – Z of plastics materials

It is good practice to identify the material of which an object is made because it enables you to understand more about the object. But it is vital for objects made of plastics as it will help you know how best to look after them. All plastics degrade over time but some are much less stable than others. It makes sense to concentrate limited resources on providing objects made of these plastics with optimum environments or you might even decide not to collect such objects at all. To find out which materials these are go to Problem plastics.

The best way to learn to identify different plastics is to study a group of objects that already have the plastic from which they are made identified. That way you can get to know what they look, feel and smell like. Clues to help you know what to look for can be found at Identify plastics.

Identification can also involve sophisticated analytical equipment of which the Fourier Transform Infrared Spectrometer (FTIR) is the most widely used. Such machines can be brought to your museum at a cost. It does however require experts to carry out the analysis and opinions differ on its value. For information on this and other forms of instrumental analysis please refer to Anita Quye and Colin Williamson ed., *Plastics collecting and conserving*, part two: analytical methods, pp.70 -73.

Plastics featured are those commonly found in museum collections. The aim of the information is to help you identify the material of which an object is made. Most plastic materials have been produced in a large number of formulations to suit particular applications and manufacturing processes. They may be what is called a copolymer, that is made up of two or more polymers, in order to increase the range of the plastic’s performance. The complexity of the subject is only hinted at here.

Many plastics have long gestation periods and were ‘invented’ at slightly different times in different countries. Dates should therefore be taken as indicative rather than absolute.

Manufacturing processes listed are those most commonly used with the particular material. It is though possible to find the material manufactured by other processes.

If you have an object made of a plastic not featured on this site please contact us so that we can remedy the situation for those who come after you.

**Acrylic** see polymethyl methacrylate

**Acrylonitrile** ABS
**butadiene styrene**
Group: thermoplastic
Developed: from 1948
Trade names: Cycolac
Manufacturing process: injection moulding; extrusion (sheet); thermoforming
Cost: low
Colour: any
Transparency: almost always opaque
Rigidity: rigid
Feel: hard
Smell: none
Other: glossy
Typical uses: domestic appliance and computer housings; Lego
Degradation: relatively stable but has tendency to yellow

**Alkathene™** see polythene

**Alketh™** see polythene

**Argosy™** see melamine formaldehyde
Bakelite™ see phenol formaldehyde

Bandalasta™ see thiourea-urea formaldehyde

Beatl™ see urea formaldehyde

Beetle™ see urea formaldehyde

Bexoid™ see cellulose acetate

Bois durci blood albumen and powdered wood
Group: thermoset
Developed: patented in Paris 1855, exhibited 1862 and 1867 International Exhibitions, London; commercial production ceased in 1875
Trade names:
Manufacturing process: compression moulding
Cost: high
Colour: black and dark brown, but sometimes has a lacquered finish
Transparency: always opaque
Rigidity: always rigid
Feel: hard
Smell: none
Other: can sometimes be identified by the moulding of a small bird’s wing or by the name ‘Bois Durci’
Typical uses: desk accessories; plaques with reliefs of notable people or mythological scenes
Degradation: relatively stable

Casein formaldehyde milk curds hardened with formaldehyde
Group: thermoset (but can also be thermoplastic to a certain extent)
Developed: patented 1899; little used since the 1980s
Trade names: Lactoid, Erinoid, Galalith
Manufacturing process: extrusion; fabrication, usually machined to shape from sheet, rod or block; textures achieved by laminating sheet on sheet
Cost: medium
Colour: any, including mottles, pearls and special effects
Opacity: usually opaque but some translucency when imitating tortoiseshell, horn and all the many decorative affects that could be achieved
Rigidity: firm but can flex
Feel: hard
Smell: occasionally of the formaldehyde used in its production
Other: accepts surface dyeing; polishes to a brilliant lustre
Typical uses: buttons, knitting needles, fountain pens, jewellery, dressing table sets, manicure sets, inlay in furniture
Degradation: Surface crazes and cracks

Cast phenolic see phenol formaldehyde

Celanese™ see cellulose acetate

Cellophane™ see cellulose acetate

Celluloid™ see cellulose nitrate

Cellulose acetate thermoplastic
Developed: invented 1894, but only developed as a material for commercial use from 1918 (although to form cellophane from 1908); not common until late 1920s.
Use fell off in 1970s but interest currently reviving, as made from wood based cellulose, a renewable resource.

**Trade names:** Celanese, Estron, Plastacele, Bexoid, Tenite, Clarifoil

**Manufacturing process:** early examples compression moulded; from c.1928 injection moulded

**Cost:** medium

**Colour:** any, usually plain but occasionally marbled

**Transparency:** transparent to opaque

**Rigidity:** strong but slightly soft, may be flexible in thin sections

**Feel:** hard

**Smell:** vinegar (when degrading)

**Other:** will accept surface colouring

**Typical uses:** as liquid to stiffen and waterproof fabric wings and fuselage of early aircraft. In solid form in spectacle frames; type-writer keys; negatives and film; toys; fancy goods e.g. by Lalique; sculpture e.g. by Naum Gabo; hair brush handles, especially Addis Ltd; also as supports for archival material from 1940s

**Degradation:** shrinks, crazes, becomes ‘sugary’ and cracks. Acidic droplets; white bloom on the surface; and distortion (warping), a result of plasticiser migration

**Cellulose nitrate**

**Group:** thermoplastic

**Developed:** displayed at 1862 International Exhibition, London; first common domestic plastic; turned into an artificial fibre like silk in 1884 called Chardonnet silk; use of all kinds almost ceases in 1940s but it is still used for ping pong balls.

**Trade names:** Parkesine 1862 – 68; Xylonite (British) and Celluloid (USA) from 1870s

**Manufacturing process:** blow-moulding; fabrication, made into blocks that are sliced into thin sheets; thermoforming of thin sheets

**Cost:** medium

**Colour:** any, including mottles, pearls and special effects such as imitations of tortoiseshell and ivory

**Transparency:** transparent to opaque

**Rigidity:** Wide range

**Feel:** hard

**Smell:** camphor (used as plasticiser), easiest to smell in containers with lids

**Other:** blade marks from the slicing into sheets sometimes visible; flammable, hence its early demise

**Typical uses:** collars and cuffs; dressing table sets and combs; billiard and ping pong balls; knife handles; jewellery and costume accessories; spectacles; toys; false teeth; sculpture e.g. by Naum Gabo; in mortars; also as support for film and still photography and from 1940s archival material

**Degradation:** internal cuboid crazing, becomes ‘sugary’ and cracks. Decomposition of the polymer releases nitrogen oxides, generating acidic wet bloom and ultimately breakdown

**Chordonet silk** see cellulose nitrate

**Clarifoil™** see cellulose acetate

**Corian™** see polymethyl methacrylate

**Crimplene™** see polyester

**Cycolac™** see acrylonitrile butadiene styrene

**Delrin™** see polyacetal

**Diatite™** see shellac

**Erinoid™** see casein
Ebonite see hard rubber

Estron™ see cellulose acetate

Fibreglas™ see glass-reinforced plastic

Florence compound see shellac

Formica™ see melamine formaldehyde and phenol formaldehyde

Galalith™ see casein

Gaydon™ see melamine formaldehyde

Glass reinforced plastic

- GRP, a composite material made of glass fibres and plastic
- usually polyester
- thermoset
- during World War 2; first used in civilian life in 1950s
- Fibreglas
- compression moulding or fabrication: hand-laying in an open mould
- low
- any
- translucent to opaque
- Rigid
- hard
- None
- very large containers, boat hulls, car panels, sculptures e.g. by Claus Oldenburg and Philip King
- Relatively stable

Gutta percha

- hard substance exuded from tropical tree that softens in hot water
- thermoplastic
- introduced from Far East in 1843; wide range of products shown at 1851 Great Exhibition, London; use falls off in 1930s
- compression moulding; extrusion
- low
- dark, but sometimes painted
- always opaque
- normally rigid
- old material is hard; modern gutta percha is often softer; dry-ish
- none
- can look woody
- golf balls; dentistry; insulation for submarine telephone cables; household uses similar to those of tin; fancy mouldings
- oxidises and embrittles, as a result mouldings are now scarce

Hard rubber see vulcanite

Horn

- thermoplastic
- in use in paleolithic era; moulding technology from early 17th century
- compression moulding; thermoforming
- medium
- natural horn colour, typically dyed black; also imitations of tortoiseshell
- translucent or opaque
- rigid but when thin flexes
Feel: sometimes textured
Smell: none
Other: fibrous texture sometimes visible
Typical uses: drinking vessels; buttons; combs; imitation jet jewellery; snuff boxes; cutlery handles; small translucent panels used e.g. in windows and lanterns
Degradation: stress cracks; some distortion and shrinkage but otherwise stable

Ivoride™ see cellulose nitrate
Kematal™ see polyacetal
Lacqrene™ see polystyrene
Lactoid™ see casein
LingaLonga™ see urea formaldehyde
Lucite™ see polymethyl methacrylate
Lyra™ see polyurethane
Makrolon™ see polycarbonate

Melamine formaldehyde
Group: thermoset
Developed: commercially, post World War II; heyday late 50s and early 60s; still in use for picnic ware and ashtrays
Trade names: Argosy; Gaydon; Melaware; Melmex
Manufacturing process: compression moulding
Cost: low
Colour: any, often two-toned
Transparency: always opaque
Rigidity: always rigid
Feel: hard
Smell: none
Other: porcelain-like; capable of high gloss
Typical uses: colourful table and picnic ware; ashtrays; a component of Formica™
Degradation: relatively stable but scratches and stains

Melaware™ see melamine formaldehyde
Melmex™ see melamine formaldehyde
Mouldrite™ see phenol formaldehyde
NatureWorks™ see polylactide
Nestorite™ see phenol formaldehyde
Nylon see polyamide
Oroglas™ see polymethyl methacrylate
Parkesine™ see cellulose nitrate
Peck™ see shellac
Perspex™ see polymethyl methacrylate
Plantic™ see polylactide
Plaskon™ see urea formaldehyde
Plastacele™ see cellulose acetate
Plexiglass™ see polymethyl methacrylate

Phenol formaldehyde
with wood flour or other filler as powder or pre-formed tablets and as liquid resin. Often called cast phenolic
Group: thermoset
Developed: with filler 1907: not widely used until after 1915; still used for electrical moulds and saucepan handles as liquid resin: 1927.
Trade names: with filler: Bakelite; Mouldrite; Nestorite; Roanoid as liquid resin: Bakelite; Catalin; Carvacraft
Manufacturing process: with filler: compression moulding as liquid resin: casting, often cut sections of rod, tube etc; often carved
Cost: medium
Colour: with filler: usually dark in colour: black, shades of green, red and brown, often mottled sometimes in wood effects As liquid resin: any, but frequently amber and green, seldom blue
Transparency: with filler: always opaque as resin: seldom transparent; often translucent and marbled; sometimes opaque
Rigidity: always rigid
Feel: hard
Smell: carbolic acid
Other: good electrical and heat resistance
Typical uses: with filler: domestic items: radio, clock and hair dryer casings, ash trays, boxes; electrical fittings; car components, aircraft and military components; cooker knobs; kettle handles; As liquid resin: napkin rings and bangles; desk accessories; wireless cabinets, especially American; jewellery; laminate surfacing, e.g. Formica™.
Degradation: with filler: relatively stable but colour darkened by exposure to light, green becoming brown, also goes dull As liquid resin: brittle but relatively stable; discours

Polyacetal also referred to as polyoxymethylene (POM) and polyformaldehyde
Group: thermoplastic
Developed: 1957
Trade names: Delrin; Kematal
Manufacturing process: extrusion; injection moulding
Cost: medium
Colour: naturally white, but any
Transparent: translucent to opaque
Rigidity: always rigid
Feel: hard
Smell: none
Other: strong; recognised as the first ‘engineering’ plastic
Typical uses: gear wheels and mechanisms; disposable lighters; bathroom taps; plectra and guitar picks
Degradation: Stable

Polyamide PA
Group: thermoplastic
Developed: 1933; nylon trade name given in 1938
Trade names: Nylon
Manufacturing process: extrusion; injection moulding
Polycarbonate
Group: thermoplastic
Developed: from 1958
Trade names: Makrolon
Manufacturing process: blow moulding; extrusion; injection moulding
Cost: medium
Colour: injection moulding
Transparency: transparent to opaque
Rigidity: rigid
Feel: hard
Smell: none
Other: can be outstandingly strong
Typical uses: safety and space helmets; compact discs and DVDs; as copolymer as mobile phone housings; car components; large bottles; glass substitute
Degradation: stable but can crack

Polyester
a category of polymer often used to describe its fibre form; a huge family of ‘plastics’; more limited, see also polyethylene terephthalate
Group: thermoplastic
Developed: 1941
Trade names: Crimplene, Dacron, Terylene
Manufacturing process: as a fibre: extrusion
Cost: low
Colour: any
Transparency: transparent to opaque
Rigidity: flexible
Feel: varies
Smell: none
Other: resilient, quick-drying, flammable
Typical uses: clothing and upholstery; also from 1955 in sheet form as support for archival material
Degradation: relatively stable

Polyethylene terephthalate
PET, a polyester
Group: thermoplastic
Developed: 1941 announced as a commercial polymer; widely used in blow-moulded form from 1980s
Trade names: related film Melinex and Mylar
Manufacturing process: especially blow moulding; injection moulding
Cost: medium
Colour: any
Transparency: transparent to opaque
Rigidity: rigid
Feel: varies
Smell: none
Other: strong
Typical uses: carbonated drinks bottles; video and audio tape
Degradation: relatively stable

**Polyformaldehyde** see polyacetal

**Poly(lactide)**
- PLA, made from corn starch
- Group: thermoplastic
- Developed: since 2000
- Trade names: NatureWorks; Plantic
- Manufacturing process: all
- Cost: medium
- Colour: any
- Transparency: transparent to opaque
- Rigidility: rigid to flexible
- Feel: varies
- Smell: none
- Other: made from renewable resources
- Typical uses: disposable plates and cutlery, trays in confectionary industry, but suitable for anything from toys to car parts
- Degradation: intended to biodegrade; crucial to keep it dry

**Polymethyl methacrylate**
- PMMA, often called acrylic
- Group: thermoplastic
- Developed: 1932, in commercial use from 1934, fashionable in 1960s
- Trade names: Oroglas, Perspex, Plexiglass, Lucite; Corian
- Manufacturing process: initially thermoforming from cast sheet and fabrication; now also casting; extrusion; injection moulding
- Cost: medium
- Colour: any
- Transparency: transparent to opaque; better optical properties than glass
- Rigidility: rigid
- Feel: hard
- Smell: none
- Other: takes a high gloss; dull sound when struck
- Typical uses: aircraft glazing; containers fabricated from sheet, e.g. handbags; blocks with embedded objects, jewellery, display stands, artists' paints
- Degradation: relatively stable; crazing resulting from stress; physical damage, especially scratches

**Polyoxymethylene** see polyacetal

**Polypropylene**
- PP
- Group: thermoplastic
- Developed: from 1956; increase in use from 1976 when initial patents ran out; became fashionable in translucent sheet form in 1990s; now one of the most used plastics
- Trade names: Propathene
- Manufacturing process: blow moulding; extrusion (as a fibre); injection moulding
- Cost: low
- Colour: any
- Transparency: translucent, but can have clarifying agents added making it transparent; also comes as clear film (modern cellophane)
- Rigidility: fairly rigid but flexible
- Feel: varies
- Smell: none
- Other: can be moulded to create an integral hinge; can achieve reasonably glossy surface scratches with fingernail
Typical uses: chair shells and garden furniture; luggage; car bumpers; petrol cans; food wrappings; microwaveable meal trays; margarine tubs; netting; household goods; carpets; packaging; rope

Degradation: relatively stable

**Polystyrene**

*Group: thermoplastic*

*Developed: became a usable material in 1930s but not used commercially until after World War II*

*Trade names: Lacqrene; Polystyrol; Styron*

*Manufacturing process: usually injection moulding; also extrusion; fabrication: especially cutting and sticking; foaming; thermoforming*

*Cost: very low*

*Colour: any, including streak and pearlised effects*

*Transparency: transparent to opaque*

*Smell: none*

*Rigidity: always rigid*

*Feel: hard, except when foamed*

*Other: can be brittle but can be toughened, e.g., high impact polystyrene (HIPS); metallic ring when tapped; good for bonding*

*Typical uses: disposable pens and razors; cutlery and vending cups; CD cases; yogurt pots; model kits; insulation and packaging food trays, hamburger and egg boxes, electronic equipment, when foamed*

*Degradation: crazing and discolours*

**Polystyrol** see polystyrene

**Polythene**

*PE, low and high density: LDPE and HDPE*

*Category: thermoplastic*

*Developed: 1933 low density but used for military purposes until 1945; 1953 high density*

*Trade names: Polythene; Alkathene; Tyvek*

*Manufacturing process: blow moulding; extrusion; injection moulding; rotational moulding*

*Cost: very low*

*Colour: any*

*Transparency: naturally translucent but can be opaque*

*Rigidity: semi-rigid to flexible depending on density*

*Feel: varies depending on density*

*Smell: wax*

*Other: scratches with fingernail; currently LDPE is the plastic with the highest volume of use*

*Typical uses: replaced enamelled kitchenware: bowls and other domestic wares, first squeezable bottles (e.g., for washing up liquid) and airtight food containers; road cones; ‘poppit’ beads; packaging film, e.g., carrier bags*

*Degradation: yellows, stiffens, and embrittles*

**Polyurethane**

*PU*

*Group: thermoset as foams; thermoplastic as fibres and surface coatings*

*Developed: from 1937; still widely used*

*Trade names: in adapted form: Lycra; Spandex*

*Manufacturing process: all*

*Cost: medium*

*Colour: any*

*Transparency: transparent to opaque*

*Rigidity: any*

*Feel: varies*

*Smell: none*

*Other: surface scratches with fingernail*

*Typical uses: furniture; paint; shoe soles; synthetic leather-like fabrics; bicycle seats; as foams, seating, large mouldings*
Degradation: discolouration followed by crumbling, the result of oxidation; foams deteriorate faster due to their greater surface area

**Polyvinyl chloride**  
*PVC*  
Group: thermoplastic  
Developed: known from 1870 but suitable plasticisers not discovered until 1933; wide use from 1940s, ongoing  
Trade names:  
Manufacturing process: all thermoplastic processes  
Cost: low  
Colour: any  
Transparency: transparent to opaque  
Rigidity: basically rigid but made soft with the use of plasticizers  
Feel: varies, can be sticky  
Smell: none  
Other: in flexible form scratches and indents with fingernail  
Typical uses: shiny leather-like fabric; fashion belts; flexible toys; inflatable furniture; cables e.g. computers and other electrical items; credit cards; blood bags; flooring; in unplasticised form: guttering, window frames, flooring; as co-polymer LP gramophone records from 1952  
Degradation: yellowing and darkening; migration of additives to the surface creating either a bloom or sticky surface, which may lead to embrittlement.

**Propathene™** see polypropylene

**Rayon** see cellulose acetate

**Roanoid™** see phenol formaldehyde

**Rubber** see vulcanite

**Scarab™** see urea formaldehyde

**Shellac**  
excretion of tropical beetle mixed with fillers such as cotton flock, powdered slate, wood flour  
Group: thermoplastic or set depending on heat used in manufacture  
Developed: known for thousand of years; used to make products from 1860s to 1940s  
Trade names: Diatite; Florence compound; Peck  
Manufacturing process: compression moulding  
Cost: medium  
Colour: dark brown, black and occasionally paler dull shades  
Transparency: always opaque  
Rigidity: rigid  
Feel: hard  
Smell: sealing wax  
Other: brittle; capable of reproducing very fine detail  
Typical uses: cases for daguerreotypes andambrotypes (early forms of photographs on glass); dressing table sets; 78 rpm records until 1948; as stiffening for bowler and riding hats; also used as lacquer  
Degradation: relatively stable

**Silastic™** see silicone

**Silicone**  
derived from sand  
Group: usually thermosets  
Developed: discovered in 1934; used commercially from 1942  
Trade names: Silastic  
Manufacturing process: injection moulding  
Cost: high  
Colour: any
Transparency: translucent to opaque
Rigidity: flexible
Feel: soft and bouncy
Smell: none
Other: water-repellent; can be subjected to high heat without damage; bouncy; feels sensuous; softer than fingernail
Typical uses: baking and ice trays; oven gloves; breast implants; baby teats; silly putty; micro-chips
Degradation: relatively stable

Spandex™ see polyurethane

Styron™ see polystyrene

Tenite™ see cellulose acetate

Terylene™ see polyester

Tyvek™ see polythene

Urea formaldehyde
Group: thermoset
Developed: patents taken out 1915 but only becomes practical for commercial use as thiourea urea formaldehyde in 1925; Improved to urea formaldehyde in 1929; role taken by other plastics by 1950s
Trade names: Beetle; Beatl; Bandalasta; LingaLonga; Plaskon; Scarab
Manufacturing process: compression moulding
Cost: medium
Colour: naturally white but any slightly muted or pastel colour; also speckled and marbled effects.
Transparency: opaque or translucent; never transparent
Rigidity: rigid
Feel: hard
Smell: usually none but occasionally a faint smell of urine
Other: brittle; less than a high gloss
Typical uses: domestic wares, picnic sets; jewellery; electric fittings and casings
Degradation: dulls, discolours, cracks; acquires an orange peel effect on the surface; badly affected by hot water; otherwise reasonably stable

Vulcanite also known as ebonite and in USA as hard rubber. It is made from chemically altered natural rubber. The process involves heat and sulphur
Group: thermoset
Developed: reaction when heated with a large percentage of sulphur to make it rigid discovered in 1839; still in use in 1930s
Trade names: 
Manufacturing process: compression moulding; fabrication; turning
Cost: medium
Colour: typically black (fades to brown) but can also be red
Transparency: always opaque
Rigidity: rigid
Feel: hard
Smell: sulphurous rubbery
Other: 
Typical uses: match boxes; combs; fountain pens; imitation jet jewellery; denture palates (with pigmentation to resemble gums); pipe stems
Degradation: often faded to a greyish greenish brown shade

Viscose see cellulose nitrate

Xylonite™ see cellulose nitrate