# A Brief History of Plastics used in Telephones and Radios in the 19th and 20th Centuries

**(J. Paskulich 2023)**

## Introduction

This writer does not claim significant expertise in this subject and this article is probably incomplete. Its focus is on plastics used in telephones, radios and related equipment into the second half of the 20th C.

Some other plastics not discussed here include:

- Polyethylene Terephthalate (PET or PETE or Polyester)
- High-Density Polyethylene (HDPE)
- Low-Density Polyethylene (LDPE)
- Polypropylene (PP)
- Modern bio-plastics

By the mid 20th C, plastics were hailed as a modern miracle but, in the 21st C, the issue of plastic pollution is a rising concern. This topic is outside the remit of this article and not pursued here.

In English, the term “plastic” (“plastick”) dates back to the 16th C but a modern definition of plastic is ***“a manufactured material that can be moulded into shape and then sets into a rigid or slightly elastic form.”***

There are two classes of plastics:
***Thermoplastic*** - once moulded into shape it will soften or melt with the application of heat and
***Thermosetting*** - once moulded into shape it will not soften or melt with heat. Note; all plastics will burn with sufficient application of heat.

Chemically, plastics are a type of polymer. Polymers are large molecules made up of long chains, or networks, of smaller molecules called monomers. Polymers can exist naturally or be created synthetically, as seen in the following discussion.

The following materials are listed in alphabetic, not chronological order. It is often difficult to establish clear timelines, as many plastics were developed within a couple of decades of each other and in concurrent use.

## 19th Century plastics

- Cellulose nitrate
- Gutta percha
- Hard Rubber
- Rubber (latex)

**Cellulose Nitrate**
Marketed as ***Celluloid, Parkesine or Xylonite*** it is a thermoplastic invented by Alexander Parkes in Britain in 1862. Treating cotton fibres (cellulose) with nitric acid, camphor etc. resulted in a fibrous mass that could be moulded into detailed shapes or rolled into sheets. Some manufacturers, including Ericsson, used this compound in the mouthpieces of their telephone transmitters etc. and it sometimes appeared as decorative elements in other early European phones. Many other domestic applications existed as well - including billiard balls, decorative containers, jewellery, children's dolls and movie film.

Cellulose nitrate has two severe drawbacks – It is highly flammable and it turned out to be chemically unstable. Over a few decades it may drastically decompose - an effect known as "Celluloid rot."

*Ericsson mouthpiece in tortoiseshell celluloid (image: https://telephonecollecting.org/Bobs%20phones/)*

**Gutta Percha**
A gum resin obtained from trees of the *Sapotaceae* family, found largely in S E Asia. It is a natural plastic that is pliable in hot water, but solid at normal temperature and also an excellent electrical insulator. From the mid 19$^{th}$ C it was widely used for domestic, medical and industrial purposes, particularly for submarine electric telegraph cable insulation and possibly in some early European phone parts. The demand was so high that it nearly led to the extinction of various gutta percha tree species. Today it is still used in dental procedures. Gutta percha shares similar chemistry to rubber.

**Hard Rubber**
Known as ***Hard Rubber*** in the USA and ***Ebonite*** or ***Vulcanite*** elsewhere, it was used in early telephone instruments and numerous domestic items. An offshoot of Goodyear's vulcanization (see Rubber), it is a hard brittle material formed from rubber, sulphur and linseed oil. It has limited strength but good electrical insulating properties and is also quite lightweight. This product can be polished and stained. It naturally tends to be dark brown-black but will slowly degrade over decades to light brown in colour. Some common uses of this material in telecommunications were terminal strips, plugs and sockets, mouthpieces, ear-caps, some Ericsson handset handles, Bell receiver ear-caps and Bell receiver shell covering.

*Telephone mouthpiece in Ebonite/Vulcanite (image: https://telephonecollecting.org/Bobs%20phones/)*

**Rubber (India rubber, latex etc.)**
Usually obtained from a tree sap, rubber is an elastic material mostly consisting of polymers of the organic compound isoprene. Originally sourced from equatorial regions in Africa, South America and SE Asia but in 2021, Thailand, Indonesia and Vietnam were the world's leading rubber producers.

Europeans first employed natural rubber in the late 1700s but it had limitations due to its instability with changes in temperature. This was solved with the introduction of the ***vulcanization*** process. Some controversy exists over the inventor of vulcanization. In the 1830s, American Nathaniel Hayward and German Friedrich Ludersdorf independently discovered that rubber treated with sulfur lost its stickiness. Thomas Hancock in Britain and Charles Goodyear in the USA both submitted patent applications for the vulcanization process (1843 and 1844 respectively). Goodyear's name is usually remembered because of its adoption as the title of the ***Goodyear Tire Company (USA)*** nearly 40 years after his death.

The ***vulcanization*** process involved heating rubber with sulphur to produce a stable product that was still elastic, strong, water and chemical resistant and a good electrical insulator - suitable for many applications. The electrical and telecommunications industries used rubber insulation extensively well into the second half of the 20$^{th}$ C. Degradation was slow and it usually had a long working life.

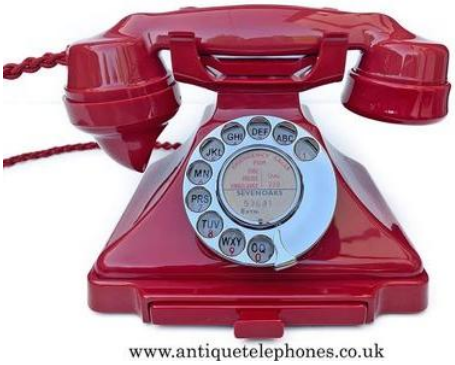
## 20$^{th}$ Century plastics

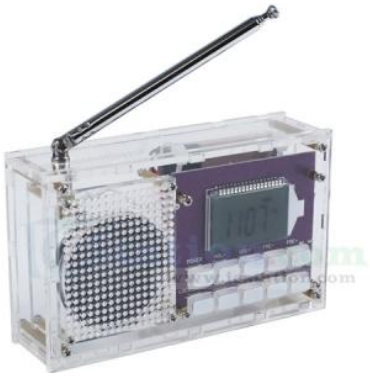
- Acrylics
- Acrylonitrile-butadiene-styrene (ABS)
- Alkyds
- Casein
- Catalin
- Cellulose acetate
- Melamine formaldehyde
- Nylon
- Phenol-formaldehyde (Bakelite etc.)
- Polycarbonate
- Polystyrene
- Polyvinyl Chloride (PVC).
- Urea-formaldehyde

**Acrylics**
Before World War 2, a transparent thermoplastic resin was developed by German chemist Dr Otto Rohm - ***polymethyl methacrylate -*** commonly called ***acrylic***. This compound was synthesised from coal gas, air and water. Introduced in Britain by ICI in 1934 and trademarked ***Diakon***, it was marketed by the Lucite Corporation. The British Post Office started using Diakon cased telephones in about 1938 and this product persisted in phones into the 1960s.

During WW2, Diakon gained another use; for aircraft cockpit canopies and gun turrets, under the trade name ***Perspex*** (ICI in Britain) or ***Plexiglas*** (in the U.S.A).

Diakon could be readily coloured with dyes or pigments and had a slightly translucent finish. It was considered an improvement over the contemporary urea-formaldehyde. It was also used to produce some of the first transparent display telephones in the 300 series that sometimes pop up in collections.

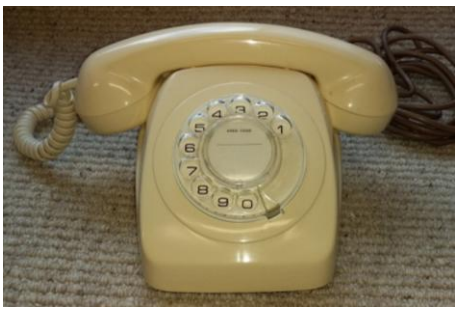


*L: 1938 acrylic (Diakon) telephone (image: https://www.pinterest.com.au/pin/811562795357771769/).*
*R: Modern radio in acrylic case (image: https://www.icstation.com/wireless-radio-receiver-clock-alarm-stereo-dual-channel-radio-with-acrylic-case-p-16153.html)*

**Acrylonitrile-butadiene-styrene (ABS)**
Patented in 1948, ABS is a relatively soft, scratch resistant and extremely tough thermoplastic. ABS is not a single plastic but a combination of three plastic materials, hence its name. It shares some characteristics with polystyrene mentioned elsewhere in this article.

Introduced into Australian telecommunications with the 800 series telephone in 1962, it became the material of choice for Australian corded telephones for the remainder of the 20th C. Cheap to manufacturer, durable and available in many colours, the 800 series phone helped fuel the dramatic expansion of Australian telephony from that time.



*1970s 800 series ABS telephone (image John Paskulich)*

**Alkyds**

Alkyds are polyesters i.e. polymers made by the esterification of a polybasic acid with a polyhydric alcohol (Glycerol, etc.). Alkyd (apparently a portmanteau of **alc**ohol and a**cid**), was patented by General Electric in 1914. Used extensively in paint products, the first moulded alkyd resins appeared around 1948. This thermosetting resin has been used to make car parts, electric switches, engine insulators, electronic components, telephone cases and television parts.

The Australian Post Office (PMG) used locally made ivory 300 and 400 model alkyd telephones from about 1954. Alkyd is very hard with good electrical properties and similar in appearance to urea formaldehyde.

**Bakelite**
See phenol-formaldehyde.

**Casein**
Trade names included ***Lactoid, Erinoid*** *and* ***Galalith***. Developed in Germany and France at the turn of the 20th century, casein plastics were made from the protein in cows' milk precipitated by the enzyme rennin and hardened in a solution of formalin. It is an attractive and hard thermosetting plastic ideally suited for many small domestic items such as buttons and jewellery. One source suggests that casein plastic parts appeared in some early telephones as well.

**Catalin**
Catalin is a brand name for the thermosetting phenol-formaldehyde resin trademarked by the American Catalin Corporation of New York City in 1927 upon the expiry of the Bakelite patents.

The Catalin Corporation managed to make its transparent PF product nearly colourless. Liquid resin was cast and cured with heat and then finished by hand. Catalin did not contain fillers, enabling it to be brightly coloured with various pigments. It was a labor-intensive process.

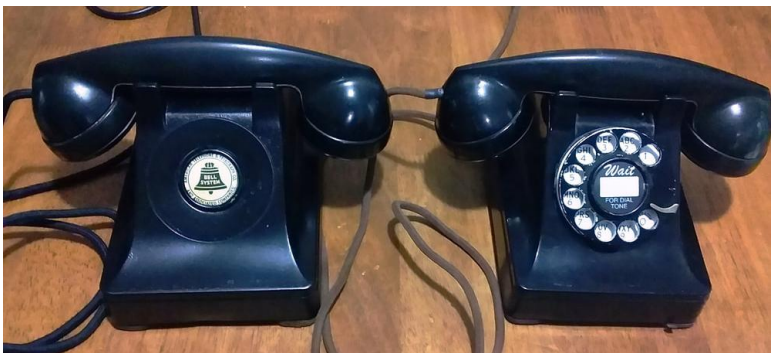
Catalin was used from the 1930s to 1950s to make coloured radio cases and also many household items such as jewellery, lamps and cutlery handles.

*Catalin radio (Image: htttp://www.thebakeliteradio.com/*

**Cellulose acetate**
Dating back to the 19th C, various compounds of cellulose acetate (CA) were synthesised from cellulose (wood or cotton fibres), acetic acids and a catalyst. A notable, early use was the "dope" used to stiffen fabric aircraft wings in WW1. Other uses included movie film and various fabrics.

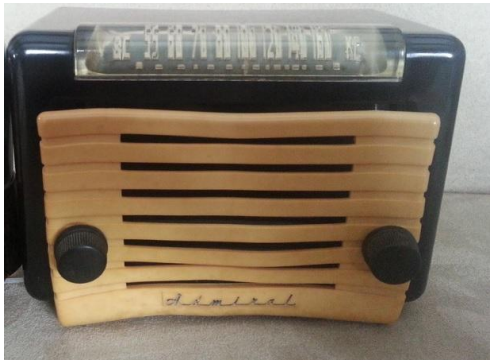
Later formulations produced a solid thermoplastic similar to cellulose nitrate (Celluloid). CA is not flammable like Celluloid but history has shown it also tends to degrade badly over time. Trade names include ***Tenite, Zylonite, Cellon*** and ***Rhodoid***.

Australian telephones were not made of CA but it did appear in British GPO 232 telephone cradles around 1938, replacing the earlier, more brittle Bakelite part. Versions of "Tenite" were used from around 1940 in many telephones in the U.S.A. In the Western Electric examples below, the RH phone case was "Tenite" and the identical LH one, zinc alloy. CA released valuable metal for the war effort.




*L-R: Zinc and "Tenite" US telephones (Image: J Paskulich)*

CA plastics appear in early radio cases and cabinets but articles available on social media generally only point out how badly the plastic degrades!




*Admiral 7T0EC Midget Bakelite Radio showing distorted Ivory Tenite Grill (image: https://www.flickr.com/photos/plasticradiomike/8911931442/)*

**Melamine formaldehyde**
Introduced post WW2, melamine formaldehyde (melamine or MF) is a hard, durable, and versatile thermosetting material. MF resins are similar to urea-formaldehyde (UF) resins but have better properties than UF, including improved moisture and heat resistance. Versions of MF are still common in building products today.

This writer cannot find any Australian examples of MF telephones but occasional comments appear in on-line forums about European MF phones.

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**Nylon**
Developed by DuPont in the USA in the 1930s, Nylon is the trade name of a family of synthetic polymers called "polyamides" commonly used to make a variety of different types of apparel and consumer goods. Unlike many other organic or semi-synthetic materials, nylon is entirely synthetic and based on petroleum products.

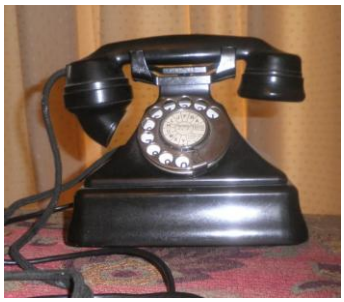
Known telecommunications applications of nylon include the protective sheath of underground cables and switch-hook and bell parts in some 800 series phones.

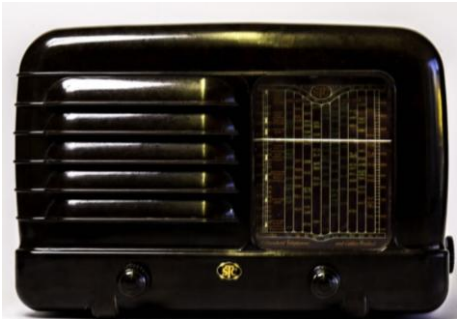
**Phenol-formaldehyde (Bakelite etc.)**
In the USA in 1909, Dr. Leo Baekeland patented a substance he had formed from two common chemicals used domestically - phenol and formaldehyde. When the chemicals were reacted and subjected to heat and pressure, a hard inert mass resulted. Baekeland later trade-named his product ***Bakelite*** (other trade-names exist) but Bakelite has been absorbed into the language as a generic word.

A thermosetting plastic usually called ***phenol-formaldehyde*** (PF), its official title is the unwieldy ***Polyoxybenzylmethyleneglycolanhydride.*** PF is often touted as the world's first, synthetic, plastic.

PF was/is used in electrical insulators, radio and telephone casings, and a diverse range of domestic and industrial products. It is usually dark brown or black, primarily because of fillers disguised with dark pigments. Contrary to popular belief, PF is not naturally opaque or dark coloured. In its basic form, it was usually amber coloured and almost transparent but also very brittle and required the fillers to improve its strength and shock resistance. Use of PF resin ***artificial amber*** for jewellery etc., may date back as early as 1910. "Catalin" (above) is a later development of PF that did not use fillers.

Virtually all black Australian table (and later wall) telephones manufactured between 1930 and 1960 were made of PF. Also, the brown or black radio cases popular from the mid 1930s through to about 1950 were of similar material.





*L-R: 1930s Bakelite Telephone (Image: J Paskulich). Bakelite radio (image https://www.brownbrosbins.com.au/antique-bakelite-radio/)*

***Cresol-formaldehyde*** is mentioned in an Australian Telecommunications Journal of 1938 but it seems to be a variant of PF and not discussed here.

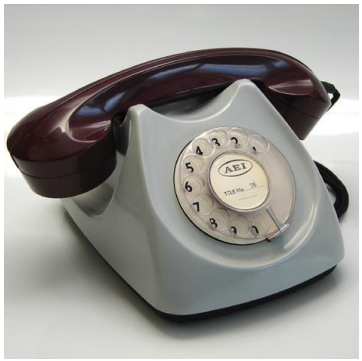
**Polycarbonate**

Polycarbonates (PC) are a group of synthetic thermoplastic polymers first commercialised in the mid-1950s. PCs used in engineering are strong, tough materials, and some grades are optically transparent. They are easily worked, moulded, and thermoformed.

There is no immediate evidence of extensive PC use in Australian (corded) telephones but they were used in American phone parts such as dial finger- plates etc.

**Polystyrene**

Polystyrene (PS) is a polymer made from the monomer styrene, a liquid hydrocarbon that is commercially manufactured from petroleum. At room temperature, PS is a solid thermoplastic but a “foamed” version is/was used in building insulation etc. First extracted in the late 1830s, PS was manufactured by the German company, IG Farben, by 1931. A 1952 Telecommunications Journal of Australia describes telephone transmitter and receiver parts made of PS. The British “Horseshoe Phone" of 1958 with its case and handset moulded in impact resisting polystyrene is another example. Its general feel and appearance is similar to the ABS plastics used in Australia from the 1960s.

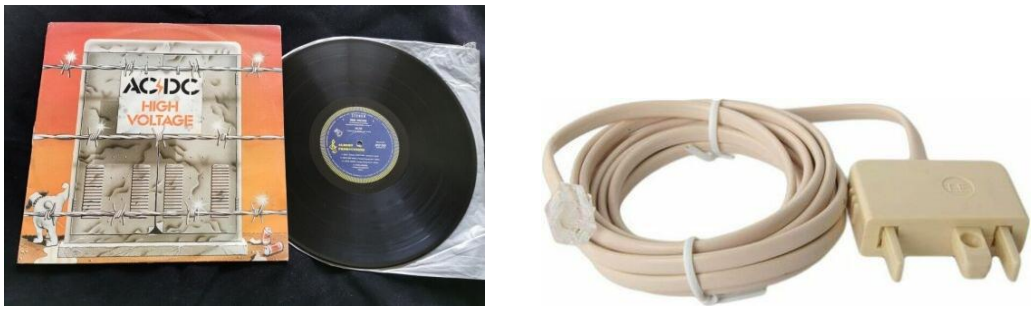


*“Horseshoe phone” (image https://www.britishtelephones.com/siemensb/cenneo.htm)*

**Polyvinyl Chloride (PVC)**
PVC is a thermoplastic material that is very cheap, easily worked and available in many different versions. It appears in two basic forms: Rigid and flexible depending on the additives used.

This material was used extensively for insulating phone cord conductors etc. since the late 1940s. Around the same time, PVC became popular in manufacturing gramophone records, hence their nickname “vinyl”.

Although first discovered in the early 19th C, it wasn’t until 1912 that Fritz Klatte, a German chemist working for Griesheim-Elektron, patented a way to produce ***vinyl chloride*** from acetylene, hydrogen chloride and the catalyst mercuric chloride. Vinyl chloride is a precursor to the manufacture of PVC - produced by polymerisation of the vinyl chloride monomer.




*L-R: PVC (Vinyl) record. Telephone cord (Images ebay.com.au)*

**Urea-formaldehyde**
The first urea-formaldehyde resin (UF) experiments occurred in the 1880s but patents for this thermosetting resin were only granted to German and British chemists in the early 1920s.

The properties of this material are very similar to phenol-formaldehyde, it is also a thermosetting plastic but because it is lighter in colour it can be pigmented to give any desired colour.

In 1925, British Industrial Plastics Ltd marketed its UF resin, trade-named ***Beetleware*** and used it in various domestic products.

With the introduction of the first British “162” Bakelite telephones from 1929, demand arose for coloured instruments. During the early 1930's, the coloured UF plastic phones were introduced.

Some technical issues arose with UF such as shrinkage/cracking and the red and green versions proved unsatisfactory in Australia, and elsewhere, due to fading in bright sunlight. It

was superseded by “Diakon” in the UK from WW2 but UF remained in use in manufacturing ivory telephones in Australia into the 1950s.

UF features in coloured radio cases from the 1930s and appears under trade names like ***Plaskon*** and ***Beetle.***

*Plaskon radio (image: https://radiospast.com/2017/11/plaskon- radios/)*

## References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