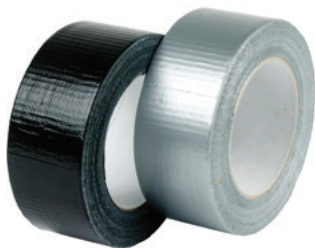


Pressure sensitive adhesive products generally have three components, facestock, adhesive, and liner. Typical exceptions to this would be pressure sensitive tapes, which only have two components: facestock and adhesive. This article will discuss the various materials used as pressure sensitive face stock. One would be **self-wound tape** (two components), the second is **sheets or rolls** of lined PSA media that are the base for graphics or other decorative uses (three components).

Just about any fabric, metal, foil, paper, plastic, or wood can be laminated to a pressure sensitive adhesive to produce a product with self-adhesive properties. Even a film like Teflon™, which has low surface energy and outstanding resistance to surface bonding, can be processed to allow a pressure sensitive adhesive to bond to one side. This will produce a type of pressure sensitive tape where the low surface energy and nonstick properties of Teflon™ are required. A typical use of a Teflon™ tape is on rails of a conveyor so the product keeps moving and does not slow down as it rubs on the rails that guide its movement. This is only one example of a pressure sensitive product and its application. Pressure sensitive adhesives have been formulated for use with all kinds of facestocks to meet many specific requirements.

FABRICS:

Various pressure sensitive cloths and fabrics are available for different applications. Pressure sensitive fabrics can be classified as woven and non-woven. A commonplace use of a pressure sensitive non-woven fabric would be automotive headliners. Woven fabrics are comparable to canvas material or any other cloth where the threads are woven on a loom to form a sheet or roll of cloth. A cloth can be made from natural threads such as wool, cotton, or synthetic polymers such as nylon & Dacron.



Pressure sensitive canvas can be used for various wall decorations such as an interior wall mural. Pressure sensitive velvet and felt are used in many hobby and craft applications to prevent marring of one object on another. Conductive nylon tape can be used to produce flexible switches, capacitive touch sensors and other textile components in a wearable electronics application. Standard “duct tape” is made using polyethylene coated cloth or scrim (PVC). An interesting fact is that standard “duct tape” is not approved for duct sealing because the cloth/resin substrate lacks the required strength and heat resistance for heat duct applications.

METALS AND FOILS

Aluminum and copper are the most common pressure sensitive metals commercially available. Other pressure sensitive metal tapes are stainless steel, nickel and carbon steel. Metals offer higher heat resistance than most other substrates, and therefore are used in applications where high temperature resistance is required.

When formulated with a silicone pressure sensitive adhesive, an aluminum foil based tape can be expected to withstand up to 600° F.



Heating, ventilation and air conditioning (HVAC) tapes are foil based, primarily aluminum, with a selection of pressure sensitive adhesives depending of the maximum temperature exposure. Pressure sensitive copper foil is used in labels, arts and crafts, EMI/ RFI shielding and other electronic applications.

PAPER:

Just about any type of paper can be turned into a pressure sensitive product; both self-wound tapes and media. Thinner papers are used to produce masking tapes and application tapes. Masking tapes come in a variety of colors ranging from natural brown to green, blue and yellow to help differentiate their usage.

Super calendered bleached paper stock and some glassine papers are used for prime label stock. These type of labels are applied to high volume consumer products using automatic application processes. Depending on the product or application these labels may need a topcoating or overlamine for protection. Tag stock and 8 pt. bleached paper are also used for product identification or in some cases point of purchase graphics.

In all of these cases the paper facestock and pressure sensitive adhesive has to be formulated to meet the requirements of its specific use. This gives an almost unlimited combination of paper facestock pressure sensitive adhesive products available to in the marketplace.



PLASTIC FILMS:

There are a vast array of plastic film and pressure sensitive adhesive combinations. Depending on use and requirements, a plastic film can be formulated with a variety of pressure sensitive adhesives. Some common commercially available products are listed below but not limited to this list.

Acrylic Poly (methyl methacrylate) Plexiglas®

Commonly known as plexiglass in thicker forms, acrylic film is available in lesser thicknesses, 2 mils typically. Acrylic is a clear brittle resin used as a pressure sensitive overlay film. Acrylic films have outstanding UV resistance.

Polycarbonate (PC) Lexan™

Polycarbonate is a strong lightweight clear thermoplastic polymer used to produce shatterproof windows, eyeglass lenses, electronic components, construction materials and clear film for graphics. Polycarbonate in 5 and 10 mil thicknesses makes excellent pressure sensitive overlamine that affords excellent abrasion resistance to the graphic.

Polyethylene (PE)

Polyethylene is the number one thermoplastic resin produced in the world. It belongs to the polyolefin group of plastics. It is the softest with the lowest heat resistance of the group. Polyethylene is commonly used in plastic bags, plastic containers, bottles and other packaging applications. Common densities of polyethylene are high-density (HDPE), medium density (MDPE), and low density (LDPE). As density decreases the resin becomes softer inducing higher flexibility and stretch to the resin. Generally, polyethylene is not clear enough for graphic use and has limited applications as a tape. Ultra-high-molecular-weight polyethylene has low surface energy and can compete with Teflon™ tapes.

Polyester Film (PET) polyethylene terephthalate Mylar®

Polyester film is widely available as a clear film in thicknesses from .5 to 7 mils. Polyester film has outstanding clarity, tear resistance, chemical resistance and is non-conductive. These physical properties suggest polyester film can be used in many applications such as electronics, magnetic media, imaging, industrial, packaging and graphics. For the graphics segment, polyester films are used in many applications. It can be used as a clear film or metalized to produce silver and gold appearing graphics. It is available in gloss and matte surface finishes. Polyester film can also be dyed. When laminated with a pressure sensitive adhesive polyester film can be used to produce clear labels, clear overlamine films, simulated metallic surfaces, synthetic mirrors, solar control films and electronic components.

Polypropylene (PP)

Polypropylene is a thermoplastic polymer that belongs to the polyolefins group. This group includes polyethylene discussed above. Polypropylene is harder, has more heat and chemical resistance than polyethylene.

The largest use of polypropylene film in a pressure sensitive product is in package sealing and strapping. For packaging and labeling applications biaxially oriented polypropylene (BOPP) is recommended for added strength and tear resistance.



At thinner thickness, less than 4 mils, BOPP has good clarity to produce optically clear prime labels. It is also compatible with many polypropylene/polyethylene consumer bottles and containers. For graphics BOPP usually has to be treated or primed before printing. Clear BOPP makes an excellent overlaminating film for interior short term applications. Pressure sensitive white BOPP is also available for graphics. Polypropylene will degrade at temperatures greater than 212° F and oxidation will occur with exterior exposure. Test thoroughly before producing exterior graphics with BOPP.

Polystyrene (PS)

Polystyrene is an aromatic hydrocarbon that has a relatively low melt point. General-purpose polystyrene is a clear, hard, and brittle resin that makes it ideal for thermo forming. It is used to make packaging products such as containers, lids, bottles, DVD cases and any other molded form. Being a brittle resin limits the use of polystyrene in producing pressure sensitive adhesive products. However, specific applications on interior flat applications can consider oriented polystyrene, (OPS), as an option to PET or PP. There are a couple of copolymers of styrene that can be considered for use with a pressure sensitive adhesive. High impact polystyrene (HIPS) and acrylonitrile butadiene styrene (ABS) are easily printable and offer good bond to the pressure sensitive adhesive. Still fairly rigid and should be used on flat surfaces only.

Polyvinyl Fluoride (PVF) Tedlar®

Clear 1 and 2 mil Tedlar® has excellent UV resistance and inertness to a wide variety of chemicals and solvents making it an ideal film for exterior applications requiring extended weathering resistance. Tedlar® film is laminated with a pressure sensitive adhesive to produce high quality overlaminating films. General Formulations has partnered with the DuPont, the makers of Tedlar®, to produce our GF GF 108 made with DuPont™ Tedlar® Clear PVF which has excellent outdoor durability and UV protection of the film and substrate up to 10 years.

Thermoplastic Polyurethane (TPU) Urethane

Urethane resins offer excellent elongation and tensile strength, elastic memory, low temperature flexibility with chemical and microbial resistance. The common varieties are aromatic and aliphatic with aliphatic offering higher optical clarity and UV resistance. Urethane resins are commonly found in industrial applications such as conveyor belts, fabric laminations and medical packaging. Thin film urethane films are offered in clear and white formulations for use with pressure sensitive adhesives. The most common use of pressure sensitive urethane films is in clear overlay applications that require exceptional strength, abrasion resistance and long-term UV resistance. Although urethane films have superior physical properties as compared to most pressure sensitive adhesive substrates the comparative cost of urethane films continues to limit its use as a pressure sensitive adhesive substrate.

Polyvinyl chloride (PVC) Vinyl

After polyethylene and polypropylene, polyvinyl chloride is the third most produced synthetic plastic polymer by volume per year. In raw form, vinyl resin is a white brittle solid with limited use in such applications such as pipe, doors and windows, plastic bottles and credit cards. Vinyl resin is very acceptable to formulation with plasticizers, pigments and other additives that induce flexibility and stability into the vinyl product. Flexible vinyl is used in residential plumbing, electrical cable insulation, flooring, signage, clothing, healthcare, inflatable products and thin films. Pressure sensitive adhesives are compatible with flexible vinyl films to produce self-adhesive products for a variety of applications.

Both self-wound tapes and digital media use flexible vinyl film as the substrate. Electrical tape is a common commercially available tape that uses flexible vinyl as the substrate. Digital media and sign vinyl use many different formulations of flexible vinyl depending on the ultimate application. Typical applications of flexible vinyl are labels, point of purchase, signs, automotive, marine and building wraps, overlaminating, fleet graphics and outdoor signage. When combining flexible vinyl with pressure sensitive adhesives, the possibilities are almost limitless. This is dependent on if the application requires long-term permanent, general purpose, high bond, short-term removal, long-term removal or repositionable adhesive properties.



Methods used to produce a flexible vinyl

Cast

Casting a flexible vinyl film is a method where all the ingredients for the film are mixed and heated into a liquid and poured onto a belt at a specific thickness, usually between 1 and 3 mils. The casting belt moves through various oven sections that evaporate any solvent and then fuse all the components together to form a continuous film of flexible vinyl film. The advantages of casting a vinyl film are that the film is relaxed with little residual shrinkage and has a very controlled thickness. The premium plasticizers help produce films that are durable and dimensionally stable with exceptional exterior exposure properties. With casting, small minimum quantities can also be manufactured which is beneficial when producing a variety of colors. The major detriment to casting flexible vinyl films is that throughput is slower and premium raw materials make unit costs higher than calendaring.

Calendered

Calendering of polyvinyl chloride (PVC) formulations is the most common method of producing vinyl films. This method uses temperature and pressure to create a vinyl film at a specific thickness (between 2.5 and 8 mils typically) and offers speed of production for economic advantages. Calendered flexible vinyl films are ideal for short-term and intermediate applications, lower unit cost, and are thicker in weight/thickness making the finished graphic easier to handle and apply. Calendered flexible vinyl pressure sensitive films are a good choice for flat or simple curved surfaces. The most recent formulations of calendered flexible vinyl films are approaching the quality cast films by reducing inherent film stretch and improving dimensionally stability offering improved heat resistance and less shrinkage for long-term graphics.



WOOD

The most common application of a pressure sensitive adhesive to a wooden substrate is in the production of pressure sensitive veneer. Various species of wood are thinly cut and laminated with a pressure sensitive adhesive and liner to produce a decorative wood finish. Pressure sensitive wood veneer is used to produce cabinets and furniture.

SUMMARY

Over the history of self-adhesive products, the choice of substrates has grown from simple paper to unlimited choices. Just about anything can be laminated with a pressure sensitive adhesive to meet any requirement. General Formulations offers flexible vinyl and polyester films to the graphics media market for many applications. If your application requires a unique substrate/pressure sensitive adhesive combination contact your General Formulations' sales representative to discuss these requirements. You may also contact your General Formulations Customer Service Representative at 800 253-3664 or on the website: www.generalformulations.com. Your customer service representative is available under Contact Us/Customer Service Team.

Acknowledgements

Plexiglas® is a registered trademark of Arkma.

Teflon™ is a registered trademark owned by Chemours.

Lexan™ is a registered trademark of SABIC.

Tedlar® is a registered trademark of E. I. du Pont de Nemours and Company.

Mylar® is a registered trademark owned by Dupont Teijin Films.