

The Miracle of Tape

Long ago the application range of tapes was limited. Based on natural rubber and rosin, the first pressure sensitive adhesives (PSAs) were designed for surgical use, electrical insulation and later for automotive (spray) painting. Today's world of tape is vast and inspiring. Consumer tape, masking tape, packaging tape, electrical tape, electronic tape, first aid bandages, diaper closure tabs—these are just a few of the broad range of commodity and specialty adhesive tapes used in today's industry and trade, DIY projects, office, household and personal care.

PSAs

PSAs differ in the adhesive base, the carrier material and construction. Adhesive tapes generally consist of a flexible carrier or backing with a layer of permanently tacky adhesive which at room temperature sticks to most substrates by contact under light pressure. With no need for activation by any energy source, PSAs adhere with no more than finger pressure and have the ability to sufficiently hold onto the adherend.

PSAs are permanently tacky and often aggressive. The carrier often executes the function of the tape, such as closing a box, protecting or decorating a surface, filling a gap or covering a wound. Providing the advantage of convenient use, these tapes offer design and production flexibility with the instant bond which shortens assembly time, and their structural strength can replace mechanical fasteners.

Technologies

PSA Technologies

Solvent-Based: Acrylate and modified acrylics, rubber and resin (synthetic and natural), and silicon. The solvent-based process achieves fluidisation by solvation and solidification by evaporation. Strong points: most versatile adhesive properties, full range of thickness.

Emulsion-Based: Acrylate and modified acrylics, and rubber and resin (synthetic and natural). The waterborne dispersions process achieves fluidisation by dispersion in water and solidification by evaporation and coagulation. Strong points: thin to medium thickness, high cohesion, applicable to solvent-sensitive films.

Hot Melt: Synthetic rubbers. The hot melt process achieves fluidisation by heating and solidification by cooling. Strong points: thin to very high thickness, high peel adhesion, high cohesion at ambient temperature, high speed.

UV-Cured: Acrylics and rubber. The reactive systems process achieves fluidisation through liquid components and solidification by curing (radiation-initiated reactions). Strong points: thin to very high thickness, high cohesion, good reversibility.

PSA Product Types

Rubber-Resin Adhesives: Adhesives based on natural or synthetic rubber, formulated with tackifying resins, oils, stabilisers and curing agents. Mainly used for packaging tapes, masking tapes and temporary surface protection, this is the most effective PSA.

Acrylic Adhesives: Adhesives based on an acrylic polymer mixed with a curing agent. These have better long-term ageing and environmental resistance than rubber.

Modified Acrylic Adhesives: Acrylic base polymer formulated with additional tackifying resins to obtain certain properties, such as high adhesion for bonding applications.

Silicon Adhesives: Adhesives similar to rubber-resin but that make use of silicon gum and silicon resins. They have high temperature resistance, good ageing conditions and stick to silicon surfaces.

PSA Product Families

Single-Coated Tapes (SC/T): Rigid film tapes, conformable film tapes, fibre-reinforced tapes, paper tapes, flat kraft paper backing, creped paper backing, textile tapes, foam backing, metal foils and electrical tapes.

Double-Coated Tapes (DC/T): Standard DC/Ts, transfer tapes, adhesive pads and strips, high-performance tapes.

Medical Tapes: First aid bandages, hospital tapes, orthopaedic tapes, transdermal systems, electrically conductive adhesives.

Transfer Tapes: Same as DC/Ts but without a carrier, practically glues on the roll. Photo mounts; joining and splicing plus fixing when thickness is one of the most important parameters.

Test Methods

Standard test methods are applied primarily for characterising PSAs and assuring product quality and consistency. Checking whether a tape is suitable for a specific application generally requires more specific tests. The following tests are typical for determining and comparing the quality of PSA tapes:

Peel Adhesion (ISO Certified)

Shear Adhesion (ISO Certified)

Breaking Strength and Elongation (ISO Certified)

Thickness

Dynamic Shear

Tack

Release Value

Unwind Force

Repulsion Resistance DC/T

Weight Added Peel Off Test (WAPO)

Raw Materials

Elastomers: Polydiene rubbers, styrenic block copolymers, acrylics, polyisobutylene and butyl rubber, ethylene-vinyl acetate copolymers (EVAc), and silicone elastomers.

Tackifier Resins: Hydrocarbon resins, rosin and rosin derivatives, and terpene resins.

Plasticizers: Generally liquid substances of low molecular mass that lower the glass transition temperature (T_g) of the adhesive. They often reduce peel adhesion at ambient temperature but increase low-temperature adhesion.

Fillers: Usually powdered, inorganic solids. They increase creep resistance and improve removability of the adhesives.

Stabilisers: In terms of stability, the polydiene elastomers are the most critical due to their main-chain double bonds. Stabilisation against UV can be achieved by UV absorbers such as derivatives of benzotriazoles and benzophenones, and by hindered amine light stabilisers (HALS) and hindered phenols.

Release Coatings: Enable the formulator to adjust the release force according to the application; for example, the unwinding force of tapes and the transfer of double-sided tapes to substrates. The three most common: release coatings based on long-chain alkyl groups, acrylic polymers with perfluorated alkyl groups, and silicones.

Coating Techniques

Coating is the process of bringing the adhesive onto a backing. The standard equipment used for solvent-based PSAs is the knife-over-roll-, roll-over-roll- and reverse-roll coater. For hot melts, roll coaters and die systems are used. Gravure coating is usually applied for very thin coatings with low viscosity adhesives. For high efficiency, coating is usually performed over a width of more than a meter. The tape rolls are obtained by cutting the web into strips with a width of a few millimetres up to several centimetres. The finishing techniques below are then applied.

Finishing Techniques (Cutting Systems)

Rewinding
Slit Rewinding
Cutting (knife or saw, lathe slitting)
In-Line Slitting
Bobbin-Winding
Packaging

Categories

Once thought of as mere commodities, tapes have evolved in design so that their functionalities meet today's cutting edge technologies, creating more products and market segments than have ever been thought imaginable. Depending on the purpose of use, a wide range of requirements must be met concerning product properties such as adhesive strength, resistance against temperature, mechanical rigidity and tensile strength, shear adhesion and others. Because of these many product requirements, a wide variety of different product groups exists on the market today.

The type of tape developed and produced in factories today depends on the demands of the converter and end-user, including the adhesive type desired, the PSA product construction, end-user environmental considerations, processing and cost targets.

Surface Protection (SPV)

Surface Protection tapes are used for temporary protection of surfaces against physical and chemical impact during fabrication, assembly, transportation or storage. They can be peeled off cleanly from the finished product without leaving residual adhesive. Also chosen for environmental reasons, they are often recyclable. SPVs are used in conjunction with metal processing, communication equipment, flat panel displays, automotive components, furniture, solar panels, window profiles and white goods.

Paint and Spray Masking

Masking tapes protect surfaces against paint and enable sharp paint edges to be made. Whether your application needs are for temperature-resistant, fine-line, or general purpose and painters' grade tapes, different masking tapes are available for each segment.

Packaging and Transportation

Various packaging tapes are available to cover a wide variety of packaging and transportation demands. Applications range from carton-sealing to bundling of heavy goods and securing pallets. Specialities include convenience opening tapes and security tape.

Electrical Insulation

Tapes are offered with different carriers and adhesives to meet various demands of reliable electrical insulation. Included are tapes for wire harness bundling, holding and identification.

Thermal Insulation and Noise Reduction

For thermal insulation and vibration and noise reduction, a wide range of tapes, mainly with foam backing material, is available for employment in industry and the home.

Binding, Reinforcing and Marking

There are many general-purpose as well as specialty tapes for the binding and reinforcing of documents and other material. Products for marking include marking tapes for electrical wires as well as aisle-marking and pavement-marking products.

Splicing of Web Material

Single- and double-coated splicing tapes are used primarily in the paper, foil, film and textile manufacturing and converting industries in order to enable continuous processes of web material. Splicing tapes are also used for core starting and roll end-tapping.

HVAC-Sealing

For constructing, maintaining and repairing applications in heating-, ventilation- and air-conditioning systems, tapes with different backing materials are used. They serve for holding, sealing seams and as moisture and vapour barriers.

Medical Application

Specialty tapes for the health care equipment industry are applied, for instance, on surgical containers, monitoring electrodes and other medical devices.

Bonding and Fastening

Single-coated tapes, double-coated tapes and transfer tapes with different backing materials and adhesives offer reliable and cost-effective solutions for a huge variety of permanent bonding and temporary mounting applications. They increase manufacturing efficiency by replacing traditional bonding and fastening materials. Focus markets for these tapes include automotive, consumer electronics, paper and printing, and flat panel display.

Electronic

A wide range of PSAs is used for special applications in the manufacturing and assembly of electronic components. Tapes are used for the bandoliering of electronic components, masking connectors on printed circuit boards and many other applications.

Safety and Reflective

Included in this category are reflective materials for vehicle markings, traffic control signs and other applications as well as printed warning tapes and tapes providing anti-slip surfaces.

Consumer and Office

This category provides a wide range of tapes for the home and office, from multi-purpose consumer tapes for gift wrapping, attaching, mending and decorating, to DIY specialty tapes for home improvement and office tapes for holding, sealing and organising.

Diaper Closure

These are PSA systems for manufacturers of disposable infant diapers and adult incontinent products.

Applications

Hundreds of varieties of PSAs are used in practically every industry:

Aircraft/Aerospace

Tapes are used in the aircraft/aerospace industry as cargo liner tape, window masks, carpet mounting tape, moisture barrier tape and composite bonding flashbraker tape.

Automotive

Tapes are used in the automotive industry for attaching parts onto the outer surfaces of car bodies, protecting against abrasion, caulking openings, insulating slabs, wrapping cable harness, masking during varnishing and supporting functions during assembly.

Tapes provide a variety of functions specifically in the automotive interior. Here general, cloth, non-woven, water-proof and other PVC tapes are used. Sealing materials, double-coated tapes, surface protection tapes (SPVs) and electrical insulation tapes are used in the dash alone, while in the engine compartment sealing materials, double-coated tapes, soft tapes and electrical insulation tapes are used in the HVAC unit and gaskets. PVC tapes used in the engine room include flame retardant tapes, heat resistant tapes, general tapes and cloth tapes.

Tapes are also used on the door sill and outer tread plates. In terms of the automotive exterior, tapes are used in conjunction with the licence plate panel, roof moulding, outer belt mouldings, rocker panel/claddings, emblem and name plate, rear spoilers, body and bumper side mouldings, side mirror and side fenders/wheel flares. Barcode labels are integrated in the production of tyres as tyre labels.

Construction Industry

Foamed plastic adhesive tapes are used for sealing windows, caulking construction splices and expansion joints, and adhesives are used to affix carpeting. PVC tapes are used for general purpose applications where a soft, conformable and flexible carrier is requested, such as PE pipe protection and fixation of foils during asbestos removal. Heavy web tape is made for use in conjunction with linoleum flooring, abrasive papers and metal coil splicing.

Consumer Electronics – Mobil Phone

Tapes are used in the manufacture of many consumer electronics devices, specifically mobile phones. Tapes provide a variety of functions in lens protection (window and camera), precision coating and mounting, dust sealing (LCD and speakers), heavy duty mounting, gasket fixation, mesh fixation and in the venting membrane.

DIY

In this application segment, packaging tapes, masking tapes, duct tapes and a variety of double-coated tapes are used.

Electrical Equipment

Tapes are used for electrical and electronics applications, such as to hold down protective insulating wrap and to band stick wound coils to maintain coil tightness and turn packaging. One-mil polyester film tapes are used in small bobbin wound coils to tab down winding finish, insulate and hold connections and outer protective wrap, and to bundle lead wires. PTFE tapes are used in electrical insulation in the oil industry.

Flat Panel Display – LCD Module

Tapes are used in the manufacture of LCD modules, both in the interior and exterior. In addition to adherence, DC/T and cushion material (DC/T + foam) provide light shielding, reflection, a thick carrier, re-workability and an easily-convertible working material. On the exterior of the LCD panel, tape bonds the silicon rubber spacer and the urethane rubber spacer.

Furniture

Transfer and foam tapes are most commonly used for fixing trims, as decorative elements and for the temporary fixing of wood panels during assembly. Transfer adhesive tapes are also used for affixing mirrors.

Medical

Medical tapes and adhesive plasters are just a few of the PSAs which are used in the medical industry. Everyday they are used in hospitals to cover wounds and during surgeries of all kinds—for fixing cover shields, for cleaning purposes in antiseptic room entrances, etc. One of the most popularly-used medical applications is the fixing of electrodes for the electrocardiogram

examination. Medical tapes are also used as dispensers for patch tests, carriers for cutaneous transfer drugs and for fixing ostomy bags and transdermal systems.

Packaging

Adhesive labels and adhesive tapes are specially designed for optimal packaging. Packaging tapes for industrial use include the application of tear-strips to open packages and boxes.

Paper Industry

In the production of paper, tapes serve to provide continuity in the running of the paper machine, coater, calender and sheeter and during rewinding and in-feed. Tape performs the integral tasks of splicing, reel closing and core start.

Printing Industry

Mounting tapes are a very important factor in any stereo mounting process and can be critical when trying to obtain the best print results. In this area, increasingly sophisticated technologies are demanding very special and diversified foam tapes. Double-coated tapes for fixing printing masks on printing machines is a key tape end-use in this application segment. Tapes are also used for joining, splicing and lithographic masking.

Tape is a ‘Multi-Functional Sheet’

The technologies, categories and applications of tapes today demonstrate that the tape industry has evolved from producing tape as commodities to producing highly diversified, technical and specialised products which touch every part of our everyday lives, from our households to the most industrialised workplaces. As the consumer continues to demand higher-quality and more efficient products, and tape producers invest increasingly in R&D and specialised product lines, the next generation of tapes will know no limits in its qualities and properties.

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