

# Little compendium of pressure-sensitive adhesive bonding and decision guide

1. Decision guide
2. Surface pre-treatment
3. Surface energy
4. Resistance to weathering
5. Temperature influence
6. Initial and final adhesion
7. Summary
8. Instructions for use of  
pressure-sensitive  
adhesive tapes

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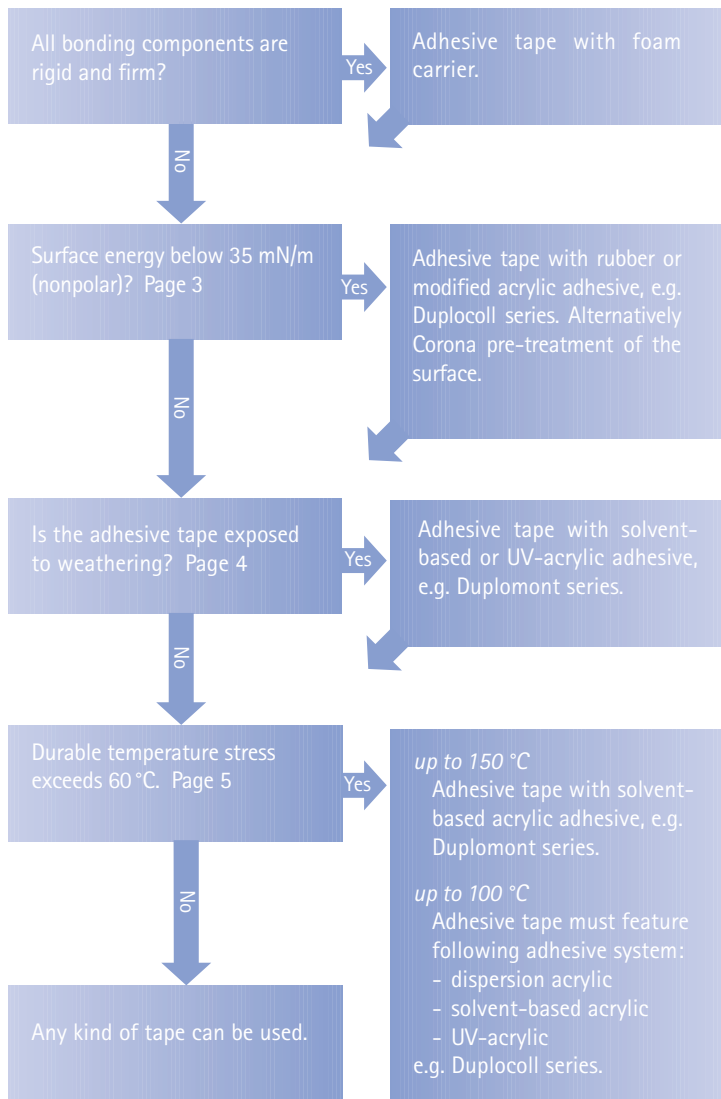
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# 1. Decision Guide



## 2. Surface pre-treatment

One important parameter for efficient bonding is the best possible preparation of the bonding surfaces in order to reach high adhesive strengths.

There are generally two cleaning methods, the chemical and the mechanical one or a combination of both.

The surfaces to be bonded must be dry and free from dust, oil, separating agents and other contaminations.

Loose paints or protective coatings have to be removed.



For cleaning the surfaces only use a clean cloth in combination with material-compatible solvents like benzene, alcohol, ester or ketones.

Change the cloth regularly when necessary.

Cleaning agents:	Isopropanol
	Cleaning benzene
	Ethylacetate
	Heptane
	Acetone or methylethylketone

All solvents must evaporate without leaving residues before bonding. Prior to bonding we recommend testing of the solvent resistance of the material to be bonded.

All the above mentioned cleaning agents are inflammable!

Evaporatable solvents must not exceed the allowable working place concentration (MAK = maximum allowable working place concentration).

# 3. Surface energy

Each material features its individual surface energy. With high surface energies you may achieve high adhesive strengths. If the surface energy is low, bonding will be difficult.

Rubber and hotmelt adhesives are general purpose adhesives, they bond to all smooth materials that feature a surface energy above 30 mN/m but they are not resistant to weathering, temperatures and aging.

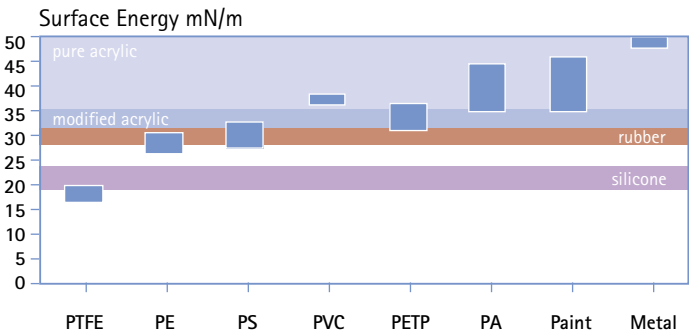
With modified acrylics bonding is only achieved at a minimum surface energy of 32 mN/m. They show better stabilities than rubber based adhesives.

Polar pure acrylics need surfaces with a minimum surface energy of 35 mN/m. They are resistant to weathering and aging and reach temperature stabilities of 150 °C up to 200 °C.

Prior to bonding on low-energy surfaces with weathering resistant pure acrylic adhesives the surfaces need to be pre-treated. Traditional Corona pre-treatment will clean the surface and enhance the surface energy to achieve quick bonding with more polar pure acrylics.

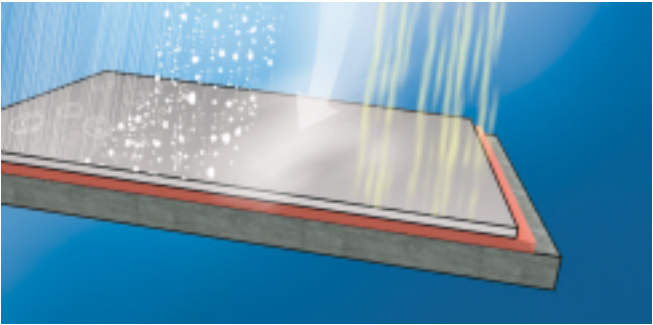
In practice the surface energy is measured by help of special inks. If the surface energy is low the ink will bead up.

Materials with			
low surface energy		high surface energy	
EPDM	Ethylene-propylene-terpolymer	ABS	Acryl nitril butadiene-styrene
EVA	Ethylene-vinylacetate	BS	Butadiene styrene
FPM	Fluorelastomer	CA	Cellulose acetate
HDPE	High-density polyethylene	CFK	Carbon fibre reinforced rubber
LDPE	Low-density polyethylene	EP	Epoxide
NBK	Nitril rubber	PA	Polyamide
NK	Natural rubber	PC	Polycarbonate
PE	Polyethylene	PMMA	Polymethylmetacrylate
PETP	Polyethylene theraphthalate	PUR	Polyurethane
PO	Polyolefines	PVC	Polyvinylchloride
PP	Polypropylene	SBR	Styrene butadiene rubber
PS	Polystyrene		
PTFE	Polyterafluorethylene		
SI	Silicone		



## 4. Resistance to weathering

For outdoor applications further aggravating parameters like UV-radiation, humidity, warm and cold temperatures and other environmental influences are to be respected. For these applications we recommend pure acrylic pressure-sensitive adhesives. They are resistant to aging and weathering.



### Chemical influences

Many applications require adhesive tapes and adhesives that are resistant to chemical influences, e.g. solvents, oils, acids, bases or plasticizers. This is also a task for pure acrylic pressure-sensitive adhesives.

### Aging

Pressure-sensitive adhesives with strongly modified adhesive masses feature a different aging behaviour which is very much depending on environmental influences. In order to also cover worst-case situations following storage stabilities apply:

Pure acrylics	2 years
Modified acrylics	1 year
Dispersion acrylics	1 year
Water-soluble adhesive	1/2 year
Rubber adhesive	
Natural rubber	1/2 year
Synthetic rubber	1 year
Silicone adhesive	1 year

# 5. Temperature influence

The temperature resistance is strongly depending on type, amount and time of stress during the application.

We differ between short-term (seconds up to minutes) and permanent (hours up to years) stress.

## Low temperatures lead to

Hard, brittle adhesive

Enhanced static shear strength

Reduced initial adhesion

Increased storage stability



## High temperatures lead to

Softened adhesive

Reduced shear strength

Enhanced initial adhesion

Reduced storage stability



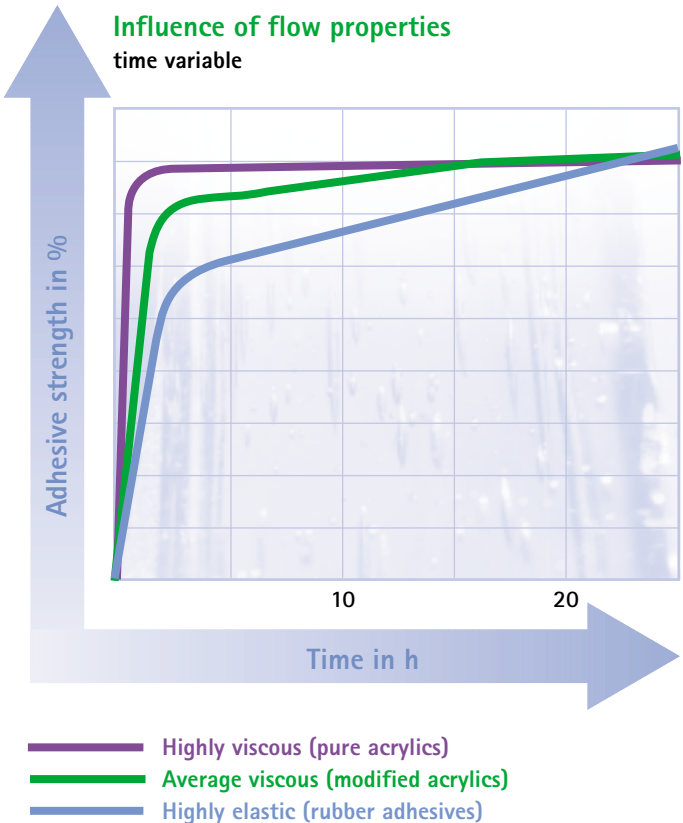
## Permanent temperature stress:

- up to 60 °C All adhesive systems
- up to 100 °C Dispersion acrylics, solvent-based acrylics and UV-acrylics
- up to 150 °C Pure acrylics

## 6. Initial and final adhesion

Soft-type adhesives generally feature an enhanced initial adhesion in comparison to hard-type ("dry") adhesives. For bonds that require a high final adhesion the use of hard adhesives is advisable.

In the case of hard adhesives full adhesive strength is only reached after a holding time of about 2 days.



# 7. Summary

## Adhesive hierarchy

	Tack (initial adhesion)	Aging	Fluid solvents	Temperature	Surface Energy
Silicones					
Pure acrylics					
Modified acrylics					
Solvent-based acrylics					
UV-acrylics					
Dispersion acrylics					
Synthetic rubbers					
Natural rubbers					
Rubber hotmelts					

## 8. Instructions for use of pressure-sensitive adhesive tapes

Application temperature	The most favourable temperature for using pressure-sensitive adhesive tapes is in the range of +18 °C to +35 °C. If bonding is carried out at low temperatures, the initial strength of the bond will be reduced.
Surfaces	The surfaces of the materials to be bonded must be dry and clean. Condensation of moisture on surfaces to be bonded (e. g. when carrying cold objects into a warmer room) must be avoided. The materials to be bonded must be free from dust, grease, oil and separating agents. Loose paint or protective coatings must be removed or stabilized.
Cleaning	For cleaning the surfaces only use a clean cloth and a solvent that is compatible with the materials, e. g. benzines, alcohol, esters or ketones.
High contact pressure promotes all-over contact	Contact pressure (approx. 10-15 N/cm <sup>2</sup> ) is applied manually with a roller or surface press. Hard-type ("dry") adhesive tapes require greater contact pressure than soft tapes. Full adhesive strength is only reached in the case of hard adhesives after at least 24 hours.
Avoid any unnecessary loads	Bonds must be made in such a way that no lever action (cleavage stress) can arise. Any shearing or tensile stress must be able to spread across the entire adhesive surface. Continuous peeling stresses impair the permanent elasticity of the bond (e. g. plates to be applied to curved surfaces must first be suitably preformed). Avoid stresses at the ends of the materials to be bonded.
Surface finish	Goods bonds are achieved on smooth surfaces: rough surfaces require thicker adhesive tape. The following are examples of problem-free bonding materials: metals, high-energy plastics (e.g. ABS, polycarbonate, rigid PVC), smooth wood, stone and glass. Plastics containing plasticizers require special attention. The plasticizer can cause changes in the adhesive layer with the result that the strength of the bond is impaired. Double sided pressure-sensitive adhesive tapes are available for most applications, but, in the case of problematic surfaces (such as polyethylene, polypropylene, plastics containing lubricants, powder coatings and rubber), appropriate testing should be carried out beforehand.
Storage	Pressure-sensitive adhesive tapes should be stored at room temperature and normal humidity (50 - 70 %).