

Processing Instructions

Adhesive Bonding

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1. Definition

1.1 General information

The word "adhesive" is defined in DIN 16 920 as a "non-metallic material which can connect parts to be joined by surface adhesion (adhesion) and internal strength (cohesion)".

Other standards and guidelines are:

- DVS 2204 — Glueing thermoplastics
- VDI 3821 — Glueing plastics

As a physical-chemical process, adhesive bonding, like welding, provides permanent joining methods. The type of the materials to be joined, the type of load, and the economy are decisive factors when choosing the most practical method of joining. Chemical and weather resistance must also be taken into account, particularly where there is a direct load through aggressive media. In these cases, welding is to be used wherever possible.

1.2 Types of adhesive

Contact adhesives (adhesion methods)

The active components of these adhesives are based on types of synthetic rubber (neoprene, chloroprene, etc.). The adhesion mechanism operates as follows:

The adhesive is lightly applied to the 2 parts to be joined together, and after a sufficient flash-time has elapsed the 2 pieces are pressed together briefly but firmly. The pressure determines the strength of the joint. Once the 2 parts have made contact, it is not possible to alter the joint.

Solvent adhesives (mainly diffusion adhesive processes)

This type of adhesive joins parts mainly by diffusing and evaporating the solvent. Solvent adhesives mainly consist of the corresponding thermoplastics and suitable solvents. It is sufficient for the adhesive to be applied to only one part. When the 2 parts have been joined, medium pressure is applied for bonding in order to avoid displacing the adhesive.

Glue

Glue is a water soluble adhesive with a vegetable, animal or synthetic base. The bonding stability is only achieved if at least one of the parts is able to absorb the water from the glue joint during the glueing process.

2-Component adhesives

They are produced with or without reaction accelerator based on polyester or epoxy resin, polyurethane or isocyanate. Light oxygen or increased temperature can also be used as the second component (also referred to as a one component reaction adhesive, e. g. the so-called second adhesives). Such adhesives are usable within the shelf life.

Melt adhesives

Melt adhesives are mainly thermoplastics. For bonding they are melted open and set by cooling. The adhesive melts open again when re-heated.

2. Bonding mechanisms

The bonding of adhesives is based either on physical processes or chemical reactions.

Physical processes:

- Evaporation of solvents (in the case of solvent adhesives and contact adhesives)
- Extraction of water (in the case of glues)
- Setting of a melt (in the case of melt adhesives)

Chemical reactions:

- Polymerisation (in the case of polyester resins, PMMA)
- Polyaddition (in the case of epoxy resins, polyurethanes)
- Polycondensation (in the case of phenol, urea, and formaldehyde resins)

2.1 Adhesion bonding

The effectiveness of an adhesive and the strength of the bond depend on the boundary surface forces of the 2 parts joined (adhesion), combined with the internal strength of the adhesive (cohesion). Neither solvents nor adhesive components interact with the plastics. Crack formation should not be expected. This method is used to join plastics to different types of materials and also to join solvent resistant plastics.

2.2 Diffusion adhesion

With diffusion adhesion, the solvent molecules migrate into the plastic and cause molecular movements through swelling and dissolving. This leads to weld type joints. By changing the molecular structure, the mechanical properties can change, possibly accompanied by the formation of cracks. The adhesion zone or the part joined can only be exposed to mechanical stresses after the solvent has been completely evaporated from it.

3. Pre-treatment

The surfaces to be joined can be pre-treated as follows:

Cleaning and de-greasing

It is recommended that oily and greasy residue is removed from the parts to be joined. Improved wetting with the adhesive is then achieved. Good results can be obtained by using methylated spirits (if necessary, observe the additional advice of the adhesive manufacturers).

Mechanical processes

Sand blasting, sanding and brushing causes an increase in the surface area and an increase in the strength of the adhesive.

Heat methods

Burning the surface with a gas flame in conjunction with atmospheric oxygen is one method which is very suitable for PE-HE (anoxidation of the surface).

Chemical methods

The adhesive properties of the polyolefine surfaces can be improved for adhesives by surface etching with chromium sulphuric acid or by using primers.

Electrical pre-treatment

A corona discharge (by means of high voltage or high frequency currents) also has a favourable effect on the polyolefine surface for adhesion).

4. Joining SIMONA plastics

4.1 SIMONA® rigid PVC

Rigid PVC can be joined to rigid PVC by diffusion adhesion, using solvent adhesive. The parts should first be cleaned using special cleaners or methylene chloride.

Examples:

- Tangit (Henkel, Düsseldorf)
The adhesive is PVC based with tetrahydrofurane as a solvent. This is particularly suitable for PVC socket welding systems. According to the manufacturer's instructions, this adhesive must not be used for glued joints in pipes which are used for the following acids:

Sulphuric acid	above 70 %
Hydrochloric acid	above 25 %
Nitric acid	above 20 %
Hydrofluoric acid	of any concentration
- Dytex (Henkel, Düsseldorf)
Its base is postchlorinated PVC, dissolved in methylene chloride (unter certain conditions it is also suitable for bonding PVC with other materials, like for example wood and concrete). However, for bonding rigid PVC with other materials 2 component systems or contact adhesives should basically be used).
- Cosmofen PLUS white (Weiss, Haiger)
This solvent adhesive is white coloured. It can particularly be recommended as adhesive for PVC-SIMOCEL-AS white and PVC-COPLAST-AS white and as edge sealing.

4.2 SIMONA® PE and SIMONA® PP

Without backing on the reverse side these 2 groups of materials are difficult to join. To join them to each other, or to other materials, a thorough preparation is necessary by roughening the surface by thermal, chemical or electrical pre-treatment.

Example: SIMONA® Longlife special adhesive is a contact adhesive which produces a very good bond between a roughened cutting pad and a wooden block.

Far better results are obtained with surface backing on one side onto which stretch fabric is pressed into the plastic (SIMONA® PP-DWU-SK). Composite structures are of particular importance combining the high chemical and thermal load capacity of the thermoplastic with the strength of the composite. This proves more economic. The main areas are laboratory construction, tank construction and linings.

For this reason the following range of 2 component adhesives is offered:

- PUR-forming adhesives, e. g. Ibola R 101 with hardener 7 from H. B. Fuller GmbH, Munich
- Epoxy resin adhesive, e. g. Araldit from CIBA-Geigy, Wehr/Baden or metal adhesive R 50 with hardener BX from Weve-Chemie, Ostfildern-Kemnat
- Polyester resins, e. g. the Palatal systems from BASF, Ludwigshafen

4.3 SIMONA® PVDF

Without backing: Foraflon adhesive is suitable for bonding PVDF to PVDF, available from SIMONA AG. PVDF adhesives contain dimethyl formamide and dimethyl acetamide. Reaction temperature above 140 °C.

With backing: The same systems can be used as indicated for SIMONA® PP. If high temperatures occur (approximately 90 — 120 °C), epoxy resins should be used.

The information here has been deliberately kept general. In any case, the information and instructions given by the adhesive manufacturer must be observed.


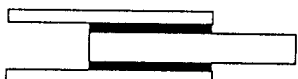






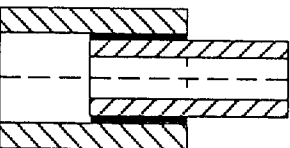
The adhesives mentioned have been tested by us. There are lots of manufacturers and products. Further addresses can be obtained from us.

5. Safety measures

Adhesives containing solvents, solvents and thinners, cleaning and de-greasing agents are dangerous substances where risks of fire and explosion exist, and they may also be harmful to health. In addition to observing the MAK-values, the following protective measures are recommended:

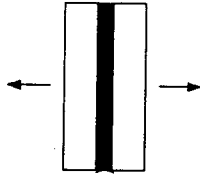
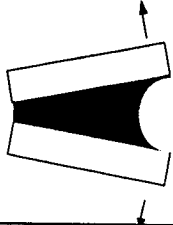

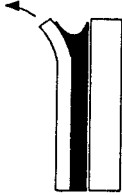
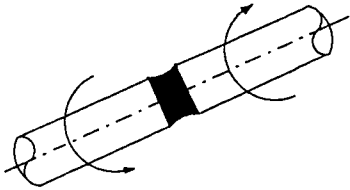
- Ventilation of the work areas
- Extraction of the solvent vapours
- Use of protection masks, eye protectors, protective gloves, protection suit
- No smoking or eating

6. Designing joints

	<p>Simple overlapping preferred for thin wall thicknesses. Advantage: Easy to perform good strength.</p>
	<p>Double overlaps give very strong connections at low cost. Aim for wall thickness ratios of 1:2:1 for economic reasons.</p>
	<p>The simple double buttstrap joint is used to achieve a smooth surface. Frequently used.</p>
	<p>The double overlapped butt joint gives a high degree of strength. Its disadvantage is that neither side has a smooth surface.</p>
	<p>The spliced joint achieves a useful degree of strength but only with larger wall thicknesses.</p>
	<p>In the case of the stepped overlap, only an adequate seam strength is achieved at high preparation costs.</p>
	<p>The straight flush double strap joint is very labour-intensive if the seam is to be prepared properly.</p>
	<p>The butt joint is hardly able to transfer any forces with a small joint. Only suitable for special cases.</p>
	<p>In the case of parts exposed to torsion (pipe connections), large joints are loaded uniformly. High strengths can be achieved.</p>

7. The main types of load affecting bonded joints

Bonded joints are to be designed so that, if possible, the whole bonding area is used. In any case, when designing the joint a tensile, shear or torsion load is preferred, which means that cracking and peeling forces have to be reduced to a minimum. The surfaces to be bonded should always be as big as possible to ensure an optimal transfer of forces.

	<p><u>Influence of tensile loads</u> The entire surface to be joined is loaded uniformly.</p> <p>Recommended joint</p>
	<p><u>Influence of cracking forces</u> The surface to be joined is exposed to uneven loads, one part being greatly loaded, the other one is not loaded.</p> <p>Not recommended</p>
	<p><u>Influence of shearing forces</u> Uniform loading of the surfaces to be joined.</p> <p>Recommended joint</p>
	<p><u>Influence of peeling forces</u> Uneven loading of the surfaces to be joined.</p> <p>Not recommended</p>
	<p><u>Influence of torsional forces</u> Uniform loading of the surface to be joined.</p> <p>Recommended joint</p>

8. Advice

Our Export Department and our Technical Application Department are long-experienced in the application and in the processing of thermoplastic semi-finished products. We look forward to assisting you.