Description

Process schematic

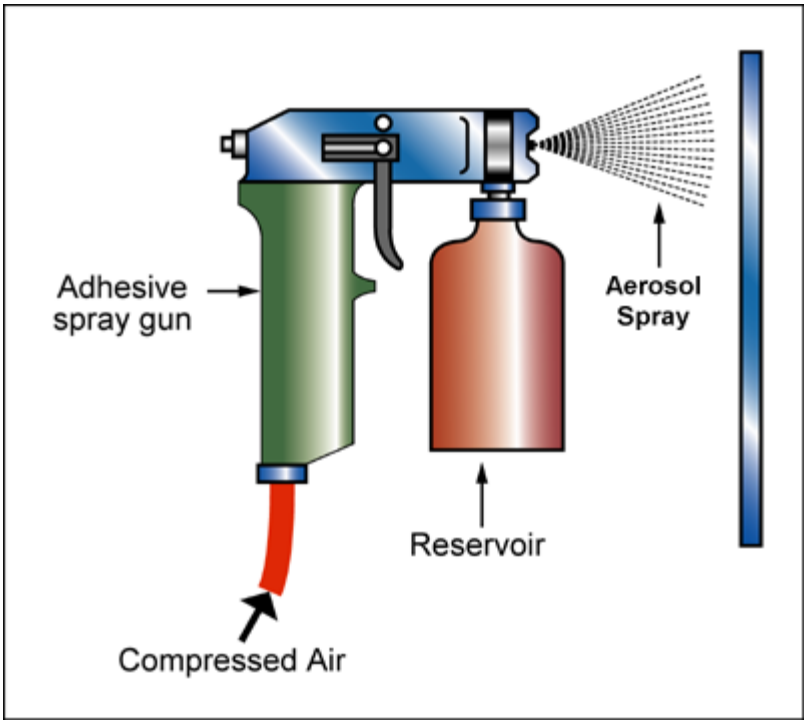

Figure caption

Adhesives are applied by spraying or with a dispenser

The process

Structural adhesives are those that are used to perform some mechanical function, though they may have a secondary role as a sealant. Many are rigid, giving a stiff bond (see the record for Rigid Adhesives); but flexible adhesives also play an important role in design. They are classified by their chemical composition.

Flexible adhesives are typified by polyurethanes include and isocyanate-based adhesives, with lap shear strengths of about 8 MPa. They bond well to a wide range of materials, are tough and flexible, have good resistance to water and solvents, and perform well from -50 °C to 80 °C.

Silicones (SIL) are synthetic polymers in which silicon replaces carbon as the major chain element. Most are two-part systems, their chemistry gives them exceptional flexibility and chemical stability. They are flexible, have useful properties from -115°C- 260 °C, good resistance to water and UV and IR radiation.

Material compatibility

Ceramics	✓
Composites	✓
Glasses	✓
Natural materials	✓
Polymers - thermoplastics	✓
Polymers - thermosets	✓

Function compatibility

Electrically conductive	✗

Thermally conductive	✗
Watertight/airtight	✓
Demountable	✓

Joint geometry compatibility

Lap	✓
Sleeve	✓
Scarf	✓

Load compatibility

Compression	✓
Shear	✓
Bending	✓
Torsion	✓

Economic compatibility

Relative tooling cost	low
Relative equipment cost	low
Labor intensity	low

Physical and quality attributes

Range of section thickness	0.394	-	394	mil
Unequal thicknesses	✓			
Processing temperature	50	-	158	°F

Process characteristics

Discrete	✓
Continuous	✓

Supporting information

Design guidelines

Adhesives have a number of features that allow great design freedom: almost any material or combination of materials can be adhesively bonded; they can be of very different thickness (thin foils can be bonded to massive sections); the processing temperatures are low, seldom exceeding 70°C; the flexibility of some adhesives tolerates differential thermal expansion on either side of the joint; adhesive joints are usually lighter than the equivalent mechanical fasteners; and adhesives can give joints that are impermeable to water and air. The main disadvantages are the limited service temperatures (most adhesives are unstable above 100 °C; silicones, exceptionally, are usable up to 260 °C), the uncertain long-term stability and the unpleasant solvents that some contain. CHOICE OF FLEXIBLE ADHESIVE Metals: Anaerobic. Cyanoacrylate, Polyurethane, Silicone, Woods: Polyvinylacetate Polymers: Cyanoacrylate, Polyurethane, Polyvinylacetate Elastomers: Cyanoacrylate, Silicone, Polyurethane Ceramics: Cyanoacrylate, Polyurethane, Polyvinylacetate Fiber-Composites: Cyanoacrylate, Polyimide, Polyvinylacetate, Silicone Textiles: Polyurethane, Polyvinylacetate, Polyurethane

Technical notes

Adhesive joints resist shear, tension and compression better than tear or peel - these last two should be avoided. Typical lap shear strengths of flexible adhesives are in the range 8 - 15 MPa. For joints loaded in shear, width (normal to the direction of shear) is more important than length (parallel to the shear direction). Butt joints are practical only when the area is large. Thin bond lines (typically 25 microns) are best, except when high impact strength is required. The essential equipment for adhesive bonding includes hot glue-guns and caulking-guns, both of which are used to apply adhesives essentially in a paste or semi-liquid form. Spray guns are used to apply liquid adhesives and can be automated. Brushes and sprays are used for manual application.

Typical uses

Flexible adhesives are widely used in the aerospace, automotive, construction, furniture and footwear industries, in packaging, and in the refrigeration industry (due to their excellent properties at low temperatures).

The economics

Adhesives offer low-cost assembly methods.

The environment

Good ventilation is essential wherever adhesives are

Links

MaterialUniverse

Reference