Bonding Difficult-to-Bond Surfaces with High Performance Tapes

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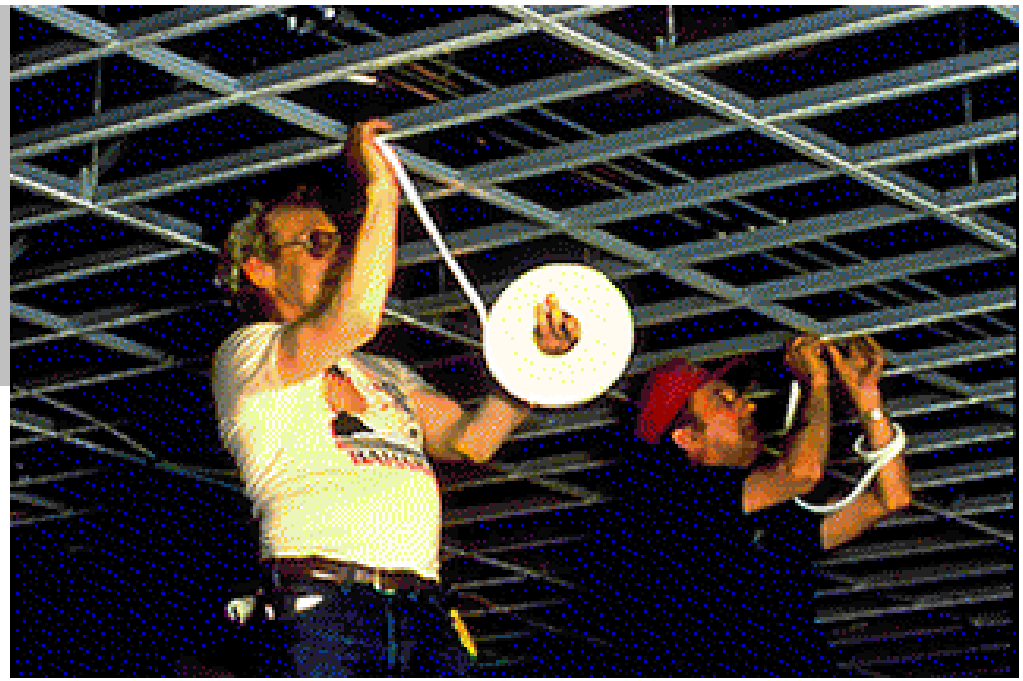
3M IATD Bonding Business



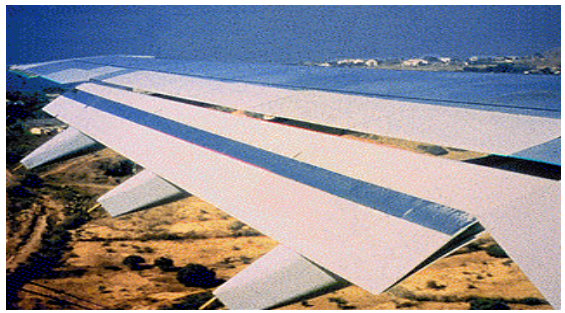
Bonding Difficult to Bond to Surfaces with High Performance Tapes

- What are High Performance Bonding Tapes?
- Adhesion
- Surfaces
- Surface Modification
- Stresses and Design Tips

High Performance Bonding Tapes

Convenience of Tape,
Strength to replace mechanical fasteners

Truck Bodies



Airbus A-300 Scuff Strip

Architectural Metal

Traffic and Commercial Signs

What Makes High Performance Bonding Tapes Unique?

- Acrylic Foam Technology
- Viscoelasticity

ENERGY ABSORPTION

Absorb and dissipate energy by the acrylic foam core

➔ The foam provides the strength!

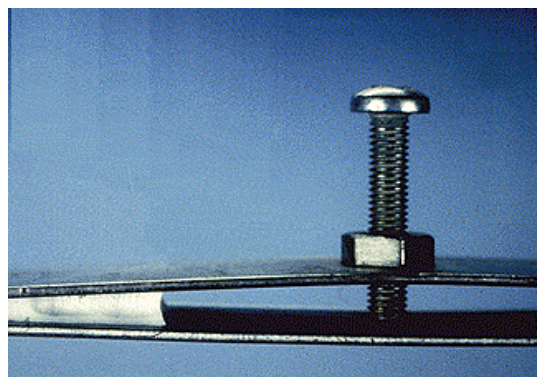
STRESS RELAXATION

Reduce long term stress in bond line by dispersing into the acrylic foam

➔ The foam protects the bond!

- Durability

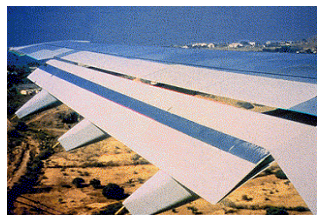
All-acrylic construction
100% Closed Cell



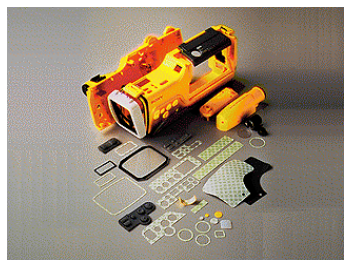
Features, Advantages Benefits of using High Performance Bonding Tapes

- Improved appearance
- Productivity

- Proven durability
- Bonds dissimilar materials



- Vibration & fatigue resistant
- Uniform stress distribution

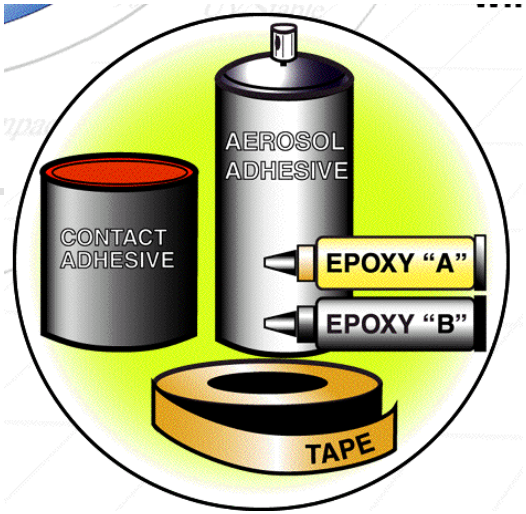


- Seals and bonds

- Weight reduction

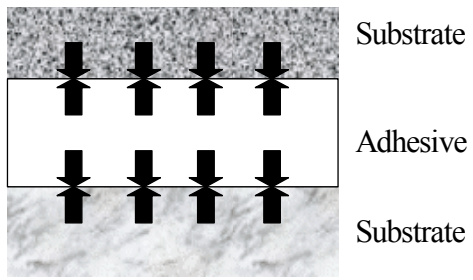
- Allows unique designs

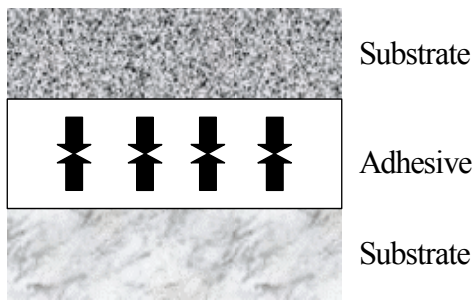
Adhesives and Adhesion



An **adhesive** is a substance is capable of holding materials together by surface attachment.

- **Adhesion** – force between dissimilar materials.
- **Cohesion** - internal strength of the adhesive.





Note: With High Performance Bonding Tapes the **cohesion** is built into the tape. Achieving surface **adhesion** is **critical** to achieving total strength.

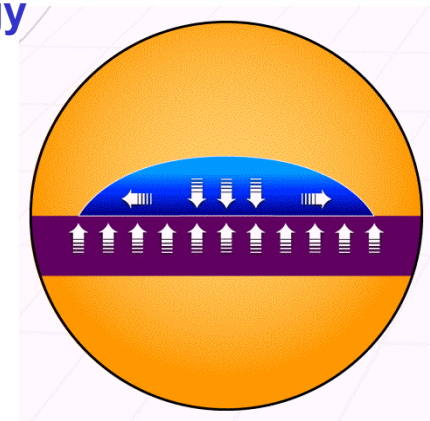
Surfaces

- Surface Energy
- Glossy Surfaces
- Surface Roughness
- Weak Boundary Layers

Surface Energy

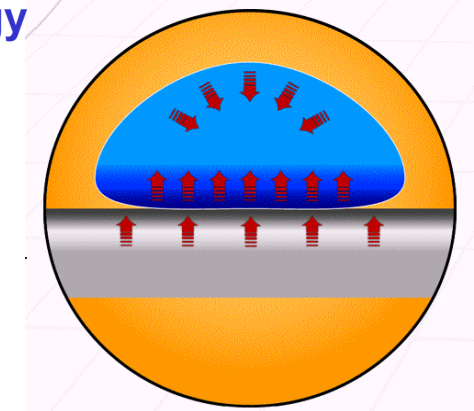
High Surface Energy

Metals
Polyimide
Polyester
Acrylic
Rigid Polyurethane
ABS
Polycarbonate
PVC (rigid)



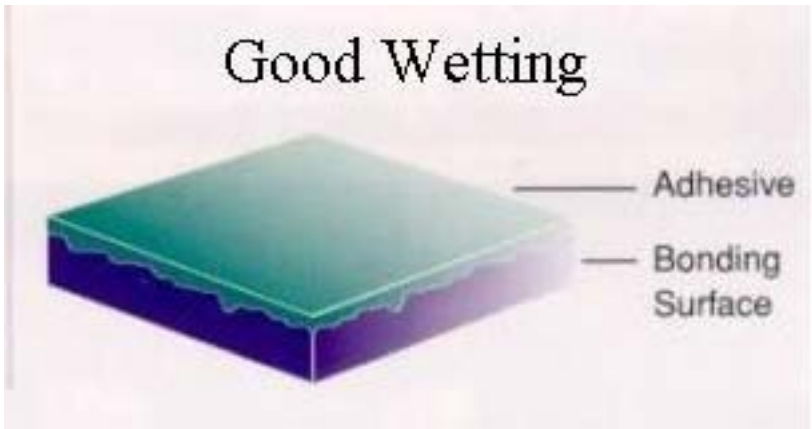
Low Surface Energy

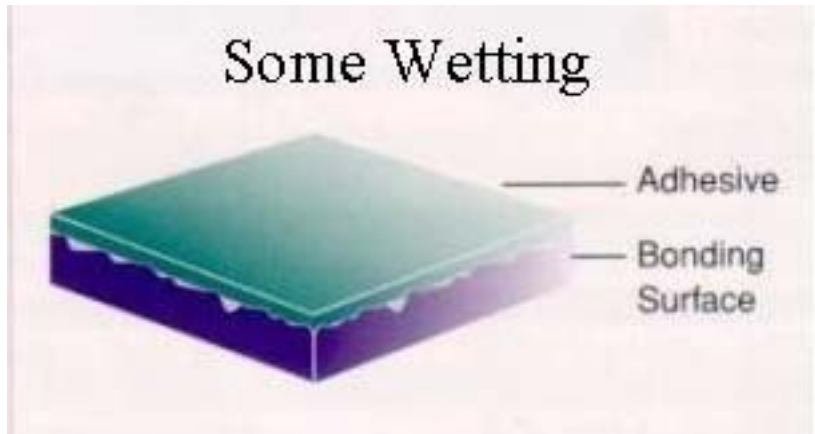
Polystyrene
Acetal
EVA
Polyurethane elastomer
Polyethylene
Polypropylene
PVF
PTFE
EPDM (Prime)

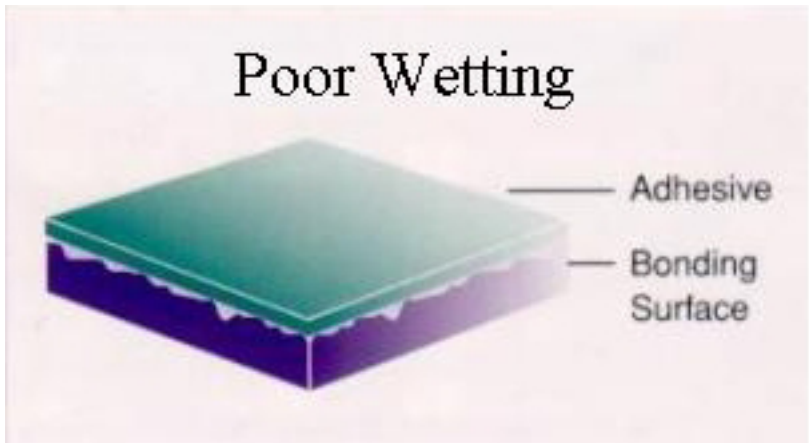


- Affects how the adhesive wets out the surface
- Most common for adhesion to be directly dependent on surface energy
- Important: Use the right tape for the surfaces involved.

Adhesive Wetting



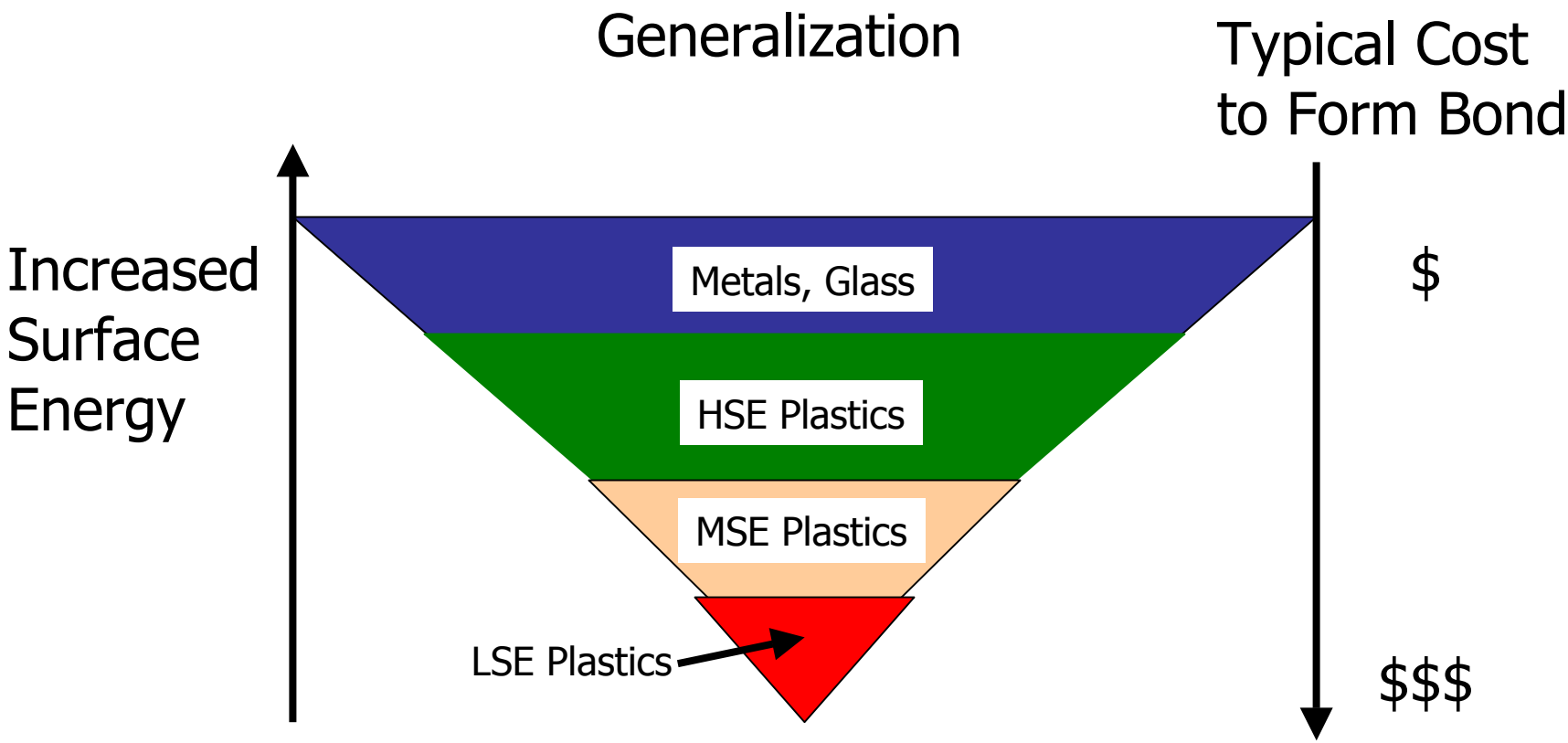




Surface Energy Of Substrates

- VHSE Substrates (>200 dynes/cm)
  - Metals, Glass
- HSE Plastics (> 37 dynes/cm)
  - Kapton, Nylon, polyester, epoxy paint, ABS, polycarbonate, rigid PVC, acrylic
- MSE Plastics (31-36 dynes/cm)
  - PVA, polystyrene
- LSE Plastics (< 31 dynes/cm)
  - Polyethylene, polypropylene, Teflon

Surface Energy



Rough Surfaces

- Abrade to make smoother
- Use thicker bondline (also good for varying bond gaps)
- Use softer tape (ie. foam tape vs solid adhesive) or lower viscosity adhesives.
- Avoid air entrapment in the bond line

Glossy Surfaces

- Glossy is good for wetting if adhesive is lower surface energy than substrate
- Light abrasion to increase contact area
- Surface energy is largest factor

Weak Boundary Layers

- Chemical additives that bloom to the surface
  - Clean with solvent
  - Abrade off the surface/clean
- Surface oxidation (e.g. rust)
  - Abrade off the surface/clean

Surface Modification - CAP

- Cleaning
- Abrading
- Priming

Cleaning

- Make sure surface is clean from dirt and oils.
- Clean with a solvent or grease cutter.

Abrading

- Usually a light abrasion works well.
- Creates more surface area.
- Creates higher surface energy.

Priming

- Primer application
  - Primer classes
  - Application methods
  - Pre-abrasion helps

Other Surface Modification

- Flame Treatment
- Flame treatment with primer

  *be careful, this can be dangerous

Tactics for Low Surface Energy Materials

- Cleaning
- Abrasion
- Priming/Surface modification
- Novel adhesive chemistry

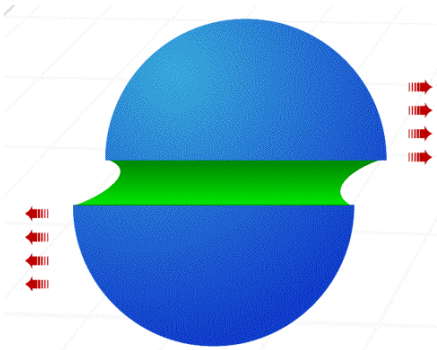
Novel Adhesive Chemistry

- Acrylic Adhesives designed to “bite into” polyolefins - acrylates

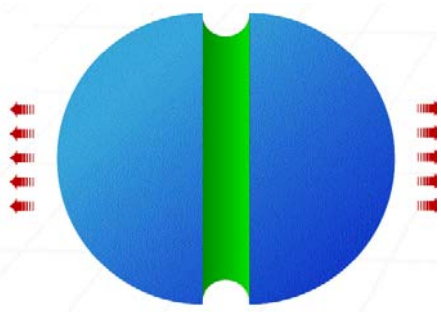
Bond Joint Design

- No matter your tactic, good bond design is the foundation to a strong joint
- Examples of bond stresses:

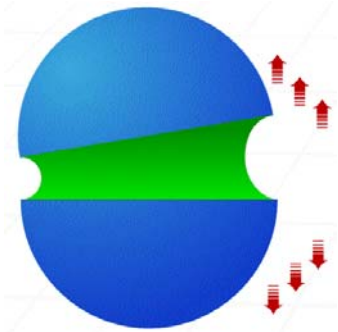
Stress Modes that can act against a Bonded Joint



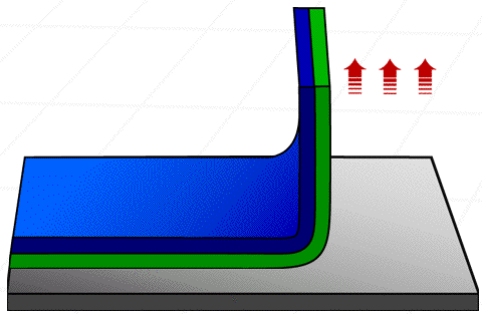
Shear



Tensile



Cleavage



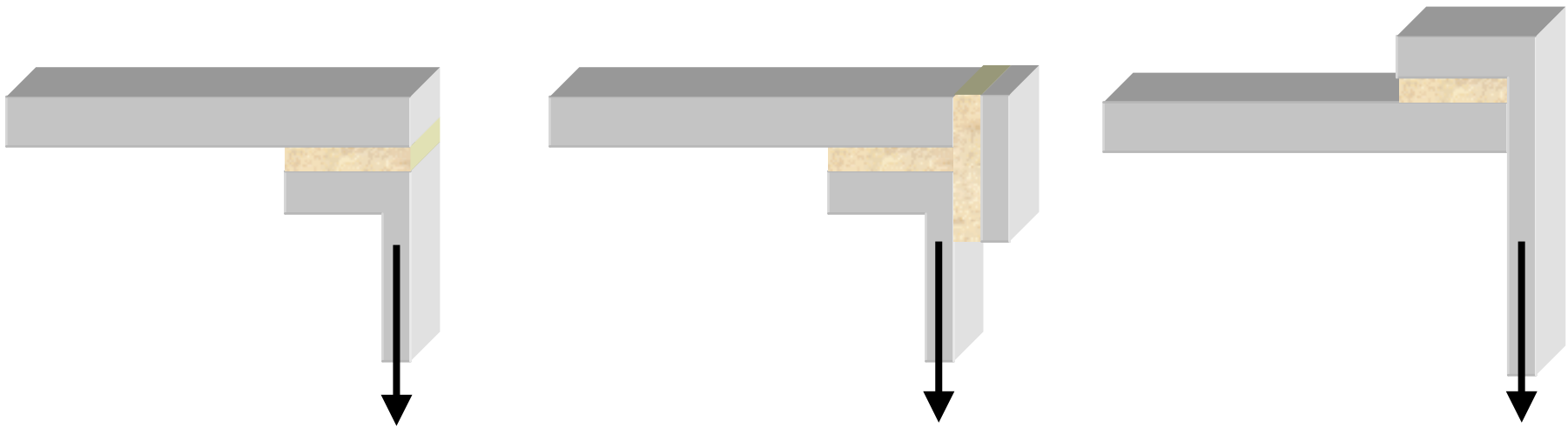
Peel

- **Better for Design**
- **More problems for Design**

Joint Design

- Designing the joint to minimize peel or cleavage stresses on the bond line and maximize tensile, shear or compressive stresses is desirable

Improving joint design to accommodate applied stress



Summary

- A good joint design and use of bonding methods for LSE materials increases productivity, design flexibility and can eliminate need for mechanical fastening.
- When in doubt, use the C. A. P. methods.