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acrylic foam tape

Acrylic Foam Tape Enhances Edge & Junction Box Seals in Solar Panel Manufacturing

High-strength, acrylic foam tape can impact productivity and efficiency in edge sealing, frame bonding, and junction box mounting.

The solar manufacturing market is always working toward grid parity. With grid parity, the cost of generating a kilowatt of energy from solar will be equal to the cost of generating a kilowatt of energy from fossil fuels. With fossil fuels at approximately $0.04/kWh and solar averaging around $0.50/kWh, there's still considerable ground to be made up.

Solar manufacturers are always looking at ways to make solar technology more efficient while reducing manufacturing costs and increasing the working life of solar panels. Implementing automation and reducing materials costs are critical goals. A key part of the process is selecting materials that can meet manufacturing process needs and lifecycle requirements. In the areas of edge sealing, frame bonding, and junction box mounting, manufacturers now have the ability to increase productivity, improve quality, and increase the effective lifecycle of solar panels by using high-strength, acrylic foam tapes.

Edge, Frame, and Junction Box

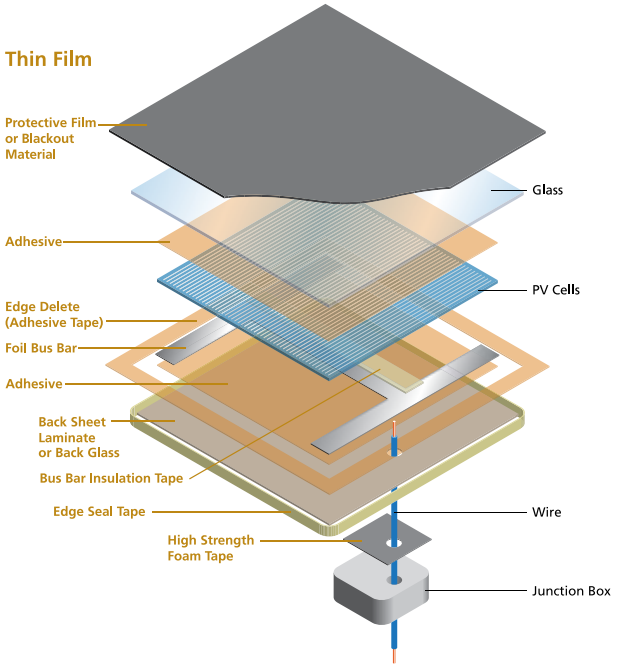
Whether working with crystalline or thin film solar technology, manufacturers need to address edge, frame (for rigid panels), and junction box attachment and sealing.

Bonding, Joining & Sealing

For rigid, crystalline solar panels, a frame provides protection, stability, and a structure for installation. Thin film panels don't use an actual frame but typically use a back pane of glass and a backrail as a carrier system. Both technologies require an edge seal to protect against moisture and the effects of heat and wind.

Junction boxes are mounted on the back or top of the panels and provide the connection to capture the energy from the panel. Obviously, it is critical that the electrical contacts within the junction box be protected from water.

Traditional metal joining technologies have proven to be costly, time-consuming, and not completely effective for the solar industry. Mechanical fasteners, such as rivets and spot welds, have been replaced by adhesive technology in many areas within solar manufacturing.



Thin film panels use a back pane of glass and a backrail as a carrier system.

High-strength acrylic foam tape provides excellent bonding plus expansion/contraction capabilities.

Bonding, joining, and sealing technology for solar panels must be able to withstand extreme environmental conditions while providing an expected 25 to 30 years of service life.

Expectations for any adhesive materials used in these applications include the following capabilities:

- Provide an effective moisture barrier to protect the solar panels and electrical connections
- Are non-conductive in order to avoid shorts
- Provide UV stability
- Resist changes in heat and cold

In addition, manufacturers are also concerned with how fast any adhesive cures. Curing time can have a direct effect on the production process.

For many years, solar manufacturers have turned to adhesive tape as sealants for solar panels. Polyethylene and polyurethane tapes have been popular in the solar market for more than 20 years. Now, these tapes are joined by acrylic foam tapes as possible solutions for solar application challenges. In addition to tapes, manufacturers are also looking at silicone adhesives, as well as epoxies, for use in these applications.

Silicone Adhesives

Silicone adhesives certainly meet the requirements for strength, durability, lasting bonds, and resistance to moisture. The use of these adhesives often requires an investment in dispensing technology, as well as careful balancing of strength versus curing time.

For example, most manufacturers might have a panel coming off a production line at the rate of one per minute. The next step would be to dip and leak test the panel. This might occur within 3-4 minutes. The curing time for any adhesive used would ideally be within this very short time frame, in order to keep production moving.

If it were necessary to wait a period of time for curing to be completed, panels would pile up before testing. In addition to slowing down production, the effects of discovering a problem during delayed testing might mean hundreds of panels could be rejected and scrapped.

Polyethylene and Polyurethane Foam Tapes

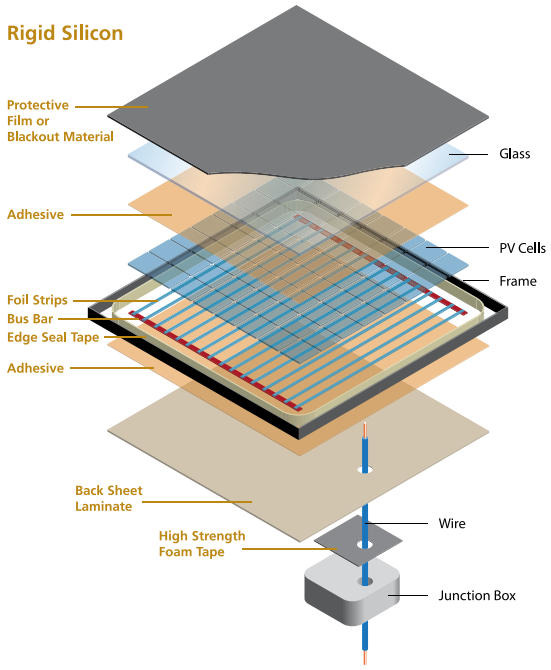
Polyethylene (PE) and polyurethane (PUR) foam tapes have long been used by solar manufacturers for edge and frame sealing and for attaching junction boxes. These tapes are made in different grades and thicknesses. Typical thicknesses are 0.8 mm, 1 mm, and 1.55 mm with a thickness on tolerance of +/- 20%, normal for a blown foam.

PE foam tapes are coated on both sides with adhesive using a transfer lamination process. The foam is corona treated so the adhesives will key into the foam. PE foams are available in tape form in densities from 33kg/m3 to 200kg/m2. The normal density for tapes of 0.8 mm to 1.5 mm thickness is 67kg/m3.

PE tape is very useful in applications where gap filling is required and the bond is not subjected to a lot of stress. PE tapes are easily applied and can fit well into the typical solar panel manufacturing process. They are also cost-effective materials.

The compressive strengths of the foams, however, are low. Cell rupture can occur with very little force and foam cells do not recover well from compression. The internal cohesive strength of the foam is poor and foam tears can occur. Flex strength during elongation and maximum static load are also low. When subjected to repeated expansion and contraction with different materials like glass, aluminum, and plastic due to high and low temperatures, the foam will degrade, and breakdown over time leading to leakage and water absorption.

There have been issues with PE foam tapes in solar applications where the foams fail after eight to nine years of service life. Selecting the appropriate materials is a critical decision for solar manufacturers whose products are expected to last longer than 25 years.



In rigid panels a frame provides protection, stability, and a structure for installation.

Acrylic Foam Tape

High-strength acrylic foam tape provides an attractive alternative for solar applications. Acrylic foam tape has been around for more than 20 years, although it is only now being applied to a broader range of applications. The acrylic looks and feels like foam but is acrylic with air bubbles and glass beads injected into it. It also gives the tape a viscoelastic effect which will stretch and retract to its original shape without breaking the bond. This provides the excellent expansion/contraction capabilities necessary for solar use without any adhesion loss.

The tapes have excellent load bearing characteristics with high dynamic shear and tension adhesion values. They can resist very high wind forces and snow loads. In addition, they are more than capable of withstanding very high UV exposure for long periods without degrading or discoloring. Unlike PE foam tapes, they withstand temperature extremes: - 40°C to + 160°C.

Acrylic foam tape can be precision die-cut.

For frame bonding and edge sealing, acrylic foam tape forms strong bonds with aluminum, glass, and backing films.

In addition to their environmental capabilities, acrylic foam tapes deliver moisture, dust, and air sealing for frame bonding, edge sealing, and junction box mounting. The tape can be precision die-cut for use as a gasket for a wide range of junction box sizes and shapes. It bonds well to polycarbonates, PPE, and other thermo-plastics.

For frame bonding and edge sealing, acrylic foam tape has strong bonding characteristics with aluminum, glass, and backing films. The tape adheres to both High Surface Energy (HSE) and Low Surface Energy (LSE) substrates. LSE surfaces – typically plastics – are essentially "non-stick" plastics, like Teflon, that don't adhere well to other materials. Some acrylic foam tapes adhere to LSE surfaces without surface treatments or primers, resulting in faster production and assembly.

In thin film production, the acrylic foam tape is used with reinforcing backing rails to support the modules and make module mounting easy.

Eliminated curing time allows manufacturers to keep the production line moving – there's no need to wait for liquid adhesives to cure. Dip tank Hi-pot testing can be performed immediately. Other cost advantages include:

- Sped up assembly process
- Reduced re-working
- Lower labor costs
- Cost-effective tape

Finally, unlike PE foam which is a solvent-based adhesive, the acrylic foam tape is environmentally friendly, a fact that will become increasing important as pressure increases to make solar panel manufacturing greener.

Material Partners

Fabrico has strategic relationships with world-class materials suppliers, such as 3M and Loctite®, to assist its customers in selecting the best material for the intended use and to expedite materials sourcing. Whether adhesive films or liquid, all critical material properties are considered in any Fabrico project, including chemical, thermal, and moisture resistance.

With more than 30 years of materials experience, Fabrico engineers also understand the impact of material selection on the overall manufacturing process, and design material systems that optimize production efficiency and improve overall cost-effectiveness.

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