Solar Attachment Adhesives for Building Applied Photovoltaic (BAPV) with Superior Bond Strength

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INTRODUCTION

Photovoltaic (PV) attachment adhesives are required to adhere to a wide array of substrates. These substrates include the roof/building surface and the PV back sheet. The attachment adhesive must exhibit superior bond strength to both the PV module and building material for their warranty lifetime while being able to withstand the harshest environmental conditions. Without an adequate attachment solution, long term reliability of BAPV arrays can be compromised.

REQUIREMENTS

	Reference Standard Documentation	
• Heat Aging	• FM 4470	• IBC, IRC, UBC
• Environmental Stress Resistance	• UL 1703, 2703	• Miami-Dade
• Wind Uplift Resistance	• IEC 61730	• ASCE 7
• Hail Damage Resistance	• IEC 61646	• ASTM
• Electrical Safety and Performance	• ICC (AC365)	• CAL Fire Code
• Fire and Flammability		

MINIMUM REQUIRMENTS – ADCO RECOMMENDATIONS

Based on Extensive Knowledge and Experience in the Roofing Industry, ADCO Recommends Minimum Test Requirements For BAPV Attachment Adhesives:

- **Peel Strength -** ASTM D-903 (12"/minute)
- **Shear Strength -** ASTM D-1102 (0.2"/minute)
- **Aging and Test Conditions:**
  - 24 hours at 25ºC/50% RH
    - Pull at room temperature
  - 7 days at -40ºC
    - Pull at -40ºC and Room Temperature
  - 7 days at 25ºC/50% RH
  - 7 days at 85ºC
  - 1000 hours Damp Heat (85ºC/85%RH)
  - 200 Thermal Cycles (IEC61646, UL1703)
  - 10 Humidity Freeze Cycles (IEC61646, UL1703)
    - Pull at 85ºC and Room Temperature (All Above)

ADCO PVA 600BT - KEY PERFORMANCE ATTRIBUTES

- High bond strength
  - High peel and shear strength
    - Resists high wind loading
    - Resists up-curl and up-lifting
- Long term durability
  - Over 20 years of field history
- Ease of installation
  - Peel and stick speed and convenience
    - Reduced installation time
    - Purpose designed release liners
      - provides superior release
    - No primers needed
      - Reduced installation time
      - Reduced training requirements
      - No toxic or flammable solvents

PVA 600BT TYPICAL ADHESIVE STRENGTH PROPERTIES

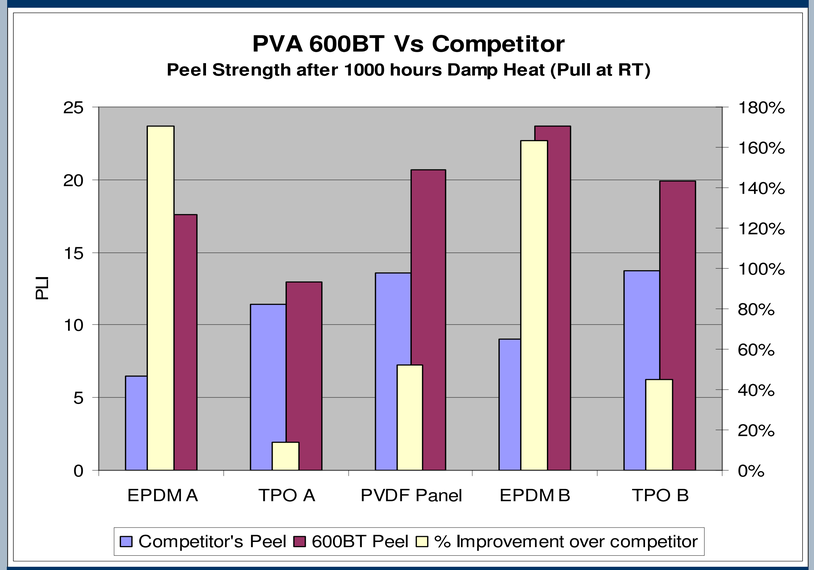
PVA 600BT Typical Adhesive Strength Properties

Flexible PVs were bonded to various substrates using PVA 600BT. Peel and shear values were then determined after exposure to the following conditions.

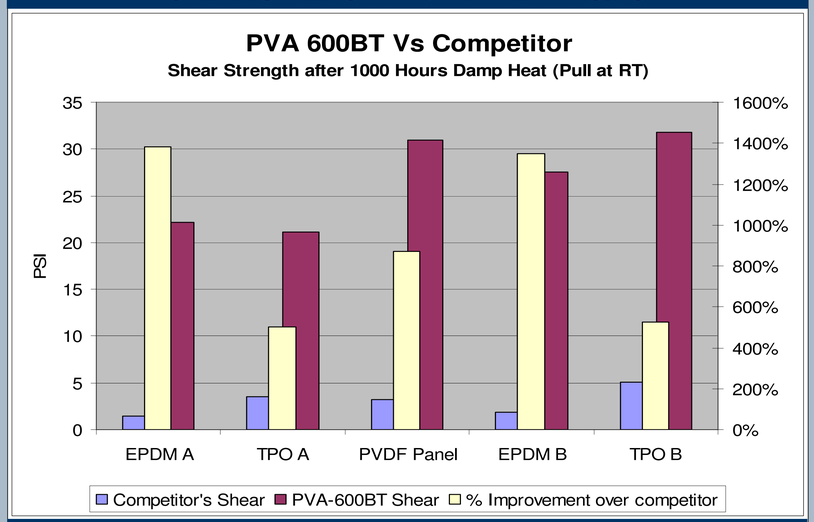
Time	Temperature	Test Conditioning	Typical Peel Values (ASTM D-903) TPO	EPDM	PVDF Painted Steel	Typical Shear Values (ASTM D-1102 TPO	EPDM	PVDF Painted Steel
			All results expressed in pli			All results expressed in psi		
24 hours	RT	RT	15	10	19	15	10	5
24 hours	70°C	RT	21	11	20	20	15	8
24 hours	70°C	70°C	3.5	3	7.5	6.5	6.5	2
24 hours	85°C	85°C	3.5	3.5	5	9	8	2.5
24 hours	-40°C	-40°C	15	15	24	30	30	10
7 days	RT	RT	15	20	20	15	13	6.5
7 days	70°C	RT	13	10	22.5	20	20	12
7 days	70°C	70°C	3.5	3	9	20	12	3
7 days	85°C	85°C	3.5	3.1	6.5	15	10	3.5
7 days	-40°C	-40°C	17	15	24	30	30	6
UL1703 & IEC61646 Conditions								
10 Humidity/Freeze Cycles		RT	23	25	18	12	6	15
1000 Hours Damp Heat		RT	15	15	9*	20	20	30
200 Thermal Cycles		1 hr @ 85°C	2.5	1.5	1.5*	4	5	8
200 Thermal Cycles		RT	20	20	10*	13	8	15

** Superstrate failure.*

PEEL STRENGTH – DAMP HEAT AGING



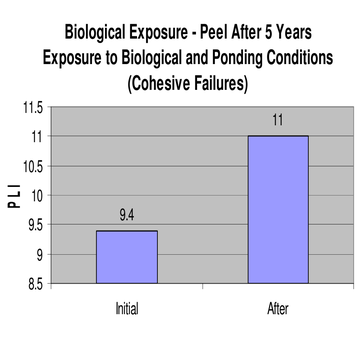
SHEAR STRENGTH – DAMP HEAT AGING

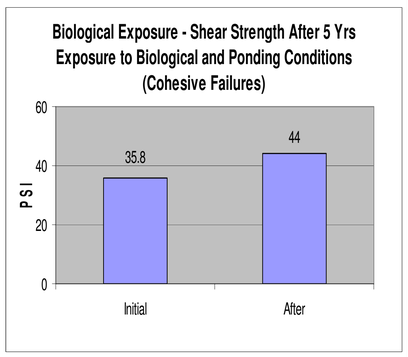


LONG TERM DURABILITY

BIOLOGICAL EXPOSURE

Samples of roofing membrane submerged in a water tank seeded with typical roofing debris for 5 years. Peel and shear strength were measured before and after exposure.





SUBSTRATES TESTED WITH

Materials Tested with PVA 600BT

The materials listed below have been tested with or are being tested with the 600BT

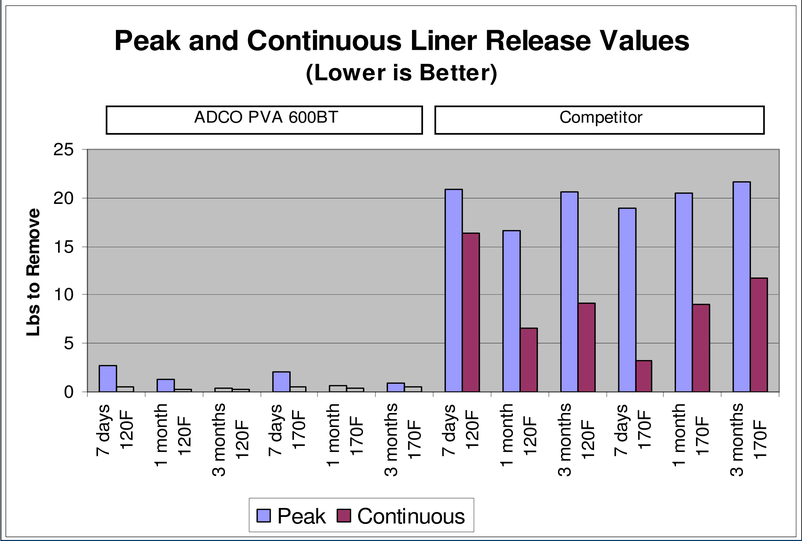
Roofing Materials		PV Materials
Carlisle TPO	Johns-Manville Granulated Mod-Bit	LPL Backsheet
Firestone TPO	Garland Smooth Mod-Bit	PVDF film (Kynar)
GAF TPO	Garland Granulated Mod-Bit	Tefzel Adherable)
Stevens TPO	Garland Coated/Granulated Mod-Bit	Glass
Johns-Manville TPO	CertainTeed Mod-Bit	
		J-Box Materials
Carlisle EPDM	Eternalastic 911 (Tropical Asphalt)	Noryl (500-701 black)
Firestone EPDM	Siplast PC-227	Lexan (SE1-GFN2)
Mulehide EPDM	Pyramic 7467 White Coating	
	Garlabrite 7411 Silver Coating	**Other Materials**
PVDF coated steel (4 brands)		Stainless Steel
Galvaneal		Sealed concrete
Galvalume Plus		

PVA 600BT is not compatible with PVC materials.

If not listed above, testing of specific substrates is recommended to ensure satisfactory results.

EASE OF INSTALLATION

LINER RELEASE FORCE AFTER HEAT AGING



CONCLUSIONS

- **PVA 600BT is a high strength, thermoset butyl that offers a broad spectrum solution to long term BAPV attachment**
- **Superior adhesion properties to many types of roofing and BAPV substrates**
- **Over 20 years of field history in the roofing industry**
- **Superior adhesion performance after vigorous reliability tests including heat aging and thermal cycling**
- **Excellent performance after harsh rooftop biological exposure**
- **Easy installation for reduced installation costs**
- **Does not require primer, reducing costs and eliminating safety concerns**
- **Peel & Stick methodology is readily accepted by the roofing industry**
- **ADCO sets the standard in performing accelerated aging tests at levels beyond any standards available today for BAPV attachment adhesives**
- **ADCO will continue to work with NREL and building regulatory bodies to provide benchmarks and set minimum application requirements for BAPV**

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This poster does not contain any proprietary or confidential information.