

VHB™ Double Coated Acrylic Foam Tapes and Adhesive Transfer Tapes

Typical Performance Characteristics

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes.

Primary Products

Thin ←

Products		F-9460PC	F-9469PC	F-9473PC	4920	4929	4930
Peel Adhesion: To Stainless Steel Room Temperature 90° Peel Jaw Speed 12 in./min. (305 mm/min.) (180° Peel for 9460PC, 9469C, 9473PC) ASTM D-3330	lb./in. (N/100 mm)	7 (120)	8 (140)	9 (160)	15 (260)	20 (350)	
Normal Tensile: (T-block) To Aluminum Room Temperature 1 in. ² (6.45 cm ²) Jaw Speed 2 in./min. (50 mm/min.) ASTM D-897	lb./in. ² (kPa)	100* (690)	100* (690)	100* (690)	160 (1100)	160 (1100)	160 (1100)
		Note: Tensile is highly dependent on good surface contact which can be difficult on rigid surfaces with thin tapes.					
Static Shear: Static Shear measured at various temperatures and gram loadings on stainless steel. 1/2 sq. in. (3.22 cm ²) overlap. Will hold listed weight for 10,000 min. ASTM D-3654	72°F (22°C) 150°F (66°C) 200°F (93°C) 250°F (121°C) 300°F (149°C) 350°F (177°C)	1000 1000 1000 1000 500 500	1000 1000 1000 1000 500 500	1500 1000 1000 1000 1000 500	500 500 500 500 1000 500	500 500 500 500 1000 500	500 500 500 500 1000 500
Dynamic Shear: To Stainless Steel 1 sq. in. (6.45 cm ²) overlap. Room Temperature Jaw Speed 1/2 in./min. (12.7 mm/min.) ASTM D-1002	lb./in. ² (kPa)	80* (550)	80* (550)	80* (550)	100 (690)	100 (690)	100 (690)
		Note: Dynamic shear is highly dependent on good surface contact which can be difficult on rigid surfaces with thin tapes.					
Temperature Tolerance: Short-Term No change in room temperature dynamic shear properties following 4 hour conditioning at indicated temperature with 100g static load	°F °C	500 (260)	500 (260)	500 (260)	300 (149)	300 (149)	300 (149)
Temperature Tolerance: Long-Term Maximum temperature where tape supports 250g in static shear for 10,000 minutes.	°F °C	300 (149)	300 (149)	300 (149)	200 (93)	200 (93)	200 (93)
Solvent Resistance: Splash testing cycle – 20 seconds submersion, 20 sec. air dry, 3 cycles		No apparent degradation of any VHB Tapes when exposed to splash testing of most common solvents including gasoline, JP-4 jet fuel, mineral spirits, motor oil, ammonia, cleaner, acetone, methyl ethyl ketone (MEK).					
Moisture Resistance: 8 years submersion in water, 5% salt water		Integrity of tape bond to aluminum for 4945 and 4950 tapes (also expected for other VHB Tapes) submersion in water and salt water. Note: Continuous submersion in liquids is not recommended and this information is provided to illustrate that occasional contact with liquids should not be detrimental to tape performance in ordinary use.					
U.V. Resistance:		This family of tapes has shown excellent U.V. resistance in outdoor weathering tests and weather-o-meter tests.					
Shelf Life:		24 months from date of manufacture when stored in original cartons at 70°F (21°C) and 50% relative humidity.					

Additional Typical Performance Characteristics

%TML	%VCM
0	100
10	90
20	80
30	70
40	60
50	50
60	40
70	30
80	20
90	10
100	0

4930	500
4950	360
4945	360

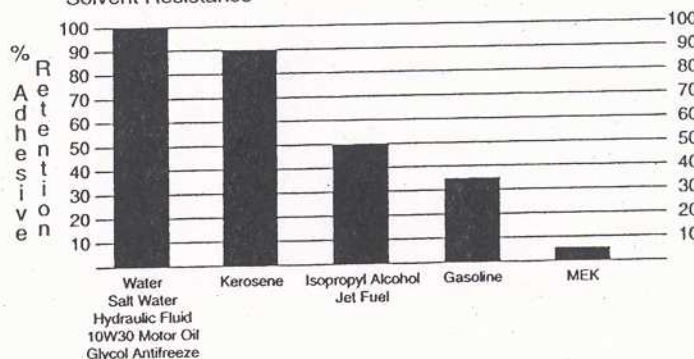
F-9460PC	$> 1 \times 10^6$
F-9469PC	$> 1 \times 10^6$
F-9473PC	$> 1 \times 10^6$
4930	$> 1 \times 10^6$
4950	$> 1 \times 10^6$
4955	$> 1 \times 10^6$
4959	$> 1 \times 10^6$
4945	$> 1 \times 10^6$

	BTU-Ft ² /Hr. °F (Watts/cm °C)	
9460PC	0.092	(0.0016)
9469PC	0.092	(0.0016)
9473PC	0.092	(0.0016)
4930	0.078	(0.0014)
4950	0.078	(0.0014)
4945	0.078	(0.0014)

Category QOQW2 Component - Polymeric Adhesive Systems, Electrical Equipment

Product Families	Substrates	Temp Rating
4950, 4930, 4920, VHB Foam Tapes	Aluminum, Stainless Steel, Galvanized Steel, Enameled Steel, Glass/Epoxy, Ceramic	110°C
	PBT	90°C
	Polycarbonate, ABS, unplasticized PVC	75°C
4956, 4941, 4950, 4926 Conformable VHB Foam Tapes	Ceramic	110°C
	Aluminum, Stainless Steel, Galvanized Steel, Enameled Steel, Polycarbonate, unplasticized PVC, Glass, Polyimide, PBT, ABS	90°C
	ABS	75°C
4945 VHB Foam Tape	Phenolic, Aluminum, Galvanized Steel, Alkyd Enamel	110°C
	Polyamide (Nylon), Polycarbonate, ABS	90°C
	Unplasticized PVC	75°C
4947, 4940, 4946, 4949, 49460PC VHB Adhesive Transfer Tapes	Aluminum, Stainless Steel, Epoxy, Ceramic, Steel, Polyimide, Phenolic, Alkyd Enamel, Steel (Galvalume)	110°C
	Aluminum, Polycarbonate, Aluminum, Galvanized Steel	90°C
	Unplasticized PVC	75°C

Solvent Resistance



- Tape between stainless steel and aluminum foil.
- 72 hours dwell at room temperature.
- Solvent immersion for 72 hours.
- Test within 45 minutes after removing from solvent
- 90° peel for foam tapes. 180° peel for transfer adhesives.
- 12 in./min. rate of peel.
- Peel adhesion compared to control.

Note: Continuous submersion in chemical solutions is not recommended. The above information is presented to show that occasional chemical contact should not be detrimental to tape performance in most applications in ordinary use.

VHB™ Double Coated Acrylic Foam Tapes and Adhesive Transfer Tapes

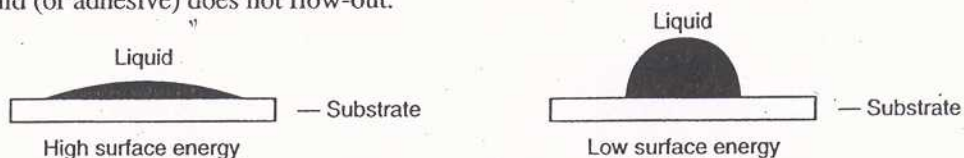
Adhesion to a Variety of Surfaces

The Effect of Surface Energy on Adhesion

Adhesion is basically the molecular force of attraction between unlike materials, similar to a magnetic force. The strength of attraction is determined by the surface energy of the material. The higher the surface energy, the greater the molecular attraction – the lower the surface energy, the weaker the attractive forces. Greater molecular attraction results in increased interfacial contact between an adhesive and a substrate. In other words, on a high surface energy material the adhesive can flow (or “wet-out”) to assure a stronger bond.

Think of an automobile which has not been waxed for years. When water contacts the surface it spreads in large puddles. By comparison, on a freshly waxed car the water will bead up into small spheres.

The unwaxed car surface demonstrates high surface energy, the molecular attraction allows the water to flow. The waxed car is an example of low surface energy, where the liquid (or adhesive) does not flow-out.

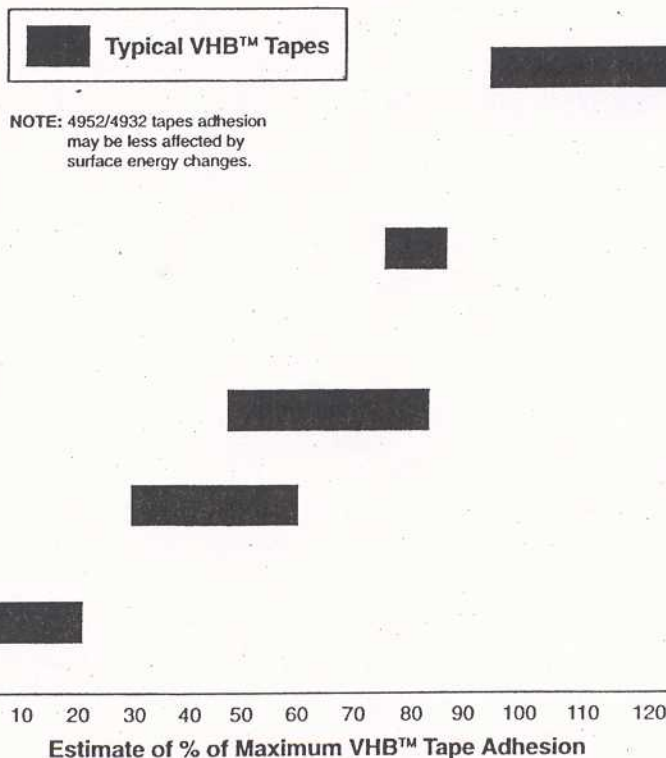


This illustration demonstrates the effect of surface energy on adhesive interfacial contact. High surface energy materials draw the adhesive closer for high bond strength.

Surface Energy Range Dynes/cm

Aluminum	
Stainless Steel	
Copper	
Zinc	400-1100
Tin	
Lead	
Anodized Aluminum	
Glass	
Kapton™	
Phenolic	
Nylon™	
Alkyd Enamel	42-50
Polyester	
Epoxy Paint	
Polyurethane	
ABS	
Polycarbonate (Lexan™)	
PVC	
Noryl™	38-39
Acrylic	
Polane™ Paint	
PVA	
Polystyrene	36-37
Acetal	
EVA	
Polyethylene	
Polypropylene	
Tedlar™	18-33
Silicone	
Teflon™	

Relationship of Peel Adhesion and Surface Energy



NOTES: There are a wide variety of formulations, surfaces finishes and surface treatments available on substrate materials which can affect adhesion. This chart is intended to provide only a rough estimate of the adhesion levels which can be expected on some common materials relative to a reference surface such as aluminum.

Expect silicone and Teflon™

Light surface abrasion will significantly increase adhesion levels on many materials, except when using 4952/4932 tapes.

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Lexan and Noryl are registered trademarks of General Electric Co.

Polane is a registered trademark of Sherwin Williams Co.

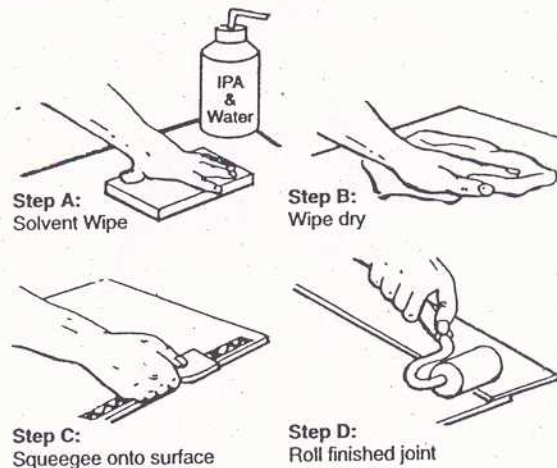
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Design Considerations

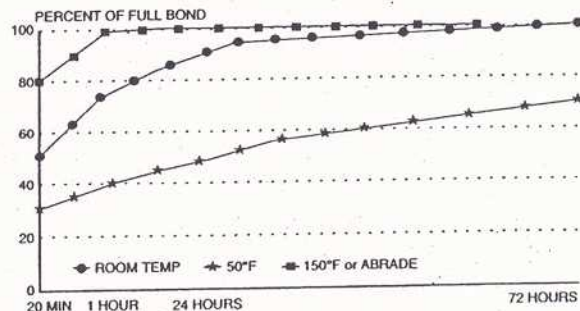
- **How much tape area to use:**
As a general rule, four square inches of tape should be used for each pound of weight to be supported in static load. More or less tape may be required depending upon the particular application. User evaluation is, therefore, required to determine optimal tape usage.
- **Bonding to rigid surfaces**
The necessary thickness of tape depends on the rigidity of substrates, their irregularity, and the amount of application pressure which can be applied to mate the surfaces. The mismatch between surfaces must be less than half of the tape thickness, in conjunction with firm lamination pressure, to establish good surface contact. To test for surface contact problems, bond tape to the rigid or irregular surface, then laminate on a test piece of clear acrylic or polycarbonate (1/4" thick), and apply pressure. Observe the bond contact area through the clear substrate.
- **How much pressure to apply**
Typically, good surface contact can be attained by applying enough pressure to ensure that the tape experiences approximately 15 psi (100 kPa). Rigid surfaces may require 2 or 3 times that much surface pressure to make the tape experience 15 psi.
- **Allow for thermal expansion/contraction and flexibility**
VHB Tapes can perform well in applications where two bonded surfaces may expand and contract differentially. The tapes can typically tolerate differential movement (shear or tensile) up to 3 times their thickness. Tape bonds are more flexible, so suitable design modifications or periodic use of rigid fasteners or adhesives may be needed to achieve required stiffness.

Application Techniques

- To obtain optimum adhesion, the bonding surfaces must be clean, dry and well unified. Typical surface cleaning solvents are isopropyl alcohol/water mixture (rubbing alcohol) or heptane. **Note:** Be sure to follow solvent manufacturer's precautions and directions for use when using solvents. (Steps A and B).
- Bond strength is dependent upon the amount of adhesive-to-surface contact developed. Firm application pressure develops better adhesive contact and helps improve bond strength. (Steps C and D).
- After application, the bond strength will increase as the adhesive flows onto the surface. At room temperature approximately 50% of the ultimate strength will be achieved after 20 minutes, 90% after 24 hours and 100% after 72 hours. In some cases bond strength can be increased and ultimate bond strength can be achieved more quickly by exposure of the bond to elevated temperatures (e.g. 150°F (66°C) for 1 hour). This provides better adhesive wetout onto the substrates.



Bond Typical Build vs. Time



VHB™ Tapes Product Selection Guide

Special Feature Products									
Thickness	Most Metals and High Surface Energy Substrates	Black	Clear	Very Conformable	Plasticizer Resistant	Conformable and Plasticizer Resistant	Low Surface Energy Substrates	Low Temp Installation	Conformable and Low Temp Installation
.002"	▲ 9460								
.005"	▲ 9469								
.010"	▲ 9473								
.015"	▲ 4920					■ 4926#			
.020"			▲ 4905*						
.025"	▲ 4930	▲ 4929*		▲ 4925*		■ 4936#	● 4932		
.040"			▲ 4910*						
.045"	▲ 4950	▲ 4949*		▲ 4940*	■ 4945	■ 4941#	● 4952	◆ 4951*	◆ 4943*
					■ 4946				
.062"						■ 4956#			◆ 4957*
.080"	▲ 4955*								
.120"	▲ 4959*								

Adhesive Types:

▲ = Multi-Purpose

■ = Plasticizer Resistant + Paint Adhesion

● = Low Surface Energy

◆ = Low Temperature Installation

*Film Liner

#Film Liner or Paper Liner Available

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Application Techniques

1. Ideal tape application temperature range is 70°F to 100°F (21°C to 38°C).

Minimum suggested application temperatures:

50°F (10°C) - F-9460PC, F-9469PC, F-9473PC, 4905, 4910, 4920, 4925, 4929, 4930, 4932, 4940, 4949, 4950, 4952, 4955, 4959 tapes

60°F (16°C) - 4926, 4926F, 4936, 4936F, 4941, 4941F, 4945, 4946, 4956, 4956F tapes

32° (0°C) - 4943F, 4951, 4957F tapes

Note: Initial tape application to surfaces at temperatures below these suggested minimums is not recommended because the adhesive becomes too firm to adhere readily. However, once properly applied, low temperature holding is generally satisfactory.

To obtain good performance with all VHB Tapes it is important to ensure that the surfaces are dry and free of condensed moisture.

2. It may be necessary to seal or prime some substrates prior to bonding. Consult 3M ITSD Technical Bulletin on Primers for more information.
 - a. Most porous (e.g. concrete) or fibered materials (e.g. wood) will require sealing to provide a unified surface. Marine grade varnishes and high performance contact adhesives (such as 3M brand 80 Neoprene Aerosol Contact Adhesive or Scotch-Grip 1357 Contact Adhesive) have been shown to produce good bond strengths with VHB tapes. **Note:** These primers must be tested by user for individual applications to determine suitability.
 - b. Some materials (e.g. copper, brass, plasticized vinyl) may require priming or coating to prevent interaction between adhesive and substrate.
 - c. Bonding to glass, ceramic tile or other hydrophylic surfaces in a high humidity environment may require the use of a silane coupling agent to help ensure a long-term bond. Consult Technical Bulletin.

Important Application Considerations

THE FOLLOWING APPLICATION CONDITIONS MUST BE EVALUATED THOROUGHLY BY THE USER TO DETERMINE WHETHER VHB PRODUCTS ARE SUITABLE FOR THE INTENDED USE.

- **Severe Cold Temperatures**

Applications which require performance at severe cold temperatures must be thoroughly evaluated by the user if the intended use will subject the VHB Tape product to high impact stresses.

- **Rigid Surfaces**

Applications of F-9460PC, F-9469PC or F-9473PC tapes involving two rigid surfaces must be evaluated by the user to ensure adequate adhesive contact and also to ensure that differences in thermal expansion rates of substrates do not adversely affect the bond line.

