



VHB™ Double Coated Acrylic Foam Tapes and Adhesive Transfer Tapes

Technical Data

March, 1998

Supersedes August, 1994

Adhesive Description

3M™ VHB™ Tapes utilize high performance adhesives which have excellent long-term holding power. The peel adhesion and tensile holding power of tapes in the VHB family are significantly higher than typical pressure sensitive tapes.

Product Description

VHB tapes are ideal for use in many interior and exterior industrial applications. In many situations they can replace rivets, spot welds, liquid adhesives, and other permanent fasteners.

Each tape in the VHB tape family has specific features. These can include high tensile, shear and peel adhesion, resistance to solvents, moisture and plasticizer migration, U.L. recognition, low outgassing, film liners, conformability and adhesive which can be applied at temperatures as low as 32°F (0°C).

VHB tapes are ideal for bonding a variety of substrates, including most metal, sealed wood and glass, as well as many plastics, composites and painted surfaces.

Note: All VHB tapes should be thoroughly evaluated by the user under actual use conditions with intended substrates to determine whether a specific VHB tape is fit for a particular purpose and suitable for user's method of application, especially if expected use involves extreme environmental conditions.

Products

Double Coated Acrylic Foam Tapes

4905	0.020 in.	(0.5 mm)
4910	0.040 in.	(1.0 mm)
4920	0.015 in.	(0.4 mm)
4925	0.025 in.	(0.64 mm)
4926	0.015 in.	(0.4 mm)
4929	0.025 in.	(0.64 mm)
4930	0.025 in.	(0.64 mm)
4932	0.025 in.	(0.64 mm)
4936*	0.025 in.	(0.64 mm)
4940	0.045 in.	(1.1 mm)
4941*	0.045 in.	(1.1 mm)
4943F	0.045 in.	(1.1 mm)
4945	0.045 in.	(1.1 mm)
4946F	0.045 in.	(1.1 mm)
4949	0.045 in.	(1.1 mm)
4950	0.045 in.	(1.1 mm)
4951	0.045 in.	(1.1 mm)
4952	0.045 in.	(1.1 mm)
4955	0.080 in.	(2.0 mm)
4956*	0.062 in.	(1.55 mm)
4957F	0.062 in.	(1.55 mm)
4959	0.120 in.	(3.0 mm)
4979F	0.062 in.	(1.55 mm)

Adhesive Transfer Tapes

F-9460PC	0.002 in.	(0.05 mm)
F-9469PC	0.005 in.	(0.13 mm)
F-9473PC	0.010 in.	(0.25 mm)

*Film-lined versions are available as tapes 4936F, 4941F and 4956F.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

Typical Physical Properties

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

		Primary Tapes					
		Thin ←					
Products		F-9460PC	F-9469PC	F-9473PC	4920	4929	4930
Adhesive Family:		A-10	A-10	A-10	VHB Tape	VHB Tape	VHB Tape
Adhesive Carrier:		None	None	None	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell
Thickness:							
Nominal	in. (mm)	0.002 (0.05)	0.005 (0.13)	0.010 (0.25)	0.015 (0.40)	0.025 (0.64)	0.025 (0.64)
Tolerance		± 20%	± 10%	± 5%	± 15%	± 15%	± 15%
Color:		Clear	Clear	Clear	White	Black	White
Release Liner:	in. (mm)	0.004 (0.10) Printed Paper	0.004 (0.10) Printed Paper	0.004 (0.10) Printed Paper	0.003 (0.08) Printed Paper	0.002 (0.05) Clear Polyester	0.003 (0.08) Printed Paper
Approximate Density: (Foam Only)	lb./ft. ³ (kg/m ³)	NA	NA	NA	50 (800)	50 (800)	50 (800)
Roll Length:							
Standard	yds. (m)	60 (54.9)	60 (54.9)	60 (54.9)	72 (65.8)	72 (65.8)	72 (65.8)
Maximum							
Standard Units							
a. 1/4" up to 1/2" wide	yd.				72	72	72
b. 1/2" and wider	yd.				216	216	216
c. 1/4" to 3/8"	yd.	60	60	60			
d. 3/8" up to 1" wide	yd.	240	240	120			
e. 1" up to 3"	yd.	360	360	120			
f. 3" and wider	yd.	360	360	180			
Metric Equivalents							
a. 6.4 mm up to 12.7 mm wide	(m)				(65.8)	(65.8)	(65.8)
b. 12.7 mm and wider	(m)				(197.5)	(197.5)	(197.5)
c. 6.4 mm to 9.5 mm	(m)	(54.9)	(54.9)	(54.9)			
d. 9.5 mm up to 25.4 mm	(m)	(220)	(220)	(110)			
e. 25.4 mm up to 76 mm	(m)	(330)	(330)	(110)			
f. 75 mm and wider	(m)	(330)	(330)	(165)			
Roll Width:							
Minimum	in. (mm)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)
Maximum	in. (mm)	60 (1525)	60 (1525)	60 (1525)	46 (1170)	46 (1170)	46 (1170)
Slitting Tolerance:	in. in. (mm)	± 1/32 ± 0.031 (± 0.8)					

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

Typical Physical Properties

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

				→ Thick	Special Feature Tapes				
4949	4950	4955	4959	4905	4910	4925	4926	4932	
VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	
Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Closed Cell	Acrylic Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	
0.045 (1.1)	0.045 (1.1)	0.080 (2.0)	0.120 (3.0)	0.020 (0.5)	0.040 (1.0)	0.025 (0.64)	0.015 (0.40)	0.025 (0.64)	
± 10%	± 10%	± 10%	± 10%	± 10%	± 10%	± 15%	± 15%	± 15%	
Black	White	White	White	Clear	Clear	Lt. Gray	Gray	White	
0.002 (0.08) Clear Polyester	0.003 (0.08) Printed Paper	0.002 (0.05) Clear Polyester	0.002 (0.05) Clear Polyester	0.005 (0.125) Red Polyethylene	0.005 (0.125) Red Polyethylene	0.002 (0.05) Clear Polyester	0.003* (0.08) Printed Paper	0.003 (0.08) Printed Paper	
50 (800)	50 (800)	45 (720)	45 (720)	60 (960)	60 (960)	50 (800)	45 (720)	50 (800)	
36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)	72 (65.8)	36 (32.9)	72 (65.8)	72 (65.8)	72 (65.8)	
72 144	72 144	36 72	36 60	72 216	72 144	72 216	72 216	72 216	
(65.8) (131.6)	(65.8) (131.6)	(32.9) (65.8)	(32.9) (54.9)	(65.8) (197.5)	(65.8) (131.6)	(65.8) (197.5)	(65.8) (197.5)	(65.8) (197.5)	
1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/2 0.5 (12.7)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	
46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	
				± 1/32 ± 0.031 (± 0.8)					

*Release Liner for tapes 4936F, 4941F and 4956F = 0.005 in (0.125 mm) Natural PE Film

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

Typical Physical Properties

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

Special Feature Tapes

4936, 4936F*	4940	4941, 4941F*	4943F	4945	4946F	4951	4952	4956, 4956F*	4957F	4979F
VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape	VHB Tape
Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell	Acrylic Foam Closed Cell
0.025 (0.64)	0.045 (1.1)	0.045 (1.1)	0.045 (1.1)	0.045 (1.1)	0.045 (1.1)	0.045 (1.1)	0.045 (1.1)	0.062 (1.55)	0.062 (1.55)	0.062 (1.55)
± 15%	± 15%	± 15%	± 10%	± 10%	± 10%	± 10%	± 10%	± 10%	± 10%	± 10%
Gray	Lt. Gray	Gray	Gray	White	White	White	White	Gray	Gray	Black
0.003* (0.08) Printed Paper	0.002 (0.05) Clear Polyester	0.003* (0.08) Printed Paper	0.005 (0.125) Natural PE Film	0.003 (0.08) Printed Paper	0.005 (0.125) Natural PE Film	0.002 (0.05) Clear Polyester	0.003 (0.08) Printed Paper	0.003* (0.08) Printed Paper	0.005 (0.125) Natural PE Film	0.005 (0.08) Red PE Film
45 (720)	50 (800)	45 (720)	45 (720)	50 (800)	50 (800)	50 (800)	50 (800)	45 (720)	45 (720)	45 (720)
72 (65.8)	36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)	36 (32.9)
72 216	72 144	72 144	72 144	72 144	72 144	72 144	72 144	72 144	72 144	72 144
(65.8) (197.5)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)	(65.8) (131.6)
1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)	1/4 0.25 (6.4)
46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)	46 (1170)
						± 1/32 ± 0.031 (± 0.8)				

*Release Liner for tapes 4936F and 4941F = 0.005 in (0.125 mm) Natural PE Film

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives 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.

Products	Primary Tapes					
	Thin ←					
	F-9460PC	F-9469PC	F-9473PC	4920	4929	4930
Peel Adhesion: To Stainless Steel lb./in. (N/100 mm) Room Temperature 90° Peel Jaw Speed 12 in./min. (305 mm/min.) (180° Peel for 9460PC, 9469C, 9473PC) ASTM D-3330	7 (120)	8 (140)	9 (160)	15 (260)	20 (350)	20 (350)
Normal Tensile: (T-block) lb./in. ² To Aluminum (kPa) Room Temperature 1 in. ² (6.45 cm ²) Jaw Speed 2 in./min. (50 mm/min.) ASTM D-897	100* (690)	100* (690)	100* (690)	160 (1100)	160 (1100)	160 (1100)
Static Shear: Static Shear measured 72°F (22°C) at various temperatures 150°F (66°C) and gram loadings on 200°F (93°C) stainless steel. 1/2 sq. in. 250°F (121°C) (3.22 cm ²) overlap. Will 300°F (149°C) hold listed weight for 350°F (177°C) 10,000 min. ASTM D-3654	1000 1000 1000 1000 500 500	1000 1000 1000 1000 500 500	1500 1000 1000 1000 1000 500	1500 500 500	1500 500 500	1500 500 500
Dynamic Shear: To Stainless Steel lb./in. ² 1 sq. in. (6.45 cm ²) overlap. (kPa) Room Temperature Jaw Speed 1/2 in./min. (12.7 mm/min.) ASTM D-1002	80* (550)	80* (550)	80* (550)	100 (690)	100 (690)	100 (690)
Temperature Tolerance: °F Short-Term °C No change in room temperature dynamic shear properties following 4 hour conditioning at indicated temperature with 100g static load	500 (260)	500 (260)	500 (260)	300 (149)	300 (149)	300 (149)
Temperature Tolerance: °F Long-Term °C Maximum temperature where tape supports 250g in static shear for 10,000 minutes.	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 many common solvents, and fuels, including gasoline, JP-4 jet fuel, mineral spirits, motor oil, ammonia cleaner, acetone, methyl ethyl ketone (MEK).					
Moisture Resistance: 10 years submersion in water, 5% salt water	Integrity of tape bond to aluminum for tapes 4945 and 4950 (also expected for other VHB Tapes) remains excellent after 10 years 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.					

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives 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.

				→ Thick	Special Feature Tapes				
4949	4950	4955	4959	4905	4910	4925	4926	4932	
25 (440)	25 (440)	20 (350)	20 (350)	12 (210)	15 (260)	17 (300)	12 (210)	20 (350)	
140 (970)	140 (970)	95 (655)	75 (515)	100 (690)	100 (690)	75 (515)	95 (655)	100 (690)	
1500 500 500	1500 500 500	1500 1000 750 750 750 750	1500 1000 750 750 750	1000 500 500	1000 500 500	1000 500 500	1000 500 500	1500 500	
80 (550)	80 (550)	70 (480)	55 (380)	70 (480)	70 (480)	75 (515)	90 (590)	100 (690)	
300 (149)	300 (149)	400 (204)	400 (204)	300 (149)	300 (149)	300 (149)	300 (149)	200 (93)	
200 (93)	200 (93)	300 (149)	300 (149)	200 (93)	200 (93)	200 (93)	200 (93)	160 (71)	

No apparent degradation of any VHB Tapes when exposed to splash testing of many common solvents and fuels, including gasoline, JP-4 jet fuel, mineral spirits, motor oil, ammonia cleaner, acetone, methyl ethyl ketone (MEK).

Integrity of tape bond to aluminum for tapes 4945 and 4950 (also expected for other VHB Tapes) remains excellent after 10 years 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.

This family of tapes has shown excellent U.V. resistance in outdoor weathering tests and weather-o-meters tests.

24 months from date of manufacture when stored in original cartons at 70°F (21°C) and 50% relative humidity.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives 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.

Special Feature Tapes

4936, 4936F	4940	4941, 4941F	4943F	4945	4946	4951	4952	4956, 4956F	4957F	4979F
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17 (300)	20 (350)	20 (440)	20 (350)	25 (440)	25 (440)	18 (315)	25 (440)	20 (350)	20 (350)	20 (350)
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90 (620)	70 (480)	85 (585)	85 (585)	140 (970)	140 (970)	110 (760)	80 (550)	65 (450)	75 (515)	60 (415)
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1000 500 500	1000 500 500	1000 500 500	1000 500	1500 500 500	1500 500 500	1250 500	1500 500	1000 500 500	1000 500	1000 500
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80 (550)	70 (480)	70 (480)	70 (480)	80 (480)	80 (550)	80 (550)	50 (345)	60 (415)	60 (415)	50 (345)
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300 (149)	300 (149)	300 (149)	300 (149)	300 (149)	300 (149)	300 (149)	200 (93)	300 (149)	300 (149)	300 (149)
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200 (93)	200 (93)	200 (93)	200 (93)	200 (93)	200 (93)	200 (93)	160 (71)	200 (93)	200 (93)	200 (93)
-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------

No apparent degradation of any VHB Tapes when exposed to splash testing of many common solvents and fuels, including gasoline, JP-4 jet fuel, mineral spirits, motor oil, ammonia cleaner, acetone, methyl ethyl ketone (MEK).

Integrity of tape bond to aluminum for tapes 4945 and 4950 (also expected for other VHB Tapes) remains excellent after 10 years 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.

This family of tapes has shown excellent U.V. resistance in outdoor weathering tests and weather-o-meters tests.

24 months from date of manufacture when stored in original cartons at 70°F (21°C) and 50% relative humidity.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

Additional Typical Performance Characteristics

Outgassing:

Tape	%TML	%VCM
F-9460PC	0.85	0.00
F-9469PC	1.29	0.02
F-9473PC	1.23	0.01
4945	1.24	0.01

TML - Total Mass Loss
VCM - Volatile Condensable Materials
NASA Reference Publication, June 1984, "Outgassing Data for Selecting Spacecraft Materials"

Dielectric Strength:
(ASTM D1000)
RMS Voltage/Thickness

Tape

F-9460PC	1,000 Volts
F-9469PC	3,500 Volts
F-9473PC	5,500 Volts

Volts/mil

Tape

4930	500
4950	360
4945	360

Insulation Resistance:
(ASTM D1000) megaohms/in²

Tape

F-9460PC	> 1 x 10 ⁶
F-9469PC	> 1 x 10 ⁶
F-9473PC	> 1 x 10 ⁶
4930	> 1 x 10 ⁶
4950	> 1 x 10 ⁶
4955	> 1 x 10 ⁶
4959	> 1 x 10 ⁶
4945	> 1 x 10 ⁶

Thermal Conductivity:
(ASTM C177)
BTU-Ft/Ft² Hr. °F (Watts/cm °C)

Tape

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)

3M™ VHB™ Tapes UL746C Listings - File MH 17478

Category QOQW2 Component - Polymeric Adhesive Systems, Electrical Equipment

Product Families	Substrates	Temp Rating
VHB Foam Tapes 4950, 4930, 4920	Aluminum, Stainless Steel, Galvanized Steel, Enameled Steel, Glass/Epoxy, Ceramic	110°C
	PBT	90°C
	Polycarbonate, ABS, unplasticized PVC	75°C
Conformable VHB Foam Tapes 4956, 4941, 4936, 4926	Ceramic	110°C
	Aluminum, Stainless Steel, Galvanized Steel, Enameled Steel, Polycarbonate, unplasticized PVC, Glass/Epoxy, PBT	90°C
	ABS	75°C
VHB Foam Tape 4945	Phenolic, Aluminum, Galvanized Steel, Alkyd Enamel	110°C
	Polyamide (Nylon), Polycarbonate, ABS	90°C
	Unplasticized PVC	75°C
VHB Adhesive Transfer Tapes F-9473PC, F-9469PC, F-9460PC	Stainless Steel, Glass/Epoxy, Enameled Steel, Ceramic, Phenolic: Nickel Plated Steel (Tape 9469 only)	110°C
	ABS, Polycarbonate, Aluminum Galvanized Steel	90°C
	Unplasticized PVC	75°C

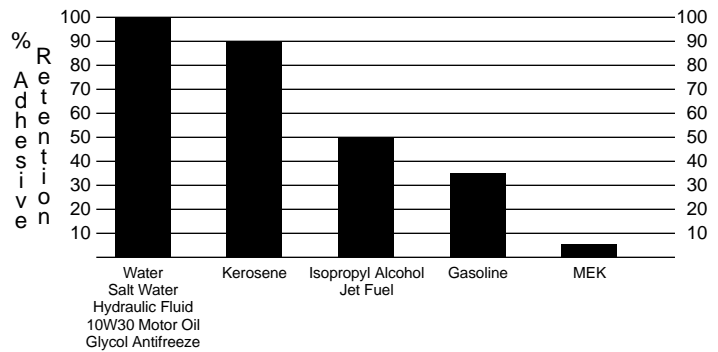
Typical VHB Tape Properties for Modeling

Thermal Coefficient of Expansion
1 x 10⁻⁴ in/in/°F
1.8 x 10⁻⁴ mm/mm/°C

Young's Modulus (25°C, 1 Hz)
(freq. and temp. dependent)
5 x 10³ kPa

Poisson's Ratio
0.5

Solvent and Fuel Resistance



Test Method

- 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 illustrate that occasional chemical contact should not be detrimental to tape performance in most applications in ordinary use.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

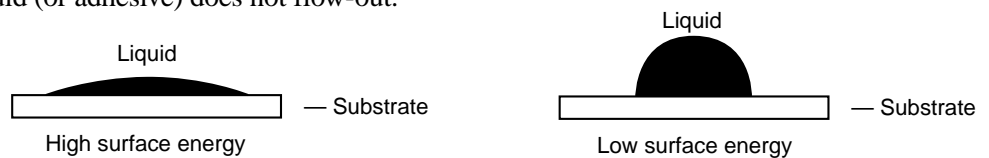
Adhesion to a Variety of Surfaces

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.

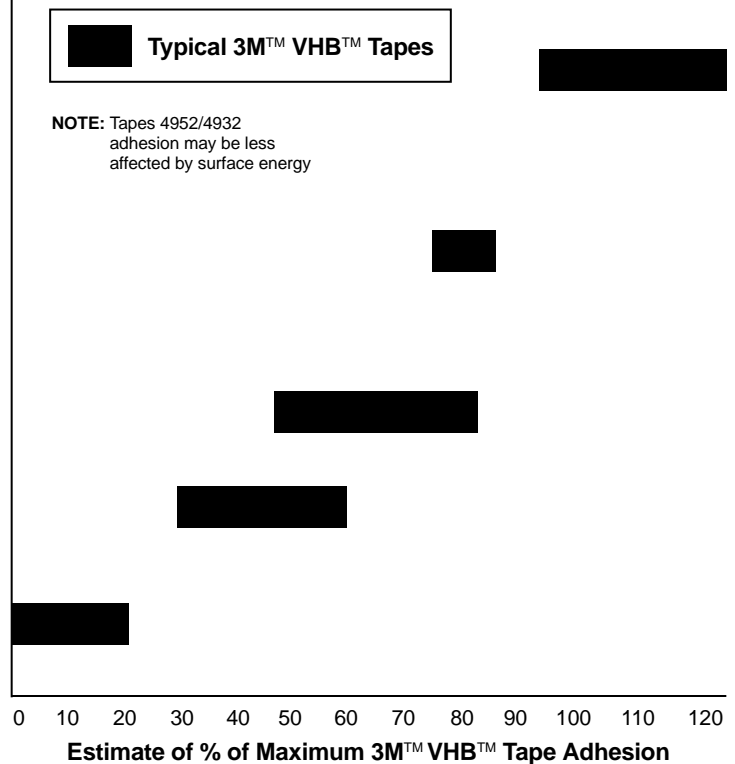


This illustration demonstrates the effect of surface energy on adhesive interfacial contact. High surface energy materials draw the adhesive closer for high bond strength.

Surface Energy Range Dynes/cm

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

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

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Lexan and Noryl are registered trademarks of General Electric Co.

Polane is a registered trademark of Sherwin Williams Co.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

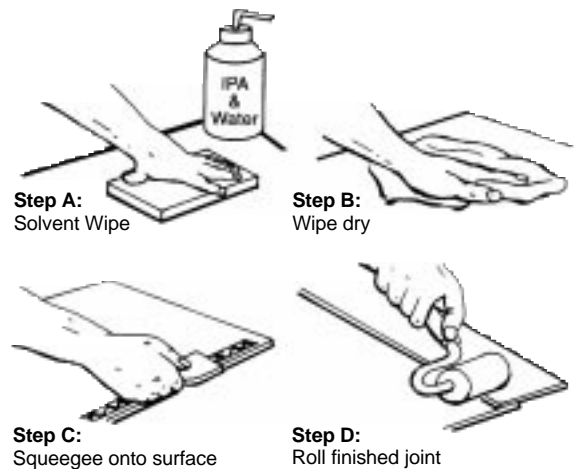
Design Considerations

- 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.

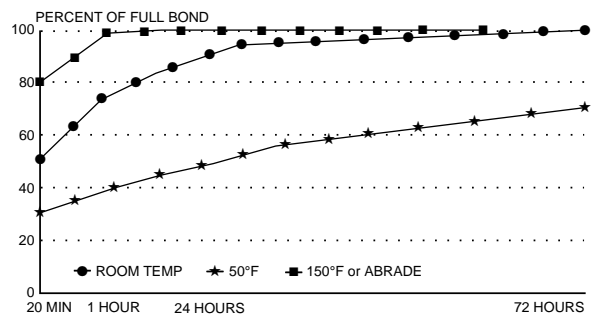
Application Techniques

- To obtain optimum adhesion, the bonding surfaces must be well unified, clean and dry. 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



3M™ VHB™ Tapes Product Selection Guide

Special Feature Tapes									
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*					■ 4979F*			
.120"	▲ 4959*								

*Film Liner

#Film Liner or Paper Liner Available

Adhesive Types:

▲ = Multi-Purpose

■ = Plasticizer Resistant + Paint Adhesion

● = Low Surface Energy

◆ = Low Temperature Installation

Note: User is responsible for determining whether the 3M™ VHB™ Tape is fit for a particular purpose and suitable for user's method of application.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

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) - tapes F-9460PC, F-9469PC, F-9473PC, 4905, 4910, 4920, 4925, 4929, 4930, 4932, 4940, 4949, 4950, 4952, 4955, 4959
60°F (16°C) - tapes 4926, 4936, 4936F, 4941, 4941F, 4945, 4946, 4956, 4956F, 4979F
32° (0°C) - tapes 4943F, 4951, 4957F

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 tapes VHB 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 BSD 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™ 80 Neoprene 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. Be sure to follow primer manufacturing precautions and directions for use when using primers.
 - 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 Silane Priming Technical Bulletin.

Important Application Considerations

THE FOLLOWING APPLICATION CONDITIONS MUST BE EVALUATED THOROUGHLY BY THE USER TO DETERMINE WHETHER VHB TAPES 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 tapes F-9460PC, F-9469PC or F-9473PC 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.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

Important Application Considerations *(continued)*

- **Plasticized Vinyls**
Tapes 4926, 4936, 4941, 4956, 4945 and 4946F have very good plasticizer resistance and adhesion to many vinyls. Because of the wide variation in vinyl formulations, however, evaluation by the user must be conducted with the specific vinyl used to ensure that performance is satisfactory. Problems related to plasticizer migration can often be predicted by accelerated aging of assembled parts at 150°F (66°C) for one week.
- **Rough surfaces.** Tapes 4932 and 4952 were designed to adhere to many low surface energy substrates. Rough surfaces created by light abrasion may actually be detrimental to bond strength.

3M™ VHB™ Double Coated Acrylic Foam Tapes and Adhesives Transfer Tapes

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free 1-800-362-3550. Address correspondence to: 3M Bonding Systems Division, 3M Center, Building 220-7E-01, St. Paul, MN 55144-1000. Our fax number is 612-733-9175. In Canada, phone: 1-800-364-3577. In Puerto Rico, phone 1-809-750-3000. In Mexico, phone: 5-728-2180.

Important Notice

The statements and technical information contained herein and based on tests and data which 3M believes to be reliable, but the accuracy or completeness of such statements and technical information is not guaranteed. User is responsible for determining whether a specific 3M™ VHB™ Tape is fit for a particular purpose and suitable for user's method of application.

Limited Warranty

3M warrants for 12 months from the date of manufacture that 3M™ VHB™ Tape will be free of defects in material and manufacture. 3M MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. This Limited Warranty does not cover damage resulting from the use or inability to use 3M™ VHB™ Tape due to misuse, workmanship in application, or application or storage not in accordance with 3M recommended procedures.

Limitation of Remedies and Liability

If the 3M™ VHB™ Tape is proved to be defective within the warranty period stated above, THE EXCLUSIVE REMEDY, AT 3M'S OPTION, SHALL BE TO REFUND THE PURCHASE PRICE OF OR TO REPAIR OR REPLACE THE DEFECTIVE 3M™ VHB™ TAPE. 3M shall not otherwise be liable for loss or damages, whether direct, indirect, special, incidental, or consequential, regardless of the legal theory asserted, including negligence, warranty, or strict liability.

ISO 9002

This Bonding Systems Division product was manufactured under a 3M quality system registered to ISO 9002 standards.



Bonding Systems Division
3M Center, Building 220-7E-01
St. Paul, MN 55144-1000



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