

LUDLUM MEASUREMENTS, INC.
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**DESIGNER AND
MANUFACTURER
OF**
*Scientific and Industrial
Instruments*

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US Nuclear Regulatory Commission
Licensing Branch
Division of Materials Safety & state Agreements
Washington DC 20555-0001

Mail Control No. 022770
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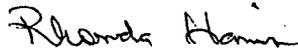
29 January 2010

Dear Mr. Struckmeyer:

In response to email dated 20 Jan 2010, I am submitting test results as written by our Engineer that was conducting the testing for your review as "Attachment 1". I have also included additional information from the manufacturer of the tape as "Attachment 2 and Attachment 3. I also have a drawing of how the source will be attached using the tape as "Attachment 4.

If additional information is needed, please contact me.

Sincerely,



Rhonda Harris

Attachment 1.

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**Ludlum Check Source Proposal
November 2009
Updated January 2010**

Ludlum Measurements has provided radioactive "check" sources mounted on the side of the instrument for many years. This mount is an aluminum housing that requires holes to be drilled into the side of the instrument. We are now looking to provide an alternative mounting for radioactive checksources that does not violate the integrity of the instrument enclosure. This alternative is especially important for our line of intrinsically safe radiation detection equipment, where drilling holes in the enclosure would mean repeating the certification tests. One other benefit to this alternative mounting is a decreased cost to the customer.

What we propose to do is to use a high-tech tape to attach the plastic check source to the instrument, and then a high strength label overlay to protect the edges. We have used both of these adhesives for many years with excellent results. (In what application?)

The high-tech tape is a 45 mil acrylic foam tape made by 3M, their Model 4949. This tape has a tensile strength of 140 lb/in². This tape has excellent durability, solvent, and moisture resistance. It has UL746C recognition. The technical data sheet lists this tape as a possible replacement for rivets and spot welds in interior and exterior applications. We have used this tape since 2002 for mounting belt clips onto instrument cases and have no reports of failures. Prior to our first use of this tape, we did run tests to assure ourselves of its durability over temperature and chemical resistance.

This tape has the following tested typical characteristics:

90 degree peel adhesion:	25 lb/in
Normal tensile adhesion:	140 lb/in ²
Dynamic overlap shear:	80 lb/in ²
Static Shear up to 200 °F:	500 g per 0.5 in ² for 7 days
Temperature tolerance (long term):	200 °F
UL746C temperature range:	-35 to 110 °C

label The tape is somewhat susceptible to being removed, if, for example, a flat screwdriver were used to get up under the tape and pry it off. To counter that, we propose to use a high strength overlay label to protect the edges. We have used this material and adhesive on most of our instrument labels since 1998. Prior to our first use, we tested the labels under severe temperature and chemical environments and assured ourselves of its performance. In the eleven years that we have been using these labels, we have been pleased with their durability. These labels are made of Lexan, and a 3M adhesive #468. This adhesive is a 0.008 in. permanent pressure-sensitive adhesive made for textured and rough surfaces. The adhesive has the following tested typical characteristics:

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Adhesion (ASTM D3330 90 degree peel):
Long term temperature range:
Water resistance:
Chemical resistance:

130 ounces/inch (72 hours)
-40 to 250 °F
water has no appreciable effect
holds securely despite exposure to
gasoline, oil, MEK, sodium chloride
solution, mild acids, and alkalis

In-house Tests of source holder (tape and label)

Before beginning tests, a one inch check source was attached to an instrument can using only the 3M VHB tape. Also attached to the can was another one inch check source using the 3M tape and it was then covered by a label with the 3M adhesive #468. The assembly then allowed at least 72 hours to cure. The following tests were deemed to approximate conditions and exposures of a typical instrument in the field.

First, a coarse (50-80 grit) aluminum oxide scrubbing pad was used on the label for at least 30 seconds using a circular scrubbing pattern. A flat-head screw driver (~1mm thick) was used at a 45° angle to try and pry the label up with 5 pounds of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

TEMPERATURE

Temperature tests were performed using ANSI standard N42.17A. (-10°C to 50°C) Temperatures were allowed to stabilize and maintained for 30 minutes. A Versa-Range Test Chamber Model 1004-3-2TPB Serial No. RC5-100 was used. At 50°C and at -10C the aluminum oxide scrubbing pad was used on the label for at least 30 seconds. A flat head screw driver ~1mm thick was used at a 45° angle to try and pry the label up with 5 lbs. of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

WATER

The can was then submerged in water for 30 minutes. The aluminum oxide scrubbing pad was then used on the label for at least 30 seconds. A flat head screw driver ~1mm thick was used at a 45° angle to try and pry the label up with 5 lbs. of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

TEMPERATURE SHOCK

A temperature shock test was performed using ANSI standard N42.17A. (22°C/-10°C), (-10°C/22°C), (22°C/50°C), and then (50°C/22°C). Each temperature change took place within 5 minutes, and the temperature was maintained for one hour. The aluminum oxide scrubbing pad was then used on the label for at least 30 seconds. Then a flat head screw driver ~1mm thick was used at a 45° angle to try and pry the label up with 5 lbs. of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

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Attachment 1

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ALCOHOL

70% Isopropyl Alcohol was then applied on and around both label and the source held by 3M tape only. The alcohol was allowed to sit for 2 minutes then it was removed with a rag. Then the aluminum oxide scrubbing pad was used on the label for at least 30 seconds. Then a flat head screw driver ~1mm thick was used at a 45° angle to try and pry the label up with 5 lbs. of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

HOUSEHOLD CLEANER

The household cleaner "Scrubbing Bubbles" was applied, forming a thick foam on and around both label and the source held by 3M tape only. The foam was allowed to sit for 5 minutes before being removed with a rag. Then the aluminum oxide scrubbing pad was used on the label for at least 30 seconds. Then a flat head screw driver ~1mm thick was used at a 45° angle to try and pry the label up with 5 lbs. of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

LUBRICATION

A common lubricant, WD-40, was applied on and around both label and the source held by 3M tape only. The WD-40 was allowed to sit for 2 minutes then it was removed with a rag. The aluminum oxide scrubbing pad was used on the label for at least 30 seconds. A flat head screw driver ~1mm thick was used at a 45° angle to try and pry the label up with 5lbs. of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

CUTTING AND TAPPING OIL

A cutting and tapping oil "Cool Tool II" was applied on and around both label and the source held by 3M tape only. The cutting and tapping oil was allowed to sit for 2 minutes then it was removed with a rag. The aluminum oxide scrubbing pad was used on the label for at least 30 seconds. A flat head screw driver ~1mm thick was used at a 45° angle to try and pry the label up with 5lbs. of measured pressure. This step was repeated on the source held by 3M tape only. There were no signs of loosening or delamination.

In conclusion, we feel that the proposed attachment method will provide a durable mounting for the check source on the side of our instrument, despite mechanical forces, temperature extremes, and chemical exposures.

Richard Smola
Design Engineer
Ludlum Measurements, Inc.

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3M**Adhesive Transfer Tapes
with Adhesive 200**

(label)

467 • 468 • 9567 • 9568

Technical Data

September, 2002

Product Description

3M™ Adhesive Transfer Tapes with 3M™ Adhesive 200 are the industry choice for metal nameplates for the industrial or electronic applications because of excellent quality, consistency and durability. In addition, as a result of 3M's innovative, proprietary process, Adhesive 200 also offers the following performance characteristics:

- Excellent high temperature performance as well as excellent shear strength (that minimizes edge lifting and slippage of parts).
- Excellent resistance to harsh environments; this adhesive can withstand splashes of organic solvents, weak acids and bases and salt water. In addition, it performs well after exposures to humidity and hot/cold cycles.
- **Outstanding peel adhesion values are outstanding on metals and HSE plastics. Peel adhesion increases with increased adhesive thickness.**

Construction

	Adhesive Type/ Color	Adhesive Thickness ¹ (mils, mm)	Liner Color, Type, Print	Liner Caliper/ Liner Release ²
Tape 467	200	2.3 mils (0.06 mm)	62# Densified Kraft	3.8 mils 15 grams/inch
Tape 468	200	5.2 mils (0.13 mm)	62# Densified Kraft	3.8 mils 33 grams/inch
Tape 9567	200 Fibred	2.3 mils (0.06 mm)	62# Densified Kraft	3.8 mils 21 grams/inch
Tape 9568	200 Fibred	5.2 mils (0.13 mm)	62# Densified Kraft	3.8 mils 29 grams/inch

Note 1: The caliper listed is based on a calculation from manufacturing controlled adhesive coat weights using a density of 1.012 g/cc. While past data pages have listed nominal thicknesses of 2 and 5 mils, the coat weight (and theoretical caliper) has not changed.

Note 2: Typical liner release value, in grams/inch, tested at 90 ipm.

3M™ Adhesive Transfer Tapes with Adhesive 200

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Typical Physical Properties and Performance Characteristics

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

I. Adhesion to stainless steel

ASTM D3330 modified (90 degree peel, 2 mil aluminum foil backing)

Dwell	Tape 467/9567		Tape 468/9568	
	ounces/inch	N/100 mm	ounces/inch	N/100 mm
15 minute room temperature (RT)	66	72	90	98
72 hour RT	91	100	130	142
72 hour 158°C (70°C)	150	164	207	226

II. Adhesion to Other Surfaces

ASTM D3330 modified (90 degree peel, 2 mil aluminum foil backing)

Dwell	Tape 467/9567		Tape 468/9568	
	ounces/inch	N/100 mm	ounces/inch	N/100 mm
72 hour RT ABS	57	62	70	77
72 hour RT glass	82	90	113	124

III. Relative High Temperature Operating Ranges

Short term (minutes/hours)	350°F (177°C)
Long term (days/weeks)	250°F (121°C)

IV. Shelf Life of Tape in Roll Form 24 months from the manufacturing date when stored at 70°F (21°C) and 50% relative humidity.

V. Environmental Performance

The properties defined are based on the attachment of impervious faceplate materials (such as aluminum) to an aluminum test surface.

Bond Build-up: The bond strength of 3M™ Adhesive 200 increases as a function of time and temperature.

Humidity Resistance: High humidity has a minimal effect on adhesive performance. Bond strengths are generally higher after exposure for 7 days at 90°F (32°C) and 90% relative humidity.

UV Resistance: When properly applied, nameplates and decorative trim parts are not adversely affected by outdoor exposure.

Water Resistance: Immersion in water has no appreciable effect on the bond strength. After 100 hours in room temperature water the bond actually shows an increase in strength.

Temperature Cycling Resistance: Bond strength generally increases after cycling four times through:
4 hours at 158°F (70°C)
4 hours at -20°F (-29°C)
16 hours at room temperature

Chemical Resistance: When properly applied, nameplate and decorative trim parts will hold securely after exposure to numerous chemicals including gasoline, MEK, oil, Freon™ TF, sodium chloride solution, mild acids and alkalis.

VI. Low Service Temperature

-40°F (-40°C)

Many applications survive below this temperature (factors affecting successful applications are: materials being bonded, dwell at RT before cold exposure and stress below the Tg [i.e., expansion/contraction stresses, impact]). Optimum conditions are: bonding HSE materials, longer time at RT before cold exposure and little or no stress below the Tg.

Note: Adhesive 200 is not recommended for low energy plastics (polypropylene, polyethylene, powder coated paints). For these surfaces please refer to 3M™ Adhesives 300, 350, 300LSE and the 300MP. The Adhesive 300LSE has been used more frequently as the bond areas in applications become smaller and smaller. It offers the smooth, high performance characteristics of the 3M™ Adhesive 200MP with higher adhesion to plastic. Adhesive 300LSE is ideal for bonding to polyethylene, polypropylene, powder coated paints and for applications where the bonded area is less than 1/4" wide.

3M™ Adhesive Transfer Tapes with Adhesive 200

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Available Sizes	Master Size	Slit Width (minimum)	Roll Length ^a	Core Size	Slit Tolerance
Tape 467	48"	1/2"	60-360 yards	3"	± 1/32"
Tape 468	48"	1/2"	60-360 yards	3"	± 1/32"
Tape 9567	48"	1/2"	1/2"-27/8" - 360 yards over 27/8"-48" - 540 yards	3"	± 1/32"
Tape 9568	48"	1/2"	1/2"-1" - 180 yards over 1"-48" - 360 yards	3"	± 1/32"

Note: Roll lengths vary by product slit width (the customer service department has more detailed information, 1-800-328-1681).

Application Techniques

For maximum bond strength (during installation of the final part) the surface should be thoroughly cleaned and dried. Typical cleaning solvents are heptane (for oily surfaces) or isopropyl alcohol for plastics. Use reagent grade solvents since common household materials like rubbing alcohol frequently contain oils to minimize the drying affect on skin. These oils can interfere with the performance of a pressure-sensitive adhesive. Consult solvent manufacturers MSDS for proper handling and storage instructions. Also, use disposable wipes, that do not contain oils, to remove the cleaning solvents.

It is necessary to provide pressure during lamination (1.5-20 pli recommended) and during final part installation (10-15 psi) to allow the adhesive to come into direct contact with the substrate. Using a hard edged plastic tool, which is the full width of the laminated part, helps to provide the necessary pressure at the point of lamination. Heat can increase bond strength when bonding to metal parts (generally this same increase is observed at room temperature over longer times, weeks). For plastic parts, the bond strength is not enhanced with the addition of heat.

The ideal adhesive application temperature range is 70°F (21°C) to 100°F (38°C). Application is not recommended if the surface temperature is below 50°F (10°C) because the adhesive becomes too firm to adhere readily. Once properly applied, at the recommended application temperature, low temperature holding is generally satisfactory (please refer to section VII of the Typical Physical Properties and Performance Characteristics).

When bonding a thin, smooth, flexible material to a smooth surface, it is generally acceptable to use 2 mils of adhesive. If a texture is visible on one or both surfaces, the 5 mil adhesive would be suggested. If both materials are rigid, it may be necessary to use a thicker adhesive to successfully bond the components. 3M™ VHB™ Acrylic Foam Tapes may be required (please refer to the data page 70-0709-3863-7).

Application Equipment

To apply adhesives in a wide web format, lamination equipment is required to ensure acceptable quality. To learn more about working with pressure-sensitive adhesives please refer to technical bulletin, Lamination Techniques for Converters of Laminating Adhesives (70-0704-1430-8).

For additional dispenser information, contact your local 3M sales representative, or the toll free 3M sales assistance number at 1-800-362-3550.

3M™ Adhesive Transfer Tapes with Adhesive 200

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Application Ideas

- Metal nameplates for the appliance or electronic markets.
- Excellent general purpose bonding in the industrial market.
- Used for nameplates and decorative plates produced on roll to roll rotary die cutting process. 3M™ Adhesive Transfer Tapes 9567 and 9568 are stabilized adhesive for narrow rolls.

For Additional Information

To request additional product information or to arrange for sales assistance, call toll free 1-800-223-7427 or visit www.3m.com/converter. Address correspondence to: 3M Engineered Adhesives Division, 3M Center, Building 220-7E-01, St. Paul, MN 55144-1000. Our fax number is 651-733-9175. In Canada, phone: 1-800-364-3577. In Puerto Rico, phone: 1-787-750-3000. In Mexico, phone: 52-70-04-00.

Certification/ Recognition

TSCA: These products are defined as articles under the Toxic Substances Control Act and therefore, are exempt from inventory listing requirements.

MSDS: These products are not subject to the MSDS requirements of the Occupational Safety and Health Administration's Hazard Communication Standard, 29 C.F.R. 1910.1200(b)(6)(v). When used under reasonable conditions or in accordance with the 3M directions for use, the products should not present a health and safety hazard. However, use or processing of the products in a manner not in accordance with the directions for use may affect their performance and present potential health and safety hazards.

UL: Many of these products have been recognized by Underwriters Laboratories Inc. under Standard, UL 969, Marking and Labeling Systems Materials Component. For more information on the UL Certification, please visit the 3M website at <http://www.3m.com/converter>.

Important Notice

3M MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's method of application. Please remember that many factors can affect the use and performance of a 3M product in a particular application. The materials to be bonded with the product, the surface preparation of those materials, the product selected for use, the conditions in which the product is used, and the time and environmental conditions in which the product is expected to perform are among the many factors that can affect the use and performance of a 3M product. Given the variety of factors that can affect the use and performance of a 3M product, some of which are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for the user's method of application.

Limitation of Remedies and Liability

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



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



Converter Markets
Engineered Adhesives Division
3M Center, Building 551-1W-02
St. Paul, MN 55144-1000



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40% pre-consumer
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3M

VHB™ Tapes

Technical Data

June, 2009

Product Description:

3M™ VHB™ Tapes provide the convenience and simplicity of a tape fastener and are ideal for use in many interior and exterior bonding applications. In many situations, they can replace rivets, spot welds, liquid adhesives and other permanent fasteners.

These 3M™ VHB™ Tapes are made with acrylic foam which is viscoelastic in nature. This gives the foam energy absorbing and stress relaxing properties which provides these tapes with their unique characteristics. The acrylic chemistry provides outstanding durability performance.

These tapes utilize a variety of specific foam, adhesive, color and release liner types to provide each product/family with specific features. These features can include adhesion to specific or a broad range of materials, conformability, high tensile strength, high shear and peel adhesion, resistance to plasticizer migration, and UL746C recognition. All 3M™ VHB™ Tapes have excellent durability and excellent solvent and moisture resistance.

Note: All 3M™ VHB™ Tapes should be thoroughly evaluated by the user under actual use conditions with intended substrates to determine whether a specific tape is fit for a particular purpose and suitable for user's method of application, especially if expected use involves extreme environmental conditions or high dead load stress.

3M™ VHB™ Tape Products

Tape Number	Color	Thickness in. (mm)	Tape Number	Color	Thickness in. (mm)	Tape Number	Color	Thickness in. (mm)
4611	Dk Gray	0.045 (1.1)	4930 (F)	White	0.025 (0.64)	4955	White	0.080 (2.0)
4618	White	0.025 (0.64)	4932	White	0.025 (0.64)	4956 (F)	Gray	0.062 (1.55)
4622	White	0.045 (1.1)	4936 (F)	Gray	0.025 (0.64)	4957F	Gray	0.062 (1.55)
4624	White	0.062 (1.55)	4941 (F)	Gray	0.045 (1.1)	4959 (F)	White	0.120 (3.0)
4646	Dk Gray	0.025 (0.64)	4943F	Gray	0.045 (1.1)	4979F	Black	0.062 (1.55)
4655	Dk Gray	0.062 (1.55)	4945	White	0.045 (1.1)	4991	Gray	0.090 (2.3)
4905	Clear	0.020 (0.5)	4946	White	0.045 (1.1)	5915 (P)	Black	0.016 (0.4)
4910	Clear	0.040 (1.0)	4947F	Black	0.045 (1.1)	5925 (P)	Black	0.025 (0.64)
4919F	Black	0.025 (0.64)	4949	Black	0.045 (1.1)	5930 (P)	Black	0.032 (0.8)
4920	White	0.015 (0.4)	4950	White	0.045 (1.1)	5952 (P)	Black	0.045 (1.1)
4926	Gray	0.015 (0.4)	4951	White	0.045 (1.1)	5958FR	Black	0.040 (1.0)
4929	Black	0.025 (0.64)	4952	White	0.045 (1.1)	5962 (P)	Black	0.062 (1.55)

(F) or (P) after the product number designate that both a paper and film liner product version are available. [e.g. 4930 (paper liner) and 4930F (film liner), 5915 (film liner) and 5915P (paper liner)]. See page 3 for specific details.

3M™ VHB™ Tapes Adhesive Types:

Multi-Purpose Acrylic: This adhesive bonds to a wide range of materials including metals, glass, and high and medium surface energy plastics and paints. This unique adhesive also has the ability to resist migration of plasticizers in vinyl substrates.

Modified Acrylic: This adhesive bonds to medium low surface energy paints and plastics, including many powder coated paints in addition to the substrates listed with the multi-purpose acrylic adhesive (except plasticized vinyl).

General Purpose Acrylic: This adhesive bonds to most higher surface energy substrates including metal, glass and high surface energy plastics.

Low Temperature Applicable Acrylic: This adhesive can make bonds down to 32°F (0°C), compared to 50°F (10°C) for most acrylic adhesives. This adhesive system bonds to most high surface energy substrates including metal, glass and high surface energy plastics.

Low Surface Energy: This high performance synthetic adhesive bonds to many lower surface energy substrates, including many plastics and power coated paints, plus smooth general purpose substrates.

3M™ VHB™ Tapes Foam Types:

Conformable: This foam provides high strength with the capability of conforming to the irregularities of rigid substrates, even when there might be slight mismatch.

Very Conformable: This foam provides the highest level of conformability while maintaining high internal strength.

Firm: This foam provides the highest level of foam strength in the 3M™ VHB™ Tapes family.

Clear: Not technically a foam, this solid acrylic material provides excellent clarity.

3M™ VHB™ Tape Families:

- 4941** This family utilizes multi-purpose acrylic adhesive on both sides of conformable foam. The adhesive provides excellent adhesion to a broad range of high and medium surface energy substrates including metals, glass, and a wide variety of plastics, as well as plasticized vinyl. The conformable foam provides good contact, even with mismatched substrates. Available in gray and black.
- 5952** This family matches the modified acrylic adhesive on both sides of very conformable foam, providing adhesion to the broadest range of substrates, including most powder coated paints. Available in black.
- 4950** This family has general purpose adhesive on both sides of firm type foam. This family is typically used on metal, glass and high surface energy plastic substrates. Available in white and black.
- 4945** This family has multi-purpose adhesive on both sides of firm foam. Available in white.
- 4910** This family of clear tapes is excellent for applications where clear or colorless is desired. The general purpose adhesive on both sides is suitable for high surface energy substrates.
- 4951** This family of tapes is based around the low temperature applicable acrylic adhesive system, utilized on both firm and conformable foam types. These products are suitable for high surface energy substrates. Available in white (firm foam) and gray (conformable foam).
- 4952** This family utilizes the low surface energy adhesive on a firm foam. Available in white.
- 4611** This family has a general purpose adhesive on both sides of firm foam. This family of tapes is typically used on metal substrates, and has the added feature of high temperature resistance, making it often suitable for bonding prior to high temperature paint processing. Available in dark gray.
- 4622** This family has general purpose adhesive on the face side (the side that typically would be bonded first) and multi-purpose adhesive on the liner side (the side exposed when the release liner is removed) of a conformable foam. Available in white.

3M™ VHB™ Tape Product Family Guide

Thickness Inches (mm)	Family ▶	4941		5952	4950		4945	4910	4951		4952	4611	4622
	Color ▶	Gray	Black	Black	White	Black	White	Clear	White	Gray	White	Dk Gray	White
	Foam type ▶	Conform	Conform	Very Conf	Firm	Firm	Firm	n/a	Firm	Conform	Firm	Firm	Conform
	Adhesive ▶	Multi-Purpose		Modified	General Purpose		Multi-Purp	Gen-Purp	Low Temp Apply		LSE	Gen-Purp	Gen/Multi
0.015 / 0.016 (0.4)		4926		5915 5915P	4920								
0.020 (0.5)							4905						
0.025 (0.64)		4936 4936F	4919F	5925 5925P	4930 4930F	4929				4932		4646	4618
0.032 (0.8)				5930 5930P									
0.040 (1.0)				5958FR				4910					
0.045 (1.1)		4941 4941F	4947F	5952 5952P	4950	4949	4945 4946		4951	4943	4952	4611	4622
0.062 (1.55)		4956 4956F	4979F	5962 5962P					4957			4655	4624
0.080 (2.0)					4955								
0.090 (2.3)		4991											
0.120 (3.0)					4959 4959F								

NOTE: For easy product comparison, data in this product information page will be organized by product family.

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.

3M™ VHB™ Tapes			Thickness		Adhesive Adhesive Type	Foam Type	Density		Release Liner Thickness			
Family	Product Number	Color	Inches	(mm) Tolerance			lb/ft ²	(kg/m ²)	Type	Inches	(mm)	Color
4941	4919F	Black	0.025	(0.64) ± 15%	Multi-Purp	Conform	45	(720)	PE Film	0.005	(0.125)	Red (printed)
	4926	Gray	0.015	(0.4) ± 15%	Multi-Purp	Conform	45	(720)	DK Paper	0.003	(0.08)	White (printed)
	4936	Gray	0.025	(0.64) ± 15%	Multi-Purp	Conform	45	(720)	DK Paper	0.003	(0.08)	White (printed)
	4936F	Gray	0.025	(0.64) ± 15%	Multi-Purp	Conform	45	(720)	PE Film	0.005	(0.125)	Red (printed)
	4941	Gray	0.045	(1.1) ± 10%	Multi-Purp	Conform	45	(720)	DK Paper	0.003	(0.08)	White (printed)
	4941F	Gray	0.045	(1.1) ± 10%	Multi-Purp	Conform	45	(720)	PE Film	0.005	(0.125)	Red
	4947F	Black	0.045	(1.1) ± 10%	Multi-Purp	Conform	45	(720)	PE Film	0.005	(0.125)	Red (printed)
	4956	Gray	0.062	(1.55) ± 10%	Multi-Purp	Conform	45	(720)	DK Paper	0.003	(0.08)	White (printed)
	4956F	Gray	0.062	(1.55) ± 10%	Multi-Purp	Conform	45	(720)	PE Film	0.005	(0.125)	Red (printed)
	4979F	Black	0.062	(1.55) ± 10%	Multi-Purp	Conform	45	(720)	PE Film	0.005	(0.125)	Red (printed)
4991	Gray	0.090	(2.3) ± 10%	Multi-Purp	Conform	45	(720)	PE Film	0.005	(0.125)	Red (printed)	
5952	5915	Black	0.016	(0.4) ± 15%	Modified	Very Conf	43	(690)	PE Film	0.005	(0.125)	Red
	5915P	Black	0.016	(0.4) ± 15%	Modified	Very Conf	43	(690)	PCK Paper	0.004	(0.10)	White (printed)
	5925	Black	0.025	(0.64) ± 15%	Modified	Very Conf	37	(590)	PE Film	0.005	(0.125)	Red
	5925P	Black	0.025	(0.6) ± 15%	Modified	Very Conf	37	(590)	PCK Paper	0.004	(0.10)	White (printed)
	5930	Black	0.032	(0.8) ± 15%	Modified	Very Conf	37	(590)	PE Film	0.005	(0.125)	Red
	5930P	Black	0.032	(0.8) ± 15%	Modified	Very Conf	37	(590)	PCK Paper	0.004	(0.10)	White (printed)
	5952	Black	0.045	(1.1) ± 10%	Modified	Very Conf	37	(590)	PE Film	0.005	(0.125)	Red
	5952P	Black	0.045	(1.1) ± 10%	Modified	Very Conf	37	(590)	PCK Paper	0.004	(0.10)	White (printed)
	5958FR	Black	0.040	(1.0) ± 10%	Modified	Very Conf	50	(800)	PE Film	0.005	(0.125)	Red
	5962	Black	0.062	(1.55) ± 10%	Modified	Very Conf	37	(590)	PE Film	0.005	(0.125)	Red
5962P	Black	0.062	(1.55) ± 10%	Modified	Very Conf	37	(590)	PCK Paper	0.004	(0.10)	White (printed)	
4950	4920	White	0.015	(0.4) ± 15%	Gen Purp	Firm	50	(800)	DK Paper	0.003	(0.08)	White (printed)
	4929	Black	0.025	(0.64) ± 15%	Gen Purp	Firm	50	(800)	Polyester	0.002	(0.05)	Clear
	4930	White	0.025	(0.64) ± 15%	Gen Purp	Firm	50	(800)	DK Paper	0.003	(0.08)	White (printed)
	4930F	White	0.025	(0.64) ± 15%	Gen Purp	Firm	50	(800)	PE Film	0.005	(0.125)	Red
	4949	Black	0.045	(1.1) ± 10%	Gen Purp	Firm	50	(800)	Polyester	0.002	(0.05)	Clear
	4950	White	0.045	(1.1) ± 10%	Gen Purp	Firm	50	(800)	DK Paper	0.003	(0.08)	White (printed)
	4955	White	0.080	(2.0) ± 10%	Gen Purp	Firm	45	(720)	Polyester	0.002	(0.05)	Clear
	4959	White	0.120	(3.0) ± 10%	Gen Purp	Firm	45	(720)	Polyester	0.002	(0.05)	Clear
	4959F	White	0.120	(3.0) ± 10%	Gen Purp	Firm	45	(720)	PE Film	0.005	(0.125)	Red
4945	4945	White	0.045	(1.1) ± 10%	Multi-Purp	Firm	50	(800)	DK Paper	0.003	(0.08)	White (printed)
	4946	White	0.045	(1.1) ± 10%	Multi-Purp	Firm	50	(800)	PE Film	0.005	(0.125)	Clear
4910	4905	Clear	0.020	(0.5) ± 15%	Gen Purp	Solid	60	(960)	PE Film	0.005	(0.125)	Red (printed)
	4910	Clear	0.040	(1.0) ± 10%	Gen Purp	Solid	60	(960)	PE Film	0.005	(0.125)	Red (printed)
4951	4951	White	0.045	(1.1) ± 10%	Low Temp Appl	Firm	50	(800)	Polyester	0.002	(0.05)	Clear
	4943F	Gray	0.045	(1.1) ± 10%	Low Temp Appl	Conform	45	(720)	Polyester	0.002	(0.05)	Clear
	4957F	Gray	0.062	(1.55) ± 10%	Low Temp Appl	Conform	45	(720)	Polyester	0.002	(0.05)	Clear
4952	4932	White	0.025	(0.64) ± 15%	LSE	Firm	50	(800)	DK Paper	0.003	(0.08)	White (printed)
	4952	White	0.045	(1.1) ± 10%	LSE	Firm	50	(800)	DK Paper	0.003	(0.08)	White (printed)
4611	4611	Dk Gray	0.045	(1.1) ± 10%	Gen Purp	Firm	52	(840)	PE Film	0.005	(0.125)	Red
	4646	Dk Gray	0.025	(0.64) ± 15%	Gen Purp	Firm	52	(840)	PE Film	0.005	(0.125)	Red
	4655	Dk Gray	0.062	(1.55) ± 10%	Gen Purp	Firm	52	(840)	PE Film	0.005	(0.125)	Red
4622	4618	White	0.025	(0.64) ± 15%	Gen/Multi-Purp	Conform	45	(720)	PE Film	0.004	(0.10)	Green
	4622	White	0.045	(1.1) ± 10%	Gen/Multi-Purp	Conform	45	(720)	PE Film	0.004	(0.10)	Green
	4624	White	0.062	(1.55) ± 10%	Gen/Multi-Purp	Conform	45	(720)	PE Film	0.004	(0.10)	Green

3M™ VHB™ 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.

Family	3M™ VHB™ Tapes			Dynamic Adhesion Performance					
	Product Number	Color	Thickness Inches	90° Peel Adhesion		Normal Tensile		Dynamic Overlap Shear	
				lb/in	N/100 mm	lb/in ²	kPa	lb/in ²	kPa
4941	4919F	Black	0.025	17	(300)	90	(620)	80	(550)
	4928	Gray	0.015	12	(210)	95	(655)	90	(620)
	4936 (F)	Gray	0.025	17	(300)	90	(620)	80	(550)
	4941 (F)	Gray	0.045	20	(350)	85	(585)	70	(480)
	4947F	Black	0.045	20	(350)	85	(585)	70	(480)
	4956 (F)	Gray	0.062	20	(350)	80	(550)	70	(480)
	4979F	Black	0.062	20	(350)	80	(550)	70	(480)
	4991	Gray	0.090	20	(350)	70	(480)	65	(450)
5952	5915 (P)	Black	0.016	13	(230)	90	(620)	90	(620)
	5925 (P)	Black	0.025	17	(300)	90	(620)	90	(620)
	5930 (P)	Black	0.032	18	(315)	90	(620)	85	(585)
	5952 (P)	Black	0.045	20	(350)	90	(620)	80	(550)
	5958FR	Black	0.040	20	(350)	100	(690)	100	(690)
	5962 (P)	Black	0.062	20	(350)	90	(620)	80	(550)
4950	4920	White	0.015	15	(260)	160	(1100)	100	(690)
	4929	Black	0.025	20	(350)	160	(1100)	100	(690)
	4930 (F)	White	0.025	20	(350)	160	(1100)	100	(690)
	4949	Black	0.045	25	(440)	140	(970)	80	(550)
	4950	White	0.045	25	(440)	140	(970)	80	(550)
	4955	White	0.080	20	(350)	95	(655)	70	(480)
	4959 (F)	White	0.120	20	(350)	75	(520)	55	(380)
4945	4945	White	0.045	25	(440)	140	(970)	80	(550)
	4946	White	0.045	25	(440)	140	(970)	80	(550)
4910	4905	Clear	0.020	12	(210)	100	(690)	70	(480)
	4910	Clear	0.040	15	(260)	100	(690)	70	(480)
4951	4951	White	0.045	18	(315)	110	(760)	80	(550)
	4943F	Gray	0.045	20	(350)	85	(585)	70	(480)
	4957F	Gray	0.062	20	(350)	75	(515)	70	(480)
4952	4932	White	0.025	20	(350)	100	(690)	100	(690)
	4952	White	0.045	25	(440)	80	(550)	80	(550)
4611	4611	Dk Gray	0.045	18	(315)	90	(590)	65	(445)
	4646	Dk Gray	0.025	15	(250)	100	(690)	80	(550)
	4655	Dk Gray	0.062	18	(315)	80	(550)	60	(415)
4622	4618	White	0.025	17	(300)	85	(580)	80	(550)
	4622	White	0.045	20	(350)	70	(480)	65	(445)
	4624	White	0.062	20	(350)	55	(380)	60	(410)

-  **90° Peel Adhesion** - Based on ASTM D3330 - To stainless steel, room temperature, jaw speed 12 in/min (305 mm/min). Average force to remove is measured. 72 hour dwell.
-  **Normal Tensile (T-Block Tensile)** - ASTM D-897 - To aluminum, room temperature, 1 in² (6.45 cm²), jaw speed 2 in/min (50 mm/min.) Peak force to separate is measured. 72 hour dwell.
-  **Dynamic Overlap Shear** - ASTM D-1002 - To stainless steel, room temperature, 1 in² (6.45 cm²), jaw speed 0.5 in/min (12.7 mm/min.) Peak force to separate is measured. 72 hour dwell.

3M™ VHB™ Tapes

Attachment 3

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.

Family	3M™ VHB™ Tapes			Static Shear					Temperature Tolerance				
	Product Number	Color	Thickness Inches	Weight (grams) that 1/2 square inch will hold 10,000 minutes (7 days)					Short Term (Minutes, Hours)		Long Term (Days, Weeks)		
				72°F (22°C)	150°F (66°C)	200°F (93°C)	250°F (121°C)	350°F (177°C)	°F	°C	°F	°C	
4941	4919F	Black	0.025	1000	500	500				300	(149)	200	(93)
	4926	Gray	0.015	1000	500	500				300	(149)	200	(93)
	4936 (F)	Gray	0.025	1000	500	500				300	(149)	200	(93)
	4941 (E)	Gray	0.045	1000	500	500				300	(149)	200	(93)
	4947F	Black	0.045	1000	500	500				300	(149)	200	(93)
	4956 (F)	Gray	0.062	1000	500	500				300	(149)	200	(93)
	4979F	Black	0.062	1000	500	500				300	(149)	200	(93)
	4991	Gray	0.090	1000	500	500				250	(121)	200	(93)
5952	5915 (P)	Black	0.016	1000	500	500	250			300	(149)	250	(121)
	5925 (P)	Black	0.025	1000	500	500	250			300	(149)	250	(121)
	5930 (P)	Black	0.032	1000	500	500	250			300	(149)	250	(121)
	5952 (P)	Black	0.045	1000	500	500	250			300	(149)	250	(121)
	5958FR	Black	0.040	1000	350	250				300	(149)	200	(93)
	5962 (P)	Black	0.062	1000	500	500	250			300	(149)	250	(121)
4950	4920	White	0.015	1500	500	500				300	(149)	200	(93)
	4929	Black	0.025	1500	500	500				300	(149)	200	(93)
	4930 (F)	White	0.025	1500	500	500				300	(149)	200	(93)
	4949	Black	0.045	1500	500	500				300	(149)	200	(93)
	4950	White	0.045	1500	1000	500				300	(149)	200	(93)
	4955	White	0.080	1500	1000	750	750	750		400	(204)	300	(149)
	4959 (F)	White	0.120	1500	1000	750	750	750		400	(204)	300	(149)
4945	4945	White	0.045	1500	500	500				300	(149)	200	(93)
	4946	White	0.045	1500	500	500				300	(149)	200	(93)
4910	4905	Clear	0.020	1000	500	500				300	(149)	200	(93)
	4910	Clear	0.040	1000	500	500				300	(149)	200	(93)
4951	4951	White	0.045	1250	500	500				300	(149)	200	(93)
	4943F	Gray	0.045	1000	500	500				300	(149)	200	(93)
	4957F	Gray	0.062	1000	500	500				300	(149)	200	(93)
4952	4932	White	0.025	1500	500					200	(93)	160	(71)
	4952	White	0.045	1500	500					200	(93)	160	(71)
4611	4611	Dk Gray	0.045	1500	750	750	750	750		450	(232)	300	(149)
	4646	Dk Gray	0.025	1500	750	750	750	750		450	(232)	300	(149)
	4655	Dk Gray	0.062	1500	750	750	750	750		450	(232)	300	(149)
4622	4618	White	0.025	1000	250	250				250	(121)	200	(93)
	4622	White	0.045	1000	250	250				250	(121)	200	(93)
	4624	White	0.062	1000	250	250				250	(121)	200	(93)



Static Shear - ASTM D3654 - To stainless steel, tested at various temperatures and gram loadings. 0.5 in² (3.22 cm²). Will hold listed weight for 10,000 minutes (approximately 7 days). Conversion: 1500 g/0.5 in² equals 6.6 lb/in²; 500 g/0.5 in² = 2.2 lb/in².

Short Term Temperature Tolerance - No change in room temperature dynamic shear properties following 4 hours conditioning at indicated temperature with 100 g/static load. (Represents minutes, hours in a process type temperature exposure).

Long Term Temperature Tolerance - Maximum temperature where tape supports at least 250 g load per 0.5 in² in static shear for 10,000 minutes. (Represents continuous exposure for days or weeks).

3M™ VHB™ Tapes**Available Sizes**

Tape Thickness inches (mm)	Standard Length yards (meters)	Minimum Width inches (mm)	Maximum Width inches (mm)	Maximum Roll Length						
				Width 1/4" up to 3/8" (6.4mm up to 9.5mm)		Width >3/8" up to 1/2" (>9.5mm up to 12.7mm)		Width 1/2" and wider (12.7mm and wider)		
				yards	(meters)	yards	(meters)	yards	(meters)	
0.015/0.016 (0.4)	72 (65.8)	0.25 (6.4)	48* (1220)	144 (131.6)	175 (160)	360 (330)				
0.020 (0.5)	72 (65.8)	0.25 (6.4)	48* (1220)	72 (65.8)	108 (98.8)	175 (160)				
0.025 (0.64)	72 (65.8)	0.25 (6.4)	48 (1220)	72 (65.8)	108 (98.8)	175 (160)				
0.032 (0.8)	72 (65.8)	0.25 (6.4)	48 (1220)	72 (65.8)	108 (98.8)	175 (160)				
0.040 (1.0)	36 (32.9)	0.25 (6.4)	48 (1220)	72 (65.8)	108 (98.8)	144 (131.6)				
0.045 (1.1)	36 (32.9)	0.25 (6.4)	48 (1220)	72 (65.8)	108 (98.8)	144 (131.6)				
0.062 (1.55)	36 (32.9)	0.25 (6.4)	46 (1170)	72 (65.8)	72 (65.8)	108 (98.8)				
0.080 (2.0)	36 (32.9)	0.25 (6.4)	46 (1170)	36 (32.9)	36 (32.9)	72 (65.8)				
0.090 (2.3)	36 (32.9)	0.25 (6.4)	46 (1170)	36 (32.9)	36 (32.9)	72 (65.8)				
0.120(4959) (3.0)	36 (32.9)	0.5 (12.7)	46 (1170)	N/A	N/A	36 (32.9)				
0.120(4959F) (3.0)	36 (32.9)	0.25 (6.4)	46 (1170)	36 (32.9)	36 (32.9)	36 (32.9)				

*Exception – 5915 (P) max. width 46 inches (1170 mm); 5925 (P) max. width 47 inches (1195 mm).

Slitting Tolerance

Standard slitting tolerance $\pm 1/32$ inch (± 0.031 inch, ± 0.8 mm).

Precision slitting with slitting tolerance of $\pm 1/64$ inch (± 0.016 in., ± 0.44 mm) is available on select products with minimum order of full web increments.

Core Size

All products are available on a 3 inch ID Core (76.2 mm).

Converted Parts

In addition to standard and custom roll sizes available from 3M through the distribution network, 3M™ VHB™ Tapes are also available in limitless shapes and sizes through the 3M Converter network. For additional information, contact 3M Converter Markets at 1-800-223-7427 or on the web at www.3M.com/converter.

Shelf Life

All 3M™ VHB™ Tapes have a shelf life of 24 months from date of manufacture when stored at 40°F to 100°F (4°C to 38°C) and 0-95% relative humidity. The optimum storage conditions are 72°F (22°C) and 50% relative humidity.

Performance of tapes is not projected to change even after shelf life expires; however, 3M does suggest that 3M™ VHB™ Tapes are used prior to the shelf life date whenever possible.

The manufacturing date is available on all 3M™ VHB™ Tape cores as the lot number. The lot number, typically a 4 digit code, is a Julian date (Y D D D). The first digit refers to the year of manufacture, the last 3 digits refer to the days after January 1. Example: A lot number of 4266 would translate to a date of manufacture of Sept. 22 (266th day of year) in 2004. On most products this is found as the 4 digits after the "9" following the product number. For tapes printed continuously around the core (e.g. 3M™ VHB™ Tape 5952 family) the lot number typically will be the string of 4 digits preceding the product number.

3M™ VHB™ Tapes

Additional 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.

Outgassing:

3M™ VHB™ Tapes	% TML	%VCM	%WVR
4930	0.77	0.01	0.21
4932	2.41	0.66	0.23
4945	1.24	0.01	0.19

TML - Total Mass Loss

VCM - Volatile Condensable Materials

WVR - Water Vapor Regained

NASA Reference Publication, "Outgassing Data for Selecting Spacecraft Materials", (11/18/2004) Available online at <http://outgassing.nasa.gov>

Dielectric Constant (ASTM D150)

3M™ VHB™ Tapes	Dielectric Constant	Dissipation Factor
4941 at 1 kHz	2.29	0.0245
	at 1 MHz	1.99
5952 at 1 kHz	2.14	0.0065
	at 1 MHz	1.95
4950 at 1 kHz	2.28	0.0227
	at 1 MHz	1.99
4910 at 1 kHz	3.21	0.0214
	at 1 MHz	2.68
4611 at 1 kHz	2.80	0.0130
	at 1 MHz	2.43

Resistivity (ASTM D257)

3M™ VHB™ Tapes	Volume Resistivity (In ohm-cm)	Surface Resistance (In ohms/square)
4941	2.1 x 10 ¹⁴	2.7 x 10 ¹⁴
5952	2.5 x 10 ¹⁴	>10 ¹⁵
4950	1.5 x 10 ¹⁵	>10 ¹⁵
4920	1.7 x 10 ¹⁵	>10 ¹⁵
4910	3.1 x 10 ¹⁵	>10 ¹⁵
4611	1.4 x 10 ¹⁵	>10 ¹⁵

Typical 3M™ VHB™ Tape Properties for Modeling

Thermal Coefficient of Expansion

- 1 x 10⁻⁴ in/in/°F
- 1.8 x 10⁻⁴ mm/mm/°C

Shear Modulus (@25°C, 1 Hz)

- 4950 Family: 6 x 10⁸ Pa
- 4941 Family: 3 x 10⁸ Pa

(Shear Modulus is both temperature and frequency dependent).

Youngs Modulus: For VHB tapes the Youngs Modulus will be about 3 times the Shear Modulus.

Poisson's Ratio
0.49

Burn Characteristics 3M™ VHB™ Tape 5958FR

Meets FAR 25.853 (a) 12 second vertical burn, Appendix F, Part I (a)(ii).

Meets NBS Smoking Density (ASTM F814/E662).

Meets Toxicity (Draeger Tube ABD0031, AITM 3.0005)

Dielectric Breakdown Strength (ASTM D149)

3M™ VHB™ Tapes	(in volts/mil)
4941	360
4926	330
5952	455
5925	520
4950	460
4920	640
4910	630
4611	330

Thermal Conductivity - K-value

3M™ VHB™ Tapes	BTU in/hr ft ² °F	(w/mK)
4941	0.53	(0.08)
5952	0.37	(0.05)
4950/4945	0.63	(0.09)
4910	1.09	(0.16)
4611	0.77	(0.11)

R-Value = thickness / K-value

(When units of K-value are BTU-in/hr ft² °F and thickness is given in inches.)

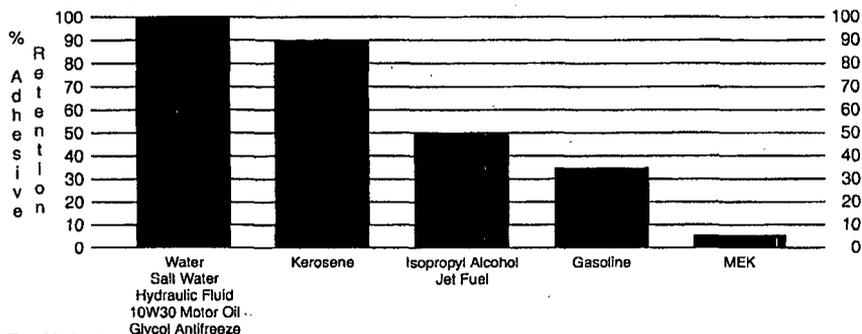
3M™ VHB™ Tapes UL746C Listings - File MH 17478

Category QQQW2 Component - Polymeric Adhesive Systems, Electrical Equipment

3M™ VHB™ Tapes/ Product Families	Substrates	Temperature Rating	
		Minimum	Maximum
4919F, 4926, 4936, 4936F, 4941, 4941F, 4947F, 4956, 4956F, 4978F	Ceramic	-35°C	110°C
	Aluminum, Galvanized steel, stainless steel, enameled steel, nickel coated ABS, glass (with or without silane coating) PVC, glass/epoxy, PBT, polycarbonate, acrylic/polyurethane paint, polyester paint	-35°C	90°C
4920, 4930, 4950	ABS	-35°C	75°C
	Aluminum, galvanized steel, enameled steel, stainless steel, ceramic, glass/epoxy	-35°C	110°C
4945, 4946	PBT, Acrylic	-35°C	90°C
	ABS, Polycarbonate, Rigid PVC	-35°C	75°C
4945, 4946	Phenolic, aluminum, galvanized steel, alkyd enamel	-35°C	110°C
	ABS, polycarbonate, polyimide, stainless steel, acrylic/polyurethane paint, polyester paint	-35°C	90°C
5915, 5915P, 5925, 5925P, 5930, 5930P, 5952, 5952P, 5962, 5962P	unplasticized PVC	-35°C	75°C
	Polycarbonate, Primer, 3M coated polycarbonate, aluminum, acrylic/polyurethane paint, galvanized steel, polyester paint, epoxy/polyester paint, epoxy paint, glass (with or without silane coating), stainless steel, enameled steel, glass epoxy, polybutylene terephthalate, Nylon, Noryl (PPE), polyphenylene ether	-35°C	90°C
5915, 5925, 5930, 5962	Rigid PVC, ABS	-35°C	75°C
	Acrylic	-35°C	90°C
5962	Acrylic	-35°C	80°C
	Cellulose Acetate Butyrate	-35°C	90°C
4991	Polycarbonate, aluminum, acrylic/polyurethane paint, polyester paint	-35°C	90°C
4611, 4646, 4655	Stainless steel, aluminum, galvanized steel, glass, glass/epoxy, phenolic	-35°C	110°C
	Nylon, polycarbonate	-35°C	90°C
4905, 4910	ABS, rigid PVC	-35°C	75°C
	Polycarbonate, aluminum, acrylic/polyurethane paint	-35°C	90°C

A current list can be found at www.ul.com (select certifications, search file MH17478)

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 angle.
- 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.

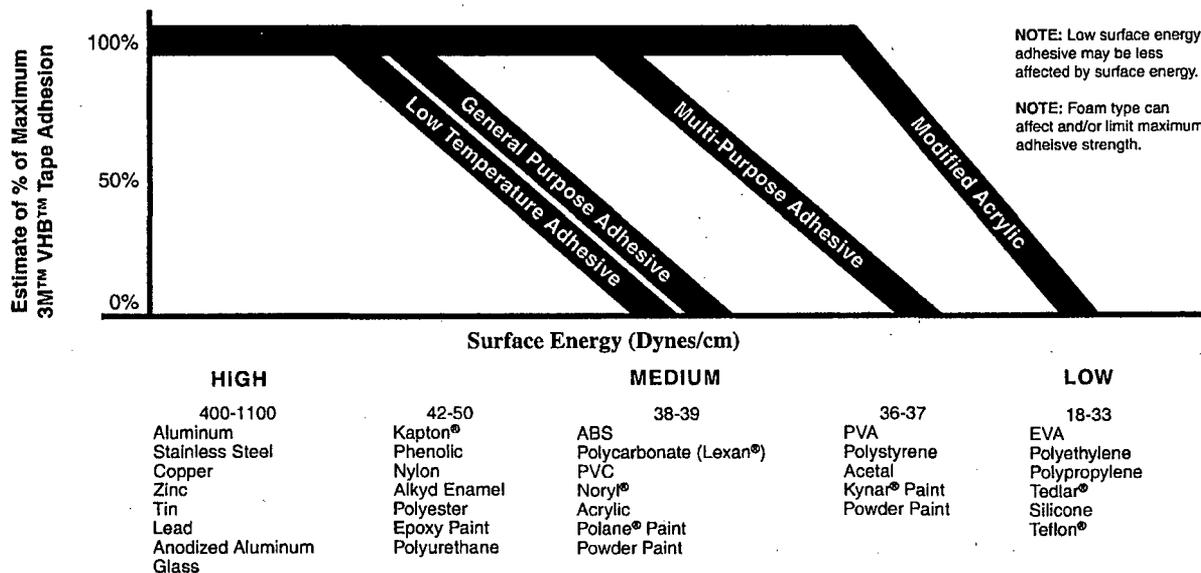
Design and Tape Selection Considerations

- **Choose the right tape for the substrate:** Adhesives must flow onto the substrate surfaces in order to achieve intimate contact area and allow the molecular force of attraction to develop. The degree of flow of the adhesive on the substrate is largely determined by the surface energy of the substrate.



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

Relationship of Adhesion and Surface Energy for 3M™ VHB™ Tape Adhesive Families



NOTE: Low surface energy adhesive may be less affected by surface energy.

NOTE: Foam type can affect and/or limit maximum adhesive strength.

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.

- **Use the right tape thickness:** The necessary thickness of tape depends on the rigidity of substrates and their flatness irregularity. While the 3M™ VHB™ Tapes will conform to a certain amount of irregularity, they will not flow to fill gaps between the materials. For bonding rigid materials with normal flatness, consider use of tapes with thickness of 45 mils (1.1 mm) or greater. As the substrate flexibility increases thinner tapes can be considered.
- **Use the right amount of tape:** Because 3M™ VHB™ Tapes are viscoelastic by nature their strength and stiffness is a function of the rate at which they are stressed. They behave stronger with relatively faster rate of stress load (dynamic stresses) and will tend to show creep behavior with stress load acting over a long period of time (static stresses). As a general rule, for **static loads**, approximately four square inches of tape should be used for each pound of weight to be supported in order to prevent excessive creep. For **dynamic loads**, the dynamic performance characteristics provided on page 4 should be useful, factoring in the appropriate safety factors.
- **Allow for thermal expansion/contraction:** 3M™ VHB™ Tapes can perform well in applications where two bonded surfaces may expand and contract differentially. Assuming good adhesion to the substrates, the tapes can typically tolerate differential movement in the shear plane up to 3 times their thickness.
- **Bond Flexibility:** While an advantage for many applications where allowing differential movement is a benefit, the tape bonds are typically more flexible than alternate bonding methods. Suitable design modifications or periodic use of rigid fasteners or adhesives may be needed if additional stiffness is required.
- **Severe Cold Temperature:** Applications which require performance at severe cold temperatures must be thoroughly evaluated by the user if the intended use will subject the tape product to high impact stresses. A technical bulletin "3M™ VHB™ Tape Cold Temperature Performance" is available for additional information. (70-0707-3991-0)

3M™ VHB™ Tapes

Application Techniques

- **Clean:** Most substrates are best prepared by cleaning with a 50:50 mixture of isopropyl alcohol (IPA*) and water prior to applying 3M™ VHB™ Tapes.

Exceptions to the general procedure that may require additional surface preparation include:

- **Heavy Oils:** A degreaser or solvent-based cleaner may be required to remove heavy oil or grease from a surface and should be followed by cleaning with IPA/water.
- **Abrasion:** Abrading a surface, followed by cleaning with IPA/water, can remove heavy dirt or oxidation and can increase surface area to improve adhesion.
- **Adhesion Promoters:** Priming a surface can significantly improve initial and ultimate adhesion to many materials such as plastics and paints.
- **Porous surfaces:** Most porous and fibred materials such as wood, particleboard, concrete, etc. need to be sealed to provide a unified surface.
- **Unique Materials:** Special surface preparation may be needed for glass and glass-like materials, copper and copper containing metals, and plastics or rubber that contain components that migrate (e.g. plasticizers).

Refer to 3M Technical Bulletin "Surface Preparation for 3M™ VHB™ Tape Applications" for additional details and suggestions. (70-0704-8701-5)

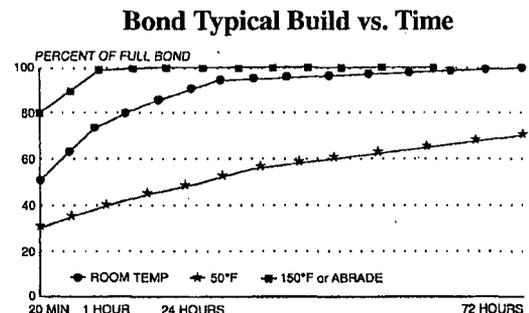
***Note:** These cleaner solutions contain greater than 250 g/l of volatile organic compounds (VOC). Please consult your local Air Quality Regulations to be sure the cleaner is compliant. When using solvents, be sure to follow the manufacturer's precautions and directions for use when handling such materials.

- **Pressure:** 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. Typically, good surface contact can be attained by applying enough pressure to insure that the tape experiences approximately 15 psi (100 kPa) pressure. Either roller or platen pressure can be used. Note that rigid surfaces may require 2 or 3 times that much pressure to make the tape experience 15 psi.
- **Temperature:** Ideal application temperature range is 70°F to 100°F (21°C to 38°C). Pressure sensitive adhesives use viscous flow to achieve substrate contact area. Minimum suggested application temperatures:
 - 50°F (10°C): 3M™ VHB™ Tapes 4950, 5952, 4910, 4952, 4611, 4622 families.
 - 60°F (15°C): 3M™ VHB™ Tapes 4941, 4945 families.
 - 32°F (0°C): 3M™ VHB™ Tape 4951 families.

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 3M™ VHB™ Tapes, it is important to ensure that the surfaces are dry and free of condensed moisture.

- **Time:** After application, the bond strength will increase as the adhesive flows onto the surface. At room temperature approximately 50% of ultimate bond strength will be achieved after 20 minutes, 90% after 24 hours and 100% after 72 hours. This flow is faster at higher temperatures and slower at lower temperatures. Ultimate bond strength can be achieved more quickly (and in some cases bond strength can be increased) by exposure of the bond to elevated temperatures (e.g. 150°F [66°C] for 1 hour). This can provide better adhesive wetout onto the substrates. Abrasion of the surfaces or the use of primers/adhesion promoters can also have the effect of increasing bond strength and achieving ultimate bond strength more quickly.



3M™ VHB™ Tapes**Special Cases:**

Rough Surfaces with 3M™ VHB™ Tapes 4932/4952 – 3M™ VHB™ Tapes 4932/4952 were designed to adhere to many low surface energy substrates. Rough surfaces created by light abrasion or textured molds are typically detrimental to bond strength with this tape family.

Plasticized Vinyl – Plasticizers compounded in soft vinyl can migrate into adhesives and significantly change their performance characteristics. 3M™ VHB™ Tapes 4941 and 4945 families have very good plasticizer resistance and adhesion to many vinyl formulations. 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 will be satisfactory over time. Problems related to plasticizer migration can often be predicted by accelerated aging of assembled parts at 150°F (66°C) for one week).

Technical Information

The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

Product Use

Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. Given the variety of factors that can affect the use and performance of a 3M product, user is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

Limited Warranty

3M warrants for 24 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. AN APPLICATION WARRANTY EXPRESSLY APPROVED AND ISSUED BY 3M IS AN EXCEPTION. THE CUSTOMER MUST APPLY FOR A SPECIFIC APPLICATION WARRANTY AND MEET ALL WARRANTY AND PROCESS REQUIREMENTS TO OBTAIN AN APPLICATION WARRANTY. CONTACT 3M FOR MORE INFORMATION ON APPLICATION WARRANTY TERMS AND CONDITIONS.

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 9001:2000

This Industrial Adhesives and Tapes Division product was manufactured under a 3M quality system registered to ISO 9001:2000 standards.

3M**Industrial Adhesives and Tapes Division**

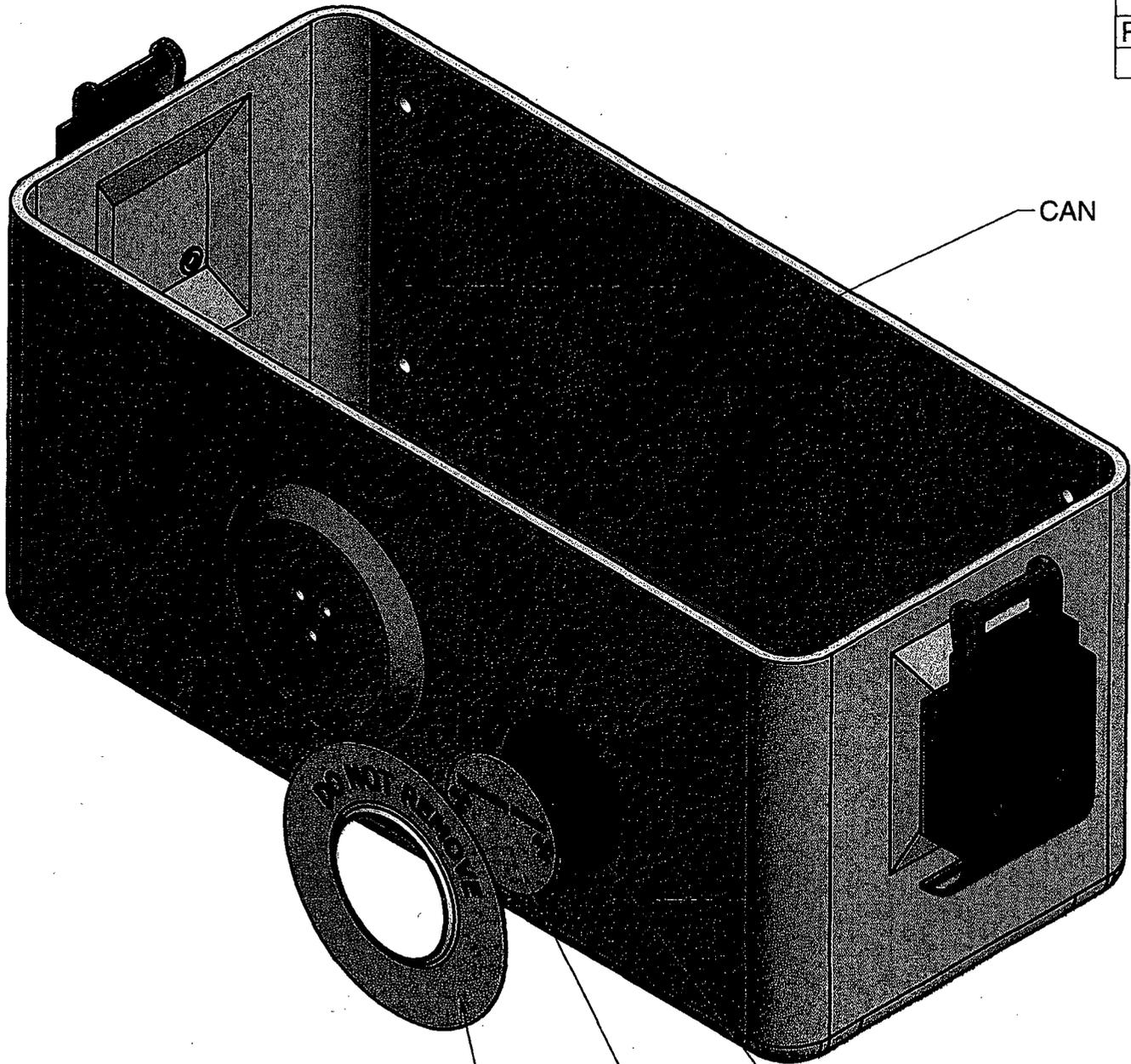
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REVISION HISTORY			
REV	DESCRIPTION	DATE	BY
1	VALID	12-2-09	RHS



7464-474
SOURCE LABEL WITH CLEAR CENTER
W/ 3M 468 ADHESIVE OR EQUIV

3M 5952 VHB
DOUBLE SIDED TAPE

CHECK SOURCE

DWN	DATE	CHK	DATE	APP	DATE
RHS	12-3-09				
DWG NUM: 4464-473				SCALE: 1:1	
TITLE CAN WITH SOURCE AND LABEL					
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