Industrial Adhesives and Tapes Division

Evaluation of 3M™ VHB™ Tapes for Solvent Resistance

Report Objectives:

3M™ VHB™ Tapes have been characterized for solvent resistance in many studies in the past. Some of these studies have been general screening of a variety of tapes in a variety of general solvent materials, and others have been in support of specific customer needs.

This report will detail the results of some of the general studies conducted on this family of tapes.

The solvent resistance across the 3M™ VHB™ Tape family is expected to be similar, and it is expected that the performance measured on these specific tapes will at least approximate the general performance that can be expected for other tapes in the family.

Note that even though we are reporting measured strength after continuous submersion in solvents, continuous submersion in chemical or solvent submersion is not generally recommended. This information is presented to show that occasional chemical contact should not be detrimental to tape performance in most applications in ordinary use. We do suggest that the user conduct tests that represent their specific situation to insure that the tape products meet the specific chemical resistance and other needs for the application.

Test Method:

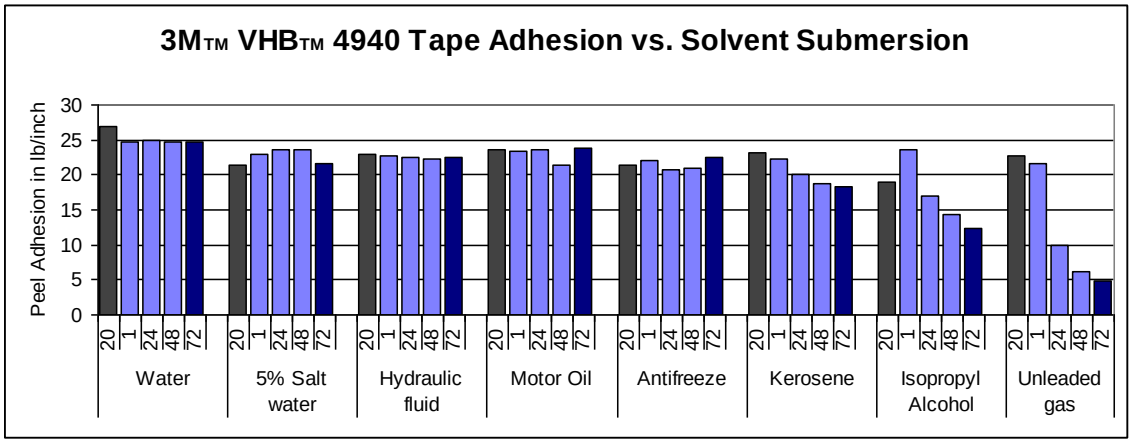
Solvent resistance of 3M™ VHB™ Tapes is usually characterized using a 90 degree peel adhesion test. This peel test is based on ASTM D3330. This test is the most sensitive for characterizing adhesion or change in adhesion of the 3M™ VHB™ Tapes, in this case change due to solvent exposure. Alternate characterization test modes, such as tensile or shear adhesion, are generally not as sensitive. Unless there is a specific substrate of interest, typically our standard stainless steel is used as a test substrate.

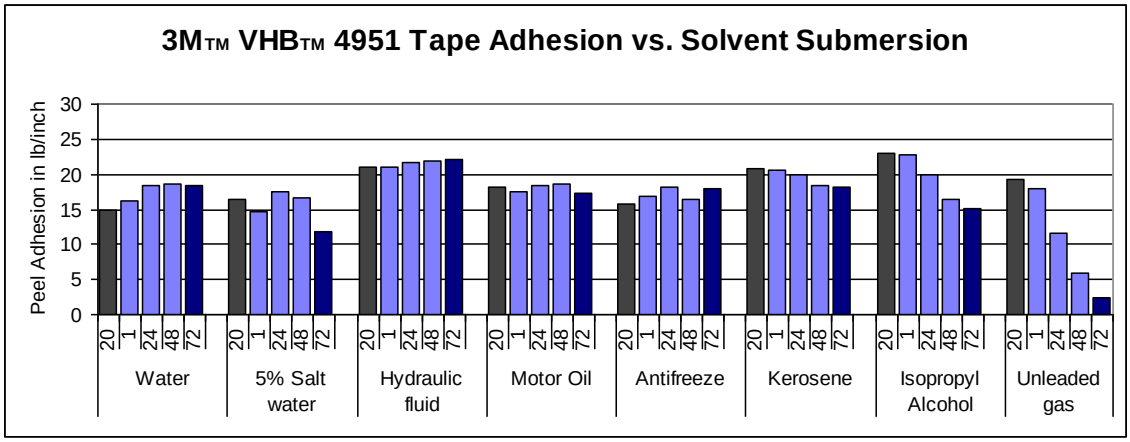
Because the data presented is from test surveys completed a number of years ago we are not able to confirm all details of the test plans. Typically we will allow full bond build (72 hours dwell at room temperature) prior to solvent submersion, and we will test quickly enough after removing from the solvent such that the adhesive or tape does not have any chance of recovery. It is assumed that those were the conditions of the tests reported. Adhesion was measured after 20 minutes, 1 hour, 24 hours, 48 hours and 72 hours complete submersion in the solvent.

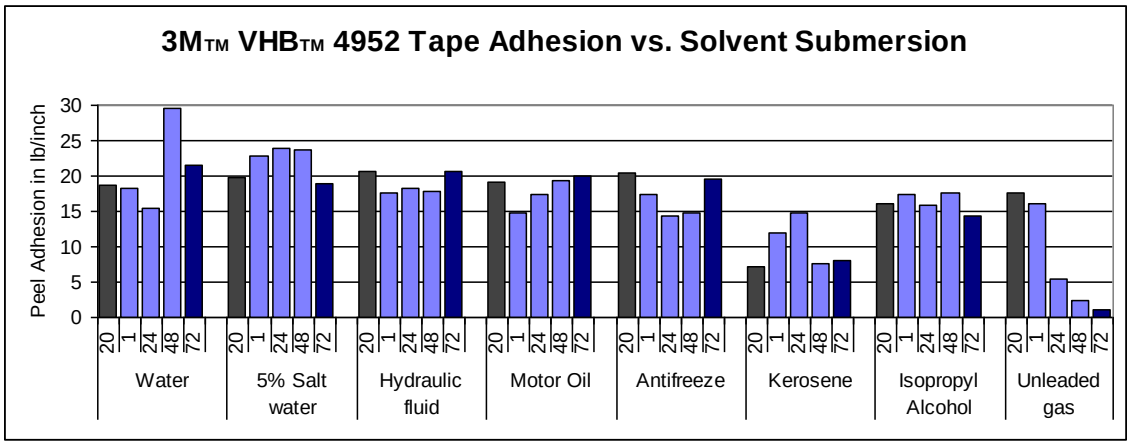
The specific tapes included in the main survey reported included 4940, 4951, 4952 and 4955. These represented a variety of foam and adhesive formulas used with 3M™ VHB™ Tapes at the time. 4940 tape used conformable foam and has since been discontinued, replaced by the 4941 family which uses similar conformable foam. 4940, 4951 and 4955 all use acrylic foam base with acrylic surface adhesive. 4952 uses acrylic foam base with synthetic rubber surface adhesive.

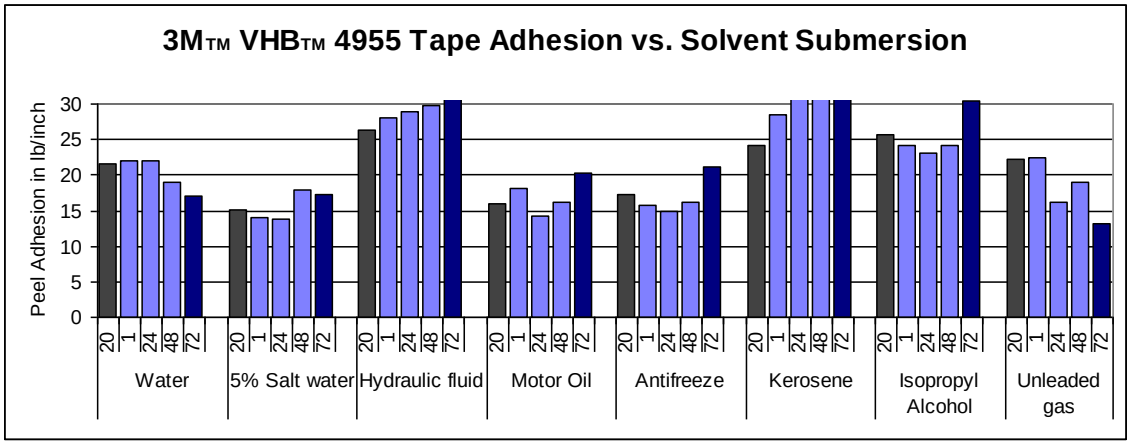
Results:

The results are shown in graphical form for the 4 tapes on page 2, and in table form on page 3. An initial control value is not included with this data so the 20 minute submersion can be considered the initial performance level. The graphs are formatted so that the 20 minute submersion is in dark gray and the 72 hour submersion is in dark blue for easy comparison of the effect after 72 hours dwell.


3M™ VHB™ 4940 Tape Adhesion vs. Solvent Submersion
Peel Adhesion in lb/inch
0
5
10
15
20
25
30
20 1 24 48 72
Water
5% Salt water
Hydraulic fluid
Motor Oil
Antifreeze
Kerosene
Isopropyl Alcohol
Unleaded gas


3M™ VHB™ 4951 Tape Adhesion vs. Solvent Submersion
Peel Adhesion in lb/inch
0
5
10
15
20
25
30
20 1 24 48 72
Water
5% Salt water
Hydraulic fluid
Motor Oil
Antifreeze
Kerosene
Isopropyl Alcohol
Unleaded gas


3M™ VHB™ 4952 Tape Adhesion vs. Solvent Submersion
Peel Adhesion in lb/inch
0
5
10
15
20
25
30
20 1 24 48 72
Water
5% Salt water
Hydraulic fluid
Motor Oil
Antifreeze
Kerosene
Isopropyl Alcohol
Unleaded gas


3M™ VHB™ 4955 Tape Adhesion vs. Solvent Submersion
Peel Adhesion in lb/inch
0
5
10
15
20
25
30
20 1 24 48 72
Water
5% Salt water
Hydraulic fluid
Motor Oil
Antifreeze
Kerosene
Isopropyl Alcohol
Unleaded gas

3M™ VHB™ Tape Solvent Resistance
Peel Adhesion vs Time in Solvent

All values in lb/inch

		Dwell Time in Solvent before Testing				
VHB Tape	**Solvent**	**20 min**	**1 hour**	**24 hour**	**48 hour**	**72 hour**
4940	**Water**	26.9	24.8	25.0	24.8	24.7
	5% Salt water	21.5	22.9	23.7	23.6	21.7
	Hydraulic fluid	23.0	22.8	22.4	22.3	22.6
	Motor Oil	23.5	23.4	23.5	21.3	23.8
	Antifreeze	21.5	22.1	20.8	21.0	22.4
	Kerosene	23.1	22.3	20.0	18.8	18.2
	Isopropyl Alcohol	19.0	23.5	17.0	14.3	12.4
	Unleaded gas	22.8	21.7	10.0	6.2	4.9
4951	**Water**	14.9	16.2	18.4	18.6	18.3
	5% Salt water	16.5	14.6	17.5	16.7	11.9
	Hydraulic fluid	21.0	21.0	21.6	21.8	22.2
	Motor Oil	18.2	17.6	18.3	18.7	17.2
	Antifreeze	15.8	16.8	18.2	16.5	17.9
	Kerosene	20.8	20.5	20.0	18.5	18.2
	Isopropyl Alcohol	23.1	22.8	19.9	16.4	15.2
	Unleaded gas	19.3	18.0	11.5	6.0	2.3
4952	**Water**	18.7	18.2	15.5	29.5	21.5
	5% Salt water	19.7	22.8	24.0	23.8	19.0
	Hydraulic fluid	20.7	17.7	18.2	17.8	20.7
	Motor Oil	19.2	14.7	17.3	19.4	20.1
	Antifreeze	20.4	17.5	14.3	14.7	19.6
	Kerosene	7.2	12.0	14.8	7.6	8.1
	Isopropyl Alcohol	16.0	17.4	15.9	17.6	14.3
	Unleaded gas	17.7	16.0	5.5	2.5	1.1
4955	**Water**	21.6	22.0	22.1	19.1	17.0
	5% Salt water	15.2	14.1	13.9	17.9	17.3
	Hydraulic fluid	26.4	28.1	29.0	29.7	31.8
	Motor Oil	15.9	18.2	14.2	16.1	20.3
	Antifreeze	17.3	15.8	15.0	16.2	21.1
	Kerosene	24.1	28.4	34.8	36.5	36.5
	Isopropyl Alcohol	25.6	24.1	23.1	24.2	30.4
	Unleaded gas	22.3	22.4	16.2	18.9	13.2

Notes:

1. Hydraulic Fluid is Mobile DTE-26 Hydraulic Oil, Motor oil is standard 10W-30, Kerosene is 1-k fuel grade
2. Test is 90 degree peel adhesion to stainless steel, based on ASTM D3330.

Notes:

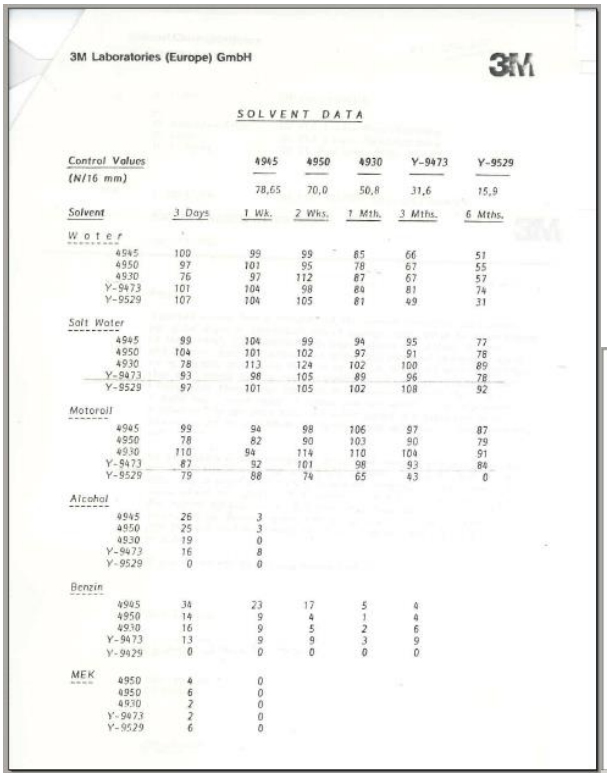
Solvents that have a negative effect on 3M™ VHB™ Tapes typically will swell/expand the foam and adhesive. In the worst cases the volume will increase 3 to 6 times and the tape will become a "Jello-like" mass. Solvents will not typically dissolve the 3M™ VHB™ Tapes.

In some cases solvents will penetrate and only slightly soften or plasticize the foam. This can have the effect of increasing or decreasing the measured adhesion levels, depending somewhat on the foam stiffness. An example of this is with hydraulic fluids or kerosene on 4955 tape adhesion. The apparent trend up in adhesion is not an effect of making the tape stronger, rather it is an effect of making the foam slightly softer and increasing the energy absorbed during the peel process.

4952 tape with the synthetic rubber adhesive has problems at times bonding to our anodized aluminum backing strip due to the texture of the anodized surface. There was some of this abnormal failure mode during these tests, and some of the test values (probably kerosene at 20 minutes dwell for example) are the result of this effect.

Additional Testing:

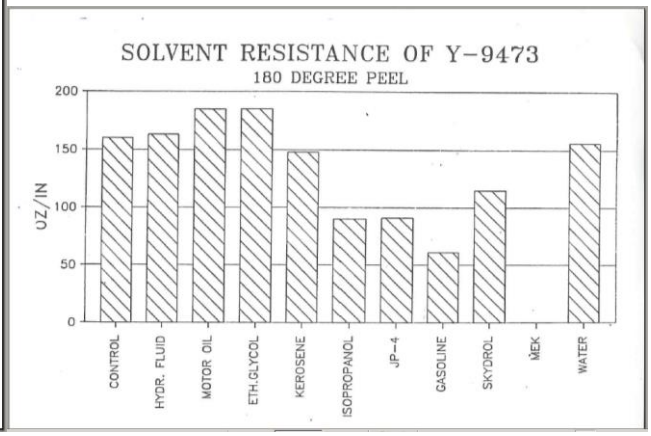
In addition to the data presented above, there are two additional test surveys that show similar performance characteristics. The first demonstrates the performance in similar solvent materials, and where the tape shows capabilities this performance was measured out to 6 months timeframe (with water, salt water and motor oil). The second survey shows similar performance where the solvents are the same and expands to several additional solvents, primarily jet fuel. These tests were run on 4945, 4950, 4930 and 9473 VHB tapes (also 9529 which is a general purpose foam tape), which demonstrates similar performance across a wider range of products tested. The data from those two surveys is included as additional supporting information below.



3M Laboratories (Europe) GmbH

SOLVENT DATA

Control Values (N/16 mm)		4945 78,65	4950 70,0	4930 50,8	Y-9473 31,6	Y-9529 15,9
Solvent	3 Days	1 Wk.	2 Wks.	1 Mth.	3 Mths.	6 Mths.
Water						
4945	100	99	99	85	66	51
4950	97	101	95	78	67	55
4930	76	97	112	87	67	57
Y-9473	107	104	98	89	81	74
Y-9529	107	104	105	81	49	31
Salt Water						
4945	99	104	99	94	95	77
4950	104	101	102	97	91	78
4930	78	113	124	102	100	89
Y-9473	93	98	105	89	96	78
Y-9529	97	101	105	102	108	92
Motoroil						
4945	99	94	98	106	97	87
4950	78	82	90	103	90	79
4930	110	94	114	110	104	91
Y-9473	87	92	101	98	93	84
Y-9529	79	88	74	65	43	0
Alcohol						
4945	26	3				
4950	25	3				
4930	19	0				
Y-9473	16	8				
Y-9529	0	0				
Benzin						
4945	34	23	17	5	4	
4950	14	9	4	1	4	
4930	16	9	5	2	6	
Y-9473	13	9	9	3	9	
Y-9529	0	0	0	0	0	
MEK						
4950	4	0				
4950	6	0				
4930	2	0				
Y-9473	2	0				
Y-9529	6	0				



Conclusions:

3M™ VHB™ Tapes have relatively good solvent resistance as demonstrated by the adhesion retention in many solvents after total submersion for 72 hours.

Adhesion retention is good in water and salt water, and a first estimate is that adhesion retention will be good in many other water based solvents or cleaners.

High viscosity hydrocarbon solvents such as hydraulic fluid and motor oil also have little effect on the adhesion level of the 3M™ VHB™ tapes tested. Lower viscosity materials such as alcohol and gasoline are more likely to cause swelling of the tape which will reduce the overall strength capability.

And last, as stated previously with the objectives, even though we are reporting measured strength after continuous submersion in solvents, continuous submersion in chemical or solvent submersion is not generally recommended. This information is presented to show that occasional chemical contact should not be detrimental to tape performance in most applications in ordinary use. We do suggest that the user conduct tests that represent their specific situation to insure that the tape products meet the specific chemical resistance and other needs for the application.