TEST REPORT

THERMATTACH THERMAL TAPES

PLASTIC PACKAGE THERMATTACH

T410

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SUMMARY OF PHYSICAL PROPERTIES

Property	T410	Test Method
Carrier	Aluminum	
Thickness, in (mm)	0.007 (0.178)	ASTM D374
Tensile Strength, psi (MPa)	6063 (42)	ASTM D412
Tear Strength, lb/in (KN/m)	390 (68)	ASTM D624
Dielectric Strength, KV ac/mm	N/A	ASTM D149
Breakdown Voltage, V ac	N/A	ASTM D149
Volume Resistivity, Ohm-cm	N/A	ASTM D257
Tested at 10 PSI		
Thermal Impedance, °C-in^2/W	1.1	ASTM D5470
Thermal Conductivity, W/m-K	0.25	ASTM D5470
Flammability	Not Rated	U.L.
Aluminum Lap Shear Adhesion, psi (Mpa)		
2 lbs application force	40 (0.276)	ASTM D1002
25 lbs application force	170 (1.17)	
Die Shear Adhesion, psi (MPa)		Chomerics test procedure #54
Steel/PQFP		
@ 25°C	170	
@125°C	40	
Peel Adhesion, lb/in (kN/m)	3.0 (0.52)	ASTM D1000
(FR4 Substrate)		
Creep Adhesion, days	>50	P.S.T.C. #7
(PQFP)		

Summary: Random production samples of Thermattach 410 thermal tapes were subjected to various environmental conditions and tested for shear and adhesion performance.

These tests include visual inspection, thermal performance, die shear strength, lap shear strength and 90° peel adhesion.

Exposure Methods

(1.0) Control Study of initial performance at room temperature environment (25° C).

(1.1) Heat Aging exposure of one thousand (1,000) hours at 125° C (250° F).

Apparatus: A forced convection Blue M oven was set at 125° C. Temperature uniformity was +/- 5° C within oven.

Procedure: Fixtures were placed in a forced convection hot air oven maintained at 125° C +/- 5° C for 1000 hours. Fixtures were then removed from oven and allowed to cool to room temperature (acclimate) for two hours minimum before evaluation.

(1.2) Temperature cycling of one thousand (1,000) cycles from 25° C to 125° C. A cycle consists of a 20 minute dwell at 25° C, heating to 125° C at 10° C/minute, a 20 minute dwell at 125° C and cooling to 25° C temperature at 10° C/minute.

Apparatus: Tenney environmental chamber #942 set to cycle from 25° C to 125° C. Temperature uniformity was ± 2° C of set point.

Procedure: Fixtures were placed in Tenney environmental chamber for a period of 1000 cycles. Fixtures were then removed from environmental chamber and allowed to acclimate to room temperature for two hours minimum before testing.

(1.3) Thermal shock exposure of 25 cycles from -50° to 100° C.

Apparatus: The low temperature bath consisted of a one gallon capacity insulated glass container. Excess dry ice was added to 0.75 gallon of isopropanol to cool bath to -50° C +0/-5° C. Temperature was measured with a Type K thermocouple located approximately one inch below the liquid surface. The bath was stirred before a temperature measurement was taken. Temperature was consistently maintained by the addition of dry ice.

Procedure: A cycle consists of placing a specimen into a 100° C boiling water bath for 10 minutes and after removal, rapidly plunging specimen into the low temperature bath of dry ice/isopropanol for 10 minutes. The specimen was then removed from the cold bath, and the next cycle started immediately.

High temperature bath: The high temperature bath consisted of a one gallon capacity Pyrex beaker filled with water. The temperature was measured with a type K thermocouple located approximately one inch below the liquid surface. Filled beaker was placed on electrical hot plate and maintained at a constant boil. Temperature was measured at 100° C (+ 0/- 2° C).

Sample fixtures: Sample specimens were placed in a solvent resistant plastic bag and hermetically sealed to ensure exposure of samples to only temperature extremes and not liquid medium.

(1.4) High temperature/Humidity Resistance 1000 hours, 85° C @ 95% RH.

Apparatus: A Tenney Versa Tenn II humidity cabinet chamber maintained at 85° C (+/-2° C) at a relative humidity of 95%.

Procedure: Fixtures were placed in a chamber and fully exposed with no attempt made to protect metal surfaces or leads. After constant exposure for 1000 hours samples were removed and allowed to acclimate to room temperature for two hours minimum before testing.

Peel Value Test

Peel adhesion at a 90° angle measuring bond strength of silicone side of adhesive tape to plastic package surface. Sample tape size 0.50 inch wide x 5.0 inch long attached to a 40 pin 2.0 inch x 0.55 inch DIP package (Zilog Z0842006 PSC) with 5 lbs applied lamination pressure. To initiate the test the 3.0 inch free end of sample is gripped into the fixture of a standard Instron upper grip. The DIP package is securely clamped to mounting table with the tape maintained at a constant angle of 90° during testing as the crosshead is driven down in tension at a rate of 2 inches per minute. The force required to peel the tape laminate is monitored by the load weighing system providing a direct measurement of bond strength. The peel value is the mean average of five samples tested and recorded in PPI (lbs per inch value).

Results

Visual: There was no evidence of delamination, tape lifting or any other signs of adhesive failure after exposure to all listed environmental test conditions.

Table 1 Peel test 90°. Control samples in accordance with 1.0 method.

Mean Average PPI	
3.35	
3.22	
3.32	**Avg. 3.3 PPI**
3.30	
3.45	

Table 2 Peel test 90°. Heat Age in accordance with 1.1 method.

Mean Average PPI	
2.78	
3.12	
3.04	**Avg. 3.1 PPI**
3.18	
3.24	

Table 3 Peel test 90°. Temperature Cycling in accordance with 1.2 method.

Mean Average PPI	
3.30	
3.27	
3.39	**Avg. 3.3 PPI**
3.26	
3.40	

Table 4 Peel test 90°. Thermal Shock in accordance with 1.3 method.

Mean Average PPI	
2.40	
2.45	
2.44	**Avg. 2.5 PPI**
2.46	
2.58	

Table 5 Peel test 90°. High Temperature/Humidity resistance in accordance with 1.4 method.

Mean Average PPI (lbs. per inch)	
2.50	
2.44	
2.47	**Avg. 2.4 PPI**
2.36	
2.46	

Lap Shear

Lap shear panels consisted of 1 inch wide x 5 inch long class 2024 aluminum strip panels attached to a FR4 plastic composite of the same dimensions. The lap shear adhesive area tested was one inch square with the acrylic side of thermal tape exposed to 2024 aluminum, and silicone adhesive side in contact with FR4 composite.

Acrylic side of thermal tape was applied to a 2024 aluminum panel first using light pressure (2-5 lbs). The silicone adhesive side of thermal tape was then attached to FR4 composite using light pressure of 2-5 lbs for a dwell time of 20 seconds. Panel samples were applied one after the other. Samples were allowed to dwell for period of one hour at 25° C to wet out adhesive to substrate. Samples were then placed into environmental conditions and no attempt was made to protect metal surfaces.

Testing of lap shear panels was per ASTM D1002 with tension cross head speed run at 0.05 inch per minute. Results are an average of 4-5 samples tested and recorded in PSI (pounds per square inch).

Visual: There was no visual evidence of adhesive failure or delamination after any environmental test conditions.

Shear Strength: Shear strength results improved in humidity and elevated temperatures. This is most likely due to increase in the modulus of the adhesive under these conditions.

Table 6 Control Study in accordance with 1.0 method.

Peak Load (PSI)	
61.2	
59.0	
61.3	**Avg. 60 PSI**
60.2	
60.5	

Table 7 Heat Aging in accordance with 1.1 method.

Peak Load (PSI)	
142.4	
132.8	
112.2	**Avg. 129 PSI**
128.9	

Table 8 Temperature Cycling in accordance with 1.2 method.

Peak Load (PSI)	
126.5	
100.9	
148.5	**Avg. 127 PSI**
137.7	
122.8	

Table 9 Thermal Shock in accordance with 1.3 method.

Peak Load (PSI)	
88.4	
66.7	**Avg. 73 PSI**
62.8	
72.3	

Table 10 High Temperature/Humidity Resistance in accordance with 1.4 method.

Peak Load (PSI)	
101.4	
143.8	
132.2	**Avg. 132 PSI**
154.1	
130.1	

Die Shear Adhesion to Topline 80386 PQFP

Die Shear: 0.50 x 0.50 inch thermal tape was applied using light pressure (2-5 lbs) to uncleaned, as supplied, Topline 80386 PQFP packages.

The acrylic adhesive side was then placed in contact with a 0.25 x 0.25 inch chip of cleaned cold rolled steel (Feeler stock). Pressure of 5 lbs was applied to steel chip for 20 seconds dwell time. Excess tape around perimeter of chip was removed, leaving only adhesive film under chip for testing. Samples were allowed to dwell at 25° C for a minimum of one hour before testing.

Apparatus: A Hybrid machine model #1760 heavy duty shear tester was used to determine shear strength values. The heater plate was turned OFF and the shear speed was one inch per minute in all tests. The heater plate was used at 125° C to determine high temperature shear for noted tests.

Die Shear Results

Visual: There was no evidence of adhesive failure, lifting, drooping or flagging on any samples after environmental exposures.

Die Shear Strength: The results of the shear strength tests show performance improvements possibly due to the increased adhesive modulus under these conditions.

Control Samples in accordance with 1.0 method.

Table 11
0.25" x 0.25" chip
@ 25° C sample temp.

Peak Load	
45.6	
31.5	
42.2	153 PSI
35.2	
36.2	

Table 12
0.25" x 0.25" chip
@ 125° C sample temp.

Peak Load	
12.4	
12.6	
15.6	63 PSI
18.4	
20.2	

Table 13 Heat Aging in accordance with 1.1 method.

Peak Load	
54.8	
56.4	
52.0	**208.3 PSI**
46.8	
50.4	

Table 14 Temperature Cycling in accordance with 1.2 method.

Peak Load	
60.2	
52.5	
67.2	**242 PSI**
59.0	
63.2	

Table 15 Thermal Shock in accordance with 1.3 method.

Peak Load	
54.4	
53.0	
53.4	**211 PSI**
45.4	
57.4	

Table 16 High Temperature/Humidity resistance in accordance with 1.4 method.

Peak Load	
99.0	
93.8	
99.8	**383 PSI**
105.2	
80.6	

Die Shear Adhesion FR4 Plastic Composite

0.50 x 0.50 inch thermal tape was applied using light pressure (2-5 lbs) to a clean surface of FR4 plastic composite strip (0.50 inch wide). The acrylic adhesive was then placed in contact with a 0.25 x 0.25 inch chip of cleaned cold rolled steel (Feeler stock).

NOTE: Before taping, steel chips were cleaned with MEK (Methylethylketone) solvent and dried with a lint free cloth. FR4 plastic composite was cleaned with alcohol wipe to remove any handling contamination. All cleaning of test surfaces was done in accordance with PSTC appendage C. (Pressure Sensitive Tape Council - cleaning of test surfaces procedure.) Pressure of 5 lbs. was applied to steel chip for 20 seconds dwell time. Excess tape around perimeter of steel chip was trimmed and removed. Samples were allowed to dwell at 25° C for a minimum of one hour before conditioning.

Apparatus: A Hybrid machine model #1760 was used to determine shear strength values. Heater plate was used in noted tests to determine high temperature shear performance. In all tests shear speed was at one inch per minute.

Shear at Elevated Temperatures: Hybrid machine Heavy Duty shear tester #1760 contains a heater base plate to run samples at elevated temperature profiles.

Heat Aged Samples: Tests were performed on die shear samples heat aged for 168 hours in oven apparatus noted in 1.1 method.

Table 17
0.25 x 0.25 inch chip
tested at 25° C
Peak Load
36.0
34.8
54.8 **Avg. 172 PSI**
44.8
45.0

Table 18
0.25 x 0.25 inch chip
tested at 125° C
Peak Load
10.1
9.8
9.7 **Avg. 40 PSI**
10.3
10.1

Table 19
0.25 x 0.25 inch chip
tested at 150° C
Peak Load
8.4
4.5
4.0 **Avg. 21 PSI**
5.4
4.0

*Heat Aged Die Shear Samples: 0.25 x 0.25 inch steel chips on FR4 plastic composite. Aged 168 hours/125° C. Note: Average of four samples tested.

Table 20
0.25 x 0.25 inch chip
tested at 25° C after heat aged
Peak Load
79.8
69.0 **Avg. 336 PSI**
95.4
91.4

Table 21
0.25 x 0.25 inch chip
tested at 125° C after heat aged
Peak Load
31.6
24.6 **Avg. 117 PSI**
29.8
31.4

	Control Samples Init. Performance (25° C)	Heat Age, 1000 hrs. (125° C)	Temp. Cycling 1000 cycles (25° - 125°)	Thermal Shock (25 cycles) (50° - 100°)	Vibration Testing (25° C and 70° C)	High Temperature/ Humidity Resist. (85° C/95%RH/1000h)
80386 PQFP on Test Boards						
Thermal performance						
w/ sink as control						
40 pin 2.0" x .55" DIP Peels						
Peel value at ambient after exposure						
(PPI)	3.3	3.1	3.3	2.5		2.5
FR4 Composite Lap Shear Panels						
Bonded to 2024 Aluminum						
Lap shear at ambient after exposure						
Applied @ 2 to 5 lbs. (PSI)	60	117.2	127	73		132
Applied @ 25 lbs. (PSI)	170					
Top Line Plastic Packages (386 PQFP)						
Die shear adhesion at ambient after exposure (PSI)	153	208	242	211		
at 125°C (psi) (PSI)	63.4					383
Creep Adhesion						
(per PSTC #7 test procedure)						
at 25° C 500 G / ¼ in^2 (DAYS)	>50					
at 125° C 500 G / sq. in. (DAYS)	>9					
at 125° C 500 G / sq. in. (HOURS)						
Die Shear Adhesion						
(Chomerics test procedure #54)						
Die shear adhesion of steel to FR4 plastic composite						
at 25° C (PSI)	172					
at 125° C (PSI)	40					
at 150° C (PSI)	21					
Die Shear Adhesion						
(Chomerics test procedure #54)						
Expose samples to 168 hrs/125° C - FR4 plastic composite adhered to Al						
Die shear adhesion						
at 25° C (PSI)	336					
at 125° C (PSI)	117					

PRELIMINARY PRODUCT DATA SHEET

CHOMERICS

Parker Seals

LEADER IN THERMAL MANAGEMENT: DESIGN, INNOVATION AND MATERIALS

THERMATTACH® T410
Thermally Conductive Tape for Silicone Contaminated Plastic Packages

DESCRIPTION

Chomerics' patented THERMATTACH® T410 double-sided adhesive tape provides an effective thermal interface and heat sink attachment method for plastic component packages. The tape is thermally conductive and has exceptional bonding properties. It can also be used to adhere components to vertical heat sinks or to metal chassis walls in place of clips, screws or other mechanical fasteners, without the need for additional thermal compounds.

THERMATTACH T410 tape consists of a high bond strength, pressure sensitive acrylic adhesive loaded with aluminum oxide and coated onto a 0.002 inch (0.05 mm) aluminum foil carrier. The other side of the foil carrier has a silicone pressure sensitive adhesive which provides adhesion to silicone contaminated plastics and other low energy surfaces. THERMATTACH T410 tape can be applied directly to the silicone mold release-contaminated package surface without using primers. THERMATTACH T410 tape can be consistently applied to meet the thermal and adhesive requirements of most designs.

Typical Properties	THERMATTACH T410	Test Method
Carrier	Aluminum	---
Color	Clear/White	Visual
Thermal Conductivity, W/m-K	0.25	ASTM D5470
Thermal Impedance, °C-in²/watt	1.1	ASTM D5470
180° Peel Test, ppi	7	ASTM D1000
Thickness, inch (mm)	0.007 (.140)	ASTM D374
Lap Shear Adhesion, psi (MPa)	170 (1.172)	ASTM D1002
Die Shear Adhesion, psi Steel/FR4 25°C 125°C	 170 40	Chomerics TP No. 54
PQFP Creep Adhesion, days at 25°C and 12 psi (.083 MPa) load at 150°C and 12 psi (.083 MPa) load	 >50 >50	Pressure Sensitive Tape Council (PSTC) #7
UL Flammability Rating	UL94	Not Rated*

*In its intended application, tape is sandwiched between device surface and heat sink surface.