

When you have a project requiring a different pressure sensitive media than you stock or are familiar with, how do you determine the correct solution for the project? You can call your media suppliers, explain the application and get a recommendation. Usually printers have multiple media sources so you will have a choice of products. To help choose the best product, each manufacturer will have a product bulletin describing the technical properties and typical performance of the media. To start, a product bulletin will usually give a short description of the media which notes the film, adhesive, and liner that makes up the product. In addition, most bulletins will verbally state the intended purpose of the media. It may state if it is permanent or removable adhesive, high tack, general purpose or low tack adhesive and if it is recommended for interior or exterior application. Descriptions of the film will usually state if the film is clear, white, gloss, matte or luster. This information can also be found in the Digital Media Application Guide found on the GF website ([www.generalformulations.com](http://www.generalformulations.com)). If the film is a vinyl it could also state if the vinyl is flexible, rigid or somewhere in between. A product bulletin should also state the thickness of the film and adhesive. General descriptions of the liner are also given. The type of material used for the liner such as paper, Kraft paper, bleached kraft, plastic, stay flat, roll label, or overlaminated could also be found along with information on liner thickness. Verbal descriptions in product bulletins can give the user a quick and efficient means of screening different pressure sensitive media products to determine which may work for their specific project.

Verbal descriptions may be helpful to get a general idea on the performance of pressure sensitive media however, verbal descriptions are open to individual interpretation that can lead to misunderstanding and possible miss-application of the product. Technical information is a precise way to compare different media under defined testing procedures. In the United States, the American Society for Testing and Materials (ASTM) has accepted procedures for testing pressure sensitive media products. ASTM is the oldest testing organization and has testing procedures for any material that needs some sort of certification in any industry. The Pressure Sensitive Tape Council (PSTC) concentrates on the tape and pressure sensitive digital media industry and has established testing procedures for products produced by this specific industry. Most PSTC procedures are based on ASTM established procedures but may be slightly adapted to tape and pressure sensitive media products. U.S. tape and pressure sensitive media manufacturers use both ASTM and PSTC procedures depending on their preference. Worldwide there are other certifying organizations. Europe and the European Union has The European Association for the Self Adhesive Tape Industry (AFERA) while Japan has Japanese Adhesive Tape Manufacturing Association (JATMA). PSTC has worked with both organizations to standardize testing procedures worldwide, especially peel adhesion and shear strength.

Some of the common testing procedures for Pressure Sensitive Media are listed below. Product bulletins are not standardized between manufacturers so the information provided will vary. Read and understand the conditions of the testing that defines the data published. Be sure the data is comparable when making a decision on the applicability of that specific media for your application.

## THICKNESS

A micrometer is used to determine the thickness of films, pressure sensitive adhesives, (PSA) and liners. Micrometers can be either manual or automatic as long as the device can be standardized and certified accurate. Manual micrometers have a little more variability in that it requires the operator to read and interpret the result. Most automatic micrometers have a digital readout that eliminates that variable.

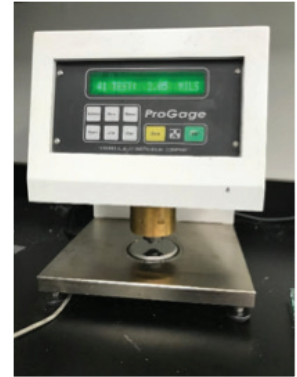
Unit of measure to denote thickness in the United states is usually 1/ 1000th of an inch, .001 inches.

Another commonly used thickness term is mils.

One mil = 1/ 1000th of an inch. Therefore, 15 mils = 15/ 1000ths or .015 inches.

Outside the U.S., metric measurements are standard. Common conversions.

1 mil or .001 inch = .0254 millimeters (mm) or 25.4 microns, micrometers, ( $\mu\text{m}$ ).



Digital Micrometer

## QUICK STICK (TACK)

Quick stick or tack of a PSA is an attempt to quantify the age old method of sticking your thumb on a pressure sensitive adhesive then removing it to determine how sticky the adhesive, (finger tack). There are many procedures that measure initial tack of an adhesive such as rolling ball, probe tack and loop tack. The first two procedures are easy to preform but the result are quite variable therefore not much more accurate than the thumb tack procedure. Loop tack has become recognized as the most accurate way to quantify tack testing results. A loop of tape or media is lowered at a constant rate onto a clean substrate allowing the weight of the tape only to wet out the substrate. Dwell time of the tape on the substrate is usually 1 minute, then the tape is removed at a constant rate by microprocessor controlled electromechanical tensile/ compression testing machine. This procedure allows for controlled testing with constant data acquisition that reduces variability and provides for reproducible results. Results of a loop tack test are reported as ounces of force required to remove the tape from the substrate per inch width of tape, Oz/ In. Once that value is known different adhesives or media can be compared. The higher the Oz/ In. value the stickier the PSA and quicker it will wet out the substrate.

## ADHESIVE BOND OR PEEL ADHESION

Peel adhesion is the most common technical information used to compare performance of different pressure sensitive adhesives and pressure sensitive media. Peel adhesion is a measurement of the force required to

remove or de-bond a pressure sensitive from the substrate to which it was applied. There are many factors that can induce variability on the bond of the PSA to the substrate such as sample width, rate of removal, angle of removal, temperature, the specific substrate and dwell time of the adhesive on the substrate. To control these variables during testing ASTM, PSTC and the others have established testing standards.



## SAMPLE WIDTH

Testing samples are specified at 1 inch. Exceptions can be made but must be noted in the results or procedure.

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## **RATE OF REMOVAL**

Standard rate of removal of the sample from the substrate is 12 inches / minute.

## **ANGLE OF REMOVAL**

Both 90° and 180° peel angle of the test sample from the substrate can be use. For most media 180° peel angle is standard. 90° angles can be used for two sided tapes.

## **TEMPERATURE**

Standard conditioning and testing temperature is 73° F., (23° C.), at 50% relative humidity. If other temperatures are used, they must be stated. Cold temperature, 32° F., (0° C.), and lower, testing can be used to simulate cold weather applications. High temperature applications may require testing at 200° F., (93° C.), or greater.

## **SUBSTRATE**

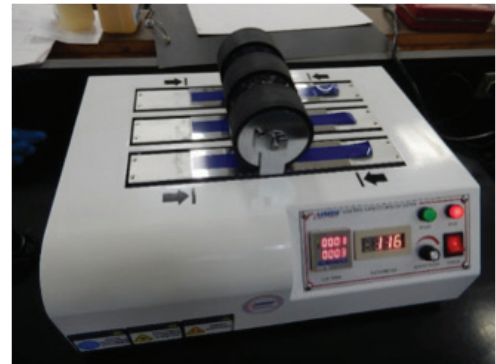
Standard substrate for most pressure sensitive media testing is a stainless steel panel. The type and finish of the panel is defined in the procedure by ASTM, PSTC and the other governing agencies. Cleaning procedure for the panel is also defined before the media sample is applied. Therefore, the procedure standardizes the substrate before sample application reducing variability of the individual results and long term reproducibility.

In some cases, a different substrate can be specified. Applications to low energy surfaces could require testing to high density polyethylene or polypropylene to better simulate real world performance.

## **SAMPLE APPLICATION**

The procedure for applying the media sample to the substrate defines the roller and rate of application to standardize the test. Rubber covered rollers of a specific durometer rubber weighing 4.5 pounds and designed so only the weight of the roller laminates the media sample to the substrate is required. The rate of sample application is 12 inches/ minute.

Photo to the left is an automatic sample roll down apparatus. This sample application method has uniform roller weight and uniform application speed that increases sample consistency over manual sample application to reduce sample variability and increases long term reproducibility.



## **DWELL TIME**

ASTM and PSTC procedures specify the time between sample application and removal for bond testing as 1 minute. This dwell time reflects more of a quick stick than an actual long term adhesive bond so most manufacturers modify the dwell time to reflect the ultimate bond the pressure sensitive media will attain. Complete adhesive wet out of the substrate usually takes a minimum of 24 hours at room temperature. To assure complete adhesive wet out some manufacturers will increase the dwell time to 72 hours at room temperature. Increased dwell time will allow uniform adhesive wet out thereby increasing long term reproducibility of the test and giving a better indication of long term media bond.

Extended dwell times, 168 hours or longer, and at higher than room temperature aging can be used to simulate long term media life. This type of conditioning is common to predict the compatibility of a PSA and vinyl film formulations over time. In all cases the dwell time and conditioning temperature must be stated when defining

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the procedure so the results can be compared on an equal basis. The final result of a bond or peel adhesion test is reported in the amount of stress required to remove a specific width of media from the substrate.

In the U.S., the result is stated in Ounces of Removal Force per Inch Sample Width = Oz/ In.

For metric reports you may see the result as Newton's per Meter Width = N/M.

### **SHEAR ADHESION**

This test is totally different than a peel, bond or quick stick test. Shear testing measures and quantifies the cohesive properties of a pressure sensitive adhesive. Cohesive strength is the internal strength, holding power, of a pressure sensitive adhesive. Stress is applied to the adhesive layer and the amount of time is measured before the stress breaks the internal bond of the adhesive causing failure. Cohesive properties of the adhesive are related to the cross-linked density of the PSA and related to temperature resistance of the PSA. As cross-linked density increases, temperature resistance increases which can also correlate to improved long term stability and improved exterior resistance.



### **SUBSTRATE**

Again the standardized testing substrate is stainless steel meeting the same requirements as in the peel adhesion testing procedure. PSTC 107 also allows for NIST fiberboard when testing packaging tapes.

### **SAMPLE APPLICATION**

Substrate cleaning and applications follow the same procedures as defined in the peel adhesion testing procedure.

### **SAMPLE AREA AND LOAD**

PSTC 107 defines the sample size as 12 mm x 12 mm or 24 mm x 24 mm. Other sizes may be used but must be stated in the report. Common sample sizes in the U.S. are ½ inch x ½ inch or 1-inch x 1-inch. These give contact areas of ¼ square inch or 1 square inch respectively.

The load as defined in PSTC 107 procedure A is 1000 grams, 1 Kg or 2.2 Pounds.

In some tests 1-pound is used as the load stress, especially with ½ inch x ½ inch samples.

### **ANGLE OF TEST**

PSTC 107 defines the angle of the test as 178°.

### **TEMPERATURE**

Standard conditioning and testing temperature is 73° F., (23° C.), at 50% relative humidity. In some cases, high temperature shear resistance may be required and the specification can define shear resistance at 200° or 300° F. In this case the shear testing apparatus will need to be placed in an oven at the defined temperature.

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Final results of shear testing will be stated in the amount of time the adhesive will resist de-bonding at a specific stress.

In the U.S., the unit of measure is time at stress = Minutes @ Pounds/ Square Inch or Hours @ Pounds/ Square Inch.

- 90 Minutes @ 4 psi
- 1.5 Hours @ 4 psi

Metric results are expressed in time at stress = Minutes @ Grams/ Square millimeter.

- 90 Minutes @ 2.82 Grams/mm<sup>2</sup>
- 1.5 Hours @ 2.82 Grams/ mm<sup>2</sup>

### **SHEAR ADHESION FAILURE TEMPERATURE**

Another type of shear testing is Shear Adhesion Failure Temperature (SAFT). This testing defines the exact temperature a PSA experiences cohesive bond failure. The procedure is the same as room temperature shear testing but conducted in a conditioning chamber that raises the temperature of the sample at a constant rate until shear failure is initiated. This test is an excellent procedure to differentiate PSA's and can be used in formulation optimization. It is very useful in R&D testing where specific requirements are defined however it requires complex testing equipment that can lead to error if it is not properly monitored. SAFT results are not usually reported on a product bulletin but if it is the result is the expected de-bonding temperature in either degrees F or C.

### **LINER RELEASE**

Liner release is the measurement of the force required to remove the liner from a pressure sensitive adhesive. Many descriptive terms can be used such as easy, moderate, medium and tight release. These verbal descriptions can give you an idea of the liner release but do not correlate to any technical value making direct comparison difficult.

Liner release values are the combination of many factors of both the PSA and liner making each combination of adhesive and liner having a unique release level. The conditions of the test also directly influence liner release. Again ASTM and PSTC have established standardized procedures. Being a bond test that measures the force to de-bond the liner from the adhesive a microprocessor controlled electromechanical tensile/ compression testing machine is used. In this test the force values are very low dictating a low range load cell for accurate results.



**Low speed 180° Liner Release Test**

### **SAMPLE WIDTH**

There are procedures for various widths, 1 inch, 2 inches and 24 mm.

### **RATE OF REMOVAL**

Common testing speeds are 12 inches/ minute, 300 inches/ minute, 300 mm/ minute and 7600 mm/ minute. Other speeds may be defined depending on application. Usually the lower speeds are used when the liner is manually removed while the higher speeds are used for high speed automatic label applications.

### **ANGLE OF REMOVAL**

Common removal angles are 90°, 180° and 135° depending on the procedure and speed. Digital and graphic media commonly use 180° liner removal angle.

## TEMPERATURE

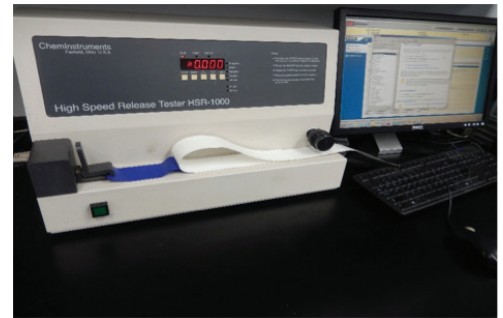
Standard conditioning and testing temperature is 73° F., (23° C.), at 50% relative humidity. If there is any aging or heat conditioning it will be stated in the in the testing conditions.

When reviewing liner release data, the test procedure will state the sample width, testing speed and angle of liner removal. These factors have to be the same to have useful data so different products can be compared. If the release data is furnished by a liner manufacturer they will usually define the standard tape use in the release testing. Again only data using standard tapes can be comparable.

While there are many variables in liner release testing the units of measurement are fairly standard.

Removal force per sample width is reported as Ounces per inch width.  
- Oz/ inch or Oz/ 2 inches

Metric unit of measure is Newtons per 10 millimeters of width.  
- N/10mm width



**High speed 180° Liner Release Test**

## OTHER SPECIFICATIONS

Many industries, U.S. Government and the U.S. Military have specifications defining performance of pressure sensitive media in specific applications. Some of these industries are automotive, appliance, aerospace, heavy equipment, lawn and garden equipment, tools and various consumer goods. These specifications usually require the media to be applied to the intended substrate then undergo some sort of accelerated exposure conditioning. These may be extended heat aging, hot - cold cycle, accelerated weathering, cold temperature exposure, chemical exposure and resistance, abrasion resistance, salt water immersion or a combination of these. The specification will usually require no cosmetic degradation of the media, no edge wing or delamination or anything else that will cause the graphic to be non-functional. Most specification will usually require a certain bond level of the media before conditioning and to maintain the level of bond after conditioning. Adhesive bond testing using ASTM or PSTC procedures will be used to certify compliance to the specification. Being able to review a product bulletin in regard to product bond will define products that may be candidates to meet a specification.

While verbal descriptions can give you an idea what application a pressure sensitive media product can fulfill, it does not offer a true technical comparison between products. Testing pressure sensitive media and the resultant data is an ideal method to compare media and have an understanding of the differences between products and how it can affect your application. Testing can be complicated but take the time to understand the testing procedures and conditions used to derive the data presented. Realize the procedures and conditions have to be equal to give a valid comparison between pressure sensitive media. If you need assistance understanding technical data presented on a product bulletin or just have technical question concerning a pressure sensitive media product contact your General Formulations Customer Service Representative at 800 253-3664 or through the website at [www.generalformulations.com](http://www.generalformulations.com).

## ACKNOWLEDGEMENTS

Photos of test equipment courtesy of General Formulations Quality Control and Product Development Laboratories.