What's in a Number?

By Walter Polifka, Business Development Manager, Adchem Corporation

In the world of pressure sensitive adhesives or PSA's, you will find no shortage of physical property data. Peel strength, shear strength, loop tack and temperature information are all readily available. The question is: How useful is all of this data? The short answer is: Not very.

As a provider of PSA solutions, we spend countless hours coaching our salespeople to understand the application and the conditions to which the PSA is subjected before we can select a product from our vast array of pressure sensitive adhesive tape products.

We are commonly asked, "What is your equivalent to Competitor's X." Or: "I need an acrylic transfer tape 5-mils in caliper with a peel strength of Y". Our response is: "What are you trying to do or what do you want the PSA to do?" Only then can we provide the value added engineering that allows us the opportunity to assist the customer in finding the technically and economically optimal solution.

The problem is people love numbers. They would sometimes rather compare numbers in the comfort and privacy of their office than interact with the vendor and divulge "secret" information. Customers may think that if they confide in us they lose control over their project when, in fact, the opposite is true. By providing comprehensive accurate information they can tap into our expertise in the chemistry and application of PSA's.

Before we look at the different properties and what can affect the "numbers," we should start with the source of the information and the test procedures themselves. There are several sources of test procedures but the most common are tests sanctioned by the Pressure Sensitive Tape Council (PSTC) and tests developed by the American Society of Test Methods (ASTM). In addition, some vendors report results from tests they have developed in house. Large customers, particularly in the automotive, fenestration, and electronics markets, require a myriad of test procedures they require to qualify. If you do compare numbers, it is important to know who conducted the tests and the test methodology. Comparing numbers from two different test methods is like comparing apples to oranges.

How the numbers are generated is equally important. Did the vendor do the testing themselves, or was an independent outside testing facility utilized? The American Association of Laboratory Accreditation (A2LA) has established standards for laboratories that include equipment calibration, technician training, laboratory environment, and record keeping. For example, A2LA has certified Adchem to ISO 17025, the standard for independent laboratories. Data published by Adchem's A2LA accredited laboratory is accurate and free from subjective commercial influences. Adchem has invested heavily in its A2LA accredited laboratory whose scope of accreditation includes the common tests run on pressure sensitive tapes.

We will look at several common properties and the factors that influence the "numbers." Different chemistries of the adhesives will influence the test results. At Adchem, our PSA chemistries include acrylic and rubber. There are also silicone PSA's. The most common properties that will have an affect on the "numbers" include dwell time (the time the PSA has been in contact with the substrate), the nature of the substrate, and the type of backing used for the test specimen.

Loop Tack is a common measure of "quick stick," how fast the PSA will adhere to the substrate. A tensile type machine lowers a loop of the test tape on to a substrate, typically stainless steel, and contacts for a specified period of time, typically one second or less, and then it is pulled away with force, usually measured in pounds per inch. When looking at loop tack numbers, it is important to know the machine speed as well as the backing used as these factors will influence the final number.

We should not leave the discussion on tack without talking about "thumb appeal" or the time-honored practice of using finger pressure to predict the quick stick properties of a PSA. This "test" does not produce any numbers that can be compared, and it is not much more reliable than depending on an arthritic knee to predict the onset of a hurricane. If my life depends on it, I'll take the satellite photos and the computer models, thank you. In addition to being totally subjective, the "thumb appeal test is susceptible to many unpredictable distortions, such as, what variety of breakfast sandwich the tester handled that morning. Adchem has engineered many systems with mediocre "thumb appeal" but with an excellent affinity for the substrate for which they were designed.

Peel numbers, usually expressed in pounds per linear inch, are impacted by the speed of the test apparatus, the dwell time or the elapsed time the adhesive has been in contact with the test surface following application, the backing material

(PET film is common but higher numbers can be generated by the use of dead-soft aluminum foil as a backing material) and the chemistry.

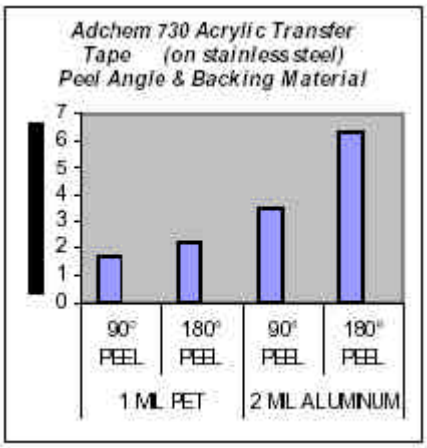

Table 1

Table 1 shows the impact of both peel angle and backing material for a typical acrylic PSA. As is readily apparent, if one does not know the test conditions, comparing the numbers is useless. Rubber-based systems in general will exhibit higher peel numbers than acrylic-based systems. PSA manufacturers will typically report immediate peel numbers since this test procedure is routinely performed as part of the company's QA process. Unfortunately these will be the lowest numbers one would see on a system and seldom relate to actual use.

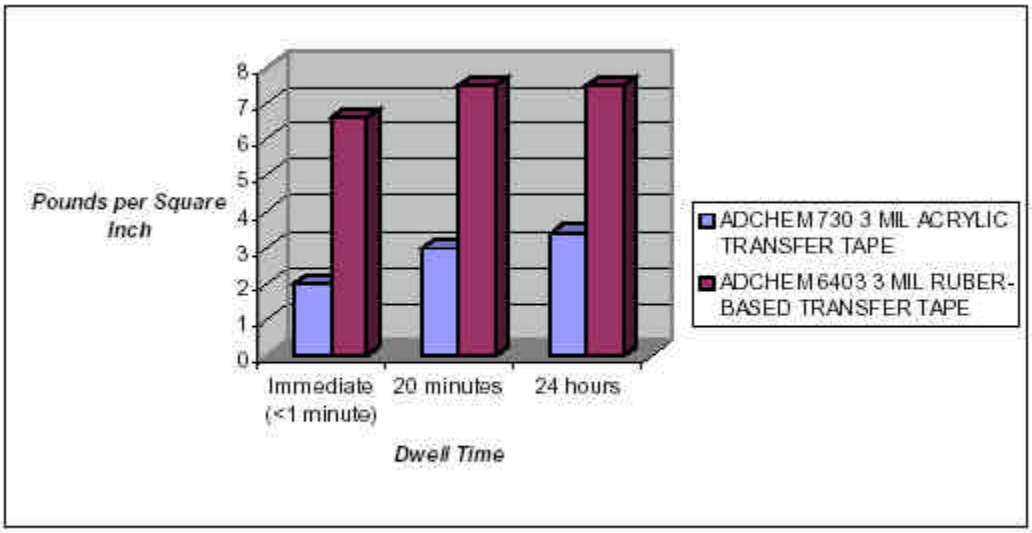

Table 2

Table 2 shows the impact of dwell time on peel strength, with different backing materials and substrate types. As is readily apparent, some conditions show little impact with dwell time while with others, the impact is quite dramatic. There are many ways to generate "numbers" so it is important that the conditions under which they were produced be well understood.

Static shear testing is done by hanging weights onto a sample of PSA and measuring the time to cohesive failure (the adhesive film splits). If the adhesive fails (the adhesive film cleanly delaminates), that would not be considered a measurement of shear strength of the adhesive system. Shear testing may be done at room temperature or at an elevated but constant temperature. Variables that need to be considered before comparing shear testing results, include the amount of the weight and the area of the test sample. Lighter weights are sometimes used at higher temperatures. Often the tests are discontinued if the sample is still "hanging" after 7 days and reported as "7 Days+." One way to discern differences is to test to failure of the first candidate.

Dynamic shear testing defines the strength of the adhesive as measured by the force required to generate a shear failure. In this case, the units are force or lbs. per square inch rather than time. Since the rate of application of the force is the determining factor, it is critical that the rate be known or reported as part of the test results.

Service Temperature is one of the more misunderstood and misused properties of a PSA tape product. The service temperature is primarily a factor of the adhesive itself. Service temperatures are typically reported as constant and intermittent. Intermittent results always need further definition. Is it 5 minutes at the elevated temperature and 5 minutes at the reduced temperature, or is it 5 days at each temperature? Vastly different results can be expected. Other factors that influence Service Temperature include the substrate that is bonded, the other ambient conditions such as how much humidity is present, how was the PSA applied - and our favorite variable – how much dwell time preceding the test.

Another number that customers commonly use to compare is the SAFT, which stands for Shear Adhesion *Failure* Temperature. The test sample preparation is identical to the Shear Testing, but in this case the test temperature is raised in increments until the sample fails. The key word is "failure." The temperature reported bears little relationship to the conditions of an actual use situation. All of the variables affecting Service Temperature come into play for the SAFT test as well. When comparing these "numbers," be sure the test conditions were identical, otherwise one is back to comparing apples to oranges.

Comparing numbers on data sheets from vendors is nearly impossible given all of the ways testing and test samples can differ. And rarely do such comparisons have any bearing on how a product will work in a given application. The best evaluation process involves side-by-side testing of all PSA candidates. Our history of side-by-side testing sometimes reveals interesting differences between published data and our own test data. This is not to say that manufacturers are publishing bad data. They are selecting test methods and conditions that put their products in the most favorable light, and they have every right to do that. It just makes it all the more difficult to compare the numbers.

Comparing products in actual use conditions and/or environment involves time and effort but it is infinitely better than comparing by "numbers" alone. As mentioned earlier, developing tests that more accurately predict the performance of the PSA in its final application have more value for the customer. Some industries already know this and Adchem has worked with others to develop meaningful tests.

For example, we created the 90º Inverted Peel Test to predict PSA behavior in the retail label market, and we worked with an automotive Tier 1 supplier to select a dynamic shear test as the one that would best predict the correct selection of a PSA candidate. These comparisons can be even more meaningful if the test samples can be produced simulating actual manufacturing conditions to duplicate the final production process.

So, when comparing numbers on PSA data sheets, what's in a number? The answer: Not much, really.