

Pressure Sensitive Adhesive Life Definitions

Mark Rutkiewicz, Innovize, 5/10/2016

Manufacturers have many definitions for how long you can use Pressure Sensitive Adhesive (PSA). These definitions are dependent on the manufacturer; there are no industry standards. First, we will look at the definitions and science behind PSAs and then define use, life and expiration. Finally, I will define the Innovize's PSA "expiration" date.

PSA Definition/Science/Background

This definition for what is a pressure sensitive adhesive is from Christoph Nagel at Tesa Tapes:

"Pressure sensitive adhesive is a permanently tacky substance that adheres to a given surface when light pressure is applied. A pressure sensitive adhesive maintains a fine balance between adhesion (holding power of the adhesive on external substrates) and cohesion (holding power of the combined internal components of the adhesive). PSAs do not require a chemical reaction to develop adhesion forces."¹

PSAs work on polar attraction, not a chemical or mechanical bond. The type of surface, surface preparation and condition are critical to the performance of the PSA. Christoph Nagel then defines "surface energy" in relation to applying/using the PSA.

"To ensure the best possible adhesion, it is optimal that the surface onto which the tape is applied has a higher surface energy or polarity than the tape's adhesive system. There are some substrates that are generally easier to bond to than others. These are the materials with higher surface tension/energy. It is important to know that coatings on the surfaces or fillers in the substrates might influence the adhesion characteristics. A painted aluminum or plasticized PVC (polyvinyl chloride) might display completely different bonding characteristics as compared to pure, unaltered materials."²

The PSA are first created in a batch (stored in barrels) and then applied (cast/coated) to a substrate. In order to deliver the PSA to the customer, the PSA can be self-wound (like tape) where opposite side of the cast substrate covers the adjacent layer of the PSA. The PSA may also be delivered as single-sided or double-sided, where a liner(s) is used to cover the PSA. In all of these methods, the surface (liner) that covers the PSA needs to have the lowest possible surface energy to allow the liner to easily release from the PSA.

As long as the liner coating remains at a low energy and covers the PSA, the PSA will not be able to attract/fill its polar bonds. If the liner is removed (exposed to air) or if the PSA gets contaminated, then the PSA peel strength will degrade. This is similar to sterile packages. As

¹ Christoph Nagel, Tesa Tapes Journal, *Tape 101: Understanding the Basics of Pressure Sensitive Tapes*, 8-2013.

² Nagel.

long as the package is sealed, the part within the package is sterile. Therefore, as long as the liner has not been removed from the PSA, the PSA will have the same characteristics as when the liner was applied.

Dave Olsen from Advanced Web made the same point and provided test results in his 2011 blog post:

“We took some current paper label stock, laser material to be exact, with an acrylic emulsion adhesive and tested and compared it against 4 year old retains of the same material. We did peel, shear, and tack on 4 common substrates including PETG, Tyvek, SBS cartons, and a stainless steel control. There was statistically no difference in the numbers between the two materials. When I discussed this fact with the Technical Director at our vendor, he was not surprised at all. He even sent me a letter, on company letterhead, stating that, ‘In reality, nothing dramatic should change with a PS labelstock construction after one year. The acrylic adhesive is chemically stable and will not oxidize or loose tack. The silicone release liner should stay near the same level as well. Likewise, after the label is applied, the adhesive does not degrade or lose tack over time . . .’ Many device companies have 5, 7 and 10 year real time shelf life info on their products and I have not heard of one PS label failure in all of that real time testing.”³

PSA peel and strength performance characteristics vary more dramatically with the surface type/finish, cleanliness, liner coating, lamination force/tension and storage conditions than with time.

Adhesive manufacturers want to limit their liability and typically only give their product a 1 to 2 years “life.” They have no incentive to test their products beyond this time frame.

“PSA Life” Definitions used by Innovize

PSA Manufacture Date: when the PSA has been formulated

PSA Coating Date: when the PSA is cast onto its substrate and when the PSA surface is covered with a “liner”

PSA Convert By (Warranty) Date: Date given by the adhesive supplier to guarantee the adhesive will convert without issues. Typically, this covers roll stability parameters of unwind, liner release and PSA edge ooze. If the PSA does not perform, the adhesive supplier will replace the PSA within this time period.

Liner Coating date: When coating (typically silicone) is applied to a paper or poly liner substrate

Part Manufacturing Date (Converted): When the converter performed one or all of the following processes on the PSA; die cut, laminated, replaced liner and/or packaged the part

³ Advanced Web Blog, Dave Olsen, *Shelf life of label stock – time to enter the late 20th century*, 3/11/2011.

PSA Part Warranty Date: when the converter guarantees the liner will be removable and the PSA will adhere to the substrate with the same characteristics as when it was first converted. If the converted part does not perform, the converter will replace the parts within this time period

PSA Best Use By Date: This needs to be determined by the final customer based on their materials and conditions

Innovize PSA “Expiration” Date Definition

Innovize (using the PSA Part Warranty Date) warrants that the liner will consistently release from the PSA and that the PSA will adhere to application surface for up to two years from the Innovize conversion date, as long as the converted product is maintained at room ambient conditions (50-90F, 5-80% RH) and stored in the Innovize-provided shipping container.

It is up to the customer to validate that the PSA will adhere to the expected surfaces for the life of the product through their own product aging or shelf life testing.