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Don't Forget the Glue!

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In the July 2022 issue of Tax Stamp & Traceability News™, Dr Marietta Ulrich-Horn of Securikett stated that her company had always maintained a strong focus on tamper-evident solutions for tax stamps, because if a genuine stamp can be transferred to another product for reuse, it's as if that stamp were actually a fake, whatever the number of security features it was carrying.

With these words in mind, it is therefore alarming to see, when passing through airport shops, how many liquor bottles are sitting on the shelves with their tax stamps half hanging off. Looking at those loose stamps, one has the impression that all it takes is a slight pull on the stamp for the whole thing to come clean off the bottle, intact – or at least intact enough to be reapplied to illicit product without raising suspicions.

Added to this observation are the stories one hears of tax stamps that are able to be fraudulently removed from a product, by means of, say, heat or water, without any perceptible damage inflicted on the stamp.

So, I thought it would be an opportune moment to focus on a component of tax stamps that usually goes unnoticed – given that it is hidden away on the underside of the stamp – but that is nevertheless an extremely important part thereof. I'm referring to the glue that adheres the stamp to a product.

This article looks at the main methods of affixing tax stamp labels to tobacco and alcohol products, as well as the best types of glue (adhesive) to use on different packaging surfaces, as recommended by experts including members of the International Tax Stamp Association (ITSA).

At the same time, the article considers other aspects that may need to be taken into account by tax stamp issuers and suppliers as far as tax stamp adherence is concerned. These include the increasing requirement for different industries to reuse packaging such as bottles and other

containers, which means that manufacturers and packers in these industries need to be able to cleanly and easily remove labels and other glue residue from used containers in order to put them back into circulation, filled with new product and, if required, affixed with a new tax stamp.

What does ISO say?

Let's start with the recommendations given by ISO 22382:2018 – the tax stamp standard – which defines 'adhesive' as a chemical mixture that bonds two materials together and that is activated by heat, pressure or chemistry. Adhesives are usually applied to the underside of the tax stamp substrate in the form of a permanent adhesive or dry gum, or they are added during the application of a tax stamp to the product.

22382 advises tax authorities to consider adhesive as a critical component of a tax stamp, since it is adhesive that ensures the stamp stays attached to its corresponding taxable product. Furthermore, given that tax stamps usually also act as closure seals to prevent the opening or retrieval of product, or refilling of the product's container, without noticeable damage to the tax stamp, it is the adhesion properties of tax stamps that have a major part to play in their tamper-evident robustness.

22382 goes on to advise tax authorities to make an informed decision on the types and combination of adhesives, based on:

- The surface properties of the product or packaging onto which tax stamps are to be applied, such as porosity, moisture content or receptiveness to different types of adhesives. For example, a tax stamp designed to go over a bottle top onto hard metal and glass surfaces has different adhesive requirements to a tax stamp on a soft cigarette pack.
- The devices applying the tax stamp, in terms of cost, speed and availability.
- The requirements for tamper-evident fixing of the tax stamp, noting that the strength of adhesion and reliability of tamper evidence are not just defined by the choice of the adhesive, but by the overall construction of the stamp.

Tax stamp adhesion methods

There are two main adhesion methods for attaching tax stamp labels to tobacco and alcohol products: wet-glue and pressure-sensitive.

Most tax stamps are of the wet-glue variety, as they are considered cheaper to produce than pressure-sensitive stamps. This is because wet-glue stamps don't require glue until the moment of application, the glue doesn't require the same level of sophisticated technology as pressure-sensitive glue, and wet-glue stamps don't need to be carried on a release liner.

With the wet-glue process, sheets or reels of printed stamps are cut into individual strips and stacked into 'bricks' ready to be loaded into a tax stamp applicator installed on tobacco and beverage production lines. The applicator then takes each stamp, applies a dab of glue, and

attaches the stamp to the final item, in what is sometimes referred to as a 'lick and stick' process. The glue is then dried, which hardens it and bonds the stamp to the product.

There are two types of adhesives that harden by drying: solvent-based adhesives and polymer dispersion adhesives.

Solvent-based adhesives are a mixture of ingredients (typically polymers) dissolved in a solvent to form a liquid glue. As the solvent evaporates, the adhesive hardens. Depending on the chemical composition of the adhesive, it will adhere to different materials to a greater or lesser degree. Starch-based adhesives, for instance, are a low-cost option for affixing tax stamps to paper and cardboard substrates such as cigarette packs.

The other type of adhesive that hardens by drying is polymer dispersion adhesive. This is a milky-white dispersion often based on polyvinyl acetate (commonly known as wood glue). It is used extensively in the woodworking and packaging industries and represents a more robust option for tax stamps than starch-based glue.

Moving to pressure-sensitive tax stamps, these are die-cut labels supplied in reel format on a release liner. Each label is pre-applied with adhesive, across its entire surface, so it can be easily removed from the liner and affixed to the item by means of light pressure, thereby forming a bond between adhesive and adherend. The bond forms as a result of the adhesive being soft, or 'wet', enough to flow to the adherend, and the strength of the bond comes from the molecular interactions that occur during bonding.

The main raw material associated with pressure-sensitive adhesives are acrylate-based polymers (or acrylics).

While pressure-sensitive labels are not as common for cigarette tax stamps as wet-glue labels, they are the more popular choice for tax stamps on alcohol products, including those applied manually. Pressure-sensitive labels can be pressed to a bottle more evenly with a larger 'wetted' area, as compared to wet-glue labels. In addition, the process is faster and more convenient, and no dispensing unit with water or liquid glue is needed.

What glue for what product?

Based on the different adhesion methods described above, what specific glues are recommended for cigarette and alcohol tax stamps?

With regard to cigarette stamps, starch-based adhesives (which are made from natural carbohydrates derived from roots, tubers and plant seeds) are used on some cigarette stamps mainly because of their low cost and abundant supply. However, these stamps have a tendency to come unstuck, so are definitely not much use for alcohol bottles – and should also be avoided for cigarettes.

A more robust alternative for cigarette stamps is polyvinyl acetate, or wood glue, as stated above, which is a widely available adhesive used for porous materials like wood, paper, and cloth.

As for alcohol products, experts advise the use of an adhesive that works with low energy surfaces. In general, metals and glass have a high surface energy and plastics have low energy, which requires the use of an aggressive adhesive to create a reliable bond.

The strongest adhesive, as recommended by ITSA members, is UV-curing hot-melt acrylic, which also has a high-tack advantage (tack is a measure of how quickly an adhesive bond is formed when two surfaces are brought together under light pressure).

Let's look at each element of this recommended adhesive:

Acrylics are resin-based adhesives that, apart from offering the best adhesion and long-term bonding ability, are able to withstand UV rays and most chemical solvents. These adhesives are also very difficult to remove, making them ideal for tamper-evident labels.

Hot-melt acrylic adhesives create a permanent bond to the adherend. They are applied in molten form to achieve flow and wetting, and they rely on cooling to a solid to give a serviceable bond. Hot-melt *pressure-sensitive* acrylic adhesives, on the other hand, retain the ability to form a serviceable bond under light pressure at room temperature, and are commonly used to manufacture pressure-sensitive tapes and labels.

UV-curing adhesives are generally acrylic-based and have become popular within the manufacturing sector due to their rapid curing time (they can cure in as little as one second), in addition to their strong bond strength.

These adhesives can also withstand harsh temperatures, which is an important property when it comes to thwarting attempts at tax stamp harvesting. For instance, the temperature at which an adhesive weakens (or yields) should be higher than the maximum substrate temperature. When this condition exists, the tax stamp substrate will fail before the adhesive.

The combination of acrylic adhesive with hot-melt and UV-curing properties is therefore deemed by ITSA members to be the strongest option for the adhesion of tax stamps and is especially relevant to alcohol stamps.

A more economical alternative for alcohol tax stamps, however, could be rubber-based adhesives, which are ideal as a general-purpose glue because of their ability to adhere to low energy surfaces.

Planning for bottle reuse and recycling

Another factor coming into play, though, which renders the choice of adhesives more complicated, relates to requirements by circular economies for the easy removal of labels and adhesive residue from packaging containers, in order that these containers can be reused.

Glues can either stick permanently to a container or be water removable. Water-removable glues are recommended for bottles that will be cleaned and reused, while rubber- or acrylic-based adhesives, with a strong tack, are recommended for bottles destined for the used-glass collection bin.

This means that the use of hot-melt acrylic adhesives, with their permanent bonding action, will not be suitable for circular economies in need of water-removable solutions – a situation that could open the door to an increase in the illegal reuse of tax stamps after removal.

To avoid this happening, tamper-evident technologies are available to change the appearance of the stamp once the bottle has been opened, or if the stamp has been peeled or washed off, or fraudulently tampered with. These technologies include kiss-cuts and perforations, indicative inks, void technology, and materials that change their appearance when exposed to heat or water.

It is therefore recommended that one or more of these technologies should co-exist on a tax stamp, along with the appropriate adhesive, in order to ensure a fool-proof solution for preventing stamp reuse and product tampering, while at the same time addressing the new challenges related to sustainability and circular economies.