SACURA BY TEPOTEC MAVINS LLC | SWITZERLAND

TAMPER-EVIDENT VACUUM PACKAGING

SWISS ENGINEERED

US PATENT 11,897,642 B2

The tamper-evident vacuum pouch operates through a dual-chamber architecture that separates the product containment region from a dedicated vacuum authentication chamber. The user places the product inside the main cavity of the pouch and closes it using a conventional closure mechanism such as a zip-lock, adhesive seal, or heat seal. This primary seal secures the product mechanically, while the tamper-evident function is implemented independently through an adjacent secondary chamber that runs along one side or edge of the pouch. This secondary chamber is transparent and optically accessible, allowing continuous visual inspection without disturbing the seal.

SYSTEM ARCHITECTURE

FIG 1.0 — ASSEMBLY & PROCESS LOGIC

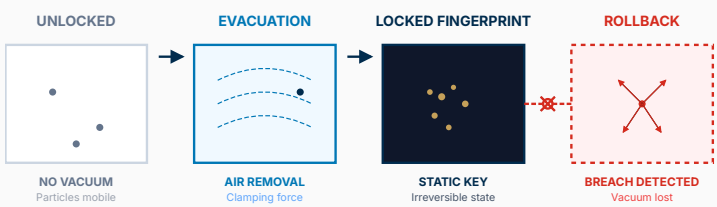
Within this secondary chamber resides a dense field of micro-scale circular particles that are free to move prior to vacuum activation. The chamber is fluidly connected to a narrow vacuum conduit or planar cavity that extends along the perimeter or sidewall of the pouch. When vacuum is applied to the system, air is evacuated uniformly from the authentication chamber through this conduit. As pressure drops, the particles are pulled into intimate contact with one another and with the containment film surfaces, causing them to mechanically interlock and arrest their motion. This process results in the spontaneous formation of a highly complex, non-repeatable particle arrangement.

COMPONENT KEY

1. **ASSEMBLY LAYERS**
   - 1a. Top seal laminate
   - 1b. Sidewall barrier stack
2. **PARTICLE FIELD**
   - 2a. Particle chamber
   - 2b. Optical inspection window
3. **VACUUM FIELD**
   - 3a. Evacuation conduit
   - 3b. Pressure equalization path

It's just Physics.

Vacuum pressure locks particles in place. Break the seal, destroy the pattern. No electronics. No way back.



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SECURITY & INTEGRITY

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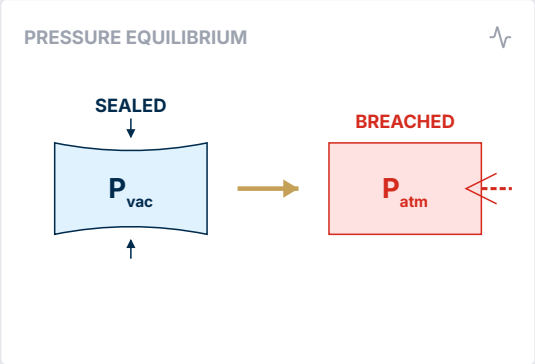
Once the vacuum state is established, the particle field becomes mechanically stable and resistant to further movement under normal handling conditions. The resulting geometry is clearly visible through the transparent inspection window, allowing a reference image of the locked particle configuration to be captured immediately after sealing. This reference image serves as a cryptographically strong visual baseline, as the probability of recreating the same particle arrangement after disturbance is practically negligible. Unlike printed codes or labels, this fingerprint is emergent, stochastic, and inherently unclonable.

BREACH DETECTION

Any attempt to tamper with the pouch, whether by cutting, puncturing, peeling from the corner, or compromising the seal at any location, disrupts the vacuum integrity of the interconnected cavity system. When external air enters the vacuum conduit, pressure equalizes rapidly, releasing the mechanical locking forces that hold the particles in place. Even a minor breach causes the particles to relax, shift, or reflow into a new configuration. This displacement is immediately observable as a deviation from the original reference image, providing a clear and irreversible indication of tampering.



Critically, the system is designed so that even indirect attacks, such as cutting the pouch away from the particle chamber or attempting to reseal after access, still result in detectable changes. Because the vacuum cavity encircles or interfaces with the pouch structure, any breach allows air to propagate into the authentication chamber, ensuring that tampering at any point manifests as visible particle displacement. As a result, the integrity of the seal can be verified visually and objectively, without electronics, active sensors, or external power, making the pouch suitable for scalable manufacturing, low-cost deployment, and high-security applications.

VERIFICATION LIFECYCLE

1. SEAL & LOCK | **2. CAPTURE REF** | **3. SHIP** | **4. VERIFY**

In essence, the tamper-evident vacuum pouch transforms a simple vacuum event into a permanent physical record of integrity. The locked particle field acts as a passive, self-generated authentication layer whose validity can be confirmed by direct visual comparison at any point in the supply chain. Any divergence from the original particle fingerprint is definitive proof that the vacuum state has been compromised, and therefore that the pouch has been tampered with.

TARGET APPLICATIONS

- CONFIDENTIAL DOCS
- PHARMA & BIO
- LUXURY GOODS
- DEFENSE & INTEL
- SILICON & TECH
- PHYSICAL ASSETS

LOOKING FOR DEVELOPMENT & R&D PARTNERS

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