Tamper Evident Plastic Bottle Caps

Tamper evident plastic bottle caps are a kind of special caps used to protect the safety of products and prevent counterfeiting, which are widely used in the industries of alcohol, beverages and pharmaceuticals. They not only functionally play the role of sealing and protection, but also improve the anti-counterfeiting ability of products through various technical means.

1. Base material selection

- PP (polypropylene): high rigidity, chemical resistance, suitable for injection molding complex anti-theft teeth structure.
- ABS (acrylonitrile-butadiene-styrene): high surface gloss, easy for plating or laser engraving, used for high-end cosmetic bottle caps.
- PETG (modified polyester): good transparency, can be combined with holographic film inside paste technology, suitable for liquor anti-counterfeiting labels.

2. Key Processes

- Two-color injection molding: outer layer of hard plastic (e.g. PP) + inner layer of soft plastic (TPE), realizing the integration of sealing and anti-counterfeiting structure.
- In-mold labeling (IML): the anti-counterfeiting label is pre-positioned in the mold and fused with the cap after injection to avoid label peeling.
- Microcellular Foaming Technology (MFT): Forms microcellular pores in the cap body, which cannot be recovered after destruction, and is used for high-value pharmaceutical packaging.

Tamper Evident Technology Classification

1. Physical structure anti-counterfeiting

- Anti-theft ring with broken teeth

Irreversible damage is realized through pre-set breaking points (e.g. 3-6 weak teeth grooves) when opening, commonly used in mineral water/beverage bottle caps, low cost but easy to be imitated.

- Disposable screw-off design

The inner wall of the cap is set with a reverse thread or ratchet structure, which separates the inner stopper from the outer cap when it is screwed open, and cannot be recovered (e.g. pharmaceutical caps).

- Labyrinth sealing structure

Complex grooves are designed inside the cap, requiring special tools to open, mostly used for industrial chemical packaging.

2. Material and process anti-counterfeiting

- Laser holographic marking

Micro-nano grating structure molded on the top of the cap, presenting dynamic 3D patterns (e.g. brand logos), requiring customized masters and high imitation difficulty.

- Fluorescent Ink Printing

Invisible ink using UV-excited development, which requires a banknote detection lamp (e.g., some white wine bottle cap lot numbers).

- Thermochromic/moisture-sensitive materials

Add thermochromic pigments (e.g. color development at 38℃) or water-induced character coating to the cap body to enhance consumer interactive verification.

3. Digital Intelligent Anti-counterfeiting

- QR code/RFID integration

Injection molding embedded NFC chip or laser burning traceability QR code, scanning code to verify the production information (e.g. Moutai's “one bottle cap, one code” system).

Market Application of Tamper Evident Plastic Bottle Caps:

- Alcohol: high-grade liquor, wine, spirits, etc. to prevent counterfeiting and piracy.
- Beverages: fruit juices, carbonated drinks, etc., to protect product quality.
- Pharmaceuticals: anti-counterfeit bottle caps are used in drug packaging to ensure the safety and effectiveness of drugs.
- High-end cosmetics: non-original caps cannot be closed. It can be quickly recognized during counter inspection.