

HOW TO SELECT HEAT SEAL COATINGS FOR LIDDING APPLICATIONS

Selection of the appropriate peelable heat-seal coating for any lidding application is a challenging process and is influenced by a multitude of parameters. We present here some of the major parameters that a converter must consider in selecting a heat-seal coating for lidding applications.

Major parameters

Lid film or lamination

Coating can be applied to a variety of substrates.

- Aluminum foil (AF)
- Polyester film (PEST)
- Oriented polypropylene (OPP)
- Polyethylene (PE)
- Paper or paperboard
- Polyvinylidene chloride (PVDC)
- Tyvek¹
- Vinyl

Cup stock, tray stock, or bottom web

A variety of rigid materials are used as cup or tray stock.

- Aluminum foil
- Polyester (PET² or PETG³)
- Polyvinyl chloride (PVC)
- Polystyrene (PS)
- High-impact polystyrene (HIPS)
- Cast polypropylene (PP)
- High-density polyethylene (HDPE)
- XT polymer⁴
- Baxex⁵
- Aclar⁶

Food, pharmaceutical, or medical products

The heat seal must be compatible with the contents of the cup or tray.

Service conditions

The heat-seal coating must be selected to withstand one or more of the following conditions.

Hot fill. Jellies, jams, syrup, sauces are often filled at 170–200°F. The heat seal must have adequate hot tack at this temperature to resist leaking.

Refrigerated or freezing temperatures. Citrus juices and concentrates are refrigerated or frozen. The heat seal must maintain its flexibility and adhesion to both surfaces at low temperatures.

Heat resistance. This property is important for retortable, autoclavable, or ovenable products. The heat seal must have bond integrity up to 350–450°F.

Chemical resistance. The coating may be in contact with greasy, oily, acidic, or corrosive food products, perhaps at elevated temperatures.

Vacuum resistance. The sealed package may be exposed to a vacuum during sterilization or other process.

Porosity. Disposable medical devices are often sterilized by ethylene oxide gas. The heat-seal coating must have adequate porosity to permit entry and exit of the gas and not react with it.

Stability to radiation. For certain medical devices or pharmaceutical uses, the heat-seal coating must not degrade or react under gamma radiation.

FDA status

Heat-seal coatings must comply with the pertinent Food and Drug Administration (FDA) regulation for the lidding substrate, food type, and service conditions.

Type of bond

The packager must specify low, moderate, or high peel strengths as well as amount of coating transfer desired. Sometimes a destruct bond is required.

Seal conditions

The coating must function within the limits imposed by

available heat, pressure, and dwell time at the bond line. This also includes considerations of sealing equipment.

Application equipment

The converter's equipment—gravure, flexo, roller coater—will have a strong influence on coating selection.

EPA considerations

Sometimes the choice between a solvent- or water-based heat seal has more influence than all of the others. Solvent-recovery equipment can also dictate the solvent to be used.

Lidding applications

Dry food

Dry food products, such as coffee lightener or powdered drink mix, place minimal demands on the peelable heat-seal coating. Dry-food constructions include:

paper/XLDPE/HS → HIPS
paper/adhesive/OPP/HS → PVC

where

X = extruded.

For this end use, a water-based EVA dispersion would function quite well. There is no toluene to absorb into the LDPE, and the EVA provides an easily peelable bond to the cup stock. An EVA coating can be applied by any method and requires a relatively low drying temperature that will not distort the polyolefin film. FDA compliance on paper and/or polyolefin is also assured with this type of coating.

Dairy creamer

There are several types of dairy creamer lid stock. The simplest is

paper/XLDPE/HS → HIPS

For this application, a moisture-resistant, peelable seal is required. An EVA-based gel lacquer is one of the most widely used heat seals. Gel lacquers are a solvent solution of a hot melt. The most common method of application is by directly heated gravure. Here again, a coating with direct-food-contact compliance on polyolefin film is required.

A more sophisticated creamer lid structure is

paper/XLDPE/AF/HS → HIPS or
paper/XLDPE/AF/primer/HS → HIPS

An EVA-based gel lacquer works well for such applications, but it sometimes bridges or membranes when it is peeled. In such cases, a vinyl primer is used to improve adhesion to the foil. Both the primer and heat seal must comply with FDA regulation 21CFR175.300.

Jelly and condiments

Jellies, jams, pancake syrup, fast food sauces are often filled at 170-200°F. Sauces are often acidic and contain aggressive components such as mustard oil. The heat seals used to hold these products must have good hot tack at 200°F to prevent leaking lids, good moisture resistance, moderate grease resistance, and good chemical resistance.

One type of construction is

The heat lid seal must maintain its flexibility and adhesion at low temperatures. Photo courtesy of RJR Archer, Inc.



PEST/adhesive/AF/primer/HS → HIPS
PVC

Here the heat seal can be a vinyl or vinyl-acrylic applied over a vinyl primer. The primer is important to protect the foil from corrosion by the product.

Another approach is

AF/adhesive/PEST/HS → HIPS or PVDC/HIPS
PVC
PP
HDPE

A reinforced EVA gel lacquer will provide good adhesion to the PEST lid substrate as well as good sealability to a broad range of cup stocks and good heat resistance for hot fill. Compliance with FDA regulation 21CFR177.1630 is an important factor in these applications.

Lidding for fresh and frozen citrus juices is a large and important market. The most common construction is

print/AF/primer/HS → PVC

where the primer and heat seal are both solvent-based vinyls. A pinhole-free coating is important to protect the foil from the corrosive citrus juices. Low-temperature adhesion is a must for frozen products. Both must comply with FDA regulation 21CFR175.300.

Greasy or oily foods

Lidding on a clear substrate for greasy foods such as cheese or peanut butter is a challenge. An often-used construction is

OPP/primer/PEST/HSE — PETC
PVC

This heat-seal coating is a solvent-based EVA/nitrocellulose hybrid with excellent film clarity and grease resistance. It complies with FDA regulation 21CFR177.1630.

Dual ovenable trays

Ovenable trays are either PET or SBS board/PET in which food products are either microwaved or heated in a thermal oven up to 400°F. The cover can be

PEST/HS — PET or
SBS/PET/HS — PET

where

SBS = solid bleached sulfite.

The heat seal for the film lid must be clear, have heat resistance to 400°F, and still be peelable after heating. A board-lid heat seal need not be clear, but it must have all the other attributes. Polyester-based coatings that comply with FDA regulation 21CFR177.1630 are used in these applications.

Autoclavable and aseptic lidding

Lidding for autoclavable and aseptic applications presents some unique problems. The heat-seal coatings must have good adhesion to foil, and they must be sealable to polypropylene for steam sterilization. The coating must also be stable to radiation sterilization. The construction is

AF/HS — PP

and the heat seal is a specially reinforced EVA gel lacquer, which provides a controlled peel. This type of package is used for medical applications, such as sterile-water and hydrogen-peroxide-sterilized aseptic packaging. The FDA regulation for the latter is 21CFR178.1005.

Retortable lidding

Few packaging concepts can match retortable lidding for extreme performance requirements. A retortable lid must withstand 121°C, 15-psi steam for 30 min without losing seal integrity and yet remain peelable after long-term shelf storage. The special heat-seal coating that can function in this environment is a modified polypropylene dispersion known as Morprime[®]. A typical lidding construction could be

0.5 mil PEST/1 mil AF/Morprime — PP or
2 mil AF/Morprime — PP

This coating is also unique in its selectivity. It must be applied to a metal substrate, such as aluminum foil, and requires drying/curing temperatures of 400°F for 30-35 s. It is sealable to either cast or molded polypropylene or to another Morprime surface at 450°F for 1 s. Typical food products packaged in retortable cups include apple sauce, orange juice, yogurt, and cheese food spreads. Morprime complies with FDA regulation 21CFR175.300.

Medical packaging

Heat-seal coatings for lidding of disposable packages for medical devices are applied onto Tyvek or surgical kraft paper, which is then sealed to several different plastic tray materials. Typical constructions are

Tyvek/primer/HS — PET
HIPS
HDPE
PP

The heat-seal coating must have adequate porosity to allow efficient entry and removal of ethylene oxide gas during sterilization, as well as good humidity resistance and sufficient heat resistance to overcome "sterilizer creep." When peeled from the tray, the coating should transfer completely from the lid to the tray flange to show evidence of closure.

Specially formulated EVA dispersions have been successful in this application. The large particle size of the dispersion provides good porosity, and the EVA polymer provides a good peelable bond to almost all of the commercially used tray stocks. These EVA coatings are also stable under radiation sterilization. FDA compliance for direct food contact on any substrate makes these waterborne coatings suitable for lidding of medical packages.

Although this survey of heat-seal coatings for lidding has covered a variety of materials, applications, and usage parameters, it is by no means exhaustive. As new lidding substrates and container materials become available, new heat-seal coatings will be required to meet the needs of the converters and end users.