V IS FOR VERSATILE – VINNOL® SURFACE COATING RESINS FOR HEAT-SEALABLE COATINGS
HOW DO YOU MEET THE MULTITUDE OF CHALLENGES IN THE HEAT-SEALABLE COATINGS SECTOR?

Formulating heat-sealing coatings is a complex task – but one that has a long tradition at WACKER. As a leading chemical company, we have been optimizing our portfolio of binders and additives since the 1950s. Today, formulators worldwide rely on VINNOL® and our services, which are available to you at over 100 subsidiaries in all key regions of the world.
Heat-sealed closure systems are often the best choice for packaging food or pharmaceuticals. Depending on the specific sealing system, heat-sealable coatings must fulfill various application needs. The VINNOL® resin portfolio enables you to control these product and process requirements.

Typical Product Requirements for Heat-Sealable Coatings
• Adhesion to aluminum substrates
• Transparency
• Thermal stability
• Chemical resistance
• Flexibility
• Seal bond strength
• Corrosion resistance
• Food-contact approval

VINNOL® fulfills these requirements through a sophisticated product concept.

Typical Process Benefits for Heat-Sealable Coatings
• Adjustable viscosity
• Solubility in a wide range of solvents
• Low levels of solvents required
• Reduction/elimination of plasticizers
• Low thermal activation temperature (e.g. 140 °C)
• Excellent compatibility with cobinders and additives
• High storage stability of coated foils/ easy unrolling of coated foils
• Minimal corrosion of process equipment

Key Advantages of VINNOL®
• Outstanding water and chemical resistance
• Low odor and taste-free
• Excellent solubility and ease of processing
• Wide formulation range
• High corrosion resistance of coatings
• High toughness and permanent flexibility
• Superior abrasion resistance

Suitable for Food Packaging
Many VINNOL® resin grades can be used for applications compliant with FDA 21 CFR 175.300 as well as European Food Contact Regulations.

Substrates Heat Sealable to Aluminum Foils Coated with VINNOL®

α combined with e.g. acrylic resins or acrylic-olefin dispersions

VINNOL® and VINNACOAT® are registered trademarks of Wacker Chemie AG.
VINNOL® is WACKER’s brand name for vinyl chloride co- and terpolymers. All grades are compatible with each other, creating a modular system for adjusting the characteristics of heat-sealable coatings.

The Basis of Heat-Sealable Coatings
VINNOL® surface coating resins with carboxyl groups are terpolymers of vinyl chloride, vinyl acetate and dicarboxylic acids. These grades are identified with an “M” in the product name. They provide excellent adhesion, particularly to metal substrates. Adhesion to glass is also enhanced.

Modifiers
VINNOL® resins without functional groups are copolymers of vinyl chloride and vinyl acetate. They are available in different molar compositions and a broad molecular weight range. These VINNOL® copolymers are used as modifiers to achieve a specific property profile. Solution viscosity and seal bond strength may be adjusted to individual demands.

VINNOL® H Grades
VINNOL® H grades are manufactured by suspension polymerization. They allow for highly transparent coatings with low water absorption – which is important for heat-sealable coatings.

In heat-sealing applications, mainly VINNOL® H grades are used.

However, emulsion-polymerized E grades, which are mainly used for applications other than heat sealing, are also available.
## Product Overview: Heat-Sealable Coatings

<table>
<thead>
<tr>
<th>Grades</th>
<th>Polymer Composition</th>
<th>K value&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Glass transition temperature&lt;sup&gt;4&lt;/sup&gt; Tg (DSC) °C</th>
<th>Viscosity&lt;sup&gt;1&lt;/sup&gt; DIN 53015 [mPa•s]</th>
<th>FDA regulation</th>
<th>FDA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>With Carboxyl Groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>175.300</td>
</tr>
<tr>
<td>VINNOL® H 15/45 M</td>
<td>84.0 ± 1.0</td>
<td>15.0 ± 1.0</td>
<td>ca. 1.0&lt;sup&gt;4&lt;/sup&gt;</td>
<td>48 ± 1</td>
<td>ca. 74</td>
<td>60 ± 10</td>
</tr>
<tr>
<td>VINNOL® H 15/45 M special</td>
<td>84.0 ± 1.0</td>
<td>15.5 ± 1.0</td>
<td>ca. 0.5&lt;sup&gt;4&lt;/sup&gt;</td>
<td>48 ± 1</td>
<td>ca. 74</td>
<td>60 ± 10</td>
</tr>
<tr>
<td>VINNOL® H 30/48 M</td>
<td>70.0 ± 1.0</td>
<td>29.0 ± 1.0</td>
<td>ca. 1.0&lt;sup&gt;4&lt;/sup&gt;</td>
<td>48 ± 1</td>
<td>ca. 65</td>
<td>45 ± 10</td>
</tr>
<tr>
<td><strong>Without Functional Groups</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VINNOL® H 14/36</td>
<td>85.6 ± 1.0</td>
<td>14.4 ± 1.0</td>
<td>-</td>
<td>35 ± 1</td>
<td>ca. 69</td>
<td>13 ± 3</td>
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<tr>
<td>VINNOL® H 15/42</td>
<td>86.0 ± 1.0</td>
<td>14.0 ± 1.0</td>
<td>-</td>
<td>42 ± 1</td>
<td>ca. 70</td>
<td>28 ± 5</td>
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<tr>
<td>VINNOL® H 15/50</td>
<td>85.0 ± 1.0</td>
<td>15.0 ± 1.0</td>
<td>-</td>
<td>50 ± 1</td>
<td>ca. 74</td>
<td>70 ± 10</td>
</tr>
<tr>
<td>VINNOL® H 40/43</td>
<td>65.7 ± 1.0</td>
<td>34.3 ± 1.0</td>
<td>-</td>
<td>42 ± 1</td>
<td>ca. 58</td>
<td>25 ± 5</td>
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<tr>
<td>VINNOL® H 40/50</td>
<td>63.0 ± 1.0</td>
<td>37.0 ± 1.0</td>
<td>-</td>
<td>50 ± 1</td>
<td>ca. 60</td>
<td>55 ± 10</td>
</tr>
</tbody>
</table>

1 20% solution in methyl ethyl ketone, dissolved at 50 °C  
2 WACKER method  
3 EN ISO 1628-2  
4 Dicarboxylic acid

### How To Read The Product Names

**VINNOL® H 15/45 M**

- **Polymerization Process:** M = Carboxyl group  
- **K Value:** H = Suspension polymerization  
- **Functional Group:** A = Hydroxyl group  
- **Vinyl Acetate Content:**  
  - A higher vinyl acetate content reduces solution viscosity and the coating-softening range while increasing coating flexibility.

### Polymerization Process

- **H = Suspension polymerization**
- **E = Emulsion polymerization**

### K Value

- Molecular weight / viscosity. A higher K value increases solution viscosity, mechanical strength and the coating-softening range.
BENEFIT FROM AN INTELLIGENT SYSTEM

Heat-Sealing Grade

Typical Coating Requirements:

- Abrasion resistance
- Resistance to aliphatic hydrocarbons
- Low gas permeability
- Permanent flexibility
- High water resistance
- High toughness
- Resistance to grease, aqueous acid and alkaline solutions

Standard Solution: VINNOL® H 15/45 M

Outstanding thermal stability

Excellent water resistance

Heat sealable at lower temperatures

Superior solubility in various solvents, especially in ester

VINNOL® H 15/45 M
VINNOL® H 30/48 M
VINNOL® H 30/48 M
Heat-Sealing Modifier

- **Viscosity**
  - **Keep stable**
  - **Reduce**
  - **Increase**

- **Seal bond strength**
  - **Reduce**
  - **Increase**

**Increase**
- Water resistance
- Flexibility of the coating
- Thermal stability
- Solubility in ester

**Reduce**
- Thermal activation temperature
- Thermal stability

**VINNOL® H 15/50**
**VINNOL® H 40/50**
**VINNOL® H 40/43**
**VINNOL® H 14/36**
**VINNOL® H 40/43**
**VINNOL® H 40/50**

**VINNOL® H 14/36**
RESINS TAILOR-MADE FOR VARIOUS REQUIREMENTS

Packaging binders are governed by a number of critical parameters: seal bond strength, viscosity and sealing temperature. With our broad range of tailor-made VINNOL® grades you can optimize your process to meet your specific requirements.

VINNOL® H 15/45 M – the Reference Grade with Manifold Advantages
VINNOL® H 15/45 M is the market reference grade and fulfills all possible needs in most heat-sealing applications. VINNOL® H 15/45 M is a carboxyl-containing copolymer of vinyl chloride and vinyl acetate, mainly used as a binder for heat-sealable coatings. It adheres excellently to metal surfaces as well as to polar substrates, e.g. PVC and PET. It is approved for food-contact applications and is in compliance with FDA 21 CFR 175.300. It is an excellent, well-established choice for many types of foodstuffs and pharmaceutical packaging.

Mayor Benefits Provided by VINNOL® H 15/45 M:
- Excellent chemical resistance
- Low water uptake
- High abrasion resistance
- High toughness
- Permanent flexibility
- Low gas-permeability
- High solubility in ketones

VINNOL® H 30/48 M
VINNOL® H 30/48 M is a coating resin containing a higher proportion of vinyl acetate polymer units compared to VINNOL® H 15/45 M.

Excellent Solubility in Pure Ester
VINNOL® H 30/48 M has the additional advantage of dissolving excellently in lower-cost esters, enabling the formation of clear, colorless solutions without any use of ketones whatsoever.

Low Viscosity
Even with an increased solids content, the resin solution is still of low viscosity. Less solvent is required as a result, reducing costs and allowing a higher resin load.

<table>
<thead>
<tr>
<th>Solid content</th>
<th>VINNOL® H 15/45 M</th>
<th>VINNOL® H 30/48 M</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>39</td>
<td>32</td>
</tr>
<tr>
<td>20%</td>
<td>680</td>
<td>100</td>
</tr>
<tr>
<td>30%</td>
<td>Gel-like</td>
<td>700</td>
</tr>
<tr>
<td>40%</td>
<td>Gel-like</td>
<td>5000</td>
</tr>
</tbody>
</table>

The lower viscosity facilitates processing and cuts solvent consumption

Heat-Sealable at Lower Temperatures
Coatings based on VINNOL® H 30/48 M can be heat-sealed even at lower temperatures due to the higher vinyl-acetate content in the polymer backbone. This lowers energy and processing costs and opens up new applications, as it enables the packaging of heat-sensitive foods such as cheese.

A lower sealing temperature saves energy and enables the packaging of heat-sensitive food.
VINNOL® H 15/45 M Special
VINNOL® H 15/45 M special is a more advanced version of VINNOL® H 15/45 M. An optimized manufacturing process, as well as slight modifications in the polymer backbone, allow significant improvements in the following properties as compared to VINNOL® H 15/45 M.

**Thermal Stability**
The product can resist higher temperatures for longer timeframes, which has a positive impact on storage stability. This characteristic makes it especially suitable for countries with hot climates.

**Water Resistance**
The seal bond strength remains very high, even under very humid or wet conditions. VINNOL® H 15/45 M special is highly recommended for packaging refrigerated foodstuffs.
The VINNOL® H 40 Grades: The Perfect Modifiers

The VINNOL® H 40 series can be used to modify various process parameters:

- Blending VINNOL® H 40 grades with carboxyl-modified grades such as VINNOL® H 15/45 M leads to a higher seal bond strength (see graph). Various VINNOL® H 40 grades have the capability to enhance the seal bond strength of VINNOL® H 15/45 M to a certain extent. On the other hand, with this combination, the sealing temperature can be significantly reduced while retaining the original bond strength.

- Due to their higher vinyl acetate content in the polymer, VINNOL® H 40 grades lead to a better solubility, lower viscosities and thus to higher dispersion and processing speeds. For example, combining VINNOL® H 15/45 M with VINNOL® H 40/43 will significantly reduce the viscosity, increase the solubility and allow for higher processing speeds.

Seal Bond Strength

Under given sealing conditions the seal bond strength can be raised by blending VINNOL® H 15/45 M with VINNOL® H 40/43 or VINNOL® H 40/50. Alternatively the sealing temperature may be significantly reduced, while retaining the original bond strength.

The ability to influence these variables allows you to seal even thermally sensitive composite systems. Therefore, a broader range of products can easily and safely be packaged.

Applications

VINNOL® has the necessary approvals for use in food packaging. It is especially suitable for packaging:

- Pharmaceuticals
- Food, in particular heat-sensitive foods, such as cheese or yoghurt
VINNACOAT® LL 8100
Under the umbrella of surface coatings resins, WACKER offers VINNACOAT® grades which complement the VINNOL® product range to serve the wide variety of packaging applications.

VINNACOAT® LL 8100 is a carboxyl-containing styrene-olefin copolymer, which is dispersible in organic solvents. It adheres excellently to metal surfaces and is suitable for heat-sealable coated aluminum to non-polar substrates, e.g. polystyrene (PS), polypropylene (PP) and polyethylene (PE). It is in compliance with food-contact regulation FDA 21 CFR 175.300. It therefore offers an alternative to acrylic-based systems for chlorine-free heat-sealing lacquers.

With VINNACOAT® LL 8100, formulators can use one single binder component for application fields ranging from juice and water cups sealed with aluminum foil lids to dairy products such as yogurt or cream.
WITH UNLIMITED POSSIBILITIES
ON VARIOUS SUBSTRATES

<table>
<thead>
<tr>
<th>Heat-sealable laminates</th>
<th>One-coat system</th>
<th>Two-coat system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blending ratio</td>
<td>Primer</td>
</tr>
<tr>
<td>Alu–Alu</td>
<td>V InnOL® H 15/45 M</td>
<td>V InnOL® H 15/45 M</td>
</tr>
<tr>
<td>Alu–NC-coated paper</td>
<td>V InnOL® H 15/45 M + V InnOL® H 40/50</td>
<td>1/1</td>
</tr>
<tr>
<td>Alu–PET</td>
<td>V InnOL® H 15/45 M</td>
<td>–</td>
</tr>
<tr>
<td>Alu–PP and OPP</td>
<td>V InnACOAT® LL 8100</td>
<td>V InnOL® H 15/45 M</td>
</tr>
<tr>
<td>Alu–PS</td>
<td>V InnOL® H 15/45 M + acrylic resin</td>
<td>1/1 – 1/4</td>
</tr>
<tr>
<td></td>
<td>V InnACOAT® LL 8100</td>
<td></td>
</tr>
<tr>
<td>Alu–PVC</td>
<td>V InnOL® H 15/45 M</td>
<td>V InnOL® H 15/45 M</td>
</tr>
<tr>
<td></td>
<td>V InnOL® H 15/45 M + V InnOL® H 40/43</td>
<td>1/1</td>
</tr>
<tr>
<td></td>
<td>V InnOL® H 15/45 M + V InnOL® H 15/50</td>
<td>1/1</td>
</tr>
<tr>
<td>Alu–PVDC</td>
<td>V InnOL® H 15/45 M + acrylic resin</td>
<td>1/1</td>
</tr>
</tbody>
</table>
WACKER is one of the world’s leading and most research-intensive chemical companies, with total sales of €4.91 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bio-engineered pharmaceutical actives and hyperpure silicon for semiconductor and solar applications. As a technology leader focusing on sustainability, WACKER promotes products and ideas that offer a high value-added potential to ensure that current and future generations enjoy a better quality of life based on energy efficiency and protection of the climate and environment. Spanning the globe with five business divisions, operating 25 production sites, WACKER is currently active in over 100 countries. The Group maintains subsidiaries and sales offices in 29 countries across Europe, the Americas and Asia – including a solidly established presence in China. With a workforce of 17,200, WACKER sees itself as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, its customers. WACKER also helps them boost their own success. Our technical centers employ local
• Sales and production sites, plus 20 technical centers, ensure you a local presence worldwide.

WACKER is one of the world’s leading and most research-intensive chemical companies, with total sales of €4.91 billion. Products range from silicones, binders and polymer additives for diverse industrial sectors to bio-engineered pharmaceutical actives and hyperpure silicon for semiconductor and solar applications. As a technology leader focusing on sustainability, WACKER promotes products and ideas that offer a high value-added potential to ensure that current and future generations enjoy a better quality of life based on energy efficiency and protection of the climate and environment. Spanning the globe with five business divisions, operating 25 production sites, WACKER is currently active in over 100 countries. The Group maintains subsidiaries and sales offices in 29 countries across Europe, the Americas and Asia – including a solidly established presence in China. With a workforce of 17,200, WACKER sees itself as a reliable innovation partner that develops trailblazing solutions for, and in collaboration with, its customers. WACKER also helps them boost their own success.

Our technical centers employ local specialists who assist customers worldwide in the development of products tailored to regional demands, supporting them during every stage of their complex production processes, if required. WACKER e-solutions are online services provided via our customer portal and as integrated process solutions. Our customers and business partners thus benefit from comprehensive information and reliable service to enable projects and orders to be handled fast, reliably and highly efficiently.

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All figures are based on fiscal 2011.
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