vestolit

Technical Coatings

For diverse coating applications

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Image 1: Coating color variations

Technical Coatings

Technical Coatings include a wide range of PVC resins specifically developed for various market segments – including Can Coatings, Coil Coatings, Fiber Screen Coatings, Paint Additives, Powder Coatings and Underbody Coatings. Each segment has its own set of unique requirements and application methods. PVC safely covers your valuables with the best performance, versatility and cost.

The category of Technical Coatings perfectly shows the versatility of PVC resins. Different manufacturing processes allow for diverse application fields in which the distinct qualities of specifically developed PVC products by Vestolit provide additional value. The multitude of end products and their respective manufacturing process will be detailed in the following.

Image 2: Technical Coating on fabric

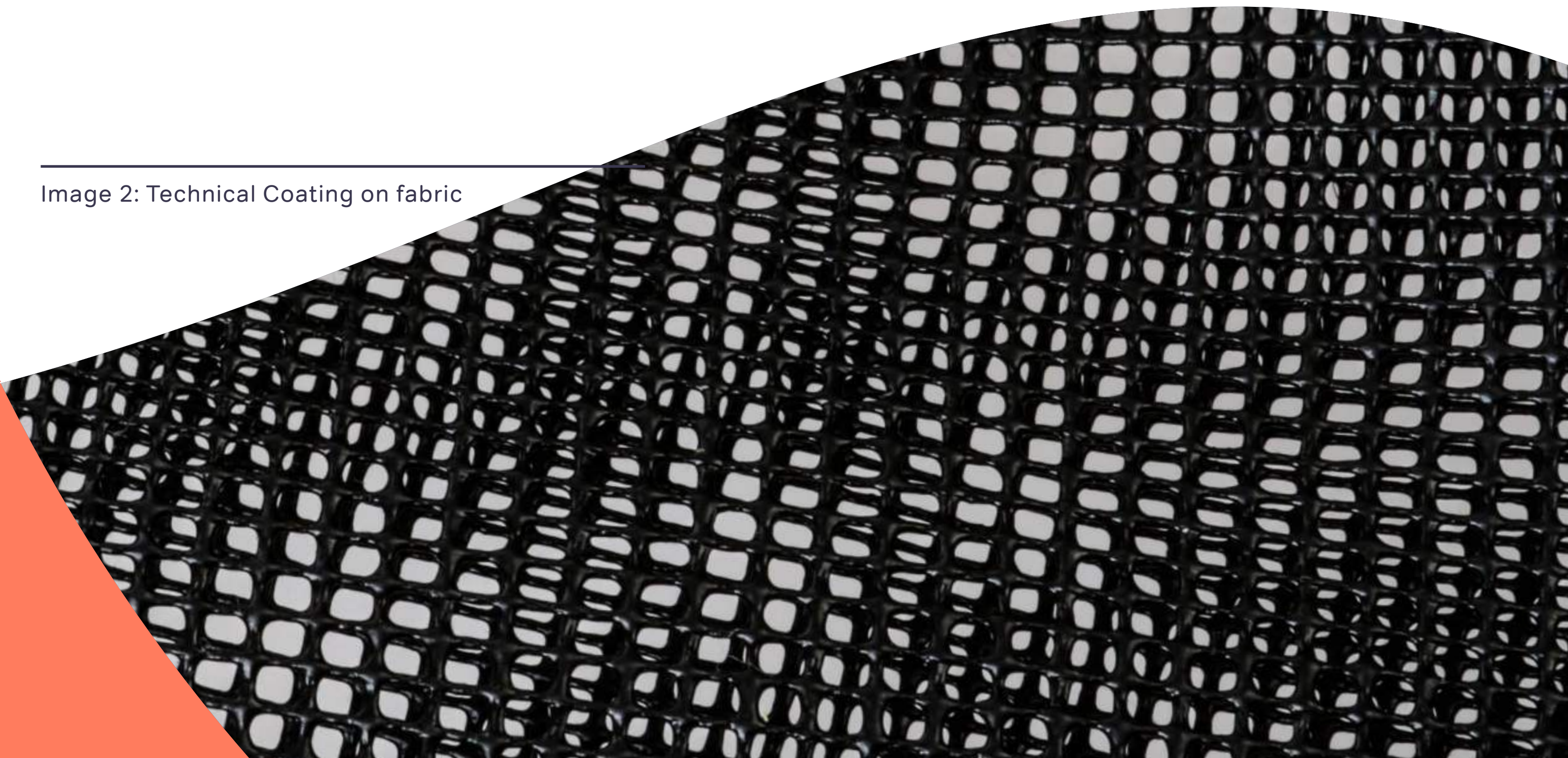

Image 3: Can Coating

Can Coatings

PVC in Can Coatings is proven safe and effective in the highly regulated food industry. Used as an interior metal can liner, it protects food from the can and the can from the food. Low surfactant content means resins do not contribute taste and/or odor to packaged food and beverages. Can manufacturing processes typically fall under two types – 2-piece (body & can-end) and 3-piece (body, top & bottom).

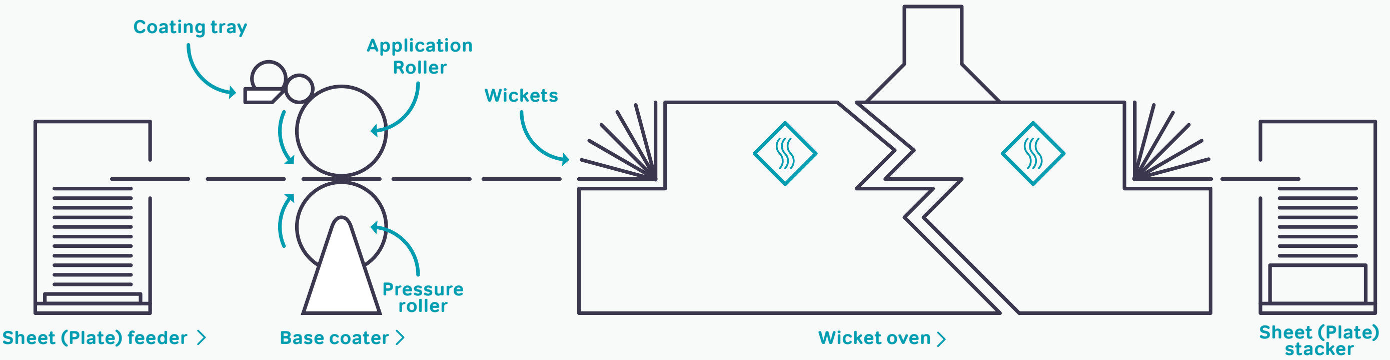

Figure 1: Inner coating process

Two-piece cans are made by forming a cup-shaped container with one piece of aluminum or steel and attaching (crimping) an end piece to it. Two-piece cans are also manufactured either by the draw-redraw process or the draw-and-iron process. After fabrication, the appropriate coating as determined by food content is applied and cured.

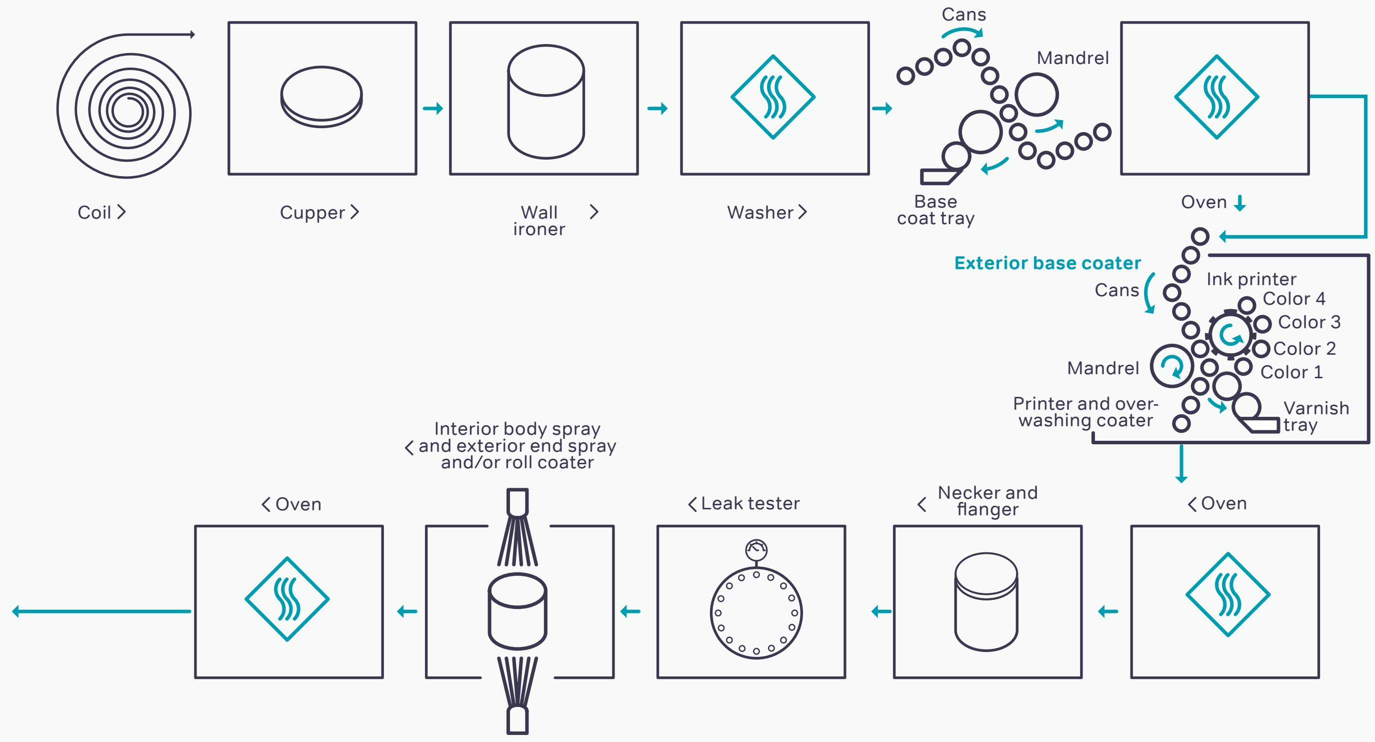

Figure 2: 2-piece forming process

In certain global regions, the external surface of the can does not get coated, but a printed label is glued on the can that displays the brand name, manufacturer and food contents. In other regions, the exterior of the can goes through an external printing process to display the same information, as depicted in figure 3. Depending on the end customer's requirements, a sheet can go through multiple printing layers and cure cycles, before being applied with a clear coat to protect the inks and also provide abrasion resistance.

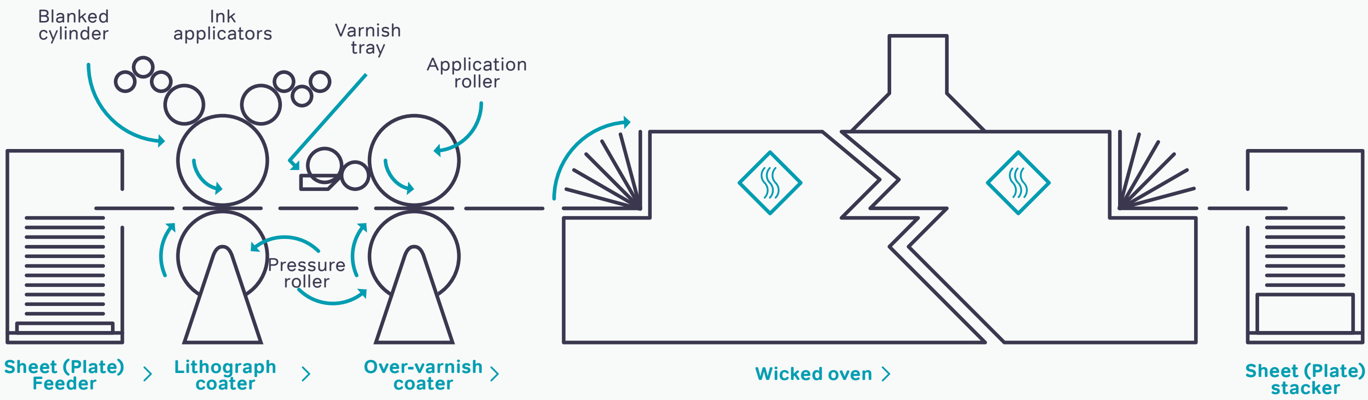

Figure 3: Internal coating process

3-piece can bodies are made from flat sheets cut from coils. The following steps provide a general guide to the manufacturing process. Processing sequence can be summarized as follows:

1. Coated sheet plates get cut and split to form body blanks or wickets.

2. Body blanks go through a forming process to form cylindical shapes.

3. The ends are welded or cemented, then coated with a seam sealer and oven cured.

4. Optionally, an addtional coating may be applied to the inside of the can for additional food protection.

5. Bottom ends are put on and seam sealed.

6. The cans go through a leak test, and are then stacked – ready to be filled with the chosen food.

Exterior coatings do not require any FDA requirements, and therefore can be formulated with a wide variety of coating types. However, they must be durable enough to withstand heat during the retort and pasteurization processes.

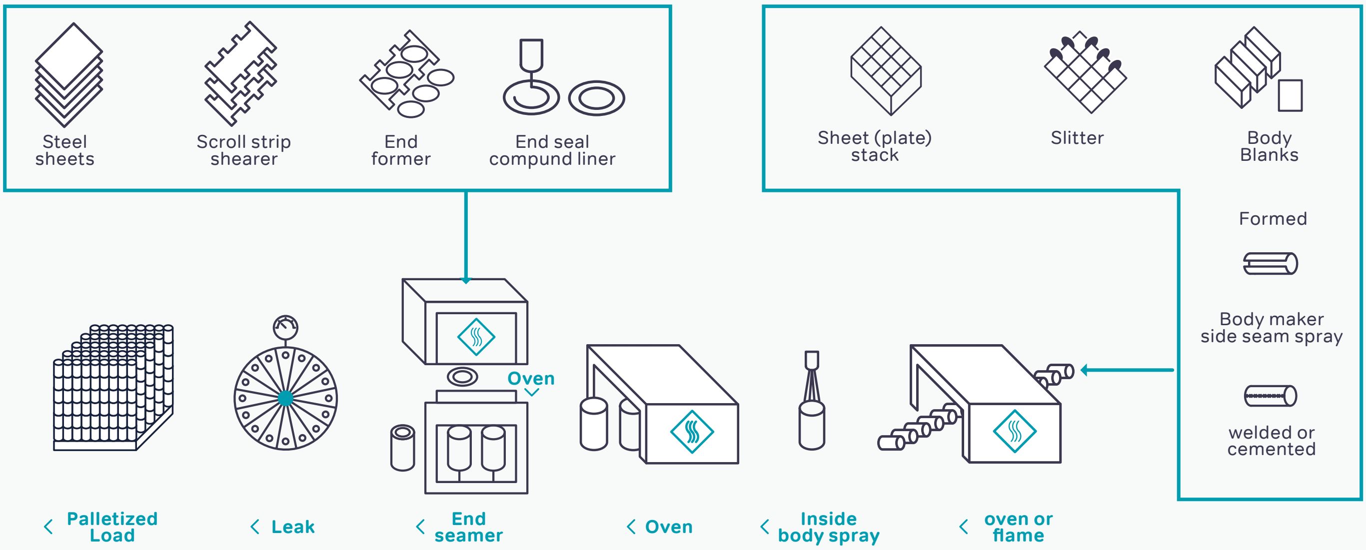

Figure 4: 3-piece forming process

Interior Can Coatings come in contact with a wide variety of foods for extended periods of time, and therefore must meet relevant food contact (FDA) regulations. However, because of the wide variety of food types being packaged in these cans, numerous coating formulations are required that meet performance requirements. The three most common FDA compliant coating types are epoxy, polyester and PVC based „Organosol“ coatings. Epoxy coatings can be solvent or water based, whereas Organosols are solvent based. They contain highly dispersed resins, primarily in a hydrocarbon solvent and other film formers like epoxy, polyester or phenolic resins to form a smooth flexible coating with good adhesion, good heat & chemical resistance. Typical composition of an Organosol coating would be ~20–40 % PVC, 20–40 % epoxy/phenolic resin, and the balance being Organic solvents. These coatings are typically baked for 10 minutes at 190°C bake to achieve optimal film properties. Average coating weights range from 15 to 20 gms/m^2.

Product Code	K value	Description
VESTOLIT G 174	70	Medium molecular weight, fine particle size, clarity, moisture and blush resistance, low taste and odor
VESTOLIT G 170-L100 UF	70	Ultrafine medium molecular weight, moisture & blush resistance, low taste and odor
VESTOLIT G 178	75	High molecular weight, fine particle size, excellent fused film and chemical resistance
VESTOLIT G 170-L120 UF	75	Ultrafine high molecular weight, good chemical, moisture & blush resistance, low taste and odor
VESTOLIT G 171	82	Ultra-high molecular weight, fine particle size, excellent fused film and chemical resistance
VESTOLIT G 170-L140 UF	82	Ultrafine ultra-high molecular weight, good chemical resistance, moisture & blush resistance, low taste and odor

Table A: Products for can coating

Coil Coatings

PVC resins are used in highly corrosive environments. This robust film allows for excellent abrasion resistance while still providing flexibility. PVC is impervious to moisture resulting in excellent barrier properties. It can be applied as a thick film if needed.

Coil Coating is a highly automated process for coating metals like steel or aluminum to give long-term protection to the metal for use in various applications.

A combination of consistent finish quality, good appearance, coating adhesion and corrosion resistance gives the metal long durability with warranties exceeding 25 years or more. In addition, the coatings are also flexible enough to be roller-formed into grooved panels or even deep drawn to form different shapes, including metal roofing, drawn cans and wall cladding.

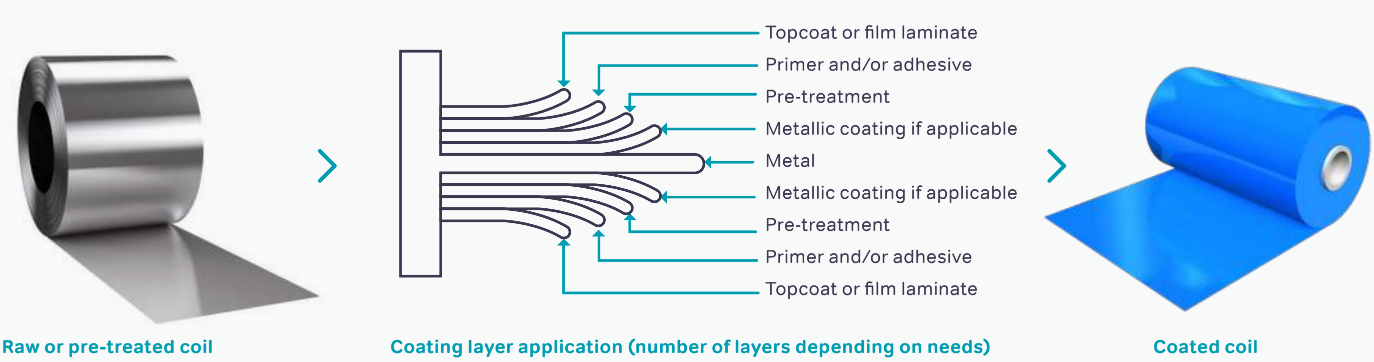

Figure 5: Coil coating process

Coil coating is a high-speed, multi-coating layer process applied on metal substrate ranging from 1.5 to 5 feet in width. Coating line speeds can reach up to 700 feet per minute. The layers are applied in sequence:

1. Substrate cleaning to remove surface oil, dirt and lubricants.
2. A thin conversion/pretreatment coating (~3.0μ) to provide corrosion inhibition and improved adhesion to subsequent coats.
3. A corrosion resistant primer (5–15μ) layer that also provides inter-coat adhesion.
4. Topcoat (100–200μ depending on coating type) for color, gloss, abrasion resistance and UV protection.

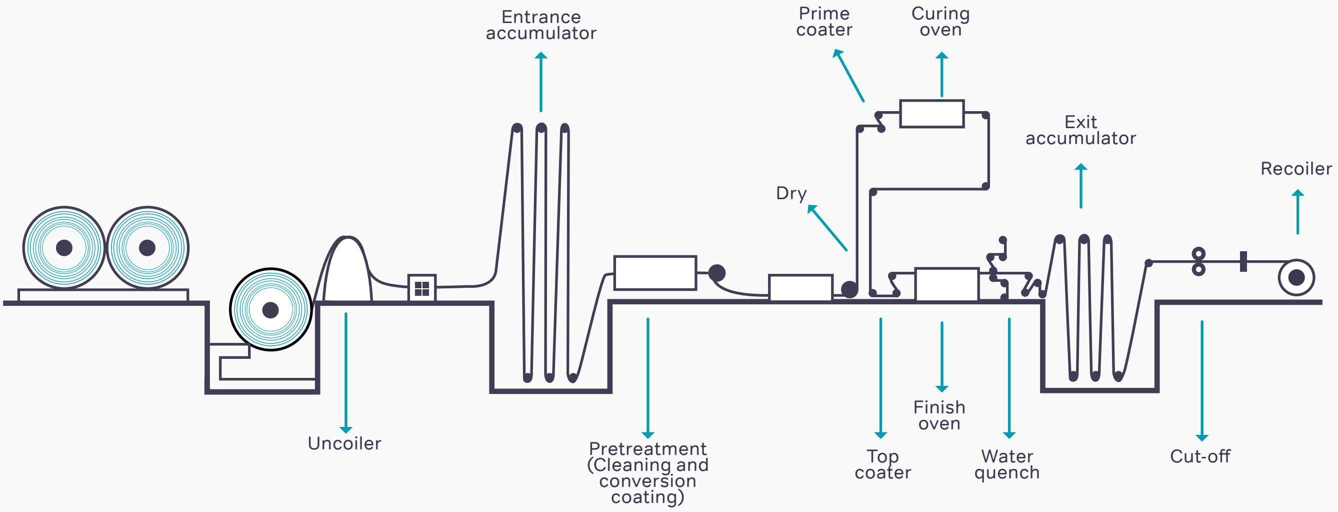

Figure 6: Automated coil coating manufacturing process

Many types of coating finishes (e.g. for Polysters, Polyurethanes, Fluocarbons and Plastisols) are used to coat metal. Coating types are chosen based on application (interior/exterior) and respective duration of warranty. Some pre-painted coils can be additionally printed, striped and embossed to create special visual effects.

PVC resins are used to produce plastisols which, due to their low volatile content, allow to be formulated into high-build thermoplastic coatings. The PVC resin is dispersed in plasticiser along with pigments, fillers and other additives, which convert into a smooth film upon application. The plastisol is roller-coated onto the sheet metal to the desired film thickness. Upon heating, the PVC absorbs the plasticiser and forms a fused (rather than cured) film. Before the film is cooled, the coating often goes through an embossing step, where creative patterns (e.g. wood grains or leather grain) can be added on to the surface.

Plastisols provide tough and flexible films. Coating thickness can range up to 100–200µ (4-8 mils) – and are very robust, giving excellent abrasion resistance and corrosion protection. Being thermoplastic, the coating should not be used for applications or environments above 60 °C for extended time periods.

Vestolit offers various PVC resin grades for such applications – they are listed in table B.

Product Code	K value	Description
VESTOLIT XG 217	65	Blending resn for reducing plastisol viscosity & aged viscosity, stability, reduces surface gloss
VESTOLIT G 179	73	High molecular weight, good mechanical properties, viscosity stability, clarity, low moisture absorption
VESTOLIT G 121 A	74	High molecular weight, good mechanical properties
VESTOLIT G 172	82	Ultra-high molecular weight, good mechanical properties, viscosity stability, clarity, low moisture absorption

Table B: Products for coil coating

Fiber Screen Coatings

Fiber Screen Coatings are aesthetically pleasing coated fabrics typically used to build sunscreens, insect screens and fabrics. These coatings allow for a low weight of the finished product while providing the desired strength. Other benefits include solar protection and energy savings.

Fiber glass is the main material of choice for producing fiber screens for industrial and consumer markets. These fibers – either in strand form or woven form – are coated with a specially formulated plastisol that provides flexibility/elasticity, water repellency, durability and color as well as chemical, flame and UV resistance to the coated fiber.

Typical plastisol formulations can contain 40 to 50 percent PVC resin; the balance being made up of plasticisers, heat Stabilisers and other additives that control flow, adhesion to the fabric, UV resistance among others. The coating process involves the fiber drawn through a plastisol filled channel (or a die) that controls the coating thickness and then passed through a curing oven when the plastisol fuses into a film. Typical coating thickness is 15–20µ. The choice of the PVC resin and plasticisers largely determines the overall physical properties.

Coated fibers still remain open after being woven into screens and provide solar protection, interior room energy savings, durability, aesthetics, acoustic control, mechanical properties, and ventilation. Other unique applications for such coated fibers are concrete reinforcement for tiled floors (protects fiber from alkali environment), and to the flooring industry for anti-slip mats. The fabric coating and weaving processes are schematically shown in figure 7 and 8.

Vestolit offers a broad array of products for fabric coating applications:

Product code	K value	Description
VESTOLIT CS 6208	62	Copolymer extender resin, viscosity reduction, fast fusion
VESTOLIT CS 6205 LP	62	Copolymer extender resin, viscosity reduction, fast fusion
VESTOLIT XG 217	65	Blending resin for reducing plastisol viscosity & aged viscosity stability, reduces surface gloss
VESTOLIT XC 866	66	Blending resin for reducing plastisol viscosity & aged viscosity stability, reduces surface gloss
VESTOLIT G A67	67	Medium molecular weight, high yield plastisol viscosity, good balance of mechanical property
VESTOLIT G E67	67	Medium molecular weight, good balance of mechanical property and plastisol viscosity stability, good foaming
VESTOLIT G 67F	67	Medium molecular weight, good balance of mechanical property and plastisol viscosity stability
VESTOLIT G 68	68	Medium molecular weight, good balance of mechanical property and plastisol viscosity stability
VESTOLIT B 7021 Ultra	70	Low viscosity plastisol resin
VESTOLIT G 173	70	Low viscosity plastisol resin
VESTOLIT T 75	73	High molecular weight, clarity and transparency, excellent mechanical property
VESTOLIT T 75M	73	High molecular weight, clarity and transparency, excellent mechanical property. The M version offers a matte gloss finish
VESTOLIT G 74	74	High molecular weight, good mechanical property and adhesion
VESTOLIT G 121A	74	High molecular weight, good mechanical properties

Table C: Coatings product overview

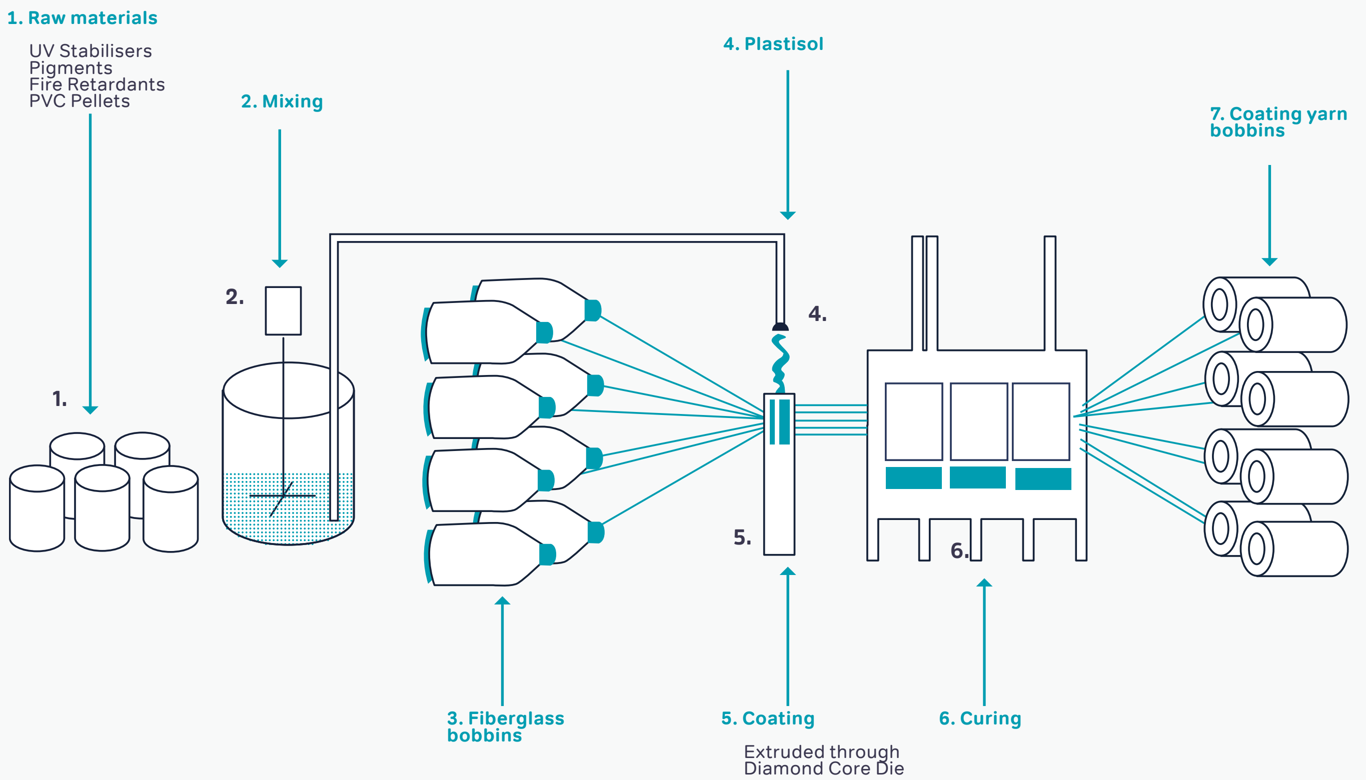

Figure 7: Coating yarn

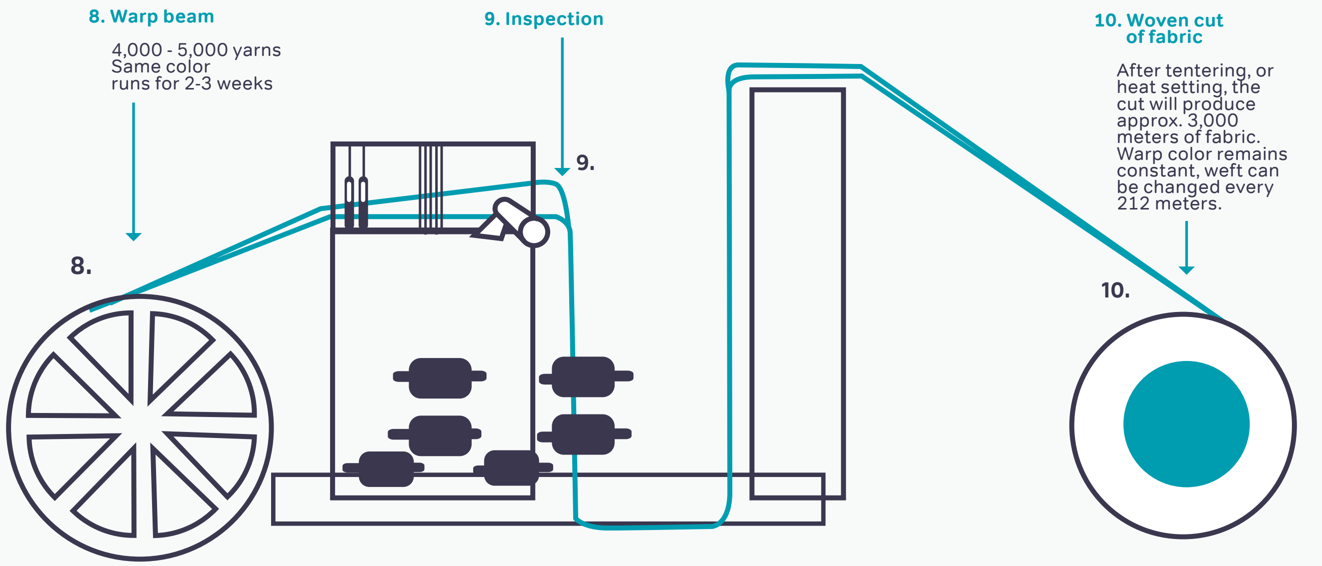

Figure 8: Weaving

Paint Additives

Used as an additive in interior architectural paint systems, PVC is an alternative to conventional gloss reducing agents that can provide better aged viscosity.

Conventional paints and coatings are offered in many colors and gloss levels, ranging from very high gloss to flat (near zero) gloss. Final gloss of the coating is realized only after complete drying. Paint manufacturers typically use inorganic gloss reducing agents like silica and talc to bring the gloss down to a desired level. Particle size as well as the amount of the gloss reducing agents are the two key factors in achieving gloss reduction. Gloss reduction occurs due to increased roughness on the coated surface, which increases the dispersity (spread) of reflected light – the more the reflected light gets dispersed, the lower the gloss. A schematic of gloss differences, as well as a sample of three gloss levels are shown in figures 9 and 10.

Certain grades of PVC resins within a defined particle size and distribution have also found use as gloss reducing agent in water-based paints, with two key differences.

Being organic, their density is much lower than inorganics, and they also have very little increase in viscosity of the paint. These PVC resins exhibit good dispersibility in water-based latex coatings and can be.

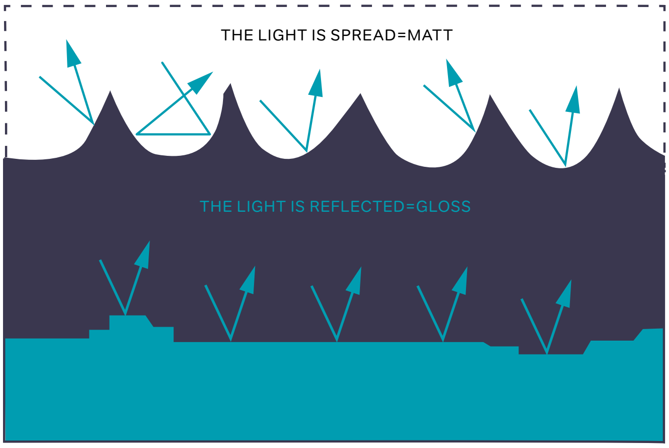

Figure 9: Light scattering on a matte paint surface

Figure 10: Gloss level of painted surfaces

Vestolit offers three different PVC grades for gloss reduction purposes:

Product Code	K value	Description
VESTOLIT XG 215	63	Smaller particle blending resin, water dispersible
VESTOLIT XC 866	66	Fine grind, very easily water dispersible
VESTOLIT XG 217	67	Sligtly coarser grind resin, very easily water dispersible

Table D: Products for paint additives

Powder Coatings

Powder coatings are used for Coatings of metals where harsh conditions are prevalent, ensuring good physical and chemical protection. PVC is recommended for fluidized-bed and electro-static applications such as dishwashers and closet racks, electrical component insulation coatings and fencing.

The Powder Coating process involves a dry, fine, free flowing powder (typically less than 50µ) that is capable of being applied electrostatically to a preheated metallic substrate to form a uniform coating. In this powder form, as there are no carrier solvents, the release of Volatile Organic Compounds (VOCs) is minimal. Additionally, whatever the initially applied coating thickness is, the final cured film thickness remains the same.

Powder Coatings are applied electrostatically via spray or dip process. Electrostatic powder spray coating involves charging the powder particles via an electrostatic grid (fluidized bed) or a high voltage (but low amperage) electrode. The article to be painted is electrically grounded, so that these charged particles are attracted to them and get deposited uniformly. A schematic is shown in figure 11. In the case of fluidized bed, the time of exposure is controlled to achieve the desired film thickness. In the case of electrostatic spray, the spray technique and flow rates are controlled to achieve a desired film thickness. This is visualized in figure 12.

There are primarily two types of Powder Coating – thermoplastic and thermoset. Thermoplastic powder coatings applied to metal will fuse to form a smooth, durable film. Being thermoplastic, they will soften upon heat and harden when cooled, and are considered very suitable for recycling. PVC is one of the dominant resin types chosen for thermoplastic Powder Coatings.

Powder coating resins are manufactured as follows:

1. Primary resins with pigments, fillers and other process aids are premixed in a batch mixer to achieve a homogeneous mix.

2. The mixture is fed into a heated extruder for further intense mixing and homogenization.

3. The extruded mixture is rolled flat, cooled and broken into small chips.

4. The chips are milled and sieved to make a fine powder.

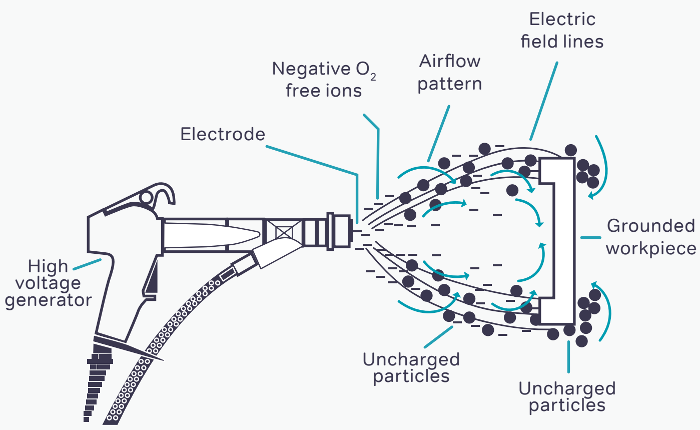

Figure 11: Scheme of a powder coating process

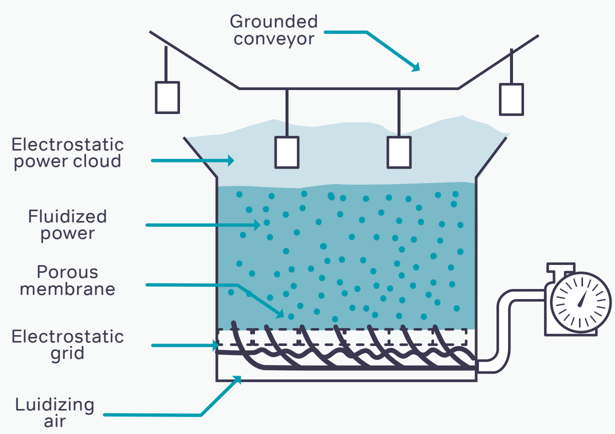

Figure 12: Fluidized bed

Image 4: Powder Coating

Key attributes include corrosion protection, UV resistance and flexibility at low temperatures. Typical thermoplastic coatings first go through a fusion step at around 80 °C, and then a full cure step at around 200 °C for 10 to 15 minutes. Thermoplastic Powder Coatings are generally chosen when thicker coatings in the range of 100–500µ are required.

In contrast, the thermoset resins are a mixture of base resin and a hardener. Upon reaching a specific reaction temperature and time, the base resin will react with the hardener to form permanent cross-linked bonds. Thermoset resin types include polyesters, epoxies and polyurethanes. Typical thermoset powder coatings will have a cure cycle of 10–15 minutes at 200 °C. Compared to thermoplastic types, coating thicknesses are under 50–100µ.

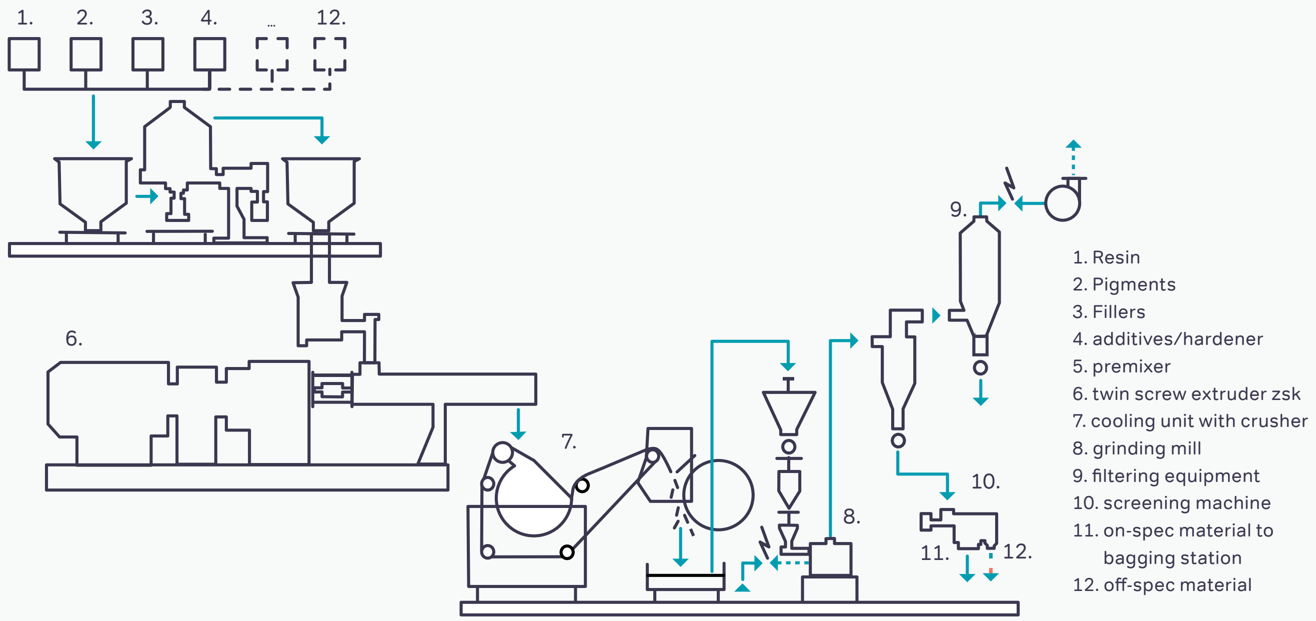

Figure 13: Typical set-up for the production of powder coating

Vestolit offers the following thermoplastic grades suitable for powder coat as well as fluidized bed applications:

Product Code	K value	Description
PRIMEX PVC 35	37	Low molecular weight, fast cure properties and fluidized bed applications
VESTOLIT G 140X466	57	Low molecurlar weight, suitable designed for powder coating application, fast cure and adhesion

Table E: Products for Powder Coatings

Underbody Coatings (UBC) and Sealants

For protection, PVC based coatings are typically sprayed on the underbody and applied over metal seams. Thanks to its heat, cold, and abrasion resistance properties, these coatings are particularly suitable for sound deadening and protecting the underbody of a motor vehicle from rust and stone chips.

Automobiles typically get five different types of coatings for protection as well as aesthetics. They can be classified and sequenced as follows:

1. Pretreatment (phosphate) – for metal coating preparation and corrosion protection. Average coating thickness = 4–7μ.

2. Electrodeposition (ED) – a coating for corrosion protection: Average thickness = 15–25μ. The coated body is sent through a baking oven to achieve full cure.

3. Underbody Coating and Sealants: for anti-corrosion, elimination of water leaks, and minimization of chipping and vibrational noise. Applied in select areas of the automobile industry.

4. Primer – to provide inter-coat adhesion between previous coats and the subsequent topcoat. Can also provide additional corrosion and chip resistance.

5. Topcoat – consisting of a base color coat and a clearcoat for gloss, smoothness and UV resistance.

Where each of these coatings are applied is shown schematically in figure 14.

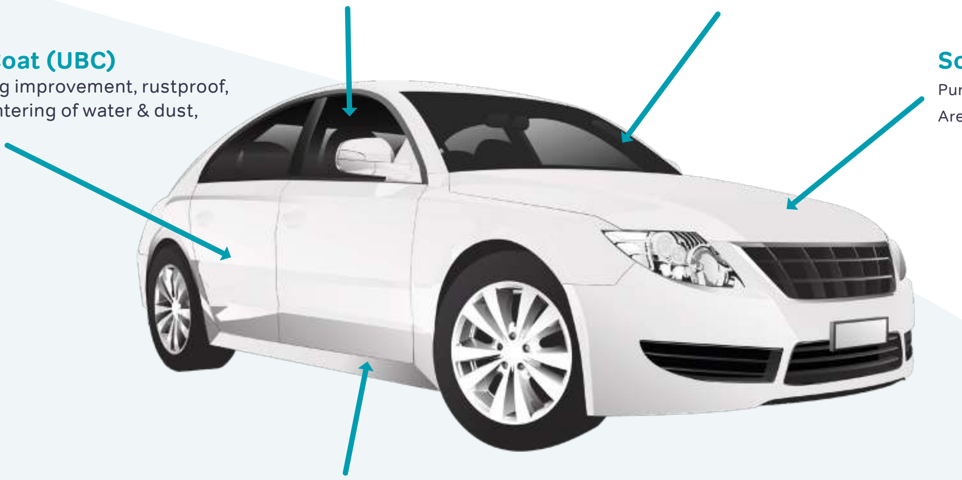

Figure 14: Coated automotive regions

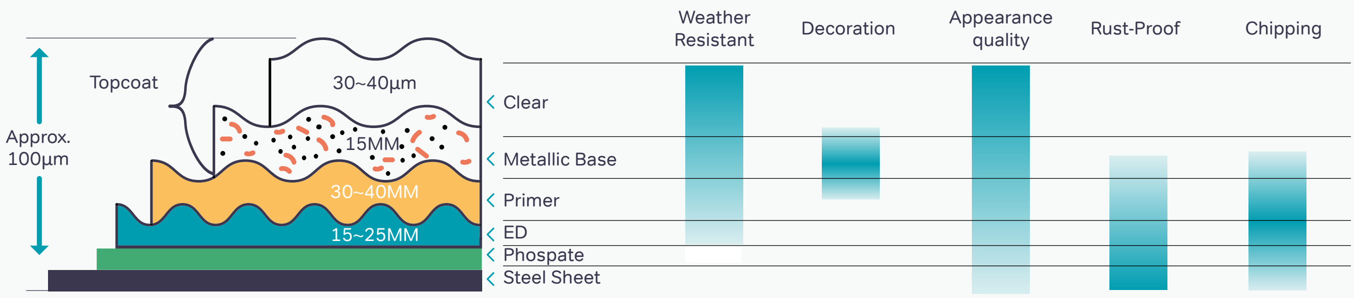

Figure 14: Scheme of an automotive paint coating

UBCs and Sealants are the third, but critical part of the overall coating process to provide corrosion protection, chip resistance and to prevent leaks from welded seams. Sealants are applied to numerous parts of an automobile like doors (around and inside), hood, trunk, exterior/interior of metal joints, wheel well and front dash. Application of Sealants onto an automobile is done either manually or with robots.

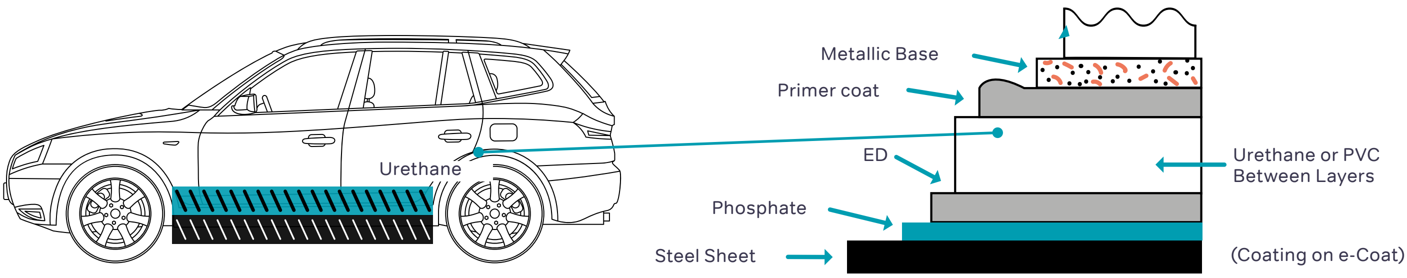

Figure 15: Scheme of an automotive paint coating

Underbody Coatings (UBCs) are used for chip resistance and corrosion protection, and in more recent times, also for additional sound/noise insulation during operation. These are typically applied either manually or robotically by using airless spray equipment. Coating thickness of the UBCs can vary widely, and are dictated by each automobile coating manufacturer. Typical areas to apply UBCs are shown in figure 15.

Each of the above-mentioned applications has different requirements, thus requiring sealant manufacturers to develop specific recipes and application techniques for each end use.

A common, but critical requirement for successful application of such a Sealant/Coating is excellent sag resistance. This is achieved by properly balancing the recipe components to get a consistent thixotropic, shear thinning behavior – low viscosity at high application shear rates, quickly reverting to high viscosity after it is applied. PVC resins are extensively used in the formulation of plastisols for automotive Sealants. Predetermined amounts of PVC resin, plasticisers, fillers, pigments, and flow control additives are used to formulate various types of Sealants. Some are specifically designed to be able to foam to achieve lower coating density and insulation. Formulators often rely on either the PVC resin and/or fillers to achieve the desired thixotropy. The choice of PVC resin and plasticiser determines the fusion cure temperature of the Sealant and the overall mechanical properties of the Sealant. In OEM settings, the fusion and cure properties of these Sealants and UBCs are matched to the OEM primer cure cycles, typically at 30 minutes at 130–150 °C. Although those requirements are trending lower in temperature. These are further subjected to an additional topcoat base cycles of 30 to 40 minutes at 125–135 °C; wet on wet technologies eliminate use of additional steps. Vestolit offers a wide range of homopolymer and copolymer resins from each of its manufacturing locations for the global Sealants and UBC market. Resin codes, the resin type, manufacturing site, as well as key attributes are summarized in table F.

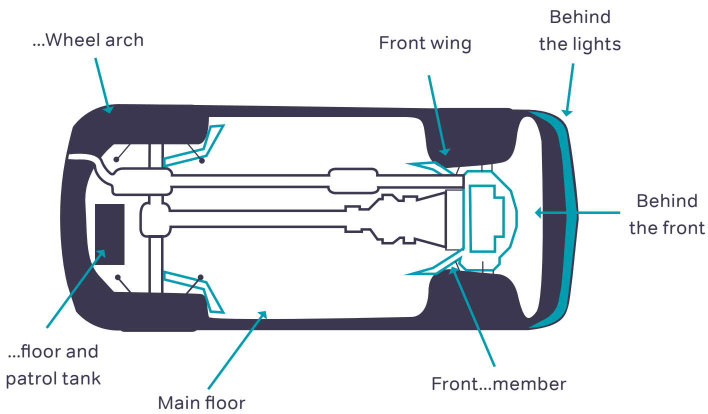

Figure 16: Coated underbody regions

Product Code	K value	Description
Homopolymers		
VESTOLIT S 67	67	High viscosity, pseudoplastic
VESTOLIT E 7031	70	Pseudo-plasticity
VESTOLIT P 1353 K	70	Producing high viscosity pastes with pronounced pseudoplastic flow for compact processing and for chemical expansion
VESTOLIT P 1353 KB	70	Producing high viscosity pastes with pronounced pseudoplastic flow for compact processing and for chemical expansion
VESTOLIT A 74 LM	74	Pseudo-plasticity, medium viscosity
VESTOLIT A 74 L	74	Pseudo-plasticity, medium viscosity
VESTOLIT G 121 A	74	Good chemical foamability for producing medium to high density foams Good dispersibility for easier plastisol preparation
Copolymers		
VESTOLIT B 7090 Ultra	67	Low viscosity, low fusion, low viscosity, excellent storage stability
VESTOLIT P 135 LV	69	4% Vinyl Acetate content. Designed for low fusion temperature applications, potential energy savings
VESTOLIT P 139 LV	69	7% Vinyl Acetate content. Designed for low fusion temperature applications, with the beneficial of potential energy savings
VESTOLIT G 136	70	5% Vinyl Ester content. Designed for low fusion temperature applications, potential energy savings
VESTOLIT G 138	75	5% Vinyl Ester content. Designed for low fusion temperature applications, potential energy savings
Blending Resin		
VESTOLIT XG FIT 074	60	Aged viscosity stability, particle size
VESTOLIT XM 100X122	64	Aged viscosity stability, particle size
VESTOLIT XG 215	64	Aged viscosity stability, particle size
VESTOLIT XC 866	66	Low gloss, good air release, fast fusion
VESTOLIT XG 217	67	Aged viscosity stability, particle size
VESTOLIT XG FIT E-51	67	Aged viscosity stability, particle size
VESTOLIT XG FIT E-52	72	Aged viscosity stability, particle size
Blending Copolymer		
VESTOLIT CS 6205 LP	62	Fast fusion, plastisol viscosity aging, particle size

Table F: Products for Underboady Coatings

Locations

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