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Flooring

PVC offers several advantages

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Content

Image 1: Interior Flooring

Flooring

Due to their high hygiene standards and ease of installation, PVC floor coverings are a popular alternative to traditional floor coverings such as wood and ceramics and are therefore used in residential and objects, e.g in hospitals, offices and other public areas. PVC floor coverings promise a durable and cost-effective solution for flooring manufacturers.

For that, carpet tiles work as the central product and are both highly customizable and easy to install. The different PVC resins in use during the production promise a tough carpet backing with good mechanical properties and reduced shrinkage.

Image 2: Sportstrack Flooring

Carpet Tile

Used in the back layer of carpet tiles, PVC is a durable and cost-effective solution for flooring manufacturers looking to provide a tough carpet backing. PVC resins provide good mechanical properties and reduced shrinkage and curl of the tiles. Select resins can provide low VOC alternatives.

Carpet tiles come in a variety of shapes, sizes, patterns and colors. They can be mixed and matched to form a variety of patterns and designs. They are easy to install and can help to repair soiled areas. Carpet tiles are mainly used in commercial applications, as an alternative to broad loom carpet, but have been gaining popularity in residential applications as well.

Production of a carpet tile

A carpet tile is made by tufting pre-dyed yarn into a fiberglass scrim followed by a base coat of plastisol and a fiberglass sheet. The base coat binds the fibers to the scrim and the scrim to the fiberglass sheet, which provides dimensional stability. Finally, a backing layer consisting of a plastisol with a high level of recycled material is applied. This layer can provide weight, cushion, and additional dimensional stability. After the carpet passes through the fusion oven and is to be cut, the backing layer is imprinted with information regarding orientation of the run to ease installation. The carpet is then cut into the particular format required and packaged face to face to prevent damage to the fibers.

Installation of carpet tile

Installation is dependent on traffic level and dimension. In low to medium traffic areas installation may be as simple as laying the tiles down on the subfloor or applying a light tackifier to keep them from moving. In heavier traffic areas, stronger adhesives may need to be applied. Special adhesives available allow the removal and replacement of individual til.

Why PVC

PVC is a durable and cost-effective solution for flooring manufacturers looking to provide a tough carpet backing with good mechanical properties and reduced shrinkage. The PVC resins chosen must fuse at a low enough temperature that the pre-dyed yarn is not affected, as it passes through the fusion oven, and minimally contribute to the overall VOC of the finished carpet tile. Low VOCs are essential to gaining Green Label Certification which is a standard in the carpet tile market.

Product Code	K value	Description
Homopolymer S-PVC		
PRIMEX P 180	57	Suspension PVC resin, homopolymer type, low molecular weight. Its main advantages are good color, good flow during injection process and good thermal stability
PRIMEX PVC 35	57	Suspension PVC resin, homopolymer type, low molecular weight. Its main advantages are good color, good flow during injection process and good thermal stability
PRIMEX P 190	59	Suspension PVC resin, homopolymer type, low molecular weight. Its main advantages are good color and good thermal stability
Copolymer Paste-PV		
VESTOLIT G 136	70	Medium molecular weight vinyl ester copolymer offering lower gelation temperatures and higher clarity. This resin exhibits fast fusion at low processing temperatures, resulting in energy savings and the ability to work with heat sensitive substrates. This resin is a great option for formulations where VOC's are a concern due to its low VOC emissions
VESTOLIT G 138	75	High molecular weight vinyl ester copolymer resin exhibiting fast fusion at low processing temperatures, resulting in energy savings and the ability to work with heat sensitive substrates. This resin is a great option for formulations where VOC's are a concern due to its low VOC emissions
Blending Resins		
VESTOLIT XG FIT 074	60	Low molecular weight homopolymer blending resin intended for use as a Formulation Improvement Tool (FIT) in plastisol formulations. This resin improves air release performance, decreases high shear viscosity and reduces viscosity aging characteristics
VESTOLIT XG 217	65	Medium molecular weight homopolymer blending resin intended for use as a formulation tool in plastisol formulations. This resin improves air release performance, decreases high shear viscosity and reduces viscosity aging characteristics

Table A: Products for carpet tile

Image 3: Carpet Tile samples

Image 4: Vinyl Cove Base

Cove Base

Vinyl coverings present a cost-effective solution to its wooden or rubber counterparts. It is used to protect the lower part of the wall from abrasion and kicks, and serves a decorative purpose by hiding structural deficiencies in the wall. Cove Base may be glued to the wall or fixed to it by mechanical means. It has a very long life-span and does not require high maintenance.

Vinyl Cove Base is made from a medium to highly filled suspension resin-based phthalate free compound that is extruded into the proper height and shape. The filler can come from traditional sources or recycled content. Surface gloss is controlled by using texturizing resins, such as VESTOLIT G CG10, or other dulling agents.

Vinyl Cove Base is sold in either plank or roll format depending on contour, flexibility and desired quantity. It is usually adhered to the wall and, if done correctly, can be removed without any damage to the wall that would be visible when reapplied or should the color scheme change. It has a very long life-span and does not require high maintenance.

Product Code	K value	Description
PRIMEX PVC 40	61	Low-medium molecular weight. It has good mechanical properties
PRIMEX PVC 440	66	Medium molecular weight. Its main advantages are good color, High flow during extrusion process and good thermal stability
PRIMEX G 30	70	High molecular weight. Its main advantages are good plasticiser absorption, low fish eyes content and good powder mix time
PRIMEX G 30 HP	70	High molecular weight. Its main advantages are higher plasticiser absorption, low fish eyes content and shorter powder mix time
PRIMEX PVC 500	70	High molecular weight. Its main advantages are higher plasticiser absorption, low fish eyes content and shorter powder mix time
PRIMEX P 250	70	High molecular weight. Its main advantages are good color, plasticiser absorption, and excelellent thermal stability
PRIMEX PVC 500 F	72	Meets the requirement from those processors that wish to use a resin with a slightly higher molecular weight than PVC500

Table B: Product Overview cove base

Cushion Vinyl (CV)

CV coverings or Cushioned Vinyls are foamed PVC floor coverings with a structured surface, often with a wood or stone look.

The CV coating consists of different layers.
The most important layers are shown in figure 1.

Image 5: Cushioned Vinyl PVC Flooring

Figure 1: Scheme of a CV-Flooring

Base coat or impregnating coat

This is the first part in a continuous manufacturing process. A PVC paste is applied to a carrier material made of (mostly) glass fleece using a squeegee. Polyester fleece, paper and other materials can also be used as alternative carrier materials. Screen printing is also partly used in the application process. After scraping, the material is gelled with a gelling drum (a metal roller heated to a temperature between 120 and 160 °C by oil) and solidified for the next step. A low paste viscosity is important for the formulation of the plastisol so that the plastisol penetrates the glass fleece and is available as a bonding layer on the reverse side. Since this layer is adjusted with a high proportion of chalk in the plastisol to reduce formulation costs, PVC is expected to be highly compatible (fillable) with chalk.

In drum gelation, it is very important that there is no tendency for plastisol to stick to the drum over a wide temperature range. PVC grades with a high proportion of emulsifiers have a particularly strong tendency to stick. It is just as important that the surface after the drum is very smooth in order not to have any defects in the foam pattern/during printing.

Image 6: CV

Image 7: Drum Gelation

Decorative coating

This layer is applied as a second coat. Either a squeegee is used for application or a reverse roll coater if very thin application thicknesses are required. A thin plastisol film is produced by counter-rotating rollers and then applied to the carrier web. The solidification is also carried out by a gelling drum. If the layer is to be foamed up afterwards, a blowing agent is added to the recipe, which remains passive during fusion and only decomposes into gases and produces a foam when it finally fuses in the oven.

A colored design is then printed onto this layer. The printing inks additionally contain a chemical substance (inhibitor) which slows down or suppresses the foaming of certain areas (scheme area D). Thus, a three-dimensional structure of the covering can be created. However, only a compact layer is applied for certain commercial areas. The PVC selection depends on a good foamability of the material with good inhibition behavior and a paste viscosity as low as possible. The inherent color of PVC should be as neutral as possible in order to avoid color shifts in the design. It is also very important that the material is compatible with the printing inks used and can therefore be printed well.

If the system is not fully integrated, it is usually interrupted at this point and the remaining coating is completed on a second subsystem.

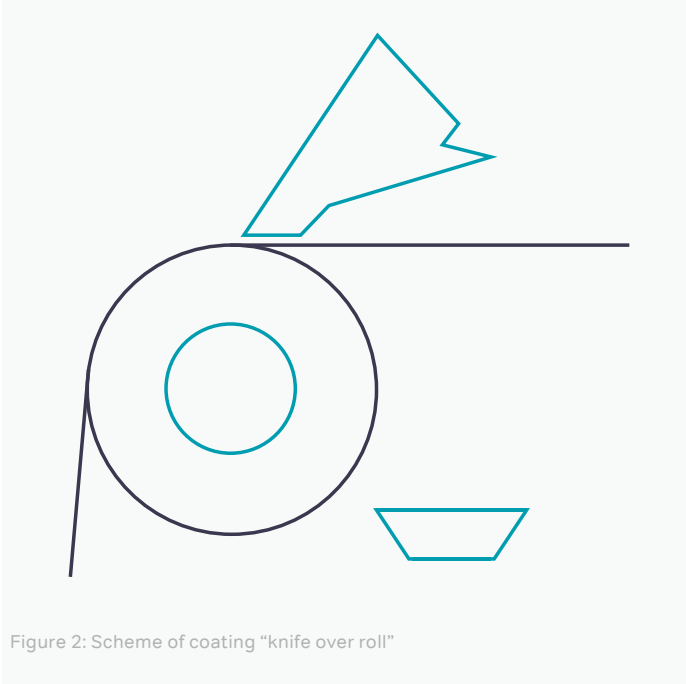

Figure 2: Scheme of coating “knife over roll”

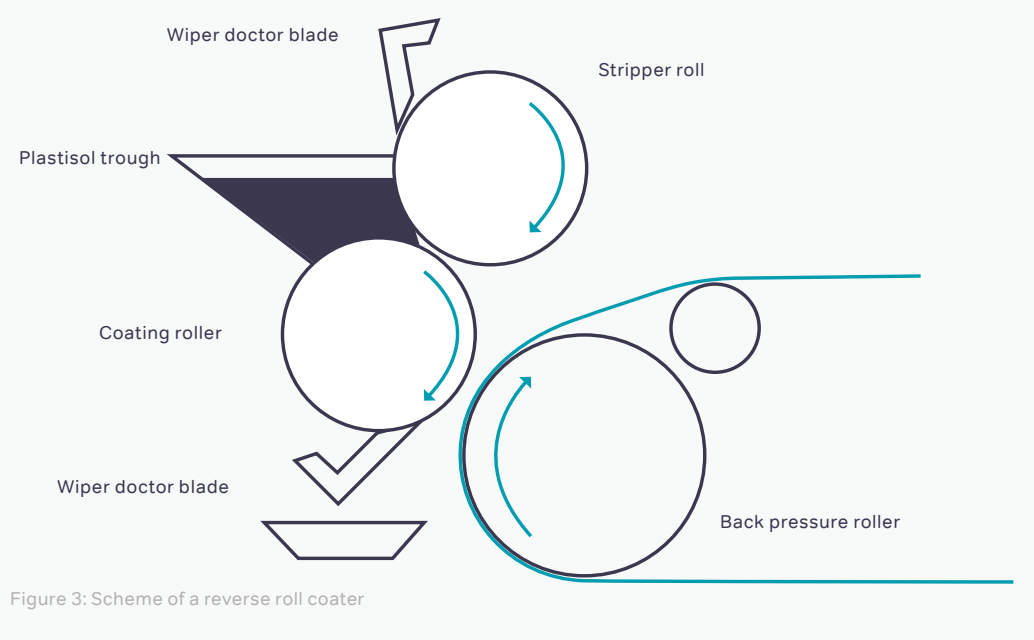

Figure 3: Scheme of a reverse roll coater

Printing of the Design

A printing layer is usually applied by several printing stations. Designs are often wood imitate, ceramics, stone or artificial.

Top layer or wearlayer

A transparent wearlayer is now applied to the printed design. Squeegee application and RRC application are also common here. Again, the plastisol is gelled using a gelling drum. When selecting the suitable PVC, a high degree of transparency is of particular importance. Here, too, a low paste viscosity is required. Frequently, the largest proportion of the mechanical properties of the covering are supplied by this layer. This is particularly critical for coverings with a thin wear layer. This is why PVC types with a higher K value are used here. If this layer is not lacquered later, the gloss of the surface depends on this layer. It is true that a higher K value leads to a reduced gloss. Furthermore, the PVC for this layer must be well deaerated, since small air bubbles from the mixing process can strongly affect/cloud the transparency. See Image 8.

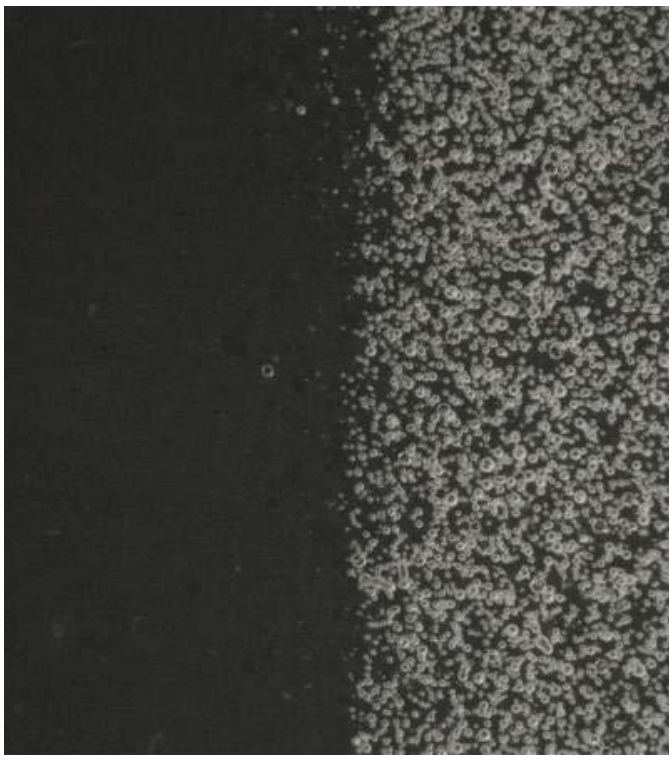

Image 8: Small air bubbles from the mixing process

Back side

To coat the reverse side, the covering is turned in the system so that the reverse side is now on its upper side. This layer is usually the thickest and is applied as a foamed layer. This mainly influences the degree of softness and the impact sound insulation. The squeegee application process is used here. A polyester fleece is partly inserted into the plastisol on the reverse side for certain qualities in order to give the finished covering a slidable reverse side. The complete covering is then passed through a oven in which all the layers are simultaneously gelled and the foam layers are foamed. Such a oven has a length of approx. 60 m in order to supply sufficient heat to the coating at processing speeds of 20 - 30 m/min and temperatures of around 200 °C.

From the PVC, good foamability in formulations with a high chalk content (cell structure and degree of foaming) is required. The viscosity of plastisol is also an important factor.

Further stations

After the oven, an advertising print is partly applied to the back. The surface of the covering (top coat) is often sealed with a PU varnish, which adjusts the abrasion resistance as well as the surface gloss. The surface can also be hot stamped from the top. This reinforces the three-dimensional structure of the covering.

CV floors provide walking comfort through their foamed layers. PVC floor coverings can be designed with a variety of motifs, even fully personalized.

Product Code	K value	Impregnation-layer	Decorative foam-layer (inhibitable)	Wearlayer	Solid backlayer	Chemical foamed backlayer	Description
Homopolymer S-PVC							
PRIMEX G 30	70			X			High molecular weight. Its main advantages are good plasticiser absorption, low fish eyes content and good powder mix time
PRIMEX G 30 HP	70			X			High molecular weight. Its main advantages are higher plasticiser absorption, low fish eyes content and shorter powder mix time
PRIMEX P 250	70			X			High molecular weight. Its main advantages are good color, plasticiser absorption, and excelellent thermal stability
PRIMEX PVC 500	70			X			High molecular weight. Its main advantages are higher plasticiser absorption, low fish eyes content and shorter powder mix time
PRIMEX PVC 500 F	72			X			Meets the requirement from those processors that wish to use a resin with a slightly higher molecular weight than PRIMEX PVC 500
PRIMEX PVC 550	75			X			Very high molecular weight and high plasticiser absorption. Highly recommended when items with high mechanical properties needs to be elaborated
Copolymer Paste-PVC							
VESTOLIT B 6021 Ultra	60					X	Low viscosity, fast fusion at low temperatures, fine cell structure, high embossing speed, excellent drum release properties
VESTOLIT G 124 A	64		X		X	X	Good chemical foamability for producing medium to high density foams. Good dispersability for easier plastisol
VESTOLIT B 6512	65					X	Low viscosity, fast expansion, very good foam color, high proportion of open cells, excellent release from metal surfaces
VESTOLIT E 7012 S	67					X	Fast expansion and very good foam color, with a high degree of open cells, wide processing range
VESTOLIT E 6841	68		X			X	Very fast expansion, fine foam structure and excellent color, chemically inhibitable
VESTOLIT G 68	68		X				Low viscosity, good air release
VESTOLIT P 124	69		X			X	General purpose resin, Good chemical foamability for medium to high density applications. Excellent viscosity stability
VESTOLIT B 7021 Ultra	70	X	X	X	X	X	Low viscosity, universal resin, low viscosity, good storage stability and low moisture absorption, excellent drum release properties
VESTOLIT B 7090 Ultra	70					X	Low viscosity, low fusion, low viscosity, excellent storage stability
VESTOLIT G 129X115	74				X	X	Good chemical foamability for producing medium to high density foams. Good dispersability for easier plastisol preparation
VESTOLIT B 7521 Ultra	75	X		X			Low viscosity, low moisture absorption, good mechanical properties
VESTOLIT T 75	75			X			Low viscosity, good air release, high gloss and clarity, superior mechanical properties
VESTOLIT T 75 M	77			X			Low viscosity, good air release, low gloss, good clarity, good mechanical properties
VESTOLIT P 1415 K80 Ultra	80	X		X	X		Low viscosity, excellent drum release, low gloss
VESTOLIT T 80	80			X			Low viscosity, good air release, high gloss and clarity, superior mechanical properties
VESTOLIT G 172	82			X			Polyvinyl Chloride Homopolymer, Low to No Odor, Low to No Taste, Blush Resistant, Ultra High Molecular Weight
VESTOLIT P 1430 K90 Ultra	90			X			Low viscosity, low gloss, excellent air release, superior transparency, mat surface finish
Blending Resins							
PRIMEX PVC 40	61				X		Low-medium molecular weight. It has good mechanical properties
PRIMEX PVC 440	66				X		Medium molecular weight. Its main advantages are good color, High flow during extrusion process and good thermal stability
VESTOLIT XG 217	67		X	X	X	X	Low to medium molecular weight homopolymer blending resin for solid and foamed plastisol applications
VESTOLIT XG FIT E-51	67		X	X	X		Increases physical properties up to 30 % compared to traditional blending resins of medium molecular weight in filled systems

Table C1: Product overview for CV-Flooring

Image 9: Interior Flooring

Luxury Vinyl Tile / Design Floor (LVT)

Luxury Vinyl Tile is the industry term used for vinyl flooring which resembles natural products, having the advantage of better wear and tear properties due to an extra layering of urethane. Because of the high abrasion resistance, LVT is often designed for use in rooms with high visitor traffic. In addition, its seamless surface offers particularly high standards of hygiene. As a result, it is often used in doctor‘s offices and hospitals, as well as in kitchens.

The outstanding feature for an LVT floor is its ability to replicate real hardwoods and stones using advanced photographic. There are four distinct layers fused together to produce the final product:

- Resilient vinyl backing
- Colored (Vinyl) layer
- Photographic film layer
- Urethane or Aluminum oxide top layer.
  This protective top layer (also called the wearlayer or mil layer) is very important to the durability of the product. Quality products will have as high as a 40 mil layer. Commercial applications can successfully utilize 20 mil or above. Lower mil layers are available, but should be specified only for light traffic applications.

Luxury Vinyl Tile Flooring Features	Luxury Vinyl Tile Flooring Benefits
Realistic photo replication of natural materials (photogravure process)	The look and feel of nature's best materials at a lower cost of Luxury Vinyl Tile flooring manufacturing. It takes advantage from printability from vinyl
100% vinyl material	Vinyl flooring satisfies Green building standards and earns LEED points in commercial applications
Inherent safety features	Meets requirements of commercial flammability codes, slip resistant requirements...and a menu of other safety codes. Excellent selection of sizes, shapes
Ease of maintenance	Simple damp mopping is the recommended cleaning procedure for LVT floors.
Water resistant	LVT floors are impervious to wet spills from top. Uses moisture barrier properties from vinyl
Scratch, denting, tearing and stain resistant	Specialized wear layers (most common are 20 mil; some offer up to a 40 mil layer). Then the floors are coated with urethane to enhance durability. It uses high mechanical properties from high molecular weight vinyls
Exceptional durability	Constructed to withstand commercial wear and tear, it's ideal for residential high-traffic areas as well as other areas of the home. 20-25 year life
Resilient	Easier to stand on for long periods of time AND as an added benefit, it tends to be warmer underfoot than ceramic. Isolation from the vinly reduces energy loses in acclimatized environments

Table D: Benefits of a LVT-Flooring

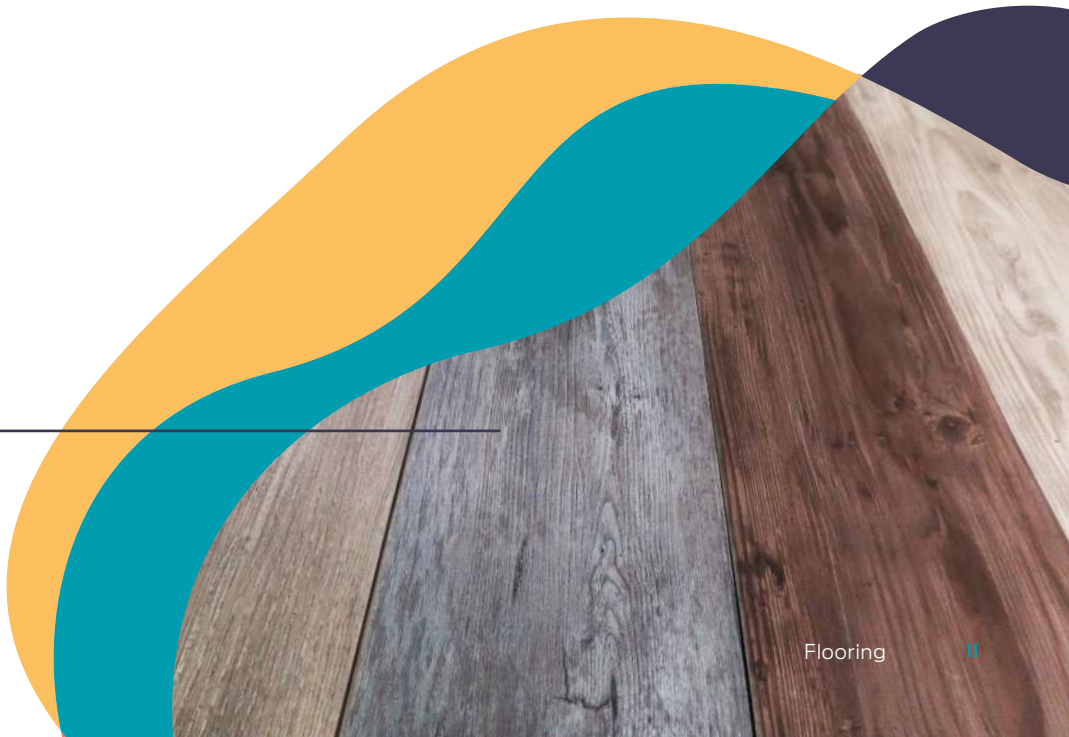

Image 10: LVT

Image 11: LVT

How Vinyl / Resilient Flooring Is Made

Vinyl flooring is made up of layers of material starting with a core of vinyl over a backing of felt or fiberglass. Decorative designs are printed on the next layer that sits on top of the core. That decorative design layer is what makes vinyl flooring so versatile. It can be made to look like almost any material. The final layer is also vinyl and is called the wear layer.

Rotogravure

The key to the many faces of vinyl flooring is the printing process, called rotogravure. Using a rotary press with photoengraved plates allows manufacturers to create the look of stone, brick, marble, wood and hundreds of other patterns and designs. If that was not enough, some manufacturers enhance the design by adding color or colored vinyl chips to the wear layer coating to add more depth to the design.

WearLayer

Practically speaking, the wearlayer, the last one applied, is most important. This top layer of vinyl is about 10 mils thick on average. The thicker the wear layer, the more durable the flooring. The flooring industry is constantly experimenting to find wear layers that are tougher and more resistant, but still beautiful and practical.

Resilient vinyl flooring offers homeowners these advantages:

Fine grit and sand can cause scratches to the surface of vinyl and over time, will diminish the look. Placing walk off mats at entrances and sweeping frequently will extend the life of your vinyl floor. Be sure the mats you buy are for vinyl floors. Some rubber-backed mats may leave stains or marks.

Recent Trends

Quick interlocking features can be obtained from a rigid bade (vinyl extruded profile). Some layers traditionally made from plastisol (e.g. wearlayer) are being replaced by extruded suspension PVC (or even Wood Plastic Composite, WPC) sheet, which is laminated on decorative layer. This option provides better clarity, superior moisture resistance, and improves cost efficiency.

Product	K value	Rigid base layer	Flexible wear/ backlayer	Description
PRIMEX S 6058	60	X		S-PVC mainly used for the production of profiles and pipes as well as expanded profiles and sheets
PRIMEX S 6558	65	X		S-PVC mainly used for the production of profiles and pipes
PRIMEX S 6555	65	X		S-PVC with a good absorption capacity for liquid additives. This product is mainly used for the production of profiles and pipes
PRIMEX S 6658	66	X		S-PVC mainly used for the production of profiles and pipes
PRIMEX PVC 440	66	X		S-PVC, homopolymer type, medium molecular weight. Its main advantages are good color, High flow during extrusion process and good thermal stability. ASTM D 1755 classification
PRIMEX P 225-2	66	X		S-PVC, homopolymer type, medium molecular weight. Its main advantages are good color, High flow during extrusion process and good thermal stability. ASTM D 1755 classification
PRIMEX G 34	67		X	S-PVC, homopolymer type, medium molecular weight. Its main advantages are low fish eyes content and good plasticiser adsorption. ASTM D 1755 classification, USP plastic Class VI for medical and food aplications
PRIMEX PVC 450	67		X	S-PVC, homopolymer type, medium molecular weight. Its main advantages are low fish eyes content and good plasticiser adsorption. ASTM D 1755 classification, USP plastic Class VI for medical and food applications
PRIMEX PVC 500	70		X	S-PVC, homopolymer type, high molecular weight. Its main advantages are higher plasticiser absorption, low fish eyes content and shorter powder mix time. ASTM D 1755 classification, USP plastic Class VI for medical and food applications
PRIMEX G 30	70		X	S-PVC, homopolymer type, high molecular weight. Its main advantages are good plasticiser absorption, low fish eyes content and good powder mix time. ASTM D 1755 classification, USP plastic Class VI for medical and food aplications
PRIMEX G 30 HP	70		X	S-PVC, homopolymer type, high molecular weight. Its main advantages are higher plasticiser absorption, low fish eyes content and shorter powder mix time. ASTM D 1755 classification, USP plastic Class VI for medical and food aplications
PRIMEX P 250	70		X	S-PVC, homopolymer type, high molecular weight. Its main advantages are good color, plasticiser absorption, and excelellent thermal stability. ASTM D 1755 classification
PRIMEX PVC 500 F	72		X	S-PVC homopolymer resin intended for flexible applications. This resin meets the requirement from those processors that wish to use a resin with a slightly higher molecular weight than PRIMEX PVC 500
PRIMEX PVC 550	75		X	S-PVC homopolymer resin intended for flexible applications. This resin has a very high molecular weight and high plasticiser absorption. Highly recommended when items with high mechanical properties needs to be elaborated

Table E: Product overview for PVC suspension resins for flooring

LVT Flooring vs SPC Flooring vs WPC Flooring:

LVT Flooring

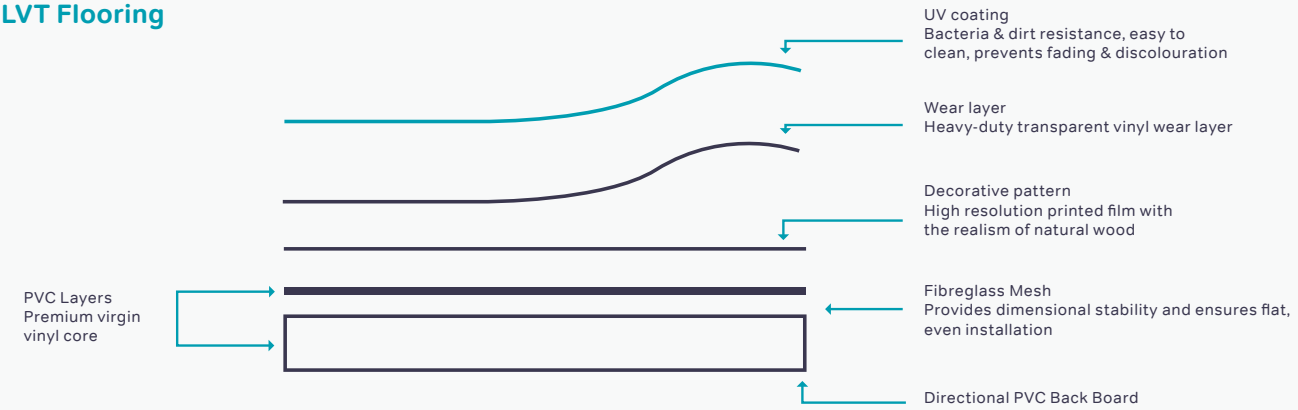

Figure 4: Scheme of a LVT

Figure 5: SPC Flooring

SPC Flooring (Figure 5)

SPC (Stone plastic composite) flooring which also called RVP (Rigid Vinyl Plank), is an upgrade of Luxury Vinyl Tiles (LVT). SPC flooring is constructed by UV coating, Wear layer, SPC print layer, SPC core, Balanced layer. Its advantages including good dimension stability, high peel strength, little noise when walking on, no warping, no distortion, 100% waterproof, heat and sound insulation, eco-friendly rigid floor, no harmful emission.

WPC Flooring (Figure 6)

WPC (Wood Plastic Composite) Its core typically consists of polyvinyl chloride, calcium carbonate, plasticisers, a foaming agent, and wood-like or wood materials such as wood flour. Manufacturers of WPC, which was originally named for the wood materials it was comprised of, are increasingly replacing the various wood materials with wood-like products.

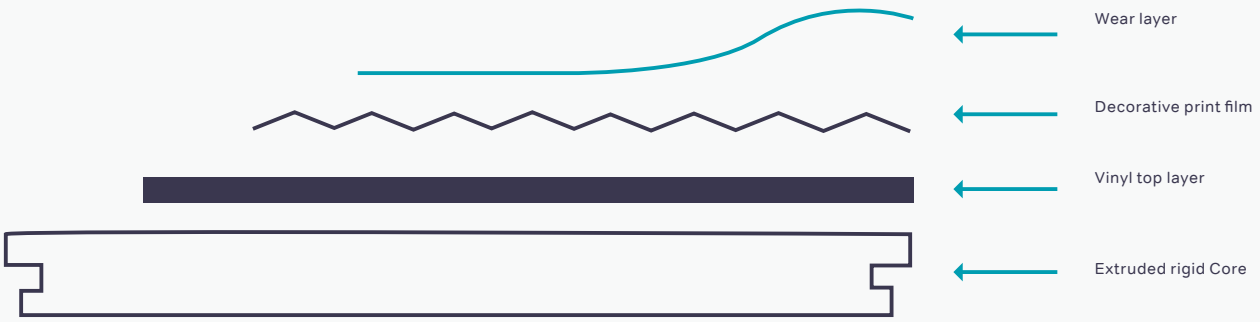

Figure 6: WPC Flooring

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