Resilient Flooring and Materiality

Transparency, Product Service Life, and Performance

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Learning Objectives

1. Provide a process for developing Owner's Project Requirements (OPR) for flooring products.
2. Learn the project conditions for successful flooring installations.
3. Learn the material ingredients in resilient flooring products.
4. Examine product manufacturing processes and installation methods for resilient flooring products.

Owner's Project Requirements

Balancing Criteria for Selection

- Product performance characteristics
- Sustainability goals
- Health and wellness goals
- Appropriate product for application
- Aesthetics
- Type of installation
- Maintenance Considerations
- Cost

OPR

Photo by Bekir Dönmez on Unsplash

When specifying products for the built environment, it is important to know the origin of a material's ingredients, how materials are used to produce finished products, and to have an understanding of the installation process and related priorities that make for a successful installation. In the planning project phase, the Owner's Project Requirements (OPR) are identified with the client, design team, and other stakeholders. For each installed product, the OPR process identifies desired product service life, application of products for a specific use, and the performance characteristics required. A process for identifying the criteria for inclusion within the OPR is part of the program as it relates to the resilient flooring product category. Specific flooring types will be reviewed to better understand their materiality and construction, including vinyl tile and sheet; luxury vinyl tile, plank, and rigid core product; linoleum tile and sheet; rubber tile and sheet; and cork tile.

N. Alabama Medical Center, Florence, AL; Architect: Gould Turner Group; Photographer: Creative Sources; LVT: Mannington Commercial

Establishing the goals of the project from the onset is crucial for the development of a successful project. As part of the process, asking the right questions is imperative in order to glean operational data and information that will be used as the basis for the design of the physical environment.

Regardless of the type of project, the questions should be geared toward gaining a clear understanding of each operation or function that takes place within a setting.

ICC Baptismal Font, Lowell, MA; Rubber Flooring: Roppe

For example, the renovation of a historic structure has different requirements regarding use and aesthetic, as well as being able to be maintained as a high traffic space, but with intermittent building users, versus a 24/7 healthcare setting. In this historic church example, various types of events range from smaller gatherings to larger celebrations – and depending upon humanitarian need could be transformed into a space to sort food or supplies during an emergency or pandemic.

Operational Programming: Multidisciplinary Team Questions

- Do you have a standard developed for specifying flooring products?
- What is the wear layer required based on the traffic level?
- What is the desired aesthetic for the project?
- Who are the end users of the product and project?

OPR

Education: Hallway; Rubber Flooring: nora by Interface

Creating a multidisciplinary team approach is critical. Involving all the stakeholders in the process provides an opportunity to glean information that will allow the designed environment to support the functions and operations occurring in each space. At some point, the criteria may be at odds – such as a certain aesthetic within a lobby, but the need to address high-traffic issues in all types of weather conditions. Having these types of conversations at the beginning of the project supports collaborative decision-making that can result in balancing–and meeting–competing goals, once the stakeholders understand the issues. In terms of OPR from a product selection process perspective, reviewing desired performance criteria along with the intended use of a space assists with selection of the appropriate product for a specific application.

Operational Programming: Multidisciplinary Team Questions

- What is the anticipated product service life for the flooring products being specified?
- How frequently do you replace flooring?
- How much attic stock do you maintain for current project and for other projects?

OPR

Education: Cafeteria – Dining Area, SUNY Buffalo; Luxury Vinyl Tile: Armstrong

Understanding all aspects of a product's service life supports planning for replacement and renovation cycles. For maintenance, it is important to anticipate the attic stock requirements based upon the flooring's expected wear and tear as well as an understanding of the impact of cleaning and disinfection protocols on the flooring.

Operational Programming: Multidisciplinary Team Questions

- What is the maintenance protocol for each different flooring product specified?
- Is EVS outsourced or in-house?
- What chemicals are currently used / proposed to be used on each flooring product specified?
- Have you had issues or concerns with maintaining any existing product previously installed?
- Do in-house staff do repairs?

Photo by Kelly Sikkema on Unsplash

OPR

Including environmental services technicians and management in the dialogue, and receiving information from them, is critical. If flooring types are specified that are different than those currently installed or there isn't familiarity with the maintenance process for the type of resilient flooring being specified, it is important to discuss and verify that the specific type of maintenance needed for a certain flooring type can be provided. For example, the cleaning and disinfection of vinyl composition tile (VCT) differs from that of other types of products, such as vinyl sheet goods, cork, linoleum, or rubber flooring products – all of which have their own specific maintenance process. From a repair perspective, some materials may be easier to repair in-house than others. This may impact specifiers' recommendations, which must take into account the expectations of the owner and related facilities staff requirements.

Operational Programming: Multidisciplinary Team Questions

- Do you have any transition issues between different flooring product types?
- What is your budget for flooring and other finishes for the project?
- What are the project's sustainability goals?
- Are you striving to achieve a certification from a green building rating system?

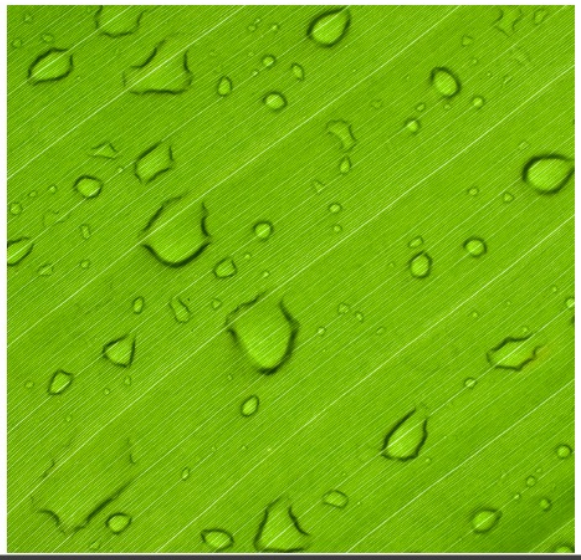


Photo by Anthony Rampersad on Unsplash

OPR

When reviewing products for a project, it is important to have an understanding of the project's sustainability goals, such as achieving green building certification, because certifications for products to meet building rating system criteria may be a requirement. It is also important to verify that performance needs will be met by a product in order to avoid premature product failure and other unintended consequences that would impact a project's sustainability goals.

Operational Programming: Multi-disciplinary Team Questions

- What technical data do you need for flooring products?
- Do you require sustainable product certifications for flooring products?
- Has COVID-19 created any additional considerations for flooring specifications?

OPR

Photo by Martin Sanchez on Unsplash

For killing SARS-CoV-2, the virus that causes the disease COVID-19, it is essential to understand three parts of the cleaning and disinfection chemical product performance requirements: 1) provide the least caustic disinfecting chemical that eradicates the virus and poses the lowest exposure to the environmental services technicians; 2) the disinfecting chemical needs to be effective in killing the virus; 3) verify that the chemicals used to clean and disinfect a surface will not harm or degrade the surface. The regulatory authority for disinfectant efficacy is found in the U.S. Environmental Protection Agency (EPA)'s List "N." The Centers for Disease Control and Prevention (CDC) provides guidance on the cleaning and disinfecting of not only surfaces, but also provides recommendations for healthcare and other community spaces, such as workplace, hospitality, schools, and homes. Ultimately, for all interior products it is recommended to contact not only the product manufacturer for cleaning and disinfecting recommendations, but also the cleaning and disinfecting chemical product manufacturer to verify efficacy and potential impact on surface degradation if a chemical manufacturer has tested their product on the specific flooring type. When a surface becomes damaged, it can become a reservoir for pathogens and create an infection transmission risk.

Tied to OPR is Overall Performance Testing & Requirements

ASTM F06.20 on Test Methods: Various Types of Test Method for ALL Resilient Flooring Products

Floating LVT Example

PERFORMANCE

CLASSIFICATION	ASTM F1700 - Class III, Type A - Smooth, Type B - Embossed
SQUARENESS	ASTM 2421/ASTM F2055 - Passes - ±0.10 in. max
SIZE & TOLERANCE	ASTM 2421/ASTM F2055 - Passes - ±0.016 in. per linear foot
THICKNESS	ASTM F386 - Passes - as specified ±0.005 in.
FLEXIBILITY	ASTM F137 - Passes - 1" mandrel
DIMENSIONAL STABILITY	ASTM F2199 - Passes - 0.020 in. per linear foot
RESIDUAL INDENTATION	ASTM F1914 - Passes - Average less than 8%, maximum single read 10%
RESISTENT TO CHEMICALS	ASTM F925 - Passes - No Change or Slight Change
RESISTANCE TO LIGHT	ASTM F1515 - Passes - $\Delta E \leq 8$
RESISTANCE TO HEAT	ASTM F1514 - Passes - $\Delta E \leq 8$
CRITICAL RADIANTFLUX	ASTM E648 - Passes - ≥ 0.45 watts/cm^2, Class 1
SMOKE DENSITY	ASTME662 - Part A - less than 450
GAUGE	5mm (.2")

Performance Information: Mohawk LVT Example

Tied to the OPR is the overall performance testing that is utilized for resilient flooring products. The ASTM Resilient Floor Coverings Committee (F06) develops and publishes test methods for resilient flooring products. Of particular mention is ASTM F925-13 Standard Test Method for Resistance to Chemicals of Resilient Flooring which is used as a minimum performance test method for evaluation of cleaning and disinfecting chemicals on resilient flooring. It is anticipated that due to additional types of disinfection methods being used because of novel coronavirus (SARS-CoV-2 virus), performance testing will continue to evolve to include the impact of UV-C (ultraviolet light for disinfection), which has been a strategy used in healthcare settings and with some mechanical systems to reduce potential spread of infection and is now being evaluated in all types of settings.

Hydrogen peroxide mist is another technology that is utilized in healthcare and being evaluated in other verticals. These strategies and other additional products and additives are currently being researched not only for efficacy but also the impact on surfaces and potential degradation, particularly if chemical cleaning and disinfection occurs prior to an additional treatment (potentially increasing the impact on a surface or material). The application methods of chemicals may also impact surfaces, citing, as an example, electrostatic sprayers which have become a popular delivery method as a result of the pandemic. This is an ever-expanding body of research being carried out by universities as well as manufacturers, all trying to better understand the impacts on resilient flooring products.

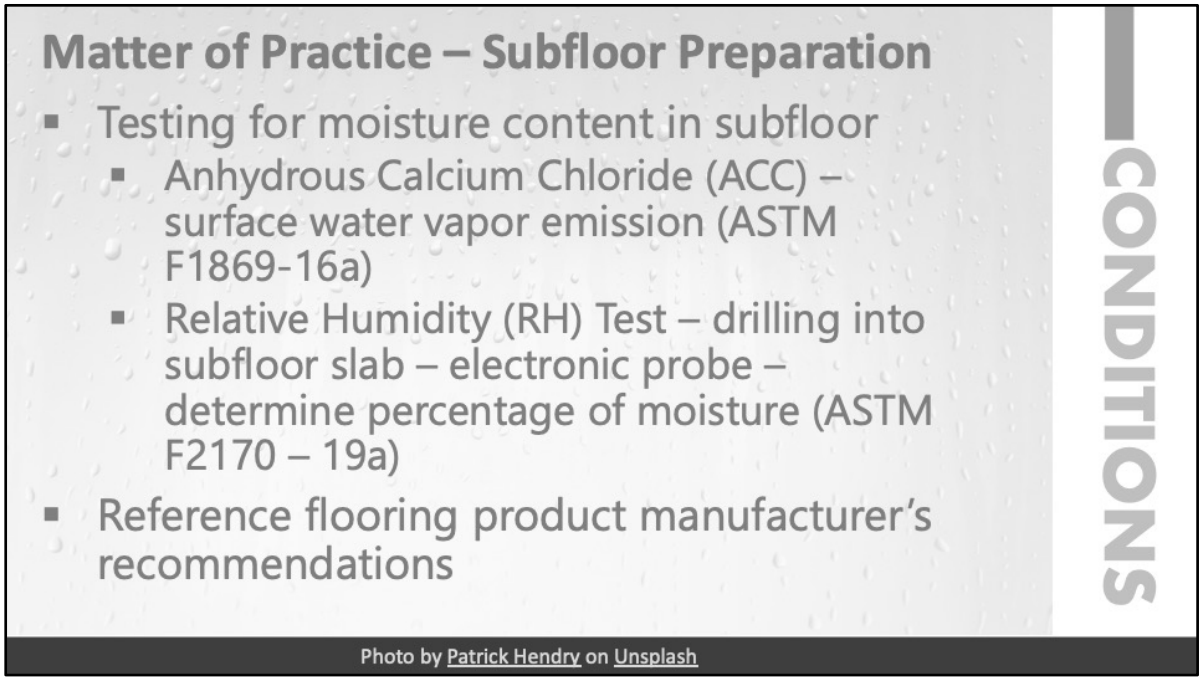
Project Conditions

Matter of Practice

Photo by Scott Webb on Unsplash

CONDITIONS

No matter what type of resilient flooring product is installed, the subfloor preparation is key to a successful installation.



Preparation involves measuring the moisture content in concrete slabs and selecting a condition appropriate adhesive for the installation. There are two types of moisture content tests – best practice would be to complete both tests: 1) Anhydrous Calcium Chloride (ACC), which measures moisture movement through the slab (MVER: Moisture Vapor Emission Rate) per **ASTM F1869-16a Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride**, and 2) Relative Humidity (RH) Test, which includes drilling into the subfloor and utilizing an electronic probe to determine the percentage of moisture based on **ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes is used for the Relative Humidity (RH) Test.**

Calculating relative humidity levels allows for the identification of the most appropriate adhesives to be used based upon site conditions. For example, many standard flooring adhesives are rated to withstand up to 80 percent relative humidity, but if resilient flooring products were to be installed in a more humid environment, a different flooring product or moisture mitigation solution would need to be specified that could withstand conditions including higher relative humidity. The recommendation is always to reference a specific product manufacturer's recommendations for the recommended adhesives based upon the site conditions.

Matter of Practice – Successful Installation

- Verify with flooring product manufacturer all installation specifications, requirements, and recommendations.
- Work with general contractor to verify qualifications and training of finish subcontractors.
- https://installfloors.org/specifications/

CONDITIONS

Escher Museum, Den Haag; Architect: Karelse & den Besten; Photograph: Escher in Het Paleis; Flooring: nora by Interface

Quality installation and the success of product specifications are based upon subfloor preparation and subsequent installation. This installation process reflects well on the designer/specifier as well as the contractors responsible for the installation. For information on specifications for using qualified installers se: https://installfloors.org/specifications/. For additional information, designers can follow the Facebook page for current information about INSTALL: https://www.facebook.com/Install-Floors-1251389358226522.

Matter of Practice – Successful Installation

- LVT and carpet example for a smooth transition over a prepared subfloor.
- Encourage specifications to be written to include requiring certified installers / vetting the installers to verify expertise with a certain type of resilient flooring installation.
- https://installfloors.org/specifications/

CONDITIONS

Installation Video: INSTALL: https://installfloors.org/ | LVT and Carpet Smooth Transition: Interface

The installation photo is an example of an LVT and carpet smooth transition that does not use a “bumper” or “speed bump” type of transition. This type of transition is important for mobility, cart traffic, and strollers, etc.

Matter of Practice – Successful Installation

- Pre-construction Meetings with general contractor and finish subcontractors
- System of communication set up during pre-construction meeting

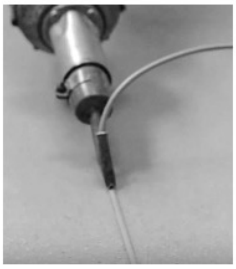
CONDITIONS

Schlau Hausmesse 2020, Germany (Bad Salzuflen); Pop-up – Custom Design: Beauflor

Pre-construction meetings are usually held prior to the start of a project. It is recommended to also have a pre-construction meeting with all finish subcontractors after the close-in of the walls and prior to starting the installation of the finishes. Verification of a communication system if questions arise must be established through the general contractor to avoid errors or misunderstandings about the details of the design intent. During these meetings, the OPR should be reviewed with the GC and subcontractors to reinforce the understanding of why the design is supportive of the users and confirm various installation methods and expectations for the completed project.

Matter of Practice – Welding Sheet Products

- Cold/Chemical Welding
- Hot/Heat Welding



CONDITIONS

Installation Photos: Hot/Heat Welding; INSTALL: https://installfloors.org/

Cold welding or chemical welding and heat welding refer to resilient products. Chemical welding vinyl (either heterogeneous or homogenous sheet) is accomplished with a 2-part adhesive that fuses the material together. Cold welding rubber sheet is a different approach that utilizes a 1-part, caulk-like substance that has bonding and filler properties rather than fusing together the separate pieces. Heat welding is essentially the same for vinyl, rubber, and linoleum in technique, but the properties of the materials require some modification specific to each type of product. Also, it is possible to install rubber and linoleum without any topical seam treatment at all. Some linoleum adhesive acts as a quasi-seam sealer from below when dry. So, it is possible just to cut the seam to fit without additional welding.

Matter of Practice – Smooth Transitions

CONDITIONS

Installation Photos: Flash Patching/Smooth Transition; INSTALL: https://installfloors.org/

In the past, universal design has been equated with accessibility – but for the University of Buffalo's Center for Inclusive Design and Environmental Access (IDEA), the definition has been expanded to include access to amenities, services, and community. From the built environment perspective, supporting independent movement for all building users requires attention to flooring transitions between products – with the goal to create a smooth transition between materials to foster mobility, cart traffic, parents with strollers, movement of materials, delivery of groceries, etc.

Matter of Practice – Smooth Transitions

- Universal design as a process – evaluating supportive environments
- Proper installation of a threshold or transition strip is essential to create seamless or smooth transition between materials.
- Goal is to support as much ease of movement for all building / space users

CONDITIONS

Cedar Lane Senior Living Community, Leonardtown, MD; EarthWerks LVP to Atlas Carpet Transition: JSR Associates, Inc.

This is an example of an installation within a senior living apartment building that transitions smoothly between LVT and carpet. It is recommended to utilize smooth transitions versus a strip that creates any height change and/or “speed bump” result.

Matter of Practice – Smooth Transitions

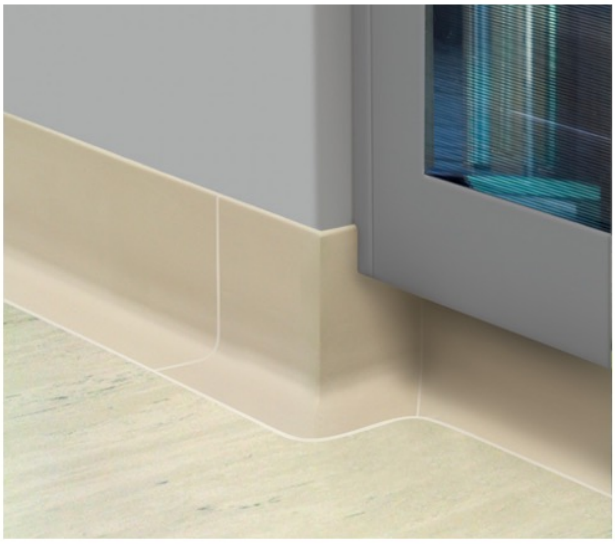
CONDITIONS

JSR Associates, Inc. Office, Catonsville, MD; Carpet to LVT Transition: Ecore Underlayment / Shaw Carpet & LVT

Materials installed to create smooth transitions: With the right subfloor preparation and use of various types of transition strips, welding techniques, and underlayment materials, material height variations can be accommodated to maximize the usefulness of a space designed to support independent movement.

In this installed example, there is rubber underlayment used for acoustical benefit and underfoot comfort. Two different mil thicknesses of underlayment were used to accommodate the carpet and LVT smooth transition between spaces - 2mm used under the carpet and 5mm used under the LVT. When using vinyl and rubber materials together, it is important to verify the compatibility with the manufacturers of the relevant products prior to specification and subsequent installation because of differences in material properties.

Matter of Practice – All in the Details



CONDITIONS

Installation Photos: Hot/Heat Welding for Integral Cove Base; INSTALL: https://installfloors.org/; Healthcare Installation: Flexco

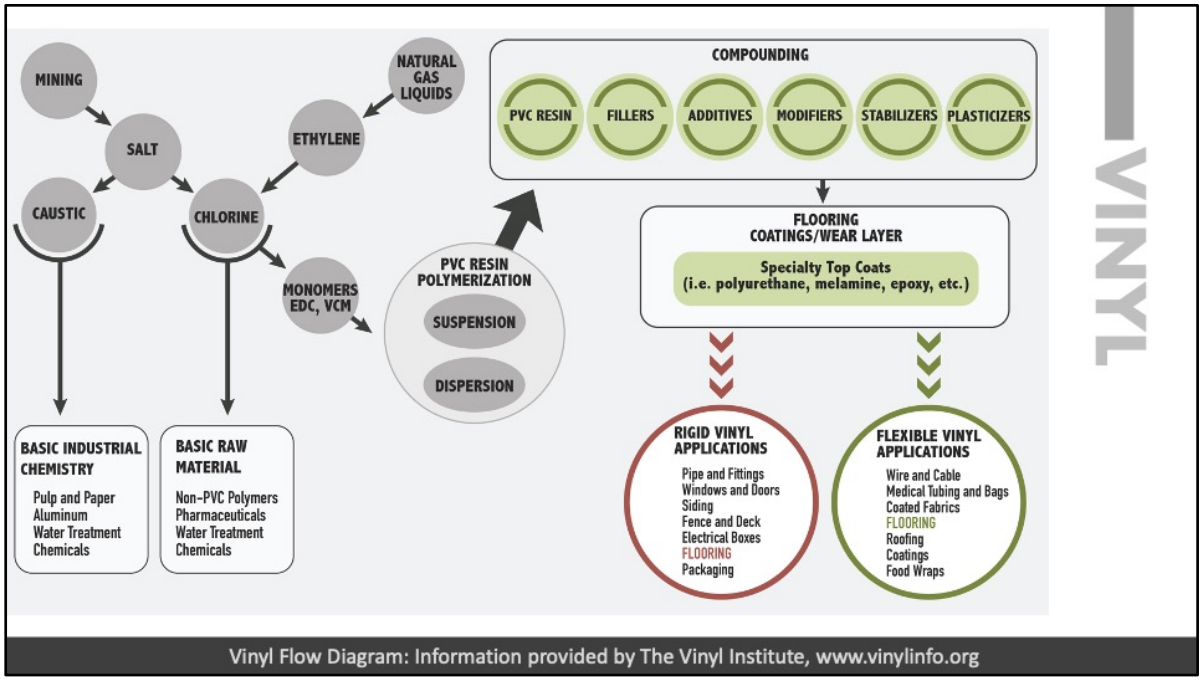
Knowing and understanding the required details discussed and included within the Owner's Project Requirements is a critical part of creating a flooring system that will meet the product life cycle expectations of the Owner. In this healthcare example, for areas that require infection control and high level of disinfection, a coved base detail would be recommended. Whereas for other types of commercial spaces, fully adhered separate wall base may be the appropriate product for the application.

Resilient Flooring Types

The following provides information on various types of flooring materials – including performance criteria, production diagrams, construction of products, installation, and product advantages.

Arcadia Trails INTEGRIS Center for Addiction Recovery, Edmond, Oklahoma; Architect: HKS, Dallas, TX; Flooring: Armstrong

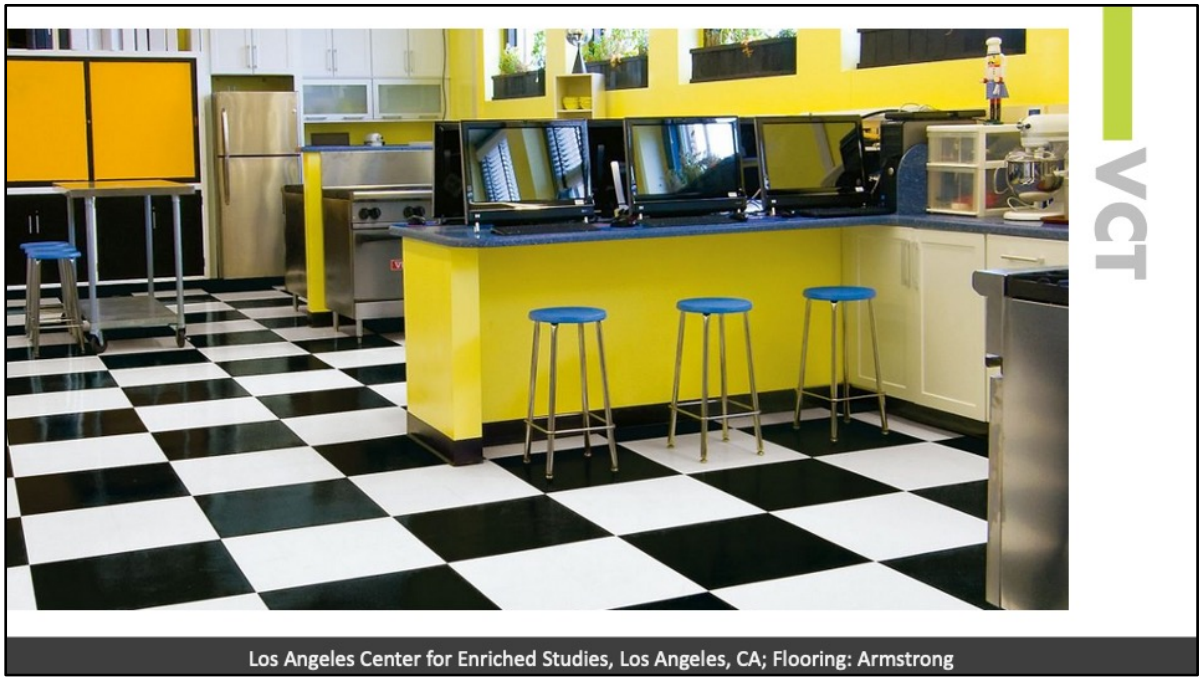
Vinyl flooring is utilized in many applications, and digital technology has expanded product offerings, creating a wide range of aesthetic possibilities.



Vinyl Flow Diagram: Information provided by The Vinyl Institute, www.vinylinfo.org

Per the diagram, salt is coupled with ethylene from natural gas, producing chlorine, which is used to create vinyl chloride monomer, a building block for polyvinyl chloride. The salt is typically sourced from large, naturally forming, underground mounds using hot water extraction . A polymerization process transforms vinyl chloride monomer into PVC resin. When compounded into vinyl resilient flooring, the resin is combined with fillers, additives, modifiers, stabilizers, and plasticizers. Fillers include calcium carbonate, also known as limestone, which is used not only for thermoplastic flooring types like vinyl, but also thermosets such as rubber flooring. Vinyl is a thermoplastic, which means that it can be reheated, remolded, and cooled without causing any chemical changes, and scrap generated in the process of manufacturing vinyl flooring can be added directly back into the mix.

PVC resin is combined with other ingredients during the compounding process based upon formulation requirements that are determined by performance characteristics for various types of flooring. There are both rigid applications and flexible applications used to make resilient flooring products.

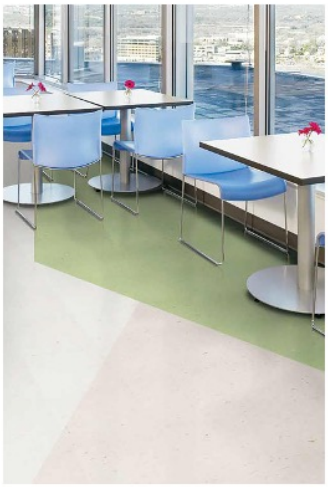


Los Angeles Center for Enriched Studies, Los Angeles, CA; Flooring: Armstrong

The primary ingredient in vinyl composition tile (VCT) is limestone. This is combined with PVC resin, plasticizers, stabilizers, pigments, etc. to create a mixture that is then processed into sheets and cut into tiles.

Vinyl Composition Tile

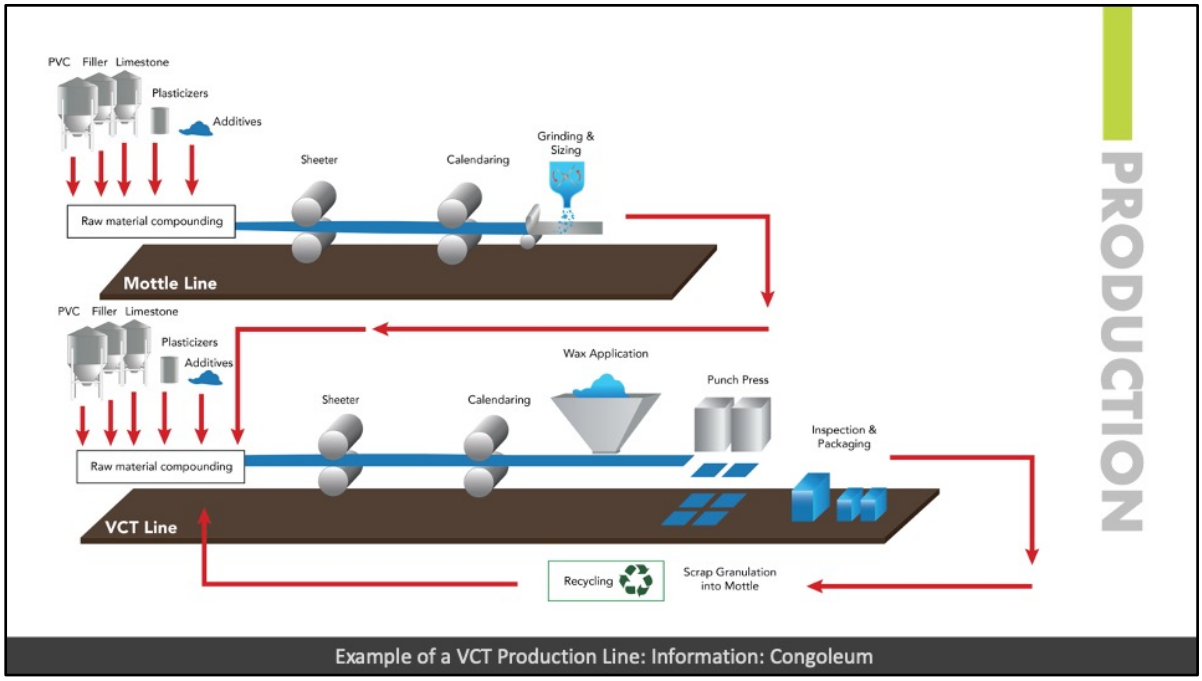
Vinyl Composition Floor Tile (ASTM F 1066)



PERFORMANCE

Education, Corporate, and Retail Examples: Tarkett

When specifying VCT, it is important to verify that the product meets the ASTM F 1066 performance standard. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.



Example of a VCT Production Line: Information: Congoleum

Vinyl Composition Floor Tile is produced in several stages beginning with the mixing of the raw materials including limestone, polyvinyl chloride, plasticizer, stabilizers and pigments. Once thoroughly mixed the material is fed into a mill and formed into a sheet and subsequently cut into tiles. VCT requires layers of polish to protect its porous surface.

VCT production generally consists of two production lines

- Line 1 – to make mottle (the colored chips that make up the pattern of the tile)
- Line 2 – to make the actual tile incorporating the base as well as the mottle

The blocks labelled Sheeter in the flowchart are essentially another calendar operation to create a continuous sheet of material.

The block labelled calendar can consist of one or more calendar rolls to reduce the product to the final gauge (thickness).
At the packaging area, scrap from inspection as well as the punch press is granulated and sent back to the VCT line to be recycled back into the product as Mottle.

Vinyl Composition Tile

High technology coating for wear, scratch and chemical resistance

High durability, through pattern PVC wear layer

CONSTRUCTION

Vinyl composition tile includes a coating that is wear-, scratch-, and chemical-resistant, but it does require additional polish to be stripped and re-applied periodically as part of regular maintenance.

Vinyl Composition Tile

INSTALLATION

Education Installation: Lancaster, PA; Installation Photos: INSTALL: https://installfloors.org/; Flooring: Armstrong

The subfloor must be properly prepared prior to installation. This avoids telegraphing subfloor roughness and imperfections through to the surface of the product.

Vinyl Composition Tile

- Modular flexibility including large format shapes, sizes, and colors
- Through-pattern product
- Withstands heavy foot- and rolling load-traffic
- Many products include a factory finish.
- Reasonable first cost

ADVANTAGES

Canyonview: VCT Installation: Congoleum

VCT is often chosen for the variety of aesthetic options available and for its reasonable first cost.

Oklahoma Children's Hospital at OU Health, Oklahoma City, OK; Architect: Miles Associates; Flooring: Armstrong

Homogeneous vinyl sheet flooring is a single layer, meaning that it is the same at the top, middle, and bottom of the sheet.

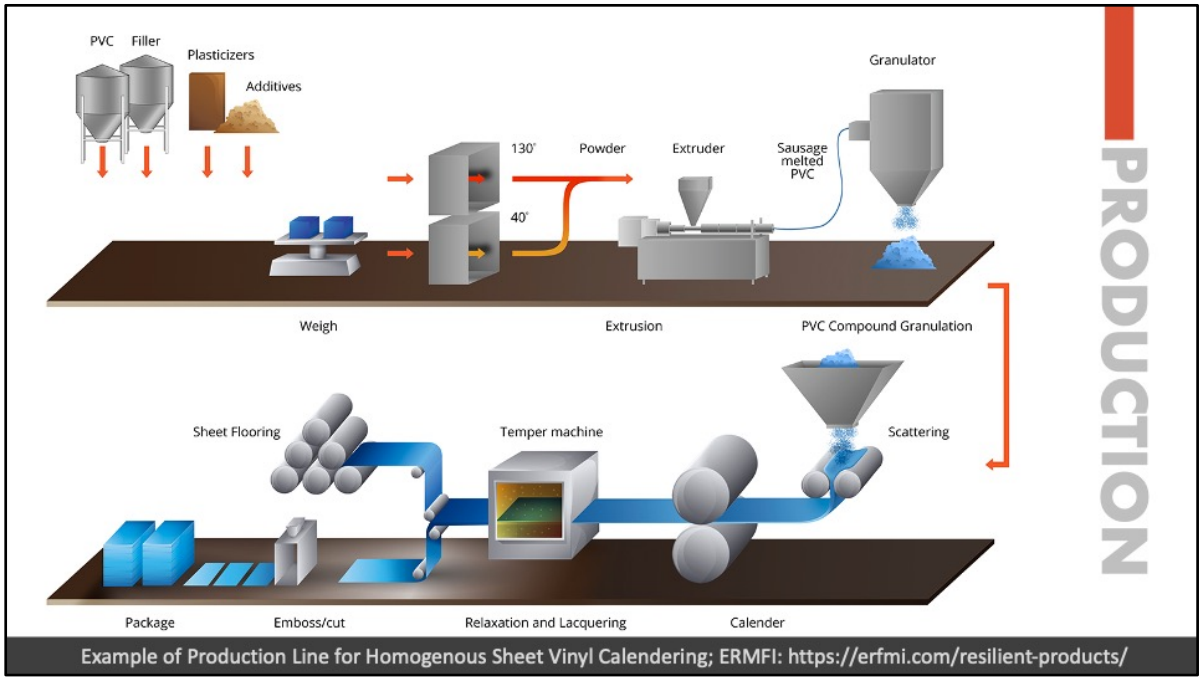
Homogeneous Sheet Vinyl

Sheet Vinyl Flooring (ASTM F 1913)

MRI/Heathcare Installation; Flooring: HMTX Teknoflor

PERFORMANCE

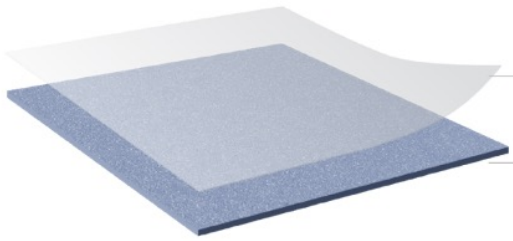
When specifying homogeneous sheet vinyl, it is important to verify that the product meets the ASTM F 1913 performance standard. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.



Example of Production Line for Homogenous Sheet Vinyl Calendering; ERMFI: https://erfmi.com/resilient-products/

Example of a production line for homogeneous calendaring: The ingredients are mixed together, after which they are extruded, then granulated, and then formed into a sheet. The sheet goes through calendar rollers and then through a heated process to create the finished product, which is rolled into sheet flooring and packaged. Sheet product can also be cut into tiles to create solid vinyl tile. The term “lacquering” is a European term that is equivalent to urethane or wear layer in the U.S.

Homogeneous Sheet Vinyl



Specialty top coats such as urethanes, for wear, scratch, chemical resistance

Through-pattern PVC wear layer

CONSTRUCTION

The product is a “through-color” product – meaning that the sheet is consistent throughout and, as with other vinyl products, includes a top coat that protects the surface from wear and tear and scratching and also provides chemical resistance.

Homogeneous Sheet Vinyl

INSTALLATION

Installation Photo of Homogeneous Vinyl Sheet: INSTALL : https://installfloors.org

The installation and considerations that govern vinyl sheet products do not vary significantly from homogeneous to heterogeneous but there are subtle nuances. If using heat welding to install, an advantage of homogeneous vinyl is that it is less sensitive to heat and therefore less likely to show scorch or burn marks if heat welded incorrectly. Homogeneous vinyl may provide slightly lower margin of error for subfloor prep, though; due to absence of patterns or embossing there is a greater propensity for subfloor imperfections to telegraph through to the surface. The smoother and more monochromatic the vinyl is, the more it shows imperfections in the subfloor, reinforcing the importance of proper subfloor preparation.

Homogeneous Sheet Vinyl

INSTALLATION

Installation Photo of Homogeneous Vinyl Sheet : INSTALL, https://installfloors.org

Exactness and attention to detail are critical to a successful installation – particularly for installations specifying high traffic use, infection control measures that need to be met, and frequent cleaning and disinfection.

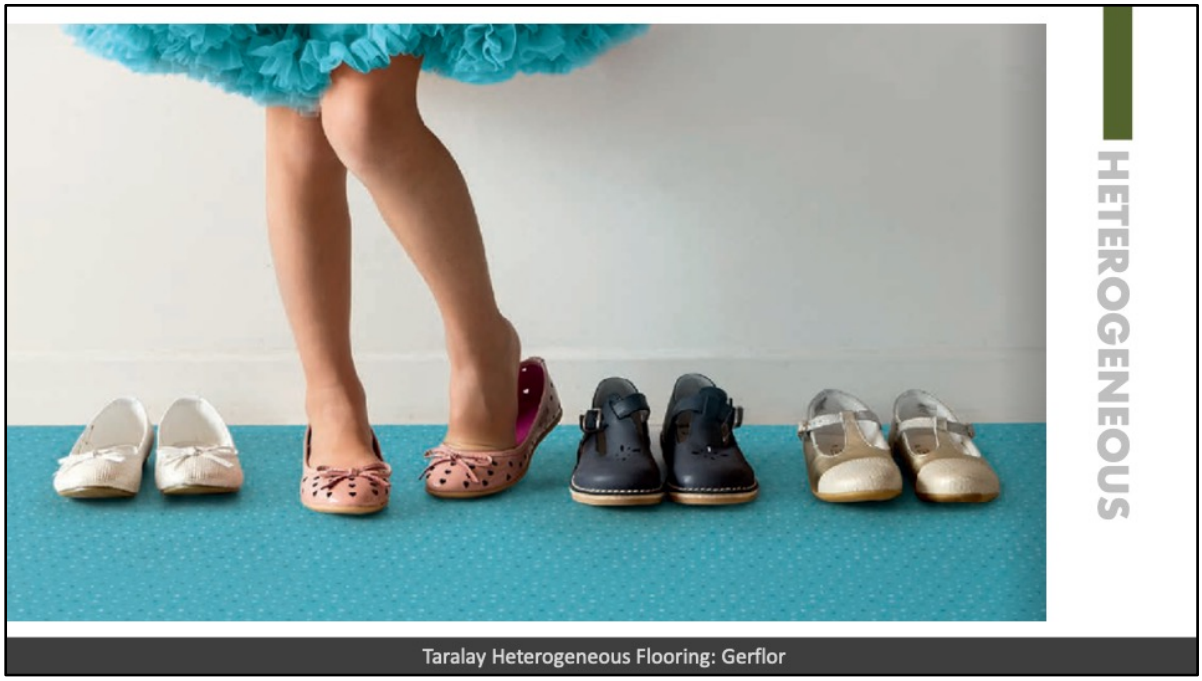
Homogeneous Sheet Vinyl

- Through-color construction provides even wear and a consistent appearance over time
- Durable under heavy rolling loads
- Seams can be heat welded
- Product can be flash coved for more efficient cleaning

Mipolam Elegance Homogeneouse Flooring: Gerflor

ADVANTAGES

Because homogeneous sheet vinyl is through-color, it provides a consistent appearance throughout a space. As with other types of resilient sheet products, seams can be cold welded or heat welded and base can be integral to the floor by being coved up the wall surface.



Taralay Heterogeneous Flooring: Gerflor

Heterogeneous means composed of multiple layers. In this type of product, each layer is different – as there is a back layer, a coated core layer, and a wear layer. If looking at heterogeneous flooring as a cross-section, there would be multiple, distinct layers – with each layer serving a specific purpose.

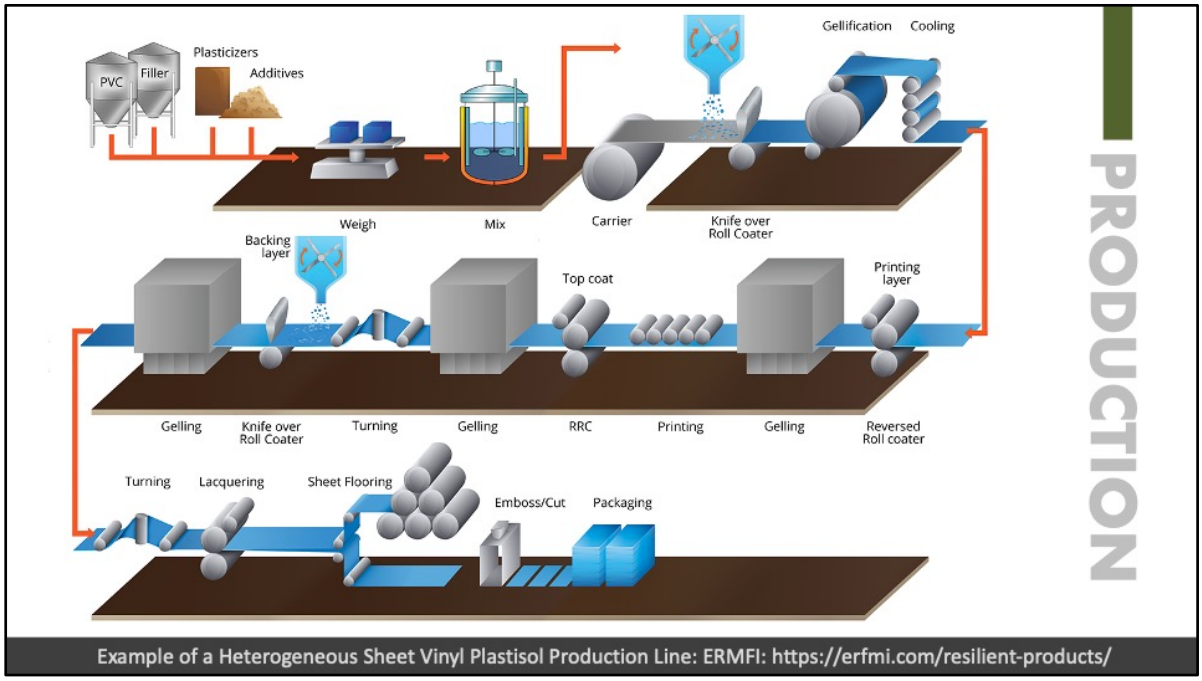
Heterogeneous Sheet Vinyl

Sheet Vinyl Flooring (ASTM F 1303)

PERFORMANCE

Heterogeneous Sheet Vinyl: Mannington Commercial

When specifying heterogeneous sheet vinyl, it is important to verify that the product meets the ASTM F 1303 performance standard. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.



Example of a Heterogeneous Sheet Vinyl Plastisol Production Line: ERMFI: https://erfmi.com/resilient-products/

Example of a Production Line of Heterogeneous Sheet Vinyl Plastisol Production. Plastisol is a liquid mixture of PVC (dispersion PVC resin), plasticizer, fillers (with the exception of the wear layer) and additives that has a consistency of a paste. This paste (or plastisol) is applied by a coating process and transformed into the solid state by heating (Gelification, in the diagram, which is contact with a hot drum). Heterogeneous Sheet can also be calendared, similar to Homogeneous Sheet Vinyl production example shown previously. Note that the term “lacquering” in the diagram is a European term that in the US is equivalent to urethane or wearlayer.

Heterogeneous Sheet Vinyl

Specialty top coats such as urethanes, for wear, scratch, chemical resistance

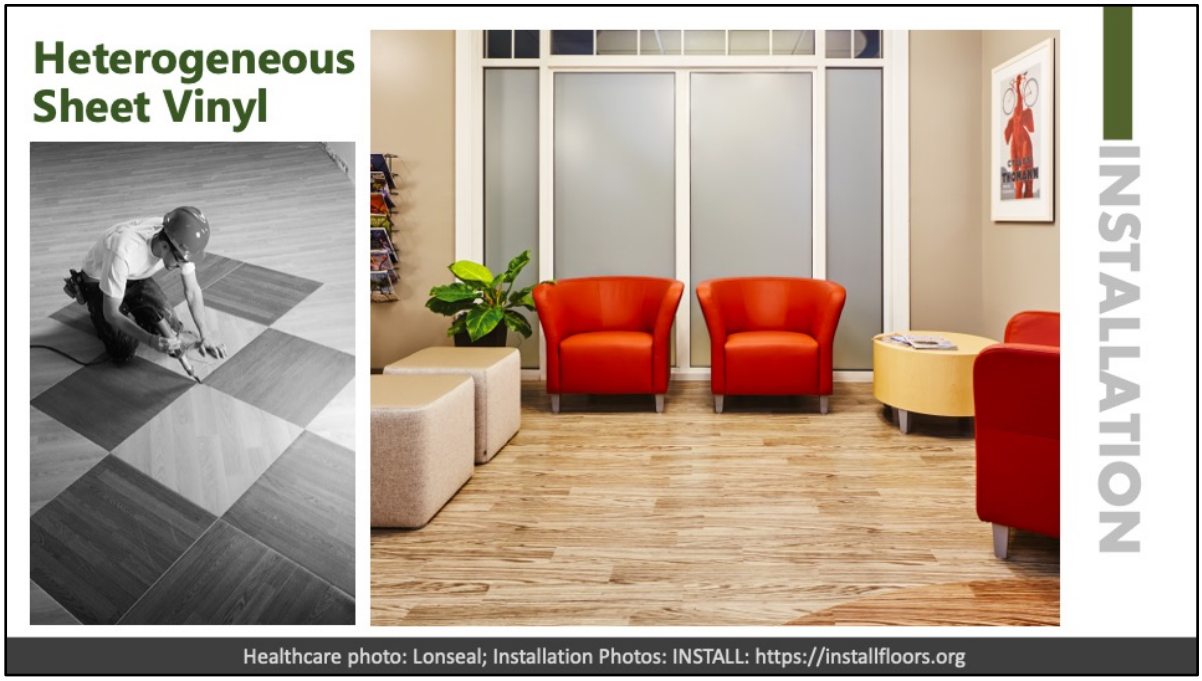
Designer printed visual

Performance wear layer for realistic visuals and textures

Fiberglass-reinforced base

CONSTRUCTION

There are a variety of construction types for heterogeneous sheet vinyl resilient flooring. This diagram is representative of one such construction type and illustrates the multiple layers that comprise this type of sheet vinyl. Note that some construction types do not include the designer-printed visual layer and there are those with and without some type of backing cloth.



The installation and considerations that govern vinyl sheet products do not vary significantly from homogeneous to heterogeneous but there are subtle nuances. In the case of heat welding, heterogeneous vinyl is more sensitive to heat and therefore more likely to show scorch or burn marks if heat welded incorrectly. Heterogeneous vinyl may provide a slightly higher margin of error for subfloor prep, because anytime embossing or patterns are inherent to the vinyl, subfloor imperfections are less likely to telegraph through to the surface. The smoother and more monochromatic the vinyl is, the more subfloor imperfections are likely to show.

Heterogeneous Sheet Vinyl

- Technological advancements provide authentic wood and stone visuals for various aesthetics
- Available in wide widths for seamless installation
- Seamless flooring with excellent top-down moisture protection
- Loose-lay and direct glue down installation
- Beautifully sustainable!

ADVANTAGES

Heterogeneous Sheet Vinyl: Healthcare Setting: Mohawk

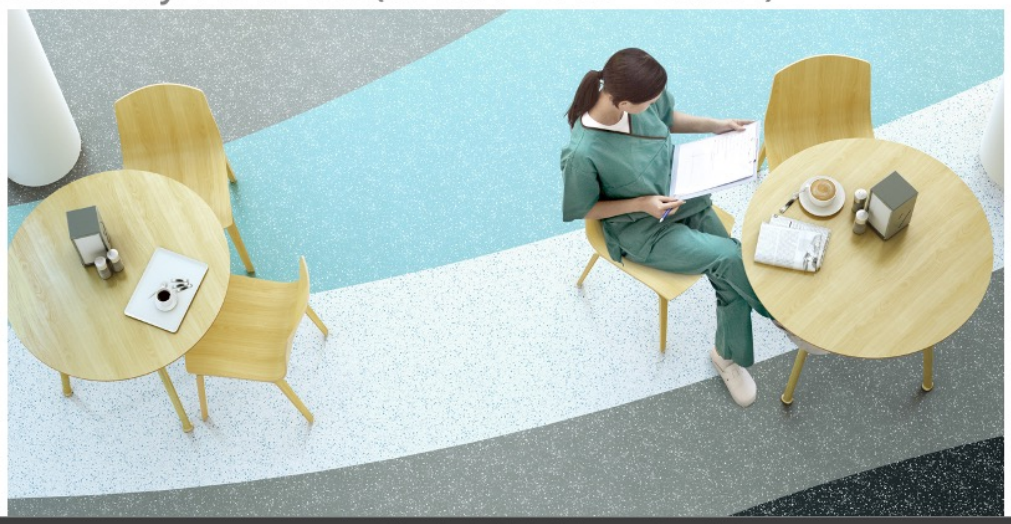
Digital technological advancements in flooring design have greatly expanded the range of creative options available to designers, enabling them to create a variety of looks while at the same time supporting wayfinding solutions, all in one durable, low-maintenance product that can withstand high-volume roller traffic.

Healthcare Setting: Solid Vinyl Tile: American Biltrite

Solid vinyl tile is often used in lieu of sheet goods because it is more manageable for installations that require access to smaller environments or those designs that have more complexity with more colors and textures utilized as part of an overall flooring design concept. Solid vinyl tile in an accent area can also be used in combination with sheet products in an adjacent space.

Solid Vinyl Tile

Solid Vinyl Floor Tile (ASTM F 1700 – Class I)



Cafeteria: Solid Vinyl Tile: American Biltrite

PERFORMANCE

When specifying solid vinyl tile, it is important to verify that the product meets the ASTM F 1700 – Class 1 performance standard. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.

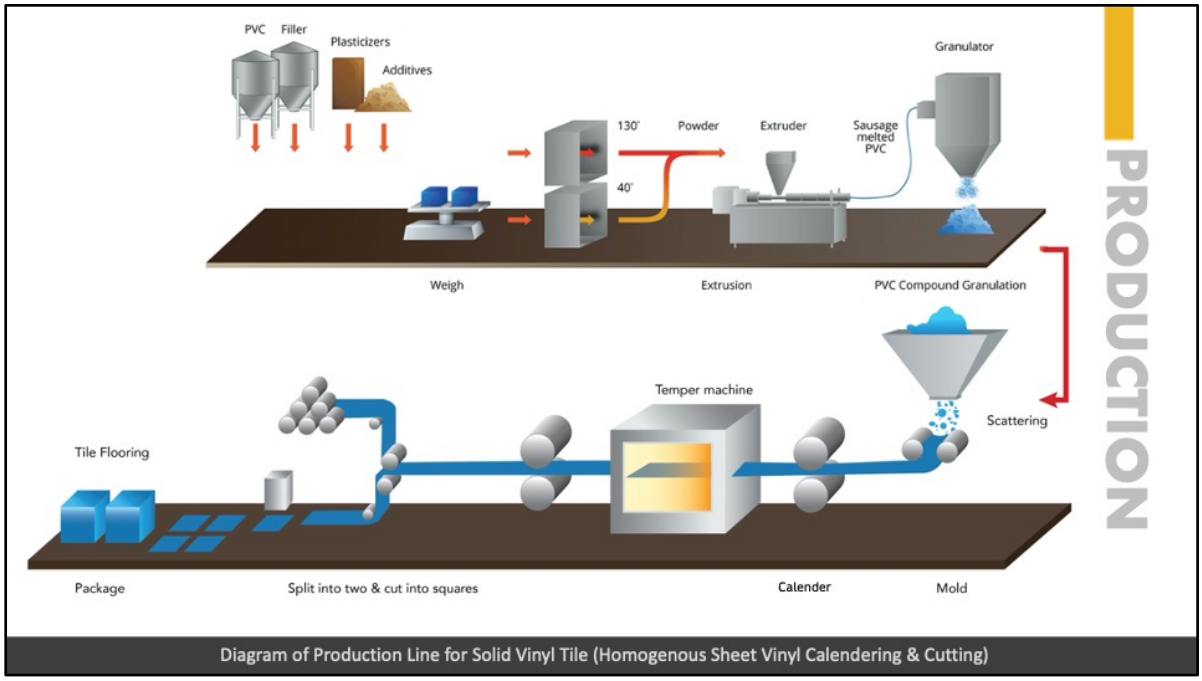


Diagram of Production Line for Solid Vinyl Tile (Homogenous Sheet Vinyl Calendering & Cutting)

The production line for solid vinyl tile, involving homogeneous sheet calendering which is then cut into individual tiles, is shown in this diagram. The initial process is the same as that of homogeneous sheet products.

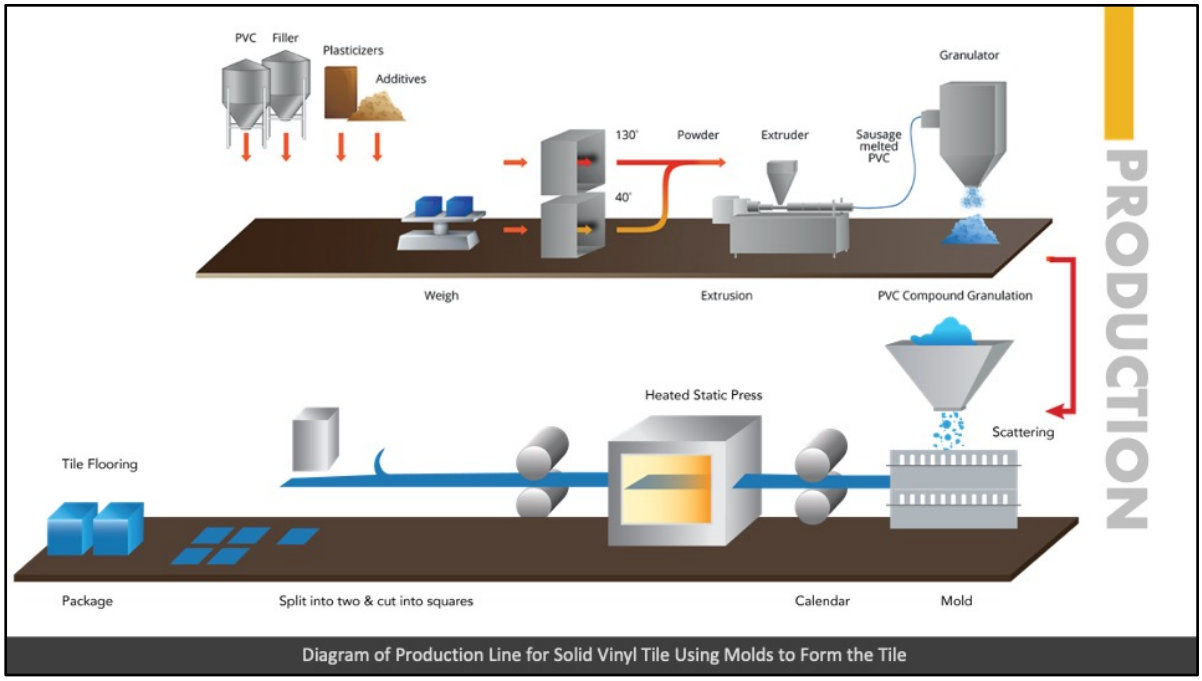
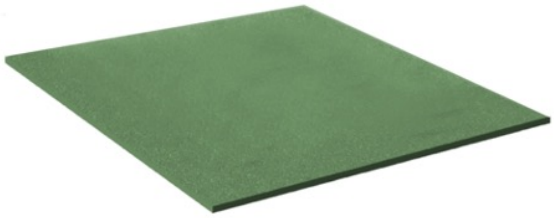


Diagram of Production Line for Solid Vinyl Tile Using Molds to Form the Tile

There is another production process for making solid vinyl tile, which involves using molds to create a thicker tile that is then split into two pieces, using the interior face as the finished face of the product. The tile is then cut and packaged.

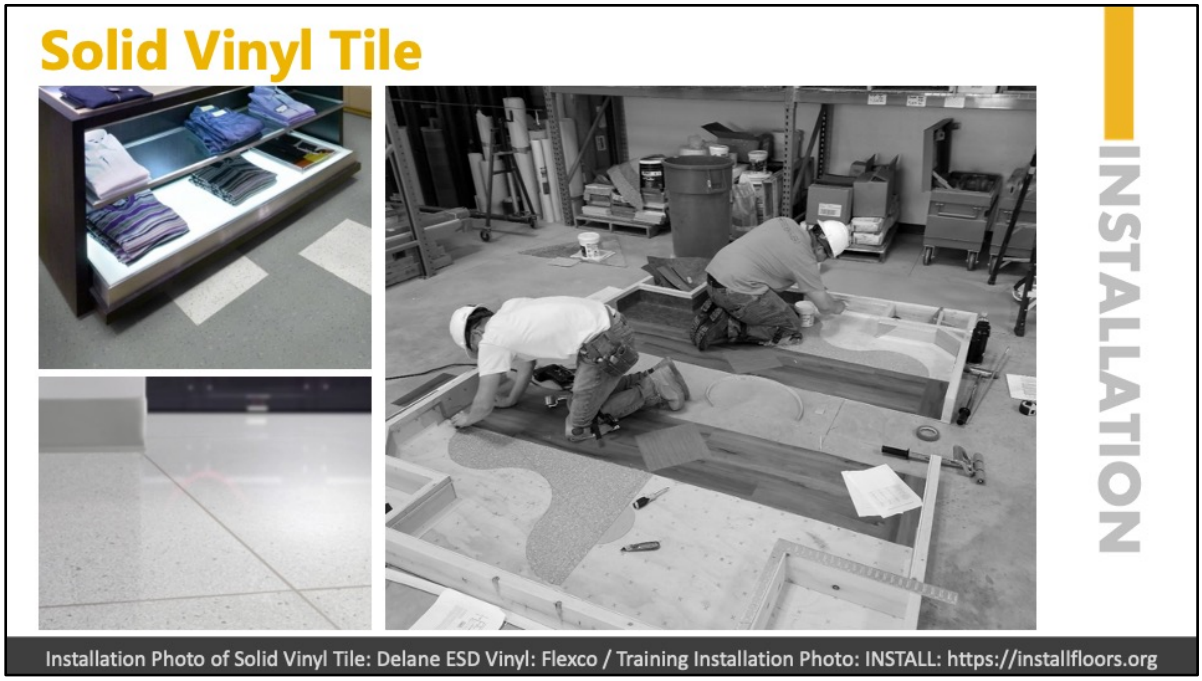
Solid Vinyl Tile



Through-pattern solid vinyl tile

CONSTRUCTION

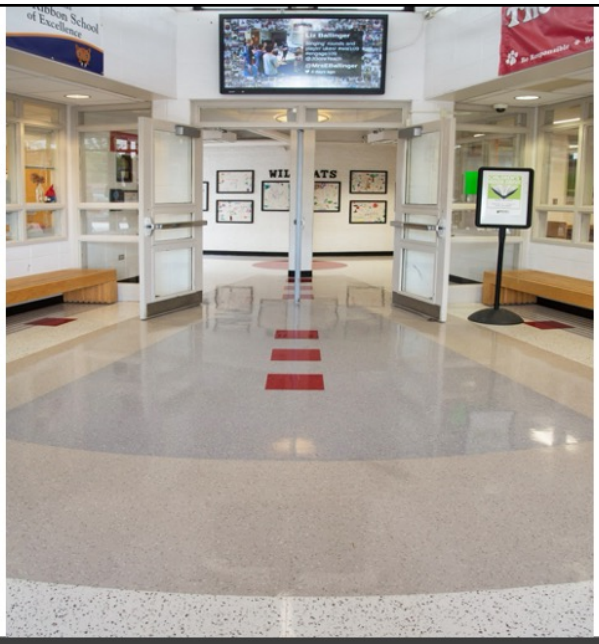
The construction is similar to homogeneous sheet, characterized by through-pattern solid design and color.



The installation and considerations that govern solid vinyl tile (SVT) are similar to vinyl sheet products, but there is less weight to manage because of the smaller sizes of the tiles, making it the best of both worlds. SVT's product construction and properties are similar to sheet vinyl. It is lighter then VCT, is a no-wax solution, and is flexible, allowing it to be coved and welded. Some customers prefer tiles to sheet, because they are easier to manipulate and install, as well as easier to use for creating floor pattern designs without having to do waterjet cutting (although, if required, SVT can be waterjet cut). There is a perception that with SVT, it is easier to replace individual tiles if needed, compared to sheet flooring.

Solid Vinyl Tile

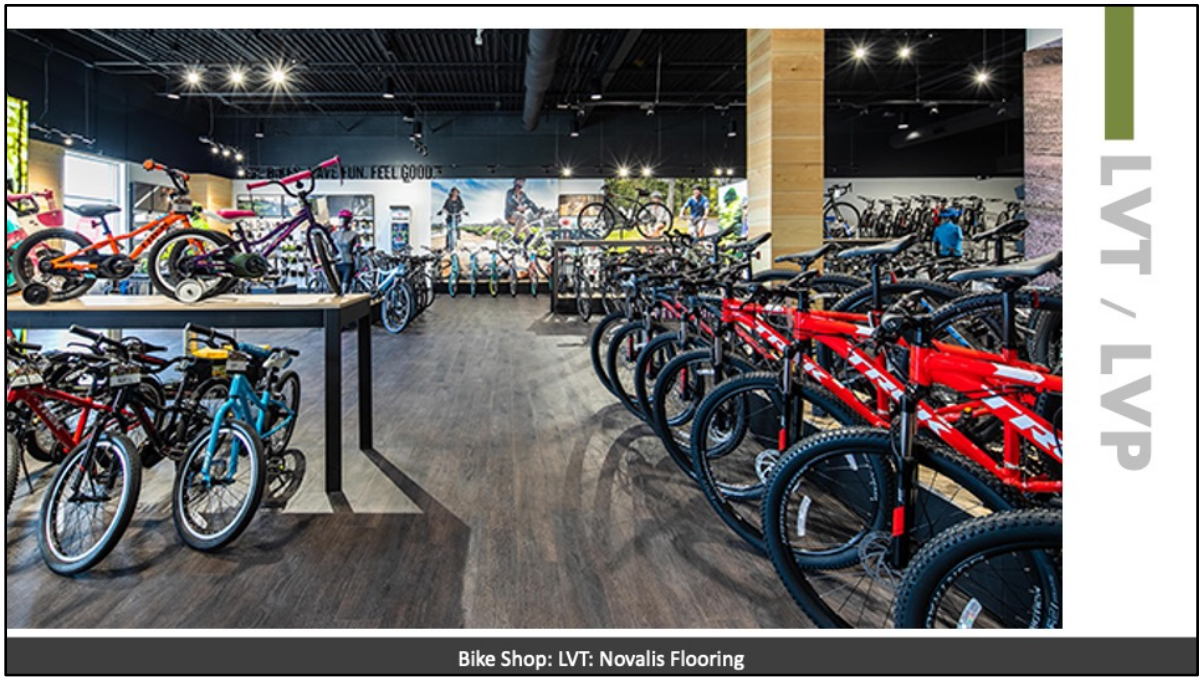
- Through-color construction provides even wear and a consistent appearance over time
- Can be heat welded and coved into base
- Performs under heavy rolling loads



ADVANTAGES

High School in Illinois; Solid Vinyl Tile, No-Wax: American Biltrite

Similar to sheet vinyl products, solid vinyl tile has the same advantages as homogeneous sheet vinyl, but with some additional flexibility.



Bike Shop: LVT: Novalis Flooring

Luxury Vinyl Tile (LVT) and Luxury Vinyl Plank are the most popular type of vinyl tile flooring – the appeal includes the versatility of various aesthetics that are available due to the advancement of technology within the digital market to create all types of looks – wood looks, which are the most common, but also stone and other natural material aesthetics and for those that prefer the materiality to be represented in the product, an opportunity for stria of dark/light patterning or abstracts represent but do not directly imitate textiles or other materials.

Flexible Luxury Vinyl Tile and Plank

- ASTM F 1700
- Class III Solid Vinyl Floor Tile

PERFORMANCE

LVT Photo: EF Contract: Engineered Floors /Inova L. J. Murphy Children's Hospital, Falls Church, Virginia, LVT: Mannington

When specifying LVT/LVP, it is important to verify that the product meets the ASTM F 1700 performance standard for Class III Solid Vinyl Floor Tyle. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.

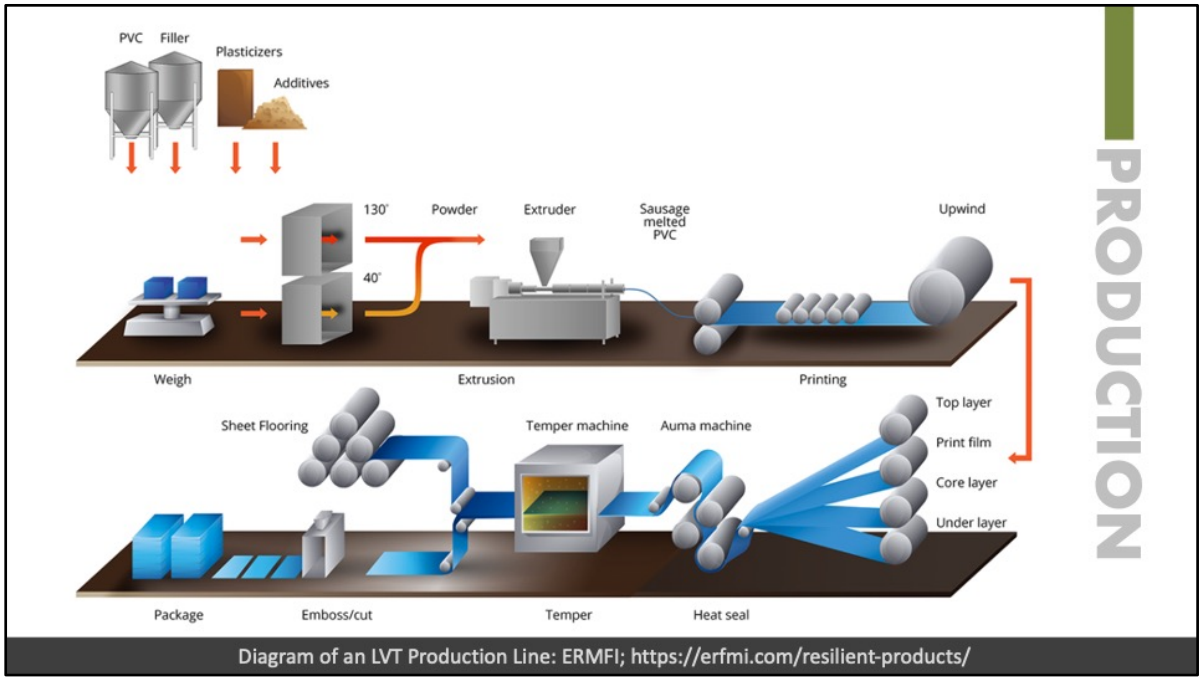
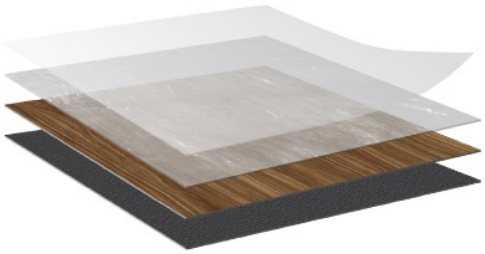


Diagram of an LVT Production Line: ERMFI; https://erfmi.com/resilient-products/

The production process for LVT/LVP is similar to other sheet products, except that there are several layers that are brought together through a calendaring process that creates the finished product. The sheet can be cut into planks or tiles.

Flexible Luxury Vinyl Tile: Glue Down



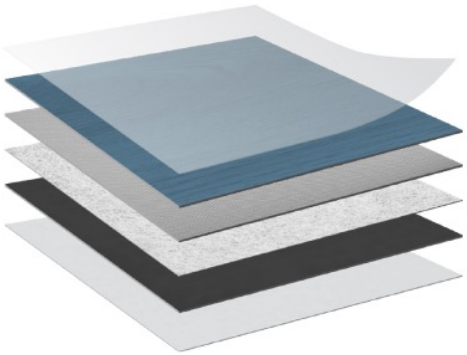
- Specialty top coats such as urethanes, for wear, scratch, chemical resistance
- Performance wear layer for textures and durability
- Print film for realistic visuals
- PVC foundation layer

CONSTRUCTION

Glue down applications for LVT and LVP have different layers (shown) than loose lay products.

Flexible Luxury Vinyl Tile: Loose Lay

CONSTRUCTION



- Transparent wear layer and coating for durability and scratch resistance
- Design layer for creating visuals and textures
- Middle vinyl layer for extra stability and support
- Fiberglass veil to minimize expansion and contraction
- Vinyl backing for high-pressure resistance
- Anti-slip layer allowing installation without adhesive and easy removal and replacement

Loose lay products have more layers because a very minimal amount of adhesive is used for the installation of the product. This requires extra stability and support from the middle vinyl layer that is added to the product construction.

Here is an installation example in a prerevolutionary building, a mill that was used to make carriages. Reinventing the space with LVT chosen for its durability while preserving the look and feel of the redeveloped historic mill building. It had been 50 years since the building was last occupied.

It is important for resilient products to acclimate to the installation location – humidity and temperature level before installing LVT – that is expected for the finish space. Also, it is recommended to separate the product into small piles of LVT planks.

The glue down installation method involves the use of an adhesive to adhere your dryback luxury vinyl flooring to the subfloor. Using an adhesive creates dimensional stability that ensures the flooring maintains its natural characteristics. The glue down method involves two distinct types of adhesives: hard set and pressure sensitive.

Hard Set — Adhesive is spread along the floor, then flooring is laid on top.
Pressure sensitive — The flooring product itself has adhesive on it and is bonded to the substrate with pressure.

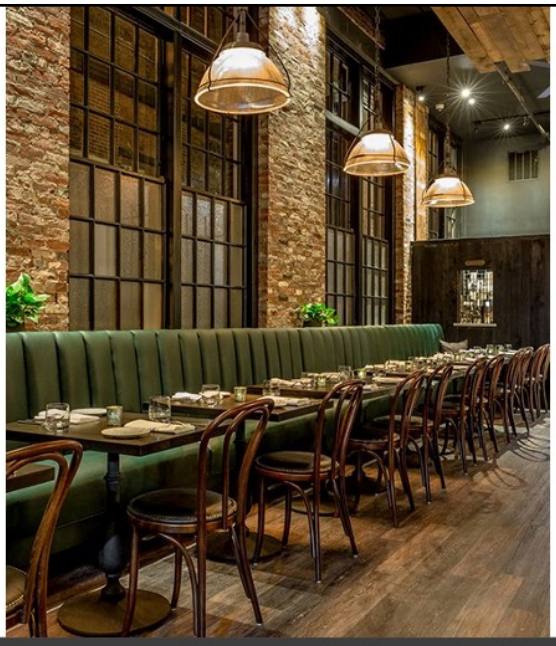
Loose lay can be installed over existing floor coverings. Vinyl flooring is adhered to the edges of a subfloor, then additional planks and tiles are typically laid in place without an adhesive.
Loose lay can be removed and replaced easily. This makes loose lay LVT an ideal option for areas where flooring may be temporary or have a short life span, as removal and replacement will not damage the substrate or the flooring material.
Loose lay is ideal for raised access floors. There are some restrictions involved but, for the most part, loose lay LVT can be easily installed over most raised access floors, especially those that require frequent access.
Loose lay has a higher sound rating than traditional LVT. While traditional LVT typically does not contribute significantly to sound reduction, loose lay LVT is a thicker product with a textured back that offers improved sound testing results, helpful in corporate, multifamily, or hospitality installations.
Loose lay tile can butt up against thicker products; at 5mm, it can work with a number of thicker products that would normally require a transition, as noted in our “smooth transitions” section above.

Loose lay LVT is only as good as the substrate over which it is installed, and the skill and practices used to install it.

Loose lay LVT does require *some* adhesive. Despite the name, loose lay LVT does require adhesive in order to provide a tight installation. However, it requires significant less adhesive than traditional LVT. A spray adhesive is usually the preferred adhesive choice. Loose lay LVT requires a flat substrate. Just like glue down or click-and-lock LVT products, loose lay LVT requires a flat substrate prior to installation. Loose lay LVT requires a solid substrate. Because loose lay LVT is mostly un-adhered to the substrate, it’s important that the substrate beneath it be fully adhered if it isn’t a concrete subfloor–solid, sound, and supportive. Soft substrates, such as recycled rubber, carpet, or cushioned sheet vinyl may have too much deflection and cause issues for a loose lay installation.

Flexible Luxury Vinyl Tile and Plank

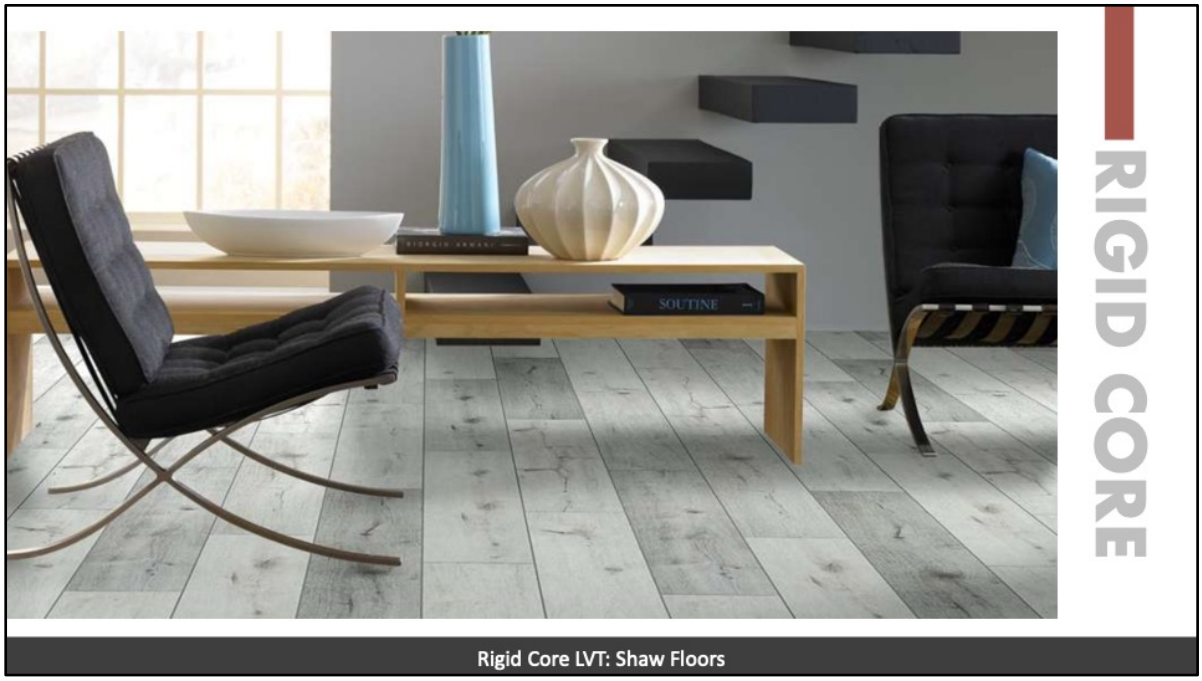
- Larger format reduces pattern repeat
- Digital capabilities provide realistic wood, stone, and similar natural material representation
- Design versatility with sizing and aesthetic options with durable finishes for various applications



ADVANTAGES

Ledger Restaurant & Bar, Salem, MA; Designer: Erica Diskin, Assembly Design Studio; Photos: Mike Diskin: Parterre

Because of the amazing aesthetics of LVT/LVP, this product has grown in popularity for all types of spaces – both residential and commercial – because it provides the desired aesthetics combined with the durability to hold up to all types of use.



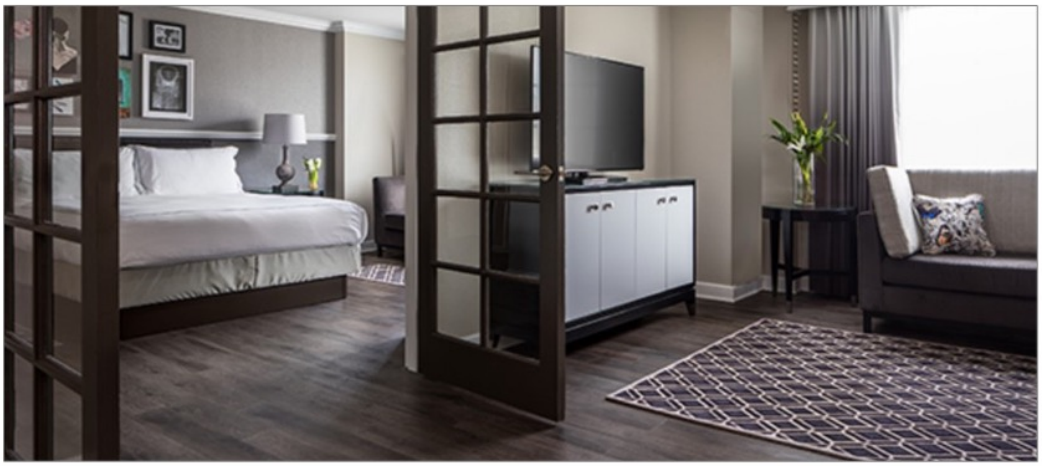
Rigid Core LVT: Shaw Floors

There are two types of rigid core flooring: SPC (stone plastic–or polymer–composite) and WPC (wood plastic–or polymer–composite).

Rigid Core Luxury Vinyl Tile and Planks

Resilient Flooring in Modular Format with Rigid Polymeric Core (ASTM F 3261)

PERFORMANCE



Rigid Core LVT: Novalis

Note that the term “luxury” is a descriptor used for vinyl tile and planks – both flexible as well as rigid core products.

When specifying rigid core products, it is important to verify that the product meets the ASTM F 3261 performance standard. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.

Both types of rigid core products are durable and stable, however **SPC (Stone Plastic (or Polymer) Composite)** is more durable and denser overall due to its limestone composition. Both work well in commercial interior spaces, but rigid core is predominantly specified in the residential market. **WPC (Wood Plastic (or Polymer) Composite)** is softer and quieter underfoot, while **SPC** offers **better** resistance from scratches or dents.

SPC features a core that is typically comprised of around 60% calcium carbonate (limestone), polyvinyl chloride, and plasticizers. WPC is a core that typically consists of polyvinyl chloride, calcium carbonate, plasticizers, a foaming agent, and wood-like or wood materials such as wood flour. Manufacturers of WPC, which was originally named for the wood materials from which it was formed, are increasingly replacing the various wood materials with wood-like plastics.

There is not much difference in the installation method between SPC and WPC LVT, but there is an important distinction between their installations. For instance, an intended click-together LVT is similar for SPC and WPC, and if some adhesive is used, the installation should not fully adhere a floating floor. Typically, loose lay is not intended to have adhesive, but some installations may require a partial adherence in the case of a commercial application.

If full adherence is required, the product should be changed to use a fully adhered installation. A non-click vinyl plank for a commercial installation does not click together as the edges butt against each other.

The product shown is a hybrid rigid core flooring product featuring a "floating floor" structure, meaning that instead of gluing or nailing the “boards” down, the installer will lock them together – side to side, end to end – creating a surface that "floats" on top of the subfloor. In some circumstances, you or your installer may prefer to use a full-spread adhesive, but it's not required.

A loose lay-installed vinyl floor can be adhered to the edges of a subfloor, then additional planks and tiles are laid in place without an adhesive.

Click, in this context, means that the vinyl flooring is installed by “clicking” or snapping planks together across a subfloor.

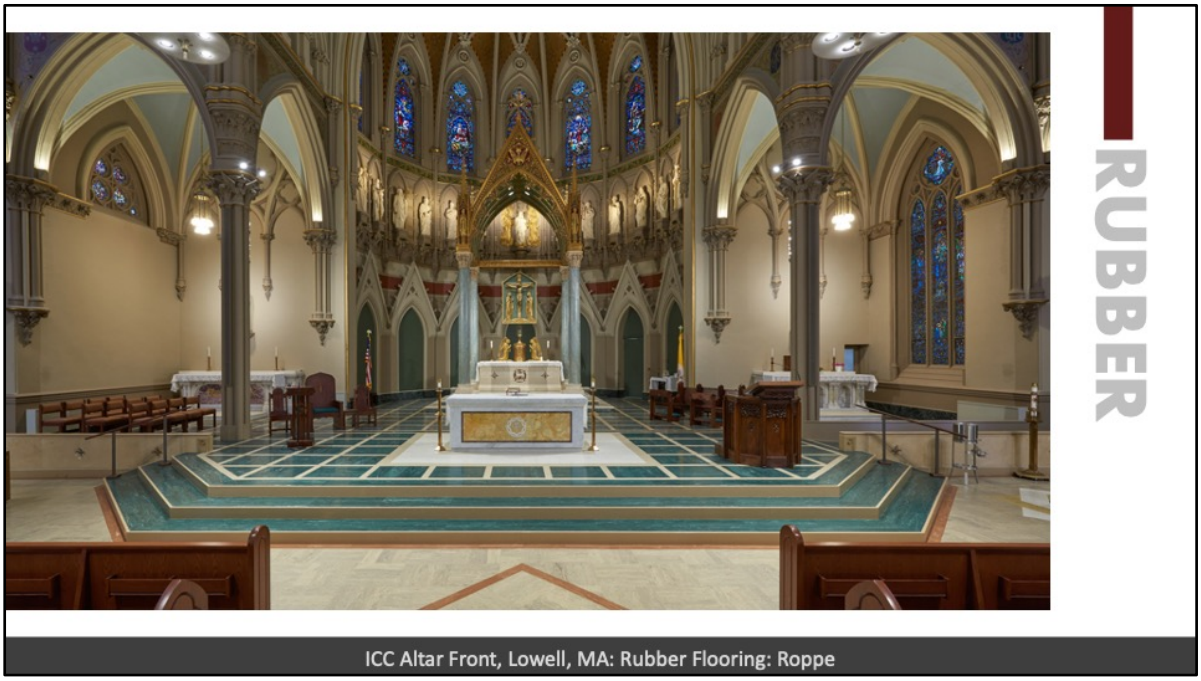
Rigid Core Luxury Vinyl Tile and Plank

- Locking systems enable floating installation for residential and light-commercial applications
- No telegraphing of minor subfloor irregularities or imperfections
- Resistance to humidity and temperature variations
- Can install over most existing hard surfaces, including ceramic tile

ADVANTAGES

Rigid Core LVT: HMTX: Metroflor

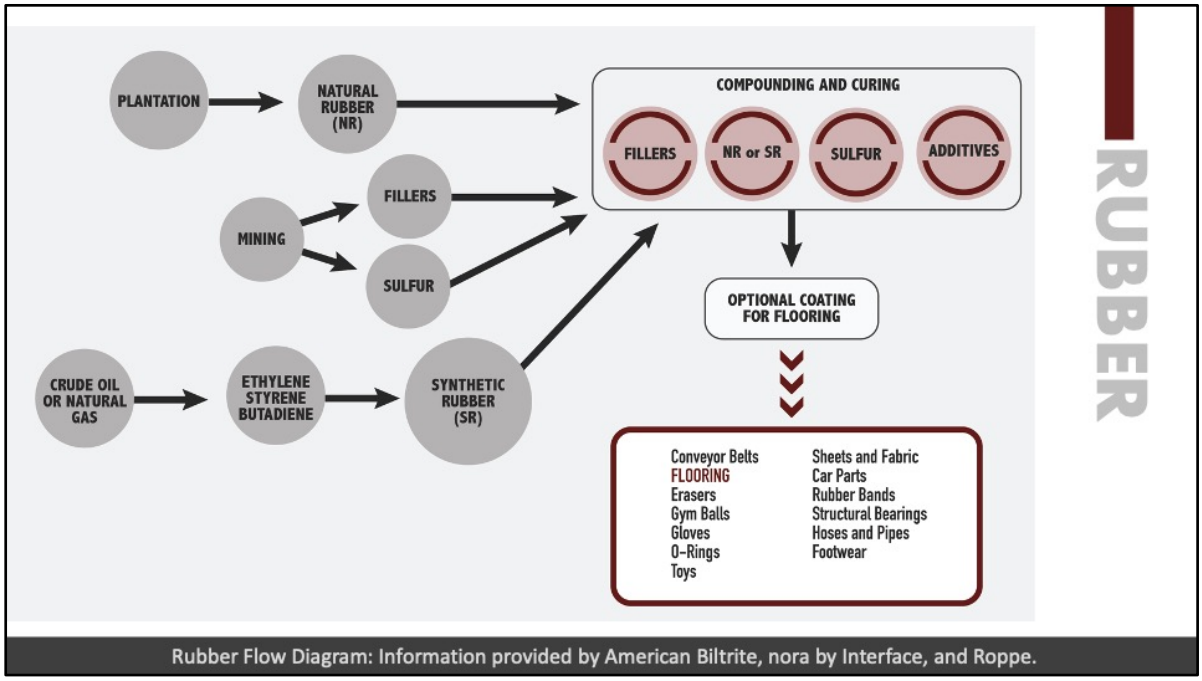
Added cushioning and sound absorption with attached underlayment are also advantages to installing rigid core products.



RUBBER

ICC Altar Front, Lowell, MA: Rubber Flooring: Roppe

Rubber used for flooring can be natural rubber (as from the rubber tree plant), but a synthetic (SBR) is predominantly utilized in making rubber flooring. Synthetic rubber was developed during WWII to compensate for the shortage of materials brought about by the lack of access to Asian rubber trees during the war.



Rubber Flow Diagram: Information provided by American Biltrite, nora by Interface, and Roppe.

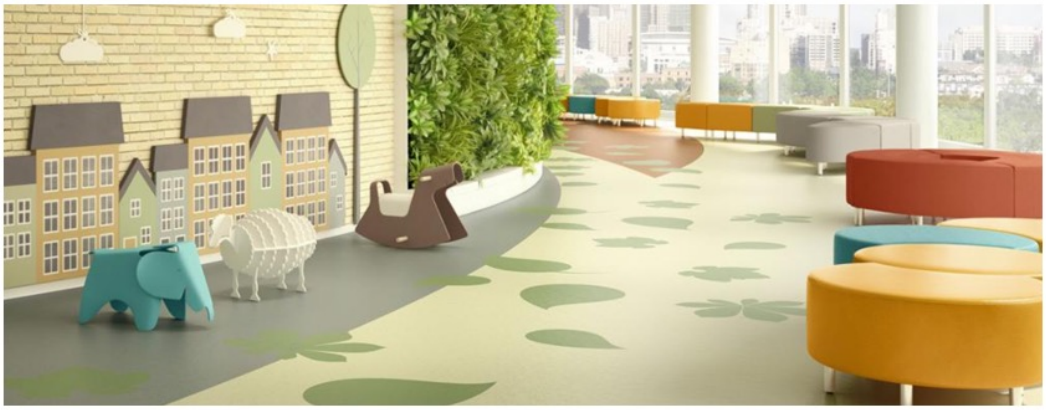
The rubber diagram shows that natural rubber does come from a plantation and synthetic rubber is made from fossil fuels. The fillers and sulfur used to formulate flooring comes from a mining process. These ingredients are compounded, and some products receive a coating added to the flooring surface for durability.

Rubber Tile & Sheet

Rubber Sheet Flooring (ASTM F 1859 or F 1860)

Rubber Tile (ASTM F 1344)

PERFORMANCE



Healthcare Setting; Rubber Flooring: American Biltrite

When specifying rubber sheet flooring, it is important to verify that the product meets the ASTM F 1859 performance standard for rubber flooring without backing and ASTM F 1860 for rubber flooring with backing. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.

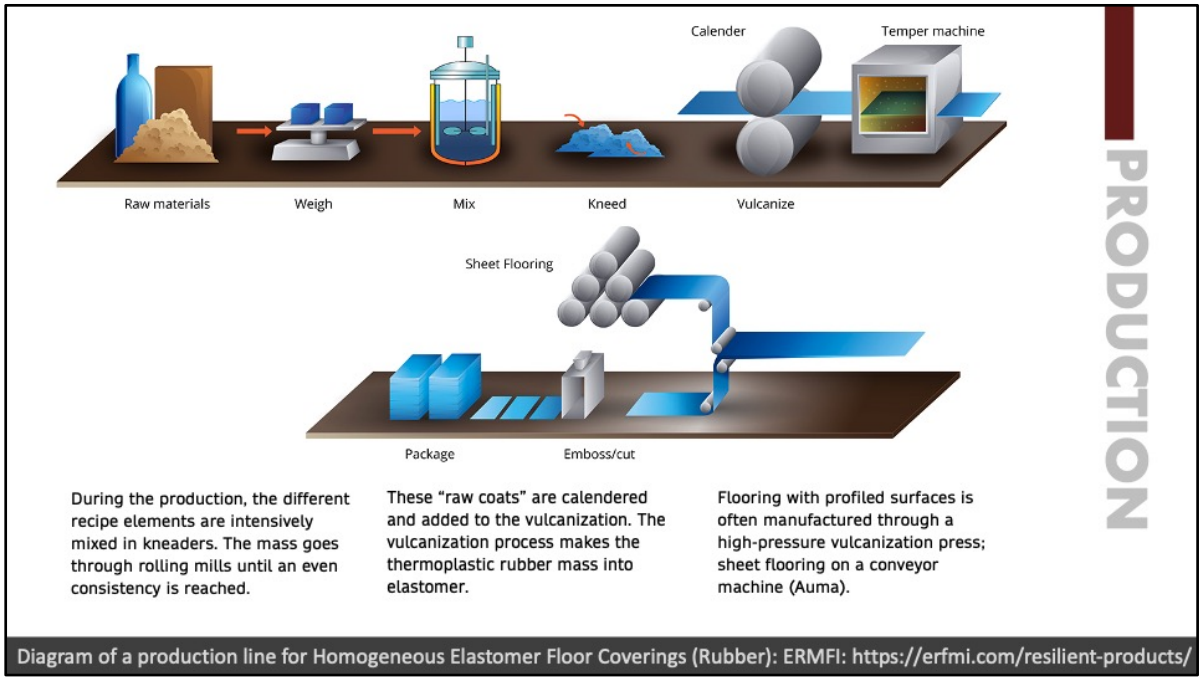
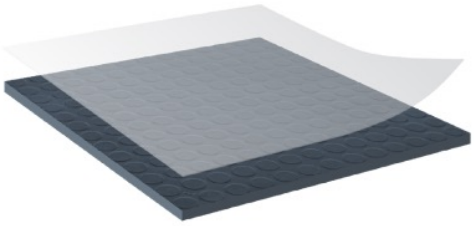


Diagram of a production line for Homogeneous Elastomer Floor Coverings (Rubber): ERMFI: https://erfmi.com/resilient-products/

This production diagram shows the combination of raw materials, and the mixing and calendering process that is utilized. Heat is used to vulcanize (set) the product and it can be made into rubber sheet and/or cut into rubber tiles.

Rubber: Tile



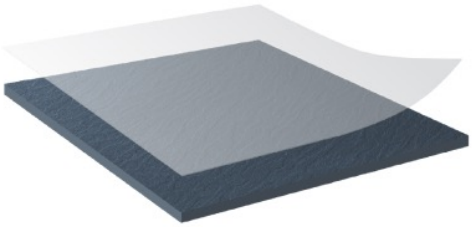
Optional polyurethane layer

Vulcanized rubber composition includes speckle, chips, or granulated rapidly renewable surface materials.

CONSTRUCTION

An optional wear layer can be added to rubber tile – shown here without backing.

Rubber: Sheet



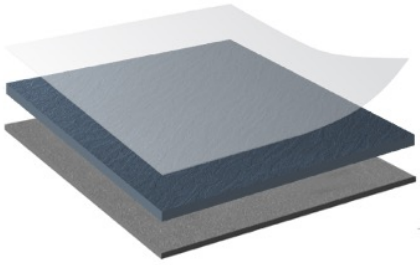
Optional polyurethane layer

Vulcanized rubber composition includes speckle, chips, or granulated rapidly renewable surface materials.

CONSTRUCTION

A wear layer can also be added to rubber sheet products, also shown here without backing.

Rubber: Sheet



Optional polyurethane layer

Vulcanized rubber composition includes speckle, chips, or granulated rapidly renewable surface materials.

Backing

CONSTRUCTION

This diagram shows the addition of backing – and would use the relevant ASTM performance standard for testing accordingly.

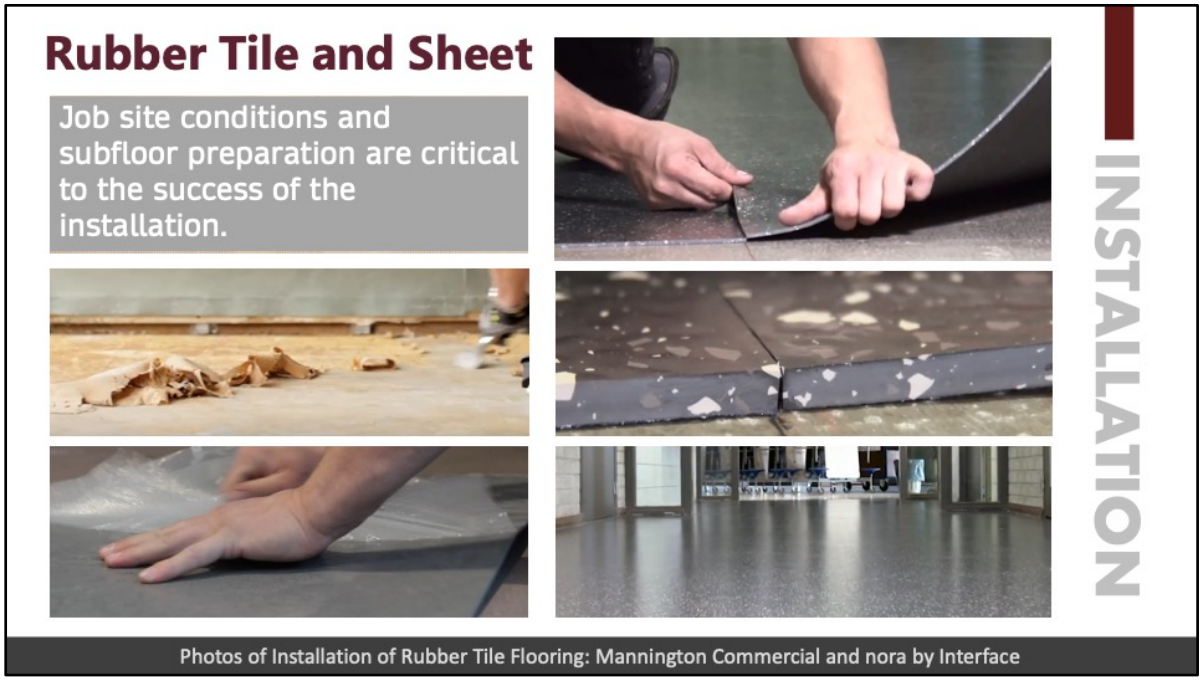
Rubber Tile and Sheet

- Strong, tough, and durable
- Water resistant
- Excellent slip resistance
- Acoustically quiet underfoot
- Promotes underfoot comfort
- Heat weld with integral cove base

ADVANTAGES

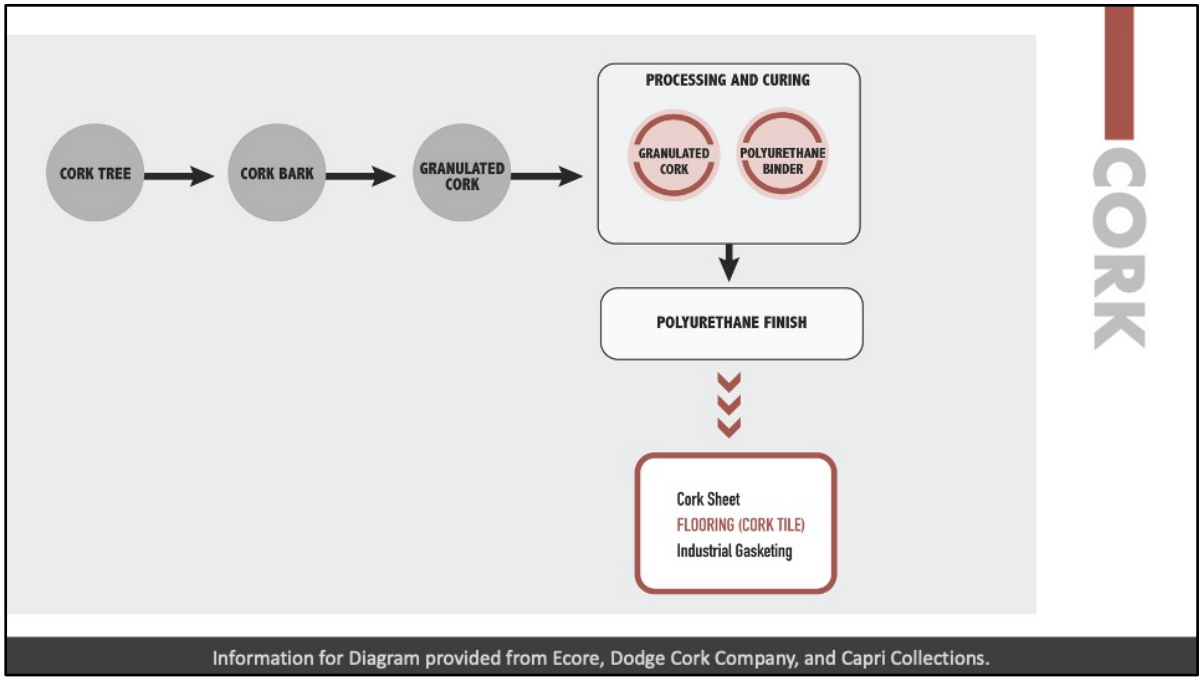
Evolving Styles Creative Elements; Dozan Park Retail; Rubber Flooring: Flexco

There are many advantages to utilizing rubber, as it is through-color, and both soft and quiet underfoot. Similar to other types of resilient sheet products it can be heat or chemically welded and formed into an integral cove base.



As with all resilient product installations, the goal is to minimize opportunities for telegraphing of subfloor imperfections through the finished floor surface.

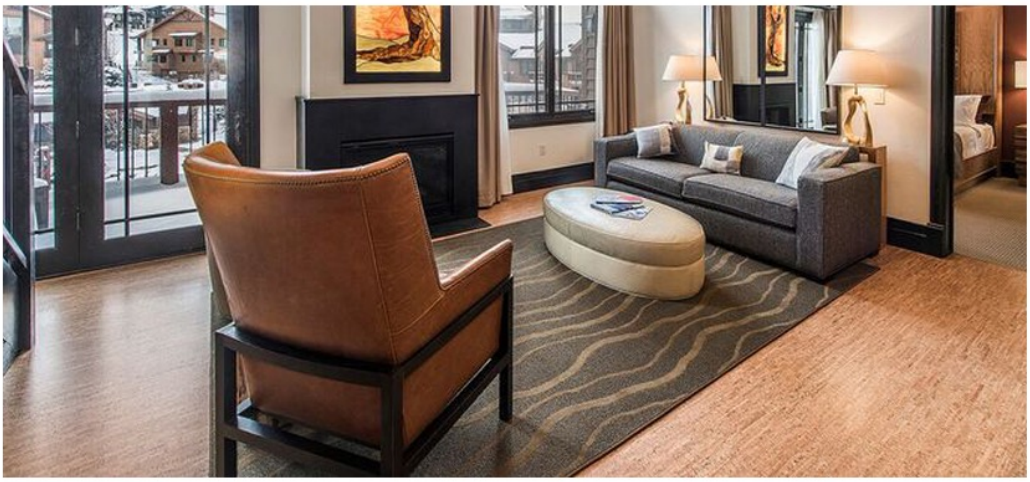
Cork is a versatile material that can be used as sheet for underlayment and tiles for finished surfaces.



Cork comes from the cork tree (which regenerates over time), and the bark is granulated and bound by polyurethane with a polyurethane finish to create a cork flooring tile.

Cork Tile Flooring

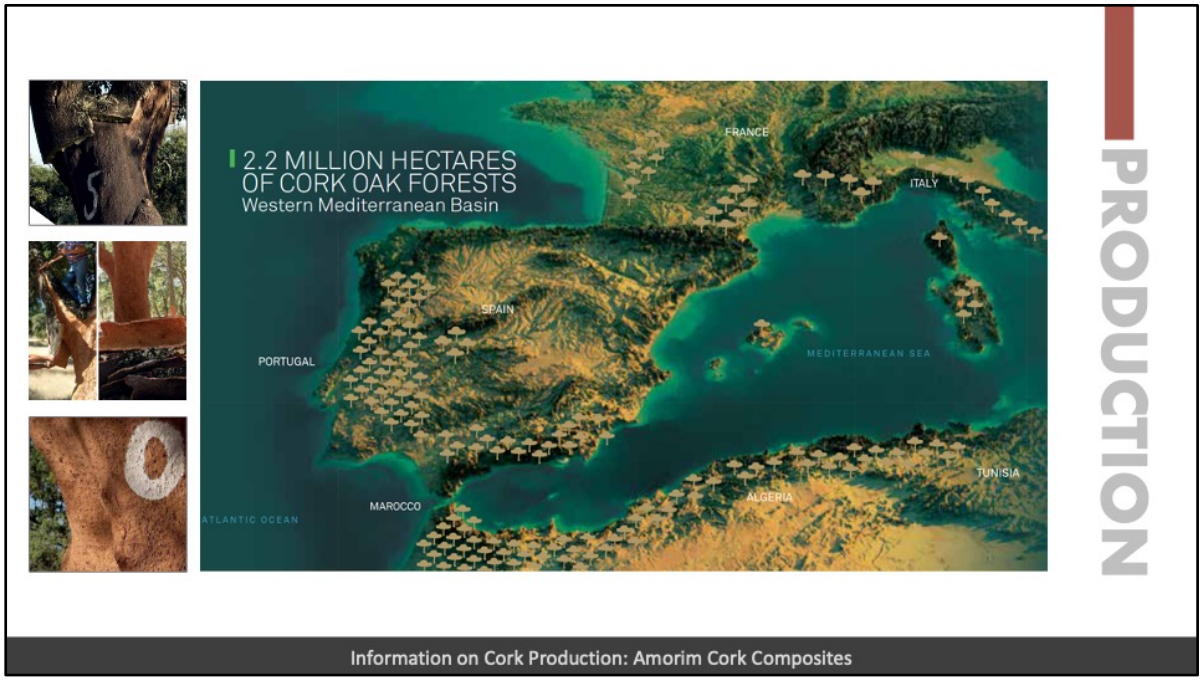
Cork Floor Tile ASTM F 3008



PERFORMANCE

Hotel Suite Installation; Cork Flooring: Capri Collections

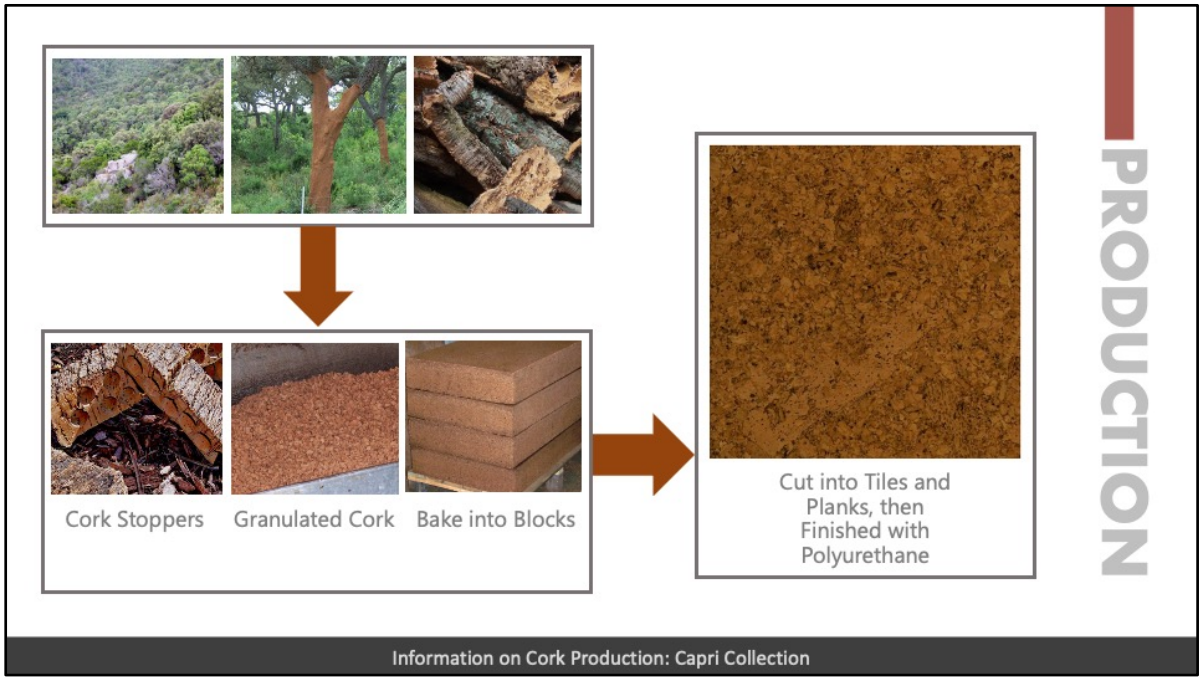
When specifying cork tile flooring, it is important to verify that the product meets the ASTM F 3008 performance standard. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.



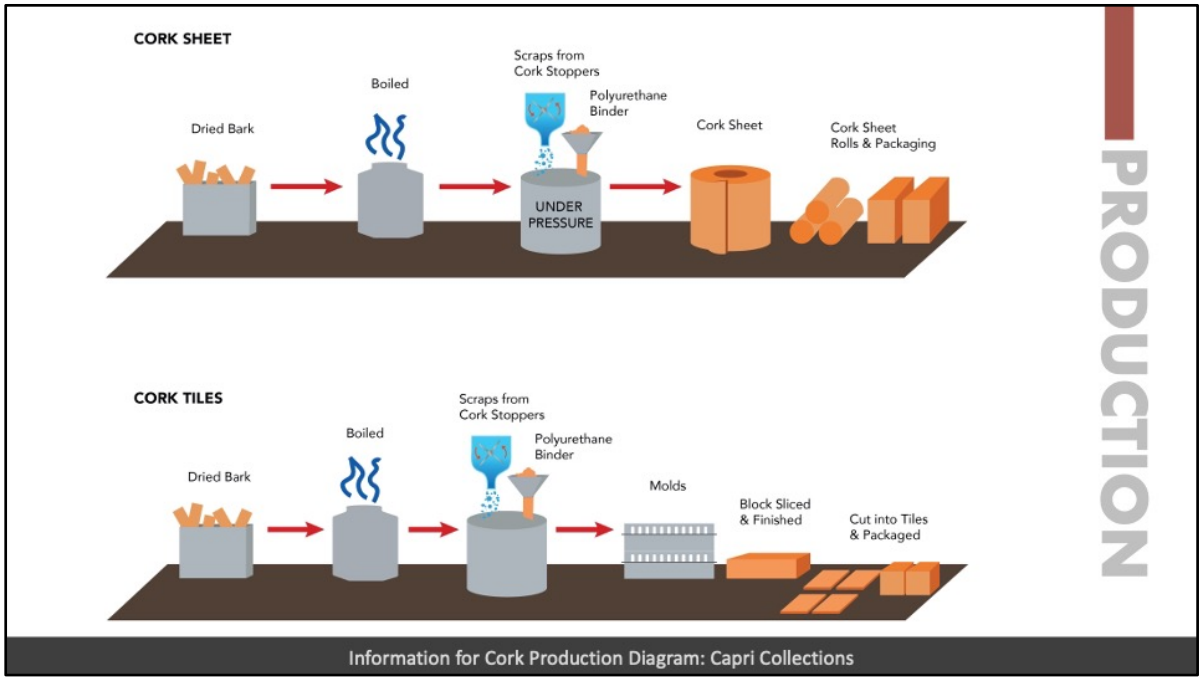
Information on Cork Production: Amorim Cork Composites

Just about every tree has an outer layer of cork bark, but the cork oak (Quercus suber) is the primary source of most cork products in the world, including wine bottle stoppers. These trees primarily grow in countries that run along the coast of the Mediterranean Sea, where there's plenty of sunshine, low rainfall and high humidity. The countries that produce the most cork include Portugal, Algeria, Spain, Morocco, France, Italy, and Tunisia.

The majority of cork used for flooring, as well as wine bottle corks, actually comes from the bark of the cork oak tree, or Quercus suber, native to the Mediterranean [sources: World Wildlife Fund and Royal Botanic Gardens, Kew]. The bark is hand-harvested every nine years, leaving a protective inner layer of bark that allows the tree to continue to grow and regenerate new bark [sources: WE Cork and Tolli]. After drying in the forest for several months, the bark is transported to a factory, where wine bottle corks are punched out of the bark. The leftover material, or post-industrial waste, is boiled and ground up, then compressed using adhesive resins. This ground-up product can be cut and used as a final flooring piece, or to make unique patterns, such as pieces of shaved bark used as a veneer, with the ground-up material serving as the backing [source: Wicander]. Some cork flooring planks include a high-density fiberboard within them as well.



The process relies on the utilization of cork scrap that is available after cork stoppers are removed from the material. Who knew that drinking wine could be supportive of cork flooring? Viva la vino!



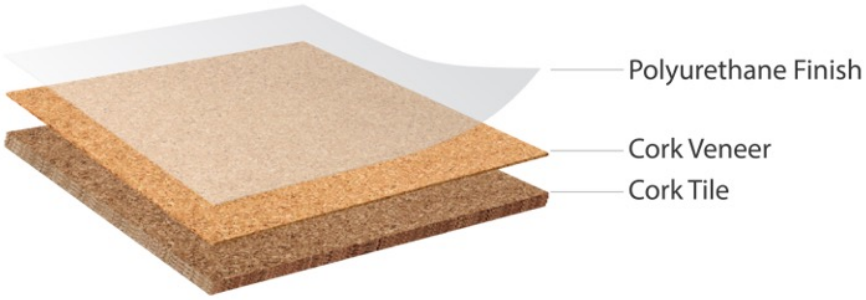
Cork sheet and tile are made similarly – except that tiles are then placed into molds, where blocks are made under pressure and subsequently sliced into tiles and finished prior to packaging.

Homogeneous Cork – Direct Glue Down

CONSTRUCTION

Cork tiles are made in 3/16-inch or 5/16-inch thicknesses and adhere to concrete or plywood as the subfloor. Glued down – prefinish with polyurethane or you can use additional polyurethane.

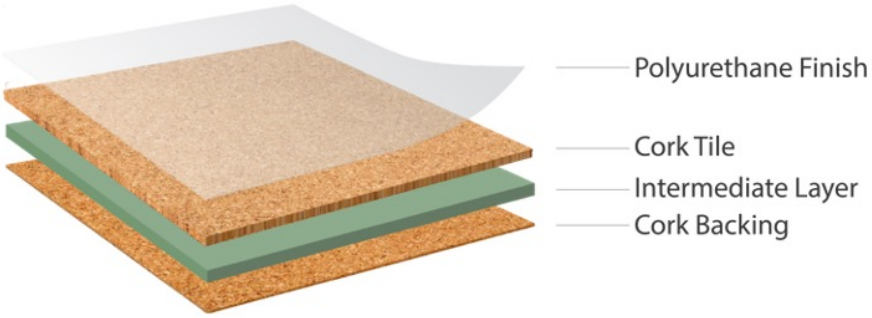
Heterogeneous Cork – Direct Glue own



CONSTRUCTION

Heterogeneous cork tiles have a veneer that is attached to the cork tile with a polyurethane finish.

Cork Tile – Floating Floor with Click System

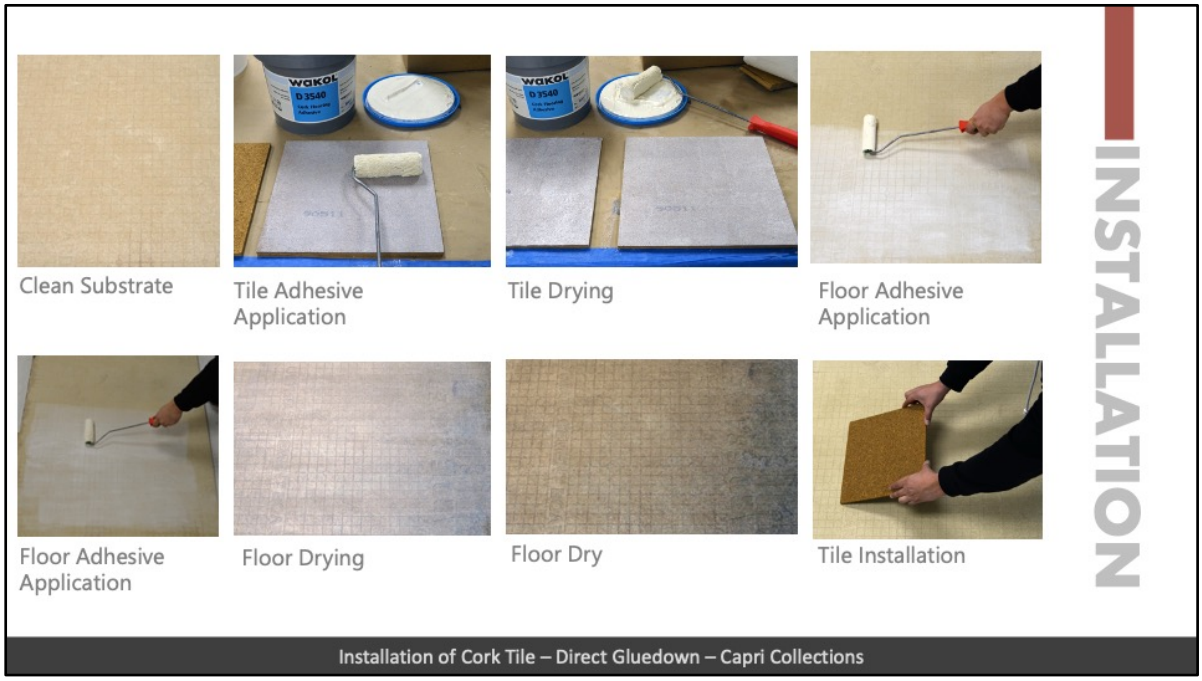


CONSTRUCTION

Cork underlayment is used for floating floors. Similar to rigid core and LVT/LVP, it's installed as a floating floor with a click system – where the tiles click together when installed. This construction has additional acoustic benefits.

Installation of Cork Underlayment for Acoustics: Flexco

There are two main types of installation processes for cork flooring. The more traditional installation method, usually used for cork flooring in tile form, is adhesive connection. First, the flooring tiles need to be acclimated to the environment inside the installation room. Then the subfloor, such as concrete or plywood, must be prepped to assure that it's even, clean, and free of moisture. The adhesive application is either direct glue down or contact method in order to fully secure the tile as it has a tendency to curl at its edges if not properly bonded.

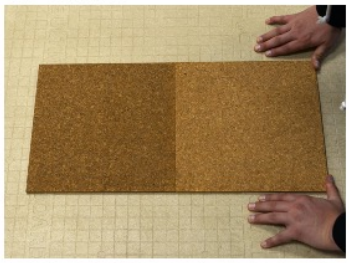


The steps shown here follow the process for installation from left to right on the top row, followed by the steps from left to right on the bottom row.

INSTALLATION

Tile Corners

Tile Mallet



Second Tile Tight

Second Tile Mallet

Installation of Cork Tile – Direct Gluedown – Capri Collections

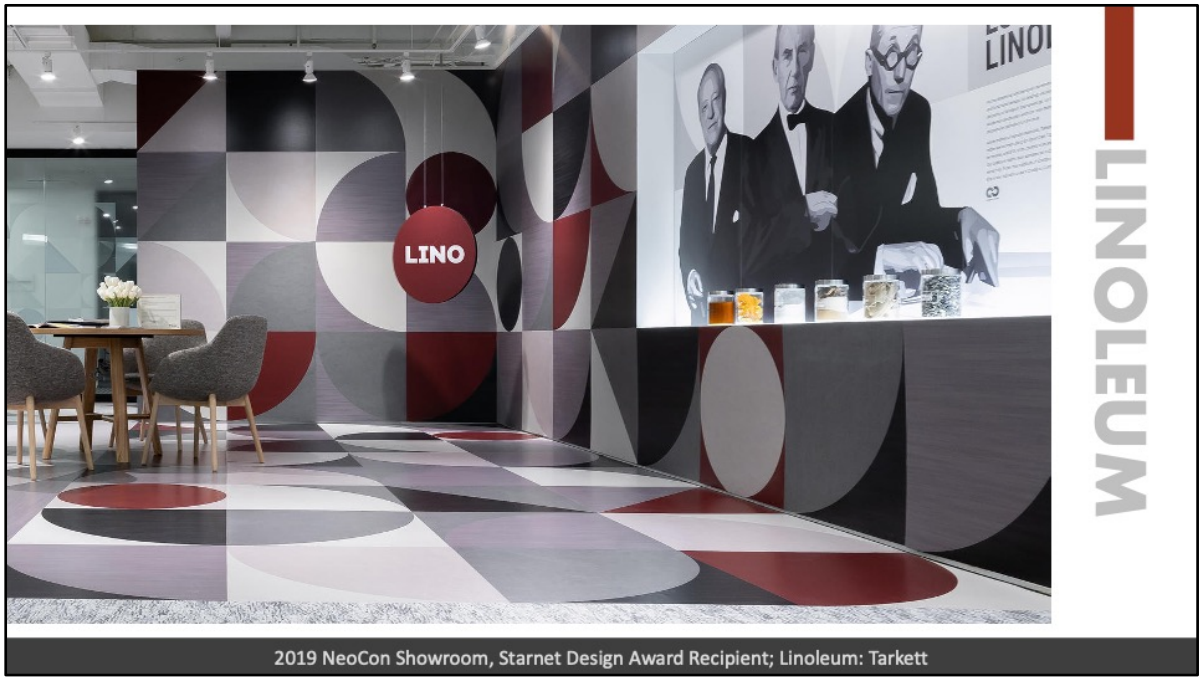
Cork Tile

- Natural material
- Harvested without harming trees – trees improve with age
- Acoustic insulator
- Thermal insulator
- Promotes underfoot comfort
- Fire-, stain-, mold-, and mildew- resistant
- Rapidly renewable
- Post-industrial recycled content

ADVANTAGES

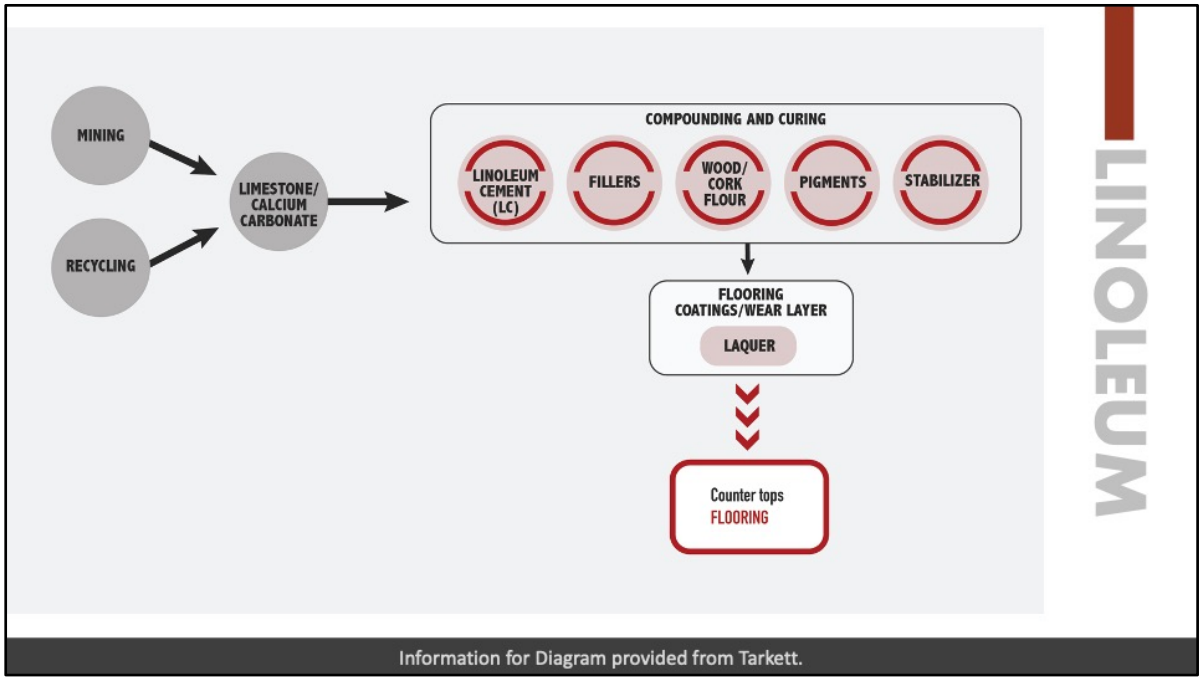
Chicago Temple; Direct Glue Down Cork Floor: Capri Collections

There are many advantages to cork flooring, including being fire-, stain-, mold-, and mildew-resistant, benefits which are not as widely known among professionals specifying flooring materials.



2019 NeoCon Showroom, Starnet Design Award Recipient; Linoleum: Tarkett

Linoleum is available in both sheet and tile form.



Limestone is mined or obtained through recycling. It is then compounded with linoleum cement, fillers, wood or cork flour, pigments, and stabilizers to create linoleum. A lacquer is used as the coating for the flooring.

Here is a diagram that shows the percentages of the various ingredients used to make linoleum flooring.

Linoleum Tile & Sheet

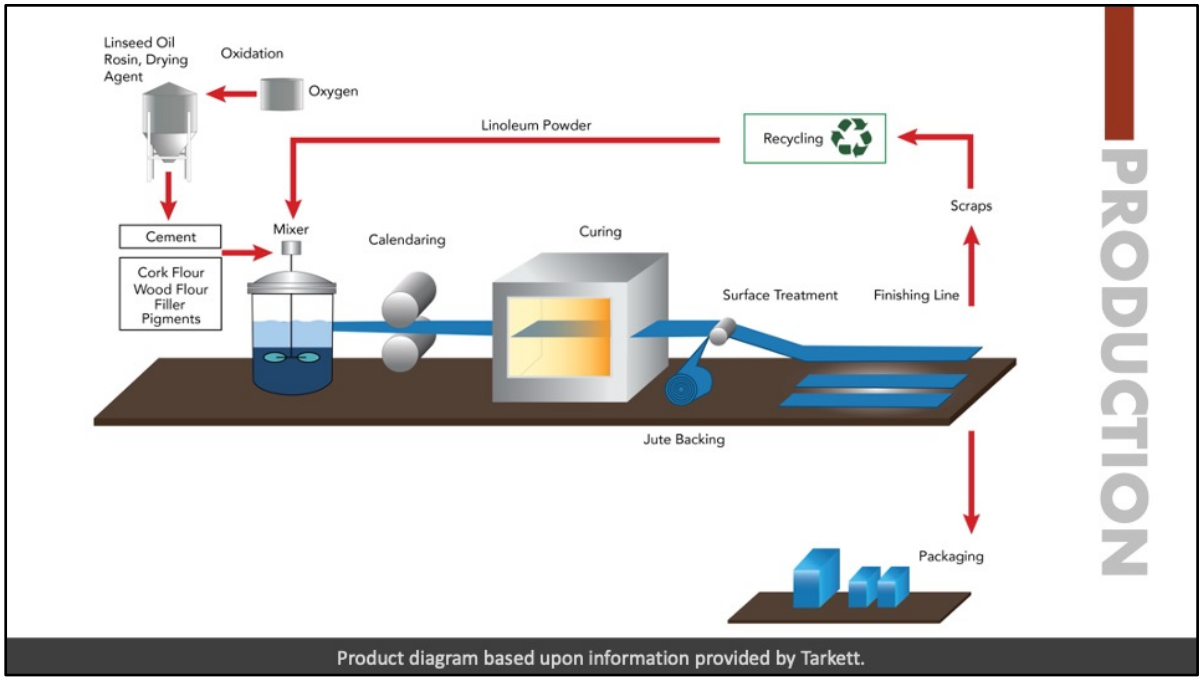
Linoleum Floor Tile ASTM F 2195

Linoleum Sheet ASTM F 2034

PERFORMANCE

Happy Eater: Linoleum: Tarkett

When specifying linoleum tile or sheet products, it is important to verify that the product meets ASTM F 2195 performance standard for tile flooring and ASTM F 2034 performance standard for linoleum. All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders coupled with lab testing for verification of compliance.



Product diagram based upon information provided by Tarkett.

Linoleum is produced in several stages.
1. Oxidation of linseed oil mixed with tall oil and rosin: Utilizing oxygen from the atmosphere a tough, sticky material called linoleum cement is produced.
2. Linoleum cement is stored in containers for a few days for further reaction, and after this it is mixed with wood flour, calcium carbonate, reused waste (if applicable), titanium dioxide, and pigments.
3. This mixture is calendared onto jute substrate and stored in drying rooms until cured to the required hardness.
4. After approximately 14 days the material is moved from the drying room to the trimming department where the factory finish is applied on the surface of the product and the end inspection is completed.
5. Lastly, edges are trimmed and the sheet is cut to length, into rolls approximately 105 feet long.
6. Trimmings and the rejected product are reused.

Linoleum Sheet and Tile

Surface Treatment

Solid Linoleum

Jute Backing

CONSTRUCTION

A jute backing is used as the backer to the solid linoleum and the lacquer finish.

Linoleum installation does, in some cases, require more knowledge and advanced skills in installation. The material has a propensity to expand in width and shrink in length when rehydrated in adhesive. There are techniques that mitigate that movement. There is also the possibility of end curl memory. Due to drying the material and rolling it in its packaging the ends of each cut must be worked out prior to installation so as to “break the memory” and allow the material to lay flat.

Linoleum

- Bio-based raw materials
- Rapidly renewable ingredients
- Through-pattern material
- Heat welded with integral cove base

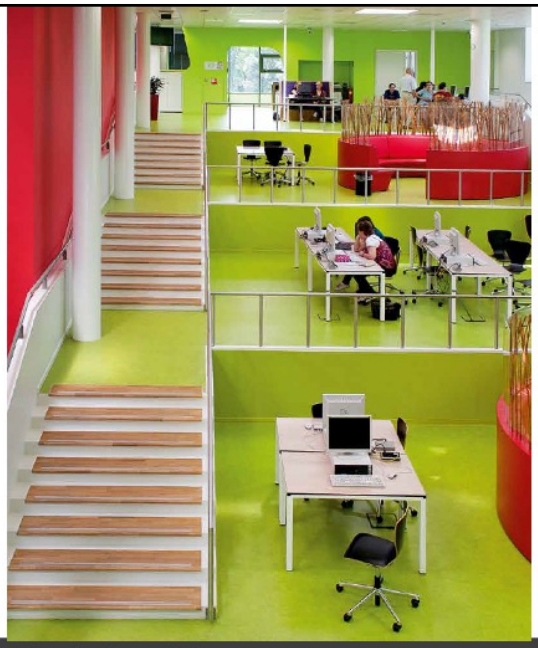
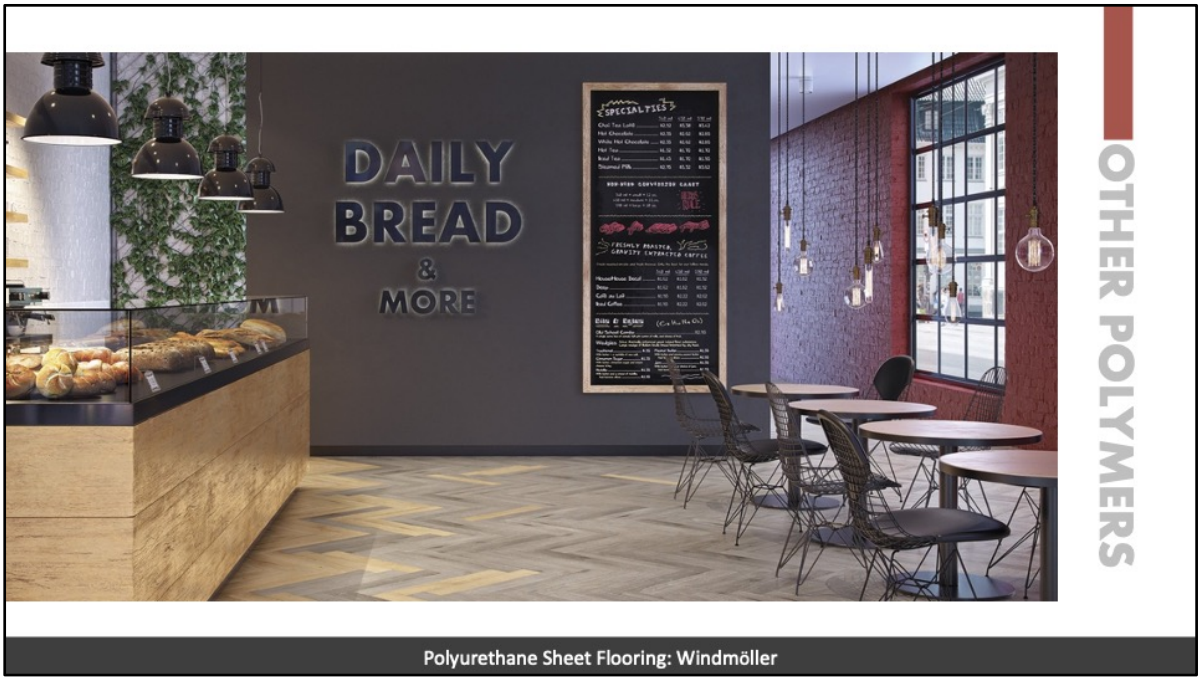


Photo: Education Space: Tarkett

ADVANTAGES

There are several advantages to utilizing linoleum; similar to other types of resilient sheet products it can be cold and heat welded, in addition to being coved up the wall for an integral base solution.



Polyurethane Sheet Flooring: Windmöller

There are other newer polymers that are being used to create resilient flooring products.

OTHER POLYMERS

- Bio-based additives
- Bio-based fillers
- Alternative polymers, such as TPO and PET are being utilized for flooring.

Polyester Composition Floor Tile: Armstrong Flooring

Other Polymers

ASTM F 2982 Polyester Composition Floor Tile

ASTM F 3009 Polyolefin Composition Floor Tile

PERFORMANCE

Other Polymer Floor Tile: Shaw: Patcraft

When specifying other polymers, it is important to verify that the product meets the relevant performance standard. Polyolefin Composite (ASTM F3009-14 (2018) and Polyester (ASTM F2982-18) are two relevant standards referenced for these types of polymers.

All resilient flooring products have ASTM standards that are used to verify various performance characteristics based upon the product type and requirements established by manufacturers and related stakeholders, coupled with lab testing for verification of compliance.

COMPOSITES

Schaumburg Library, Schaumburg, IL; Rubber and Cork: Capri Collections

The opportunity for rubber and cork or vinyl and cork composites is a growing market within the resilient flooring industry. Many composites also used bio-based components or fillers.

Product advantages for vinyl and cork could include bio-based plasticizer, rapidly renewable material in the case of cork, flexibility for applications such as cove bases, and the ability to withstand roller traffic up to 2000 psi. Product characteristics for rubber and cork are similar, with no plasticizers and high slip-resistance with the combination of cork and rubber anticipated in areas where moisture is present.

Here is an installation of a rubber and cork composite in a residential setting.

Sheet Vinyl, Fiberglass Stabilization Layer, and Acoustic "Cushion" Layer: Nox Global

And here is a composite with sheet vinyl product that has a fiberglass stabilization layer and a cushion layer for underfoot comfort and improved acoustic benefit.


THANK YOU

Thank you for you time.

This concludes The American Institute of Architects Continuing Education System Course.

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JANE ROHDE, AIA, FIIDA, ASID, CHID, ACHA, LEED AP BD+C, GGA – EB, GGF

Principal

JSR Associates, Inc.

jane@jsrassociates.net

Technical Advisor to Resilient Floor Covering Institute (RFCI)

www.rfci.com