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Purpose and Scope

These Recommended Practices provide a comprehensive single source of knowledge pertaining to laboratory flooring. These Recommended Practices cover the specifications, installation, testing, maintenance and safe use of laboratory flooring. SEFA has made these Recommended Practices available as a guide for regulatory agencies, architects, engineers, consultants, specification writers, contractors, manufacturers and dealers of laboratory flooring, installers, facilities managers and users who specify, recommend for purchase, install and/or use laboratory flooring.

These Recommended Practices focus specifically on the required characteristics of flooring, used in the most common laboratory applications. These criteria include:

- Chemical Resistance
- Abrasion and Scratch Resistance
- Ease of Cleaning
- Impact Resistance
- Hardness
- Slip Resistance
- Dynamic Rolling Load Resistance
- Bacterial Resistance
- Spill Containment/Seamless Construction
- ESD Protection
- Offgassing

These Recommended Practices provide guidance on which of these attributes are important to consider based on the type of lab under consideration.

There are several, more specific attributes prescribed for critical applications in the industry, including, for example, biosafety laboratory requirements, cleanroom requirements, electronics handling requirements, hazardous drug laboratory requirements. This Recommended Practice does not cover those additional requirements. Standards and recommendations exist for those types of applications and users should refer to those for guidance.

While generally not required for performance considerations, environmental considerations can also play an important role in selecting flooring for a particular laboratory.

The scope of SEFA 14 is limited to flooring types that are most commonly used in laboratories. Although SEFA attempts to be inclusive of all generic products normally used in laboratories and welcomes information about such products for inclusion in SEFA 14, SEFA does not represent that every potential product is included. The products included in this version of SEFA 14 are the following:

- Vinyl
- Rubber
- Linoleum
- Ceramic
- Porcelain
- Quarry
- Polished Concrete

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- Floor Coatings/Finishes/Paints
- Resinous Floor Systems
- Access Flooring
- Interlocking Flooring
- Static Control Flooring

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While SEFA attempts to provide professionally appropriate information to manufacturers, specifiers and users, it is the sole responsibility of manufacturers, specifiers and users to determine the appropriateness of the information and interpretations of it for their use in determining which products and guidelines are appropriate for their intended uses.

2.0 Performance Criteria

2.1 Chemical Resistance

Users should consider the chemical and staining agents that might be used in the laboratory. Common guidelines can be found by referring to: The work surface manufacturer printed data for chemical and stain resistance, NEMA LD3-2000 for wood product chemical resistance, ASTM D3023 and ASTM C1378 for stain resistance or the most current versions. Because chemical and stain resistance is affected by concentration, time, temperature, humidity, housekeeping and other factors, it is recommended that users test samples in their actual environment with the substances they use.

Many labs use liquid nitrogen in various ways and in many cases there are spills on the floor that result in damage to the flooring material. The drastic change in temperature from the liquid nitrogen generally causes the flooring material to crack in some way. Even materials such as concrete can be damaged. Users should be aware that no commercially available flooring material is warranted against this. Users should therefore take precautions for labs that use liquid nitrogen. One option is to use mats or other materials that can be replaced to protect the flooring material in areas where liquid nitrogen may be spilled. Some users have reported using steel plates in areas where liquid nitrogen may be used to protect the underlying flooring material.

2.1.1 Chemical Resistance Test

The purpose of the chemical stain resistance test is to evaluate the resistance a floor material has to chemical spills.

Test Method A – For volatile chemicals – A cotton ball, saturated with the test chemical, was placed in a one ounce bottle (10mm x 7mm test tube or similar container). The container was inverted on the test material surface for a period of 24 hours. Temperature of test: 23° +/- 2°C (73° +/- 4°F). This method was used for the organic solvents.

Test Method B – For non-volatile chemicals – Five drops (1/4cc) of the test chemical were placed on the test material surface. The chemical was covered with a watch glass (25mm) for a period of 24 hours. Temperature of test: 23° +/- 2°C (73° +/-4°F). This method was used for all chemicals listed below other than solvents.

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	A
2.	Acetate, Ethyl	A
3.	Acetic Acid, 98%	B
4.	Acetone	A
5.	Acid Dichromate, 5%	B
6.	Alcohol, Butyl	A
7.	Alcohol, Ethyl	A
8.	Alcohol, Methyl	A
9.	Ammonium Hydroxide, 28%	B
10.	Benzene	A
11.	Carbon Tetrachloride	A
12.	Chloroform	A
13.	Chromic Acid, 60%	B
14.	Cresol	A
15.	Dichloracetic Acid	A
16.	Dimethylformamide	A
17.	Dioxane	A
18.	Ethyl Ether	A
19.	Formaldehyde, 37%	A
20.	Formic Acid, 90%	B
21.	Furfural	A
22.	Gasoline	A
23.	Hydrofluoric Acid, 37%	B
24.	Hydrofluoric Acid, 48%	B
25.	Hydrogen Peroxide, 30%	B
26.	Iodine, Tincture of	B
27.	Methyl Ethyl Ketone	A
28.	Methylene Chloride	A
29.	Monochlorobenzene	A
30.	Naphthalene	A
31.	Nitric Acid, 20%	B
32.	Nitric Acid, 30%	B
33.	Nitric Acid, 70%	B
34.	Phenol, 90%	A
35.	Phosphoric Acid, 85%	B
36.	Silver Nitrate, Saturated	B
37.	Sodium Hydroxide, 10%	B
38.	Sodium Hydroxide, 20%	B
39.	Sodium Hydroxide, 40%	B
40.	Sodium Hydroxide Flake	B
41.	Sodium Sulfide Saturated	B
42.	Sulfuric Acid, 33%	B
43.	Sulfuric Acid, 77%	B
44.	Sulfuric Acid 96%	B
45.	Sulfuric Acid, 77% & Nitric Acid, 70% equal parts	B
46.	Toluene	A
47.	Trichloroethylene	A
48.	Xylene	A
49.	Zinc Chloride, Saturated	B

2.1.2 Acceptance Level

After 24-hours exposure, exposed areas were washed with water, then a detergent solution and finally with isopropyl alcohol. Materials were then rinsed with distilled water and dried with a cloth.

Samples are numerically rated as follows:

0 – No Effect – No detectable change in the material surface.
1 – Excellent – Slight detectable change in color or gloss but no change in function or life of the surface.
2 – Good – A clearly discernible change in color or gloss but no significant impairment of surface life or function.
3 – Fair – Objectionable change in appearance due to discoloration or etch, possibly resulting in deterioration of function over an extended period of time.

Insert Sample Pictures

Results will vary from manufacturer to manufacturer due to differences in composition and finish formulations and applications processes. Individual test results for the specified 49 reagents will be verified with an established third party independent SEFA 3 test submittal form. Suitability for a given application is dependent upon the chemicals used in a given laboratory.

2.2 Abrasion and Scratch Resistance

Users should consider the likelihood of uses causing abrasion, wear or scratches to the floor surface. Common guidelines are found in ASTM D4060 (Standard Test Method For Abrasion Resistance Of Organic Coatings By The Taber Abraser), ASTM F510 (Standard Test Method for Resistance to Abrasion of Resilient Floor Coverings Using an Abrader with Grit Feed Method), ASTM C241 (Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic), ASTM C1243 (Standard Test Method for Relative Resistance to Deep Abrasive Wear of Unglazed Ceramic Tile by Rotating Disc)

Abrasion resistance of stone can be tested with a number of methods, including the European standard EN 14157 (EN 14157 2017) and the US standard ASTM C 241-90 (ASTM C 241–90 2005).

2.3 Ease of Cleaning

While a regular schedule of maintenance and housekeeping is always recommended including cleaning up spills immediately, some laboratories, e.g., those working with pathogens and radioactive isotopes, may be required to select non-porous materials and smooth surfaces for their lab flooring. Common guidelines include ASTM D4488, ASTM G122 and NEMA LD3-3.4-2000.

2.4 Impact Resistance

Users should consider the likelihood of uses causing damage due to impacts. Common guidelines are found in ASTM F1265 (Standard Test Method for Resistance to Impact for Resilient Floor Tile), ASTM C1870 (Standard for Impact of Falling Steel Ball on Ceramic Tile), and ASTM D2794 (Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

2.5 Hardness

A durometer is a tool that measures the hardness of a material. Hardness can impact the comfort, both perceived and actual, of walking and standing on a flooring material. Softer materials are generally considered more comfortable to stand on. Conversely, softer materials require more energy to move on and can increase fatigue to personnel. Softer materials also increase the force required to move rolling carts and other equipment. The user should take all of these factors into consideration when choosing a flooring material.

Common guidelines are found in ASTM D2240 (Standard Test Method for Rubber Property – Durometer Hardness) which can be used to measure the hardness of resilient flooring materials, including vinyl, rubber, linoleum, and VCT.

2.6 Slip Resistance

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Users should consider the slip resistance characteristics of the flooring surface. Testing generally involves measuring the coefficient of friction of the surface of the flooring material. The higher the coefficient of friction, the better the slip resistance. A common guideline is ASTM D2047 (Standard Test Method For Static Coefficient Of Friction Of Polish-Coated Flooring Surfaces As Measured By The James Machine). Testing can be done either dry, wet, or with some other contaminant, such as grease, oil or hydraulic fluid. Test results provide the user with a relative scale of the slip resistance of the flooring. A common guideline for the slip resistance of flooring is a coefficient of friction of 0.5 or higher.

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In areas where added slip resistance is desired for safety, users should consider choosing a flooring material with a higher coefficient of friction. Some flooring materials are designed specifically to be "safety" flooring. Users should rely on guidance from manufacturers of these materials in those cases.

In environments where the footwear can be controlled for specific needs, the user should also consider the slip resistance of the particular footwear with the specified flooring. A common guideline for this is ASTM F2913 (Standard Test Method for Measuring the Coefficient of Friction for Evaluation of Slip Performance of Footwear and Test Surfaces/Flooring Using a Whole Shoe Tester)

2.7 Dynamic Rolling Load Resistance

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Users should consider the effects of dynamic rolling loads on the performance of the flooring system. Common guidelines include ASTM F2753 (Standard Practice to Evaluate the Effect of Dynamic Rolling Load over Resilient Floor Covering System).

2.8 Bacterial Resistance

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Users should consider the ability of the flooring system to resist bacterial growth. Useful guidelines for assessing a flooring materials resistance to bacteria include ASTM E2180 Standard Test Method for Determining the Activity of Incorporated Antimicrobial Agent(s) In Polymeric or Hydrophobic Materials; ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi, and ISO 846 Plastics – Evaluation of the action of microorganisms.

2.9 Spill Containment/Seamless Construction

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Users should consider the ability of the flooring system to contain spills. Resinous floor coverings can be applied in a monolithic coating that covers the entire floor and can be applied up the walls to create an effective spill containment system. Keep in mind that any cracks that develop due to shifts or cracks in the underlying subfloor will create the potential for liquids to leak through the floor. Resilient sheet vinyl, sheet rubber, or sheet linoluem can also provide an effective spill containment system. Sheets of flooring materials are glued to the subfloor and seams between the sheets are welded together to provide a liquid-tight system. Sheet material can also be applied up the wall to create an effective spill containment system.

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2.10 ESD Protection

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Users should consider the requirements for protection against electrostatic discharge (ESD). Static charges are developed when a person walks across a floor and when rolling equipment is rolled across the floor. ESD can damage sensitive electronics, disrupt data, and ignite explosives. ESD protective flooring is designed to either minimize the charges that are generated, or drain generated charges to ground, or both. For electronics handling a common guideline is ANSI/ESD S20.20 (Protection Of Electrical And Electronic Parts, Assemblies And Equipment). For areas with data processing equipment, a common guideline is Motorola R56 (Standards and Guidelines for Communication Sites). For areas with a danger of explosives, a common guideline is NFPA 77 (Recommended Practice On Static Electricity). Proper ESD footwear must be worn by personnel if flooring is to provide grounding and static protection to people.

2.11 Offgassing

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Users should consider the requirements for limiting offgassing from flooring materials. Some flooring materials, including those that are composed of polymer materials may emit gases over time, which could negatively impact the environment and/or laboratory operations. Useful guidelines for assessing the offgassing of flooring materials include CA Protocol 01350"Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." and ASTM E595 "Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment."

3.0 Environmental Considerations

There are a number of environmental considerations that have become prevalent in the flooring industry. Many of these have been prompted by the various "green" building programs that now exist, including the Leadership for Energy and Environmental Design (LEED) building certification program developed by the U.S. Green Building Council (USGBC).

3.1 Environmental Attributes of Flooring Products

Specific attribute that can be considered for flooring Include:

- **Material Composition**
  - Renewable – Materials that are rapidly renewed, such as wood, cork, and bamboo.
  - Recylable – Materials that can be recovered and reused, either to make new flooring or that can be used for another purpose. Some manufacturers will have "take-back" programs that provides a way for end-users to send product back to the manufacturing for recycling.
  - Reusable – Some products, such as interlocking flooring, can be picked-up and reused if the
  - Recycled Content – Some flooring is made using recycled materials and manufacturers will generally list recycled content as part of their specifications. Recycled content can be either post-consumer (from a product that has been used), or post-industrial (waste from a manufacturing process).
  - Red-List Free – products that do not contain any materials on the "red-list" compiled by the International Living Future Institute (ILFI) as part of their Living Building Challenge. The red-list includes harmful chemicals and materials that are commonly found in building products and have a known negative impact on the human health and/or the environment.
- **Low VOC** – "Low-VOC" refers to products that emit low levels of volatile organic compounds (VOCs) into the indoor environment. This characteristic is also referred to as "low-emitting". If the product is installed with an adhesive, it is important to consider the emissions from both the product itself and the adhesive used. The California DEP has developed a standard, CA Protocol 01350 that provides a standardized test method for determining the VOCs emitted from products. There are a number of third-

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party testing organizations that provide certifications that products meet this requirement. Some of the more popular ones include:

    - FloorScore by SCS
    - MAS Green Certified by MAS Testing

- **Durability and Longevity** – Of course, the longer a product lasts, the less of an impact it will have on the environment. Over many years, there will be less product needed to be manufactured, less product to dispose of, less time and energy spent on replacement and repairs.
- **HPD/EPD** – There has been a move in the industry for manufacturers to become more transparent in what is in their products and how they are made. In this regard, two product specifications have been developed:
    - Health Product Declaration – HPD – This is a standardized format for reporting product contents and associated health information. It will include product ingredients, chemical hazards, potential health effects, exposure routes, and safety data sheets. Having an HPD doesn't mean that a product is safe, it only means that this information has been reported for the given product.
    - Environmental Product Declaration (EPD) – This is a standardized and independently verified report that uses a Life Cycle Assessment (LCA) that provides comparable information about the environmental impacts of a products over its entire life, from sourcing of materials to disposal of finished product.

3.2 Environmental Certification and Ratings

LEED Considerations – The LEED system rates a building for environmental impact based on a number of characteristics including energy use, impact on the surrounding environment, and materials used in construction. Individual products don't earn LEED points, but can contribute the earning of points in specific categories. The categories that are relevant to flooring include:

- Materials and Resources – A building will earn points in this category for the products that are used in the construction. Specific sub-categories include:
    - Environmental Product Declarations – If a product has an EPD, it will contribute to this category.
    - Responsible Sourcing of Raw Materials
        - Extended Producer Responsibility – If a product has an HPD, it can contribute to this category.
        - Bio-based Materials – Products with Bio-Based content above a certain percentage, can contribute to this category.
        - Wood Products – Natural wood products can contribute to this category
        - Materials Reuse – Products that are re-used in a renovation can contribute to this category.
        - Recycled Content – Products with recycled content can contribute to this category.
        - Local Sourcing – Products that have raw materials and that are produced within a certain distance of the project can contribute to this category.
    - Indoor Environmental Quality - Low Emitting Materials – Products that meet the requirements of CA Protocol 03150 can contribute to this category.

Declare - The "Declare" product classification is part of the International Living Future Institute's (ILFI) Declare program, which is a transparency platform and product database for building materials. The Declare program aims to promote healthier and more sustainable building products by providing clear and transparent information about their composition and environmental attributes. Under the Declare program, products are classified into three categories based on their environmental and health attributes:

1. Red-List Free - Products classified as "Red List Free" do not contain any chemicals or substances on the program's Red List, which includes chemicals that are known or suspected to have adverse health effects and are restricted or prohibited for use in building products.
2. LBC Compliant - Products classified as "LBC Compliant" meet the requirements of the Living Building Challenge (LBC). These products comply with the Red List imperatives of the LBC and contribute to healthier and more sustainable building projects.
3. Declared - Products classified as "Declared" have disclosed their full ingredients list and have undergone an evaluation process to assess their environmental and health impacts. While these products may contain some chemicals on the Red List, they provide transparency about their composition and allow building professionals to make informed decisions.

Mindful Materials – Mindful Materials is a platform that provides a listing of products and their environmental and health attributes. It relies on standard information including HPDs and EPDs to provide a common source of information to architects, designers, and other stakeholders.

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Cradle-to-Cradle Certification (C2C) - The Cradle to Cradle Certified™ certification, managed by the Cradle to Cradle Products Innovation Institute, is a globally recognized standard for assessing environmentally sustainable products and materials. It is based on the principles of the Cradle to Cradle design framework, which emphasizes the creation of products that are safe for human health and the environment, designed for recyclability and reuse, and manufactured using renewable energy and responsible resource management practices. The Cradle to Cradle Certified™ program evaluates products and materials based on five key categories:

- **Material Health:** Products are assessed to ensure they are free from harmful chemicals and substances that could pose risks to human health or the environment. This includes evaluating the chemical composition of materials and ensuring they are safe for use and disposal.
- **Material Reutilization:** Products are evaluated for their potential to be recycled, upcycled, or safely returned to nature after use. This involves assessing the recyclability and biodegradability of materials and ensuring they can be effectively recovered and reused in closed-loop systems.
- **Renewable Energy and Carbon Management:** Manufacturers are required to demonstrate their commitment to using renewable energy sources and reducing greenhouse gas emissions throughout the product lifecycle. This includes assessing energy consumption, carbon footprint, and emissions associated with production, transportation, and use.
- **Water Stewardship:** Products are evaluated for their impact on water resources and ecosystems. This includes assessing water usage, water quality, and wastewater management practices to ensure they minimize environmental impacts and promote sustainable water stewardship.
- **Social Fairness:** The Cradle to Cradle Certified™ program also considers social factors such as labor practices, community engagement, and equity in the supply chain. Manufacturers are encouraged to demonstrate their commitment to fair labor practices, worker safety, and social responsibility.

Products that meet the requirements of the Cradle to Cradle Certified™ program are awarded one of five certification levels: Basic, Bronze, Silver, Gold, or Platinum, based on their performance across the five categories. Certification provides recognition for products that meet high standards of environmental and social responsibility and helps consumers and businesses make informed choices about sustainable purchasing.

4.0 Lab-Grade Flooring Performance Requirements by Lab Type

The required attributes for flooring will depend on the type of laboratory. Table 4-1 provides a summary of the attributes that are required for a flooring material to be considered Lab-Grade for a particular lab type. The user should select the lab type that best matches the types of activities conducted in their laboratory and may consider multiple lab types for labs that have multiple uses.

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This table includes requirements for:

- **Chemical Resistance –** To meet this requirement, the flooring material must be tested per the test method described in Section 2.1 and have no more than 4 Level 3 conditions.

- **Static Load Limit –** To meet this requirement, the flooring material must be tested per ASTM F970 and pass when tested to 250 psi.

- **Ease of Cleaning –** To meet this requirement, the flooring material must be tested per NEMA LD3-3.4 and achieve a minimum rating of 20.

- **Impact Resistance –** There is no one test that would be relevant to all flooring types. The requirements are specific to the material type as follows:

  - **Vinyl/Rubber/Linoleum/VCT –** The flooring must pass the requirements of ASTM F1265.
  - **Ceramic/Porcelain/Quarry/Polished Concrete –** The flooring material must achieve a minimum rating of 100 inch-pounds.
  - **Coatings/Finishes/Paints/Resinous –** The flooring material material must achieve a minimum rating of 100 inch-pounds.

- **Slip Resistance –** The flooring material must be tested per ASTM F970 and achieve a Static Coefficient of Friction, when tested in dry conditions of ≥0.5.

- **Dynamic Rolling Load –** This requirement is applicable to vinyl, rubber, linoleum, and VCT. To meet this requirement, the flooring material must be tested per ASTM F2753 for 10,000 revolutions with no damage or change. The other flooring types covered in this document, due to their nature, would naturally pass this test and do not have to be tested to satisfy this criteria.

- **Bacterial Resistance –** To meet this requirement, the flooring material must be tested per ASTM G21 and meet the criteria as noted in Table 4-1, depending on the nature of the laboratory.

- **ESD Protection –** To meet this requirement, the flooring material must meet the requirements of ANSI/ESD S20.20, which requires the flooring system to have a resistance of <1.0x10^9 ohms as tested per ANSI/ESD STM7.1. It is important to note that an ESD control program that meets the requirements of ANSI/ESD S20.20 also requires the use of ESD footwear and that the footwear must be tested in conjunction with the flooring per ANSI/ESD STM97.1 and ANSI/ESD 97.2.

- **Offgassing –** To meet this requirement, the flooring material must meet the requirements of CA Protocol 01350 for VOC emissions.

Requirements are specific to the lab type and not all lab types have all of these requirements.

In addition to these requirements specific functions require spill containment characteristics, which include:

- Impervious to Liquids
- Seamless or Welded Seams
- Integral Cove Base

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- Monolithic or Poured Floors

Table 4-2 provides a summary of these properties by lab function.

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Table 4-1 Lab-Grade Flooring Performance Requirements

5.0 Flooring Types

5.1 Vinyl

Vinyl flooring is commonly sold in tile form and sheet form. Sheet vinyl flooring is typically offered in 6 feet and 2 meter widths for commercial and residential spaces.

Homogeneous vinyl is made of a single layer and is sometimes referred to as through-color, meaning the color and visual on the surface goes all the way through the floor. This gives the flooring rigidity and toughness along with vibrancy and depth of color. Hence, it can be used in places that experience heavy foot traffic. This type of flooring is typically available in solid colors and multi-color chip configurations. It is incredibly durable and stain resistant which makes it a great flooring choice for heavy traffic areas. Products are commonly available with specialty top coats , such as urethanes, for added durability and improved maintenance characteristics.

- A proven product for health care and education applications.
- True through-color construction provides even wear and a consistent appearance over time.
- Durable performance even under heavy rolling loads.
- Products provide ease of cleaning, superior damage and abrasion resistance.
- Seams can be heat welded which fuses the product together creating strong, clean, seams which aids in infection prevention.
- Product can be flash coved for more efficient cleaning to help with infection control and spill containment.

Heterogeneous vinyl features a multi-layer construction with a wear layer which may provide a printed image or consists of solid chips made from vinyl resin providing endless design possibilities, lasting performance, and low maintenance cost. A layer of foam may be included for underfoot comfort which reduces impact noise and sound transmission and provides added flexibility for ease of handling and installation. Depending on the construction, these products are typically used in commercial, light commercial, residential, and multi-family applications.
Products come with either a fiberglass, felt or foam backing. Fiberglass-backed vinyl can be installed without glue, or as a modified loose-lay product using minimal adhesive.
Felt and foam-backed products are applied to the subfloor with the use of an adhesive.

- Technological advancements provide authentic wood and stone visuals and patterns that reflect popular design trends in higher-end products like stone, tile, and hardwood.
- Available in wide widths for a seamless installation that provides excellent top-down moisture protection.
- Commercial grades of heterogeneous vinyl flooring offer not only superior durability but also attractive design alternatives.
- Warm, quiet and beautiful.

5.2 Rubber

Available in sheets or tiles, this resilient flooring option is sleek, contemporary, and comfortable underfoot. Colors, which are contained throughout the thickness of rubber flooring, vary from earthy to bright and run all the way through for a hue that won't fade or wear. The surface texture can vary from smooth marbleized or chip designs to many raised textures, including circular, square, flagstone, hammered or diamond-plate patterns and many others. Rubber has long been a solution for high-traffic settings that demand a durable material, resistance to water and burns, and is easy to clean and install.
With waterproof and slip-resistant properties that make it ideal for harsh environments that require frequent or harsh cleaning, rubber flooring is commonly used in institutional and commercial facilities. Some rubber tiles are engineered to work in areas where petroleum products, animal fats, and vegetable oils are present to provide a safe work environment. Rubber flooring is an excellent alternative, if you're looking for something durable, quiet, and warm to walk on. In the past, rubber floors were appreciated for durability over beauty, but today's rubber flooring can be as dazzling as any other type of resilient flooring choice. Rubber typically has a higher initial cost

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but lasts for a very long time. With its natural resilience and strength, rubber flooring is often used in high impact commercial and industrial areas including fitness centers, healthcare applications, and education facilities.
With advancements in colors, designs and textures, rubber flooring is increasingly popular in office and residential settings. A popular option for garages, rubber is also ideal for hardworking areas such as kitchens, baths, entries, and exercise rooms.
There are several variations of rubber flooring including natural rubber, synthetic rubber and recycled rubber. Different versions of rubber flooring exist for a number of situations including fatigue resistance in areas where people are standing or walking for long periods and heavy traffic floor stress in industrial environments. Rubber flooring products are available in sheet form and tiles.

Benefits of rubber flooring include:

- Durability – Rubber is strong, tough, and resilient under a variety of conditions. Properly cared for rubber flooring can last for 20 years or more.
- Resistant to motor and cooking oils – excellent product in environments where oil and grease are factors such as auto shops and food preparation areas.
- Easy Maintenance – Cleaning rubber flooring generally requires no more than a damp mopping.
- Softness – Despite its durability, rubber is soft underfoot, one of its important features for active health clubs and fitness centers.
- Water-resistant – Most rubber flooring is highly resistant to damage from moisture on both the top and bottom surfaces of the material.
- Quiet – The elasticity of rubber flooring makes it very quiet to walk on. Heels don't click, and dropped objects land softly.
- Excellent slip resistance.

5.3 Linoleum

Invented in the 1860s – with a number of improvements since then – linoleum as a floor covering has been largely replaced with vinyl flooring which has similar properties of flexibility and durability but with greater brightness and translucency. The term "linoleum" is often misused for other types of resilient sheet flooring, such as homogenous vinyl sheet. The compositions of these materials, however, are very different. Linoleum is made from all natural ingredients. Included in these natural ingredients are linseed oil, wood flour, limestone, cork, and tree resins. Linseed oil is derived by pressing flaxseed that is dried and ground into a powdery binder. This is combined with limestone, which is extremely abundant, pine resin, and cork and wood flours to form a doughy material to which color is added. Once pressed, it is rolled onto a jute backing and dried. Jute is spun from fibers of jute plants.

Linoleum is available in both tile and sheet form. Tiles often include an added layer of fiberglass for added dimensional stability.

Characteristics of linoleum flooring include:

- An all-natural, bio-based, renewable construction: linseed oil, jute, cork powders, and tree resins
- Very durable, withstands heavy traffic and scratches, and lasts for decades
- Available in a wide variety of colors
- Colors and patterns run all the way through
- Available in sheets or tiles
- Sheet linoleum lends itself to vibrant designs through borders and insets.
- Soft in feel and warm to the touch.
- Through-pattern wear layer provides durability and a consistent long-lasting wear appearance.
- Colorfast – even as it naturally wears down over time the hue found on the surface of the floor does not fade.
- Abrasion and gouge resistant.
- Naturally insulating and light-reflective colors.

- Resistant to alcohol-based hand sanitizers.
- Biodegradable – linoleum will decompose over time without releasing harmful gasses or toxins into the air.
- Natural, antibacterial properties.

5.4 Vinyl Composition Tile

Vinyl Composition Tile (VCT) is a finished flooring material used primarily in commercial and institutional applications. VCT is a popular choice due to its low cost and durability. The tiles can be used in a wide range of color and design combinations to create unique, custom effects. The durable through-color construction provides years of lasting beauty. VCT is an economic, commercial grade product built to last. That, paired with the low cost of VCT installation and the ease of maintenance, makes VCT an attractive option for a variety of commercial applications. Millions of square feet of this well-known product have been installed in retail stores supermarkets, hospitals, and schools.

The primary raw material in VCT is limestone which is a natural, highly abundant ingredient. Vinyl and color pigments are added to provide product flexibility and design. These products, composed of polyvinyl chloride (PVC) chips, limestone, other fillers, a thermoplastic binder and color pigments are formed into sheets of varying thicknesses (1/8" is most common) by heat and pressure. The sheets are cut into floor tiles with the most common size being 12" x 12". VCT is composed of 85% North American limestone and has a very low carbon footprint and is recyclable which contributes to LEED credits and reduces environmental impacts through landfill diversion and the cost of waste disposal.

- Modular flexibility including large format shapes and sizes
- Long life value with true through-pattern VCT
- Withstands heavy foot and rolling load traffic
- Many products include a factory finish that makes initial maintenance quick and easy
- Budget-friendly value with a history of great performance

5.5 Ceramic

Ceramic tiles are thin, flat tiles that are usually shaped with beveled edges. They may provide corrosion resistance, thermal protection, wear resistance, and/or surface decoration. Ceramic tiles come in many different shapes, sizes, and colors. They are secured to a surface such as a subfloor with mortar. The spaces between the tiles are filled with grout. In flooring applications, cross-shaped plastic spacers are used to separate the tiles prior to grouting.

Types

There are many different types of ceramic tiles, both in terms of categories and features. Examples include:

- mosaic
- ribbed
- vitrified
- quarry
- saltillo
- terra-cotta
- earthenware
- stoneware

Applications

Ceramic tiles are durable and hard wearing. Most ceramic tiles are categorized by the Porcelain Enamel Institute (PEI) according to their wear resistance. For example, PEI Class 1 tiles are only for wall applications; they are not suitable for foot traffic. PEI Class 2 tiles can handle light traffic, such as in residential bathrooms. PEI Class 3 tiles can handle light-to-moderate traffic, and are suitable for residential floors. PEI Class 4 tiles are for moderate-to-

heavy traffic, and can be used in medium commercial or light industrial settings. PEI Class 5 tiles can handle heavy to extra-heavy traffic, making them suitable for all types of commercial and industrial floors.

Ceramic tiles are rated for scratch hardness according to the Mohs scale, which measures the ability of ceramic tiles to withstand scratches from a variety of minerals, ranging from the softest (talc) to the hardest (diamond). Ceramic tiles that are designed for residential use typically have a rating of 5. Ceramic tiles that are designed for industrial or heavy traffic areas have a rating of 7 or higher.

Specifications
Manufacturers of ceramic tiles may use proprietary mixtures of elements to make products. Typically, these mixtures include clay mixed with sand, feldspar, quartz, and water. These ingredients are mixed in a mill to create a substance called body slip. The body slip contains approximately 30% water at this point, until it is heated and dried to reduce the moisture content to about 6%. The body slip has the appearance of dust or powder and is compressed into the ceramic tile shapes using a high pressure electric or hydraulic press.

After pressing, the formed tile shape is called bisque. The bisque tiles are dried to remove the remaining moisture. Some ceramic tiles remain unglazed, but most are glazed using a glassy substance that contains a mix of pigments that give the ceramic tiles their color and surface characteristics. Glazed ceramic tiles are fired in tunnel kilns or roller-hearth kilns at temperatures of approximately 2000º F, permanently fusing the glaze to the surface of the tile.

There are two special types of ceramic tiles for use outdoors. Vitrified tiles have been treated to have very low porosity, making them strong and stain resistant. Impervious or porcelain tiles are fired at very high temperatures, making them very dense. Porcelain ceramic tiles have a high impact resistance to minimize breakage. Both vitrified and porcelain ceramic tiles are able to withstand the freezing and thawing conditions of outdoor applications. Other specialty types include pre-grouted ceramic tiles, which come from the manufacturers in large, pre-assembled sheets for quick installation.

5.6 Porcelain

Porcelain and quarry tiles are made from a clay mixture that's fired in a kiln. Porcelain tile is made from more refined clay and it's fired at higher temperatures. This makes it denser and more durable than ceramic tile.
Ceramic tile is usually created by mixing a base of clay with different types of minerals and water. A stoneware clay body will be fired at around 1,800-2,000°F and have water absorption between 0.5%-3.0%, with some even as high as 20%.
Porcelain tile on the other hand is made out of a mixture of clay, sand, and feldspar. Feldspar is a naturally occurring mineral in granite. The sand strengthens the mixture, while the feldspar melts, fusing together all the materials making the tile denser than a standard ceramic tile, thus stronger (30% stronger than granite!) and more stain resistant. Porcelain tile will be fired at a temperature up to 2,300°F. The higher firing temperature will drive out more water, and with the feldspar melting to form a low-order glass, the tile will be far more impervious. The American standards as set by the TCNA (Tile Council of North America) for a porcelain product is that it must absorb less than or equal to 0.5% of water.
The difference is in the body.

- Both can have a ceramic glaze, the difference is in the body. There are both un-glazed and glazed porcelains.
- The PEI rating is for the hardness of the glaze or surface of the tile and does not pertain to whether it is porcelain or ceramic.
- The tile industry traditionally has described porcelain tile as being a practically impervious form of ceramic tile, meaning that the tile will absorb equal to or less than 0.5% of water.

What are the benefits of porcelain body tile?

- Greater body strength of the tile and less likely to crack.
- Freeze/thaw resistance - makes porcelain a great choice for outdoor use.
- With porcelain body tile there is less expansion and contraction of the floor.

5.7 Quarry Tile

Quarry tile is a building material, usually 1⁄2 to 3⁄4 inch thick, made by either the extrusion process or more commonly by press forming and firing natural clay or shales.[1][2] Quarry tile is manufactured from clay in a manner similar to bricks.[3] It is shaped from clay, and fired at a high temperature, ~2,000 F°.[3]

The most traditional size in the US is nominally 6 in × 6 in × 1⁄2 in thick. Other common sizes include 4 in × 8 in and 8 in × 8 in.

In the UK, traditional surface dimensions generally vary from 6 in x 6 in, to 12 in x 12 in. Such tiles, given the generally local and non-standardized production, commonly vary between those dimensions, but rarely stray outside of them.

Modern quarry tiles are generally thinner than their historic counterparts, sometimes as thin as 1/4 in; by comparison, older tiles were rarely thinner than 3/4 in and could be as thick as 1 1/4 in thick.

Additionally, modern tiles can be found in different shapes, such as rectangular.

Traditional quarry tiles were unglazed and either red, grey, black/ very dark blue; however, modern "decorator" tiles come in a variety of tints and finishes. Industrial quarry tile is available with abrasive frit embedded in the surface to provide a non-slip finish in wet areas such as commercial kitchens and laboratories.

Quarry tile is extensively used for floors where a very durable material is required. It can be used either indoors or outdoors, although freeze-resistant grades of tile should be used outdoors in climates where freeze-thaw action occurs. Quarry tile is used less often as a wall finish and is occasionally used for countertops, although the wide grout joints can make cleaning of countertops difficult. Most commercial kitchens require a quarry tile to be used because of its slip resistant and non-porous properties.[4]

Quarry tile is usually set in a thick bed of cementitious mortar. The joints between tiles are usually grouted with cementitious grout. Grout joints are traditionally about 3⁄8 inch in width. Matching trim shapes such as coves, bases, shoes, and bullnoses are available to turn corners and terminate runs of the tile.

For traditional/historic applications, tiles were generally laid in lime mortar, doubling as grout, and with very fine grout joints (sometimes butted without joints, similarly to mosaic tiles).

Due to the typically square shape, quarry tiles were historically, and still today, restricted to either square or diamond patterns.

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5.8 Polished Concrete

Polished concrete is made in a multi-step process where a concrete floor is mechanically ground, honed and polished with bonded abrasives in order to cut a concrete floor's surface. It is then refined with each cut to achieve a specified level of appearance.

This process also includes the use of a penetrant chemical known as a hardener. The concrete hardener penetrates into the concrete and creates a chemical reaction to help harden and dust-proof the surface. During concrete polishing, the surface is processed through a series of steps (in general a minimum of four grinding steps of processing is considered polished concrete) utilizing progressively finer grinding tools. The grinding tools are progressive grits of industrial diamonds in a bonded material such as metal/hybrid/resin often referred to as diamond polishing pads. Polished concrete is a "green" flooring system and can contribute to LEED scores. Concrete is not considered polished before 1600 grit, and it is normally finished to either the 1600 or 3000+ grit level. Dyes designed for concrete polishing are often applied to add color to polished concrete as well as other options such as scoring, creating radial lines, grids, bands, borders, and other designs. Any grinding under 1600 grit is considered a honed floor.

Polished concrete floors have the following advantages:

- low-maintenance – polished concrete is easily maintained with the use of clean water or a neutral pH cleaner. There are also many cleaners designed for the proper maintenance of polished concrete available. There is never a need for wax to be added as it will only dull the finish
- durable – polished concrete is finished with hardeners that give it exceptional durability
- non slippery – due to high coefficient of friction
- dust-proof – minimizing risks dust mite and allergen problems; excludes support of mold growth
- ambient light – highly reflective polished concrete reduces lighting needs and can improve natural lighting

5.9 Floor Coatings/Finishes/Paints

Paints and resinous coatings are applied to concrete floors in thin coats. The primary advantages of these materials are ease of application and coverage over a wide area. These have a longer usable life than floor finishes but less than permanent floor systems. Paints and coatings tend to wear off in time and must be reapplied periodically. Some materials are not applicable for cleanrooms because the materials abrade, chip away, or are highly loaded with carbon or volatile organic compounds (VOCs).

5.10 Resinous Floor Systems

Resinous floor system generally consist of materials that are mixed on site and chemically cure to form a durable, seamless floor covering. The most common materials used in the market are epoxy and urethane. Urethane systems generally have higher durability and thermal shock resistance.

Because they are mixed, and cure on-site, proper installation techniques are required to ensure proper performance. Generally, installers have special training and certification.

Resinous floor systems are often formed in several layers, commonly including:

- a base layer that provides resistance to moisture and thickness to cover irregularities in the subfloor; often 1/8” thick or more.
- A finish layer that provides the finished color and wear surface.
- Materials can be added to the finished layer to provide enhanced slip resistance

Benefits of resinous floor systems include:

- Chemical resistance
- Ability to withstand heavy vehicle traffic
- Seamless, including the ability to be installed up the wall to provide a seamless cove base
- Because epoxies are manufactured, on-site, proper installation techniques are critical to the successful performance of this type of material
- Good cleanability

5.11 Interlocking Flooring

There are now several interlocking options of many of the various types of flooring suitable for laboratory use, primarily interlocking versions of vinyl tile and rubber tile. There are also various interlocking mechanisms available. Interlocking mechanisms have varying degrees of liquid-tightness and all have seams. Benefits of interlocking flooring include:

- Generally require less subfloor preparation, can often be installed over an existing floor, and therefore offer much less downtime in a renovation.
- Many types can be easily disassembled and moved and are therefore useful for temporary needs

5.12 Access Floor Systems

A raised floor (also raised flooring, access flooring, or raised-access computer flooring) provides an elevated structural floor above a solid substrate (often a concrete slab) to create a hidden void for the passage of mechanical and electrical services. Raised floors are widely used in modern office buildings, and in specialized areas such as command centers, Information technology data centers and computer rooms, where there is a requirement to route mechanical services and cables, wiring, and electrical supply.[1] Such flooring can be installed at varying heights from 2 inches (51 mm) to heights above 4 feet (1.2 m) to suit services that may be accommodated beneath. Additional structural support and lighting are often provided when a floor is raised enough for a person to crawl or even walk beneath.

In the U.S., underfloor air distribution is becoming a more common way to cool a building by using the void below the raised floor as a plenum chamber to distribute conditioned air, which has been done in Europe since the 1970s.[2] In data centers, isolated air-conditioning zones are often associated with raised floors. Perforated tiles are traditionally placed beneath computer systems to direct conditioned air directly to them. In turn, the computing equipment is often designed to draw cooling air from below and exhaust into the room. An air conditioning unit then draws air from the room, cools it, and forces it beneath the raised floor, completing the cycle.

An alternative approach to raised floor evolved to manage underfloor cable distribution for a wider range of applications where underfloor air distribution is not utilized. In 2009 a separate category of raised floor was established by Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC) to separate the similar, but very different, approaches to raised flooring. In this case the term raised floor includes low-profile fixed-height access flooring.[3] Low-profile fixed-height access flooring is useful where there is a need to quickly and easily accommodate changes of technology and floor plan configurations. Underfloor air distribution is not included in this approach since a plenum

chamber is not created. The low-profile fixed-height distinction reflects the system's height ranges from as low as 1.6 to 2.75 inches (41 to 70 mm); and the floor panels are manufactured with integral support (not traditional pedestals and panels). Cabling channels are directly accessible under light-weight cover plates.

5.13 Static Control Floor Systems

Static Control Floor Systems are designed to reduce the generation of charges, drain generated charges to ground, or both. These functions are primarily achieved by adding conductivity to the flooring material and connecting the flooring material to ground. As such, static control flooring is always considered a system where several components make up the complete path to ground. For example, a glue-down tile system consists of the conductive tile, the conductive adhesive and a grounding connection. If a finish is applied, the finish would also be considered part of the overall system. A common failure mechanism of static control flooring systems is the application of a standard, insulative wax on a static protective floor. The wax creates an electrically insulating barrier that breaks the electrical path to ground.

Static control flooring systems that would be used in a laboratory environment come in many types and styles. These include:

- Vinyl Tile and Sheet
- Rubber Tile and Sheet
- Linoleum Tile and Sheet
- Vinyl Composite Tile
- Interlocking Tile
- Paints and Coatings
- Resinous Floor Systems

ESDA TR7.0 provides detailed descriptions of the types of static control flooring systems available, their uses, and the methods of testing their static control properties.

6.0 Installation Guidelines by Flooring Type

6.1 General Installation Considerations

There are a number of items that need to be considered for any flooring installation. These include:

Subfloor Preparation: Ensure that the subfloor is clean, flat, dry, and structurally sound before installation. Remove any existing flooring materials and debris. Gluing flooring materials requires proper preparation of the subfloor to ensure a proper bond. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring provides guidance for preparing concrete floors to receive resilient flooring. While this guideline is written for resilient flooring, it applies to any subfloor preparation.

Acclimation: Maintain temperatures within the range recommended by the manufacturer, but not less than 65° F or more than 85° F. Allow the flooring material to acclimate to the room's temperature and humidity levels for a minimum of 48 hours before installation. Maintain temperature in the space from

48 hours before installation to 48 hours after installation. This helps prevent issues such as expansion or contraction after installation.

Storage Prior to Installation: Be sure to store materials prior to installation in accordance with manufacturer's instructions. Some materials, such as rolls, can distort significantly if not stored properly.

Moisture Testing: High levels of moisture in subfloors can lead to a number of common flooring failures. As such, it is important to conduct moisture testing on concrete subfloors to ensure they meet manufacturer recommendations. Excessive moisture can lead to adhesive failure and other problems. Available standard procedures used in the industry include:

- ASTM F 1869 Test Method for Measuring Moisture Vapor Emission Rate of Concrete Sub floor Using Anhydrous Calcium Chloride
- ASTM F 2170 Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.

Adhesive Selection: Use the appropriate adhesive recommended by the flooring manufacturer for the specific type of resilient flooring being installed. Follow the manufacturer's instructions for application and drying times.

Installation Method: Follow the recommended installation method specified by the flooring manufacturer. This may include full spread adhesive, perimeter adhesive, or floating installation methods.

6.2 Vinyl, Rubber, Linoleum, and Vinyl Composition Tile

These flooring products are glued down to provide high performance in areas with heavy foot and rolling load traffic. Installing a sheet floor is a very exacting process that requires excellent cutting and seaming skills, and subfloor knowledge. Professional installation by a reputable flooring dealer is highly recommended. The Resilient Floor Covering Institute (RFCI) has a number of guidelines for installing resilient flooring materials including vinyl, rubber, linoleum and VCT. These relevant documents include:

- RFCI IP #1 Recommended Installation Practice for Homogeneous Sheet Flooring, Fully-Adhered
- RFCI IP # 2 Recommended Installation Practice for Vinyl Composition Tile (VCT)

6.3 Ceramic, Porcelain, and Quarry Tile

Tile Council of North America (TCNA). TCNA publishes the TCNA Handbook for Ceramic, Glass, and Stone Tile Installation, which is widely regarded as the industry standard for tile installation methods and practices.
The handbook covers a wide range of topics related to tile installation, including substrate preparation, adhesive selection, tile layout, grouting, and maintenance. It provides detailed instructions and illustrations to help installers achieve proper and durable installations. The National Tile Contractors Association (NTCA) also contributes to the development of standards and guidelines for tile installation. ANSI A108/A118/A136.1:2021 – "Installation of Ceramic Tile" is another resource for installation guidelines of ceramic tile.

6.4 Polished Concrete

Creating a finished polished concrete floor is a multi-step process that includes:

1. **Surface Preparation**: Cleaning the concrete surface, addressing any cracks or imperfections, and ensuring a level and smooth foundation.

2. **Grinding Process**: Using a concrete grinder equipped with diamond abrasives, the concrete surface is gradually ground down to remove imperfections and achieve a uniform texture. If desired, the concrete can be ground to reveal the aggregate for a decorative touch.
3. **Polishing Process:** The polishing process involves using finer grits of diamond abrasives to refine the surface further. A floor polisher or concrete polisher equipped with polishing pads is used to progressively achieve the desired level of gloss. You can choose between a wet polishing method or a dry method, depending on your preference.
4. **Densification and Sealing**: A chemical densifier is applied to the concrete surface. This densifier undergoes a chemical reaction that enhances the hardness and durability of the concrete. Following densification, a concrete sealer is applied to protect the surface from stains, moisture, and foot traffic.

While there is no one standard that covers this entire process, ASTM D523 Standard Test Method for Specular Gloss can be referred to for specifying the final appearance of the polished concrete.

6.5 Floor Coatings/Finishes/Paints

Standard guidelines for installing floor paints can vary depending on the type of paint being used and the specific conditions of the floor. As always, make sure to follow manufacturer's guidelines.

Some basic steps that should be part of any application of a coating, finish, or paint include:
Surface Preparation: Thoroughly clean the floor surface to remove dirt, grease, oil, wax, and other contaminants. Use a degreaser or cleaner appropriate for the specific type of flooring material. Repair any cracks, holes, or imperfections in the floor using an appropriate patching compound or filler. Allow the repairs to fully cure according to the manufacturer's instructions.
Etching (if necessary): For concrete floors, especially in garages or industrial settings, it may be necessary to etch the surface to promote adhesion. This is typically done using an acid etching solution or mechanical methods such as shot blasting or grinding.
Priming: Apply a primer to the floor surface to improve adhesion and promote proper curing of the paint. Choose a primer suitable for the type of paint and substrate being used. Allow the primer to dry completely according to the manufacturer's instructions.
Paint Application: Stir the paint thoroughly before application to ensure uniform consistency. Apply the paint using a brush, roller, or sprayer, depending on the size and type of the floor area. Work in small sections, applying the paint evenly and avoiding drips or puddles.
Coverage: Follow the manufacturer's recommended coverage rate and application instructions, including any specific temperature and humidity requirements. Apply additional coats as necessary to achieve the desired color and coverage. Allow each coat to dry completely before applying the next coat.
Drying and Curing: Allow the paint to dry and cure according to the manufacturer's instructions before subjecting the floor to foot traffic or heavy loads. This typically involves waiting at least 24 hours or longer, depending on the type of paint and environmental conditions.
Optional Sealant or Topcoat: Depending on the type of paint used and the intended use of the floor, applying a clear sealant or topcoat may be beneficial to provide additional protection and durability. Follow the manufacturer's recommendations for application and curing.

6.6 Resinous Flooring

The Resin Flooring Association (FeRFA) based in the United Kingdom, is a trade association representing the resin flooring industry. FeRFA has a number of resources regarding resinous flooring system including "Guide to the Specification and Application of Synthetic Resin Flooring". This guidance document provides guidance, best practices, and technical information for resinous flooring installation, including surface preparation, product selection, and installation techniques.

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ASTM C722-18 "Standard Specification for Chemical-Resistant Monolithic Floor Surfacings" covers the requirements for aggregate-filled, resin-based, monolithic surfacing for use over concrete floors in areas where chemical resistance and the protection of concrete are required. The application methods for these floor surfacing shall include troweled, broadcast, slurry broadcast, self-leveling, sprayed, and reinforced. The resin chemistries include epoxy, urethane, polyester, and vinyl ester.

6.7 Interlocking Flooring

In general, there is no industry standard guideline for interlocking flooring installation, so it is important to follow the manufacturer's installation instructions and recommendations.

Interlocking flooring systems are designed to be installed without adhesives. Some require well-prepared subfloors. Some can be installed over poorly prepared subfloors and even over existing flooring. It is important to follow the manufacturer's guidelines and make sure that the product in consideration can be installed in the given application. Also, keep in mind if there is a need for the floor to be able to contain liquids. There are some systems that are designed for this, but many are not.

6.8 Access Flooring Systems

Installation of access flooring systems is a complicated process. These systems are designed to provide a floor that is stable and capable of holding significant weight, while creating a space below for utilities. Properly installed, they are capable of creating a stable, secure and level surface over a less than perfect subfloor. Each system will have its own installation procedures and requirements, so it is critical to follow the manufacturer's guidelines. Many have specific installers that are certified for the given system. The Access Floor Association (AFA) also has a guidance document (PSA MOB PF2 PS/SPU Performance Specification) with information on access flooring systems.

6.9 Static Control Flooring Systems

As noted in Section 5.13, there are a number of static control flooring systems, including resilient materials, resinous systems, paints, and interlocking systems. All of these will install similarly to their non-static control counterparts. ANSI/ESD TR7.0 "Flooring Systems" provides a comprehensive review of these systems and some general guidance for installation. Some things to keep in mind with regard to static control flooring installation include:

- If an adhesive is required for the system, it should be a conductive adhesive which will electrically connect the flooring material to a grounding point.
- All static control flooring systems must be connected to an electrical ground to provide a complete path for static charges to be discharged. This is often achieved simply by putting one end of a piece of copper tape (often 2 ft long) into the adhesive and connecting the other end to the ground lug of an electrical outlet or a steel post in the building.
- If a finish is applied to seal and/or protect the floor, it must be a conductive finish. A conventional finish will insulate the floor and prevent it from being able to discharge static charges.

7.0 Care and Maintenance Guidelines

7.1 General Maintenance

Maintaining laboratory flooring is crucial for ensuring a safe and functional environment, as laboratories often have specific requirements due to the nature of their work. Moreover, some laboratories may have limitations in how they can be maintained. For example, floor finishes can contribute to airborne particulate and are therefore not used in cleanrooms.

Some general guidelines for maintaining laboratory flooring include:

Regular Cleaning: Sweep or vacuum the floor daily to remove dust, dirt, and debris. Use a soft-bristle broom or a vacuum with a soft brush attachment to avoid scratching the floor surface. Mop the floor regularly using a neutral pH cleaner and warm water. Avoid using abrasive cleaners or harsh chemicals that could damage the floor finish.

Disinfection: Disinfect the floor regularly, especially in areas where biological or chemical contamination may occur. Use disinfectants approved for laboratory use and follow the manufacturer's instructions for dilution and application. Pay special attention to high-touch areas such as doorways, workbenches, and equipment surfaces.

Regular Inspection: Inspect the floor regularly for signs of damage, wear, or deterioration. Look for cracks, chips, discoloration, or uneven areas that may indicate the need for repair or maintenance. Check floor seams and joints for integrity, especially in areas subjected to heavy loads or foot traffic.

Some industry guidelines available include:

- BS 6263-2:1991 "Care and maintenance of floor surfaces Code of practice for resilient sheet and tile flooring" provides recommendations as a basis for the initial treatment and subsequent maintenance of cork, linoleum, plastics and rubber flooring in sheet and tile form. General guidance on the care and maintenance of flooring in particular environments and special buildings is given.

- Resilient Floor Covering Institute (RFCI) provides resources and guidelines for the installation, maintenance, and care of resilient flooring materials such as vinyl, linoleum, and rubber. Their guidelines address topics such as cleaning methods, maintenance schedules, and product recommendations for resilient flooring.

- ASTM F510 "Standard Specification for Cleaning Agents for Resilient Flooring" outlines the requirements for cleaning agents used on resilient flooring, such as vinyl, linoleum, and rubber.

- ASTM D4386-95(2016) "Standard Practice for Application of Floor Polishes to Maintain Multilayer Composite Tile or Flooring" provides guidance for the use of finishes on composite flooring materials, including vinyl composition tile.

7.2 Protective Finishes

Protective finishes are often used to protect flooring materials and make them easier to clean. Always consult the manufacturer of the flooring system for recommended finishes. Not all floor finishes are compatible with all flooring materials. Also, keep in mind that some finishes will not hold up to certain chemicals. Finally, in some cases conventional finishes are not appropriate to be used at all. Finishes will create additional particulate and are therefore not appropriate for cleanrooms. Also, conventional finishes used on static control flooring will insulate the flooring system and prevent it from working properly.

7.3 Reagents

Do not allow reagents to remain in contact with the flooring longer than necessary. Clean up spills promptly and thoroughly to prevent damage to the floor finish or underlying substrate.

7.4 Removal of Stains

End users should consult the supplier for recommendations.

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Column1	Conformance Spec	BSL1-2	BSL3-4	Chemistry/ General	Chemistry/ Organic	Physics	Cleanroom	Vivarium ABSL 1&2	Vivarium ABSL 3&4	Engineering/ General	Workshops	Electronics	Trace Metals	Computational	K-12
Chemical Resistance	SEFA 49	No More Than 4 Level 3 Conditions	No More Than 4 Level 3 Conditions	No More Than 4 Level 3 Conditions	No More Than 4 Level 3 Conditions		No More Than 4 Level 3 Conditions	No More Than 4 Level 3 Conditions	No More Than 4 Level 3 Conditions			No More Than 4 Level 3 Conditions	No More Than 4 Level 3 Conditions		No More Than 4 Level 3 Conditions
Static Load Limit	ASTM F970	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi	Pass at 250psi
Ease of Cleaning	NEMA 3-3.4	Min Rating of 20	Min Rating of 20	Min Rating of 20	Min Rating of 20		Min Rating of 20	Min Rating of 20	Min Rating of 20		Min Rating of 20	Min Rating of 20	Min Rating of 20	Min Rating of 20	Min Rating of 20
Impact Resistance - Sheet Vinyl, Rubber, Linoleum, VCT	ASTM F1265					pass				pass	pass				pass
Impact Resistance - Ceramic/Porcelain/Quarry Tile/Polished Concrete	ASTM C1870					100 in-lbs				100 in-lbs	100 in-lbs				100 in-lbs
Impact Resistance - Coatings/Finishes/Paints/Resinous	ASTM D2794					100 in-lbs				100 in-lbs	100 in-lbs				100 in-lbs
Slip Resistance	ASTM D2047	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry	Static COF >0.5 Dry
Dynamic Rolling Load Resistance	ASTM F2753	10,000 cycles - no damage, no change	10,000 cycles - no damage, no change	10,000 cycles - no damage, no change	10,000 cycles - no damage, no change	10,000 cycles - no damage, no change		10,000 cycles - no damage, no change			10,000 cycles - no damage, no change				10,000 cycles - no damage, no change
Bacterial Resistance	ASTM G21	Rating of 2 or less	Rating of 0				Rating of 2 or less	Rating of 2 or less	Rating of 0						
ESD	ANSI/ESD S20.20					<1.0x10^9 Ohms as Tested by	<1.0x10^9 Ohms as Tested by					<1.0x10^9 Ohms as Tested by		<1.0x10^9 Ohms as Tested by	
Offgassing	CA Protocol 01350/ ASTM E595	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant	CA Protocol 01350 Compliant

Column1	BSL1-2	BSL3	BSL4	Chemical Handling	Chemical Waste Disposal	Wet Processing	Vivarium ABSL 1&2	Vivarium ABSL3	Vivarium ABSL4
Generally Impervious to Liquids	X			X			X		
Seamless or Welded Seams		X			X			X	
Integral Cove Base		X	X			X	X	X	
Monolithic or Poured Resinous Flooring			X			X			X