Substrate Evaluation & Preparation Guidelines

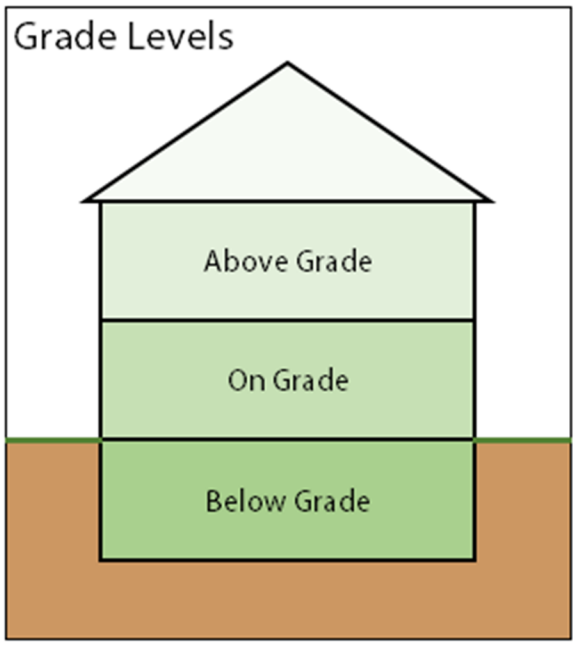
Proper substrate evaluation and preparation is a critical component of all successful floor covering installations. The condition of the substrate has a significant impact on the final appearance as well as the performance of the floor covering. Substrates to receive Forbo products must be structurally sound, rigid, smooth, flat, clean, and permanently dry. The substrates must be free of all foreign materials including, but not limited to, dust, solvent, paint, wax, oils, grease, residual adhesive, adhesive removers, film-forming curing compounds, silicate penetrating curing compounds, sealing, hardening or parting compounds, alkaline salts, excessive carbonation or laitance, mold, mildew, and other foreign materials that might affect the rate of moisture dissipation from the concrete, the adhesion of flooring to the concrete, or cause discoloration of the flooring from below.

Substrate evaluation and preparation should not begin until a stable, conditioned environment has been established as described in ***Forbo's General Installation Guidelines***.

NOTE: The results of moisture testing, pH testing, porosity testing, and adhesive mat bond testing are directly influenced by the environment in which the tests are conducted. Results of tests conducted prior to establishing a stable, conditioned interior environment should not be relied upon for determining if suitable conditions exist for installation.

Terminology

(Refer to the latest version of ASTM F 141.)



- **Above Grade** - Above the surface of the ground, as related to floor location, above a well-ventilated space with at least 18" (457.2 mm) between the bottom of the lowest horizontal structural member and any point of the ground.
- **On Grade** - In contact with the ground, as related to floor location, in contact with the ground or with less than 18" (457.2 mm) of well-ventilated space between the bottom of the lowest horizontal structural member and any point of the ground.
- **Below Grade** - Below the surface of the ground, as related to floor location, part or all of the floor is below the ground.
- **Subfloor** - The structural layer intended to provide support for design loadings which may receive resilient floor coverings directly if the surface is suitable or indirectly via an underlayment if its surface is not suitable.
- **Substrate** - The underlying support surface upon which the flooring is installed.
- **Underlayment** - A material placed under resilient floor, or other finished flooring, to provide a suitable installation surface.
- **Flooring System** - All components associated with the installation of flooring materials including, but not limited to, subfloors, substrates, patching and leveling materials, primers or other coatings, moisture control products, adhesives, welding rods and installation accessories (transitions, base, etc.).

Substrate Evaluation: Flooring Substrates

Concrete Substrates

(Refer to the latest version of ASTM F 710.)

- The surface of concrete floors to receive resilient flooring must be dry, clean, smooth, and structurally sound. They must be free of dust, solvent, paint, wax, oil, grease, residual adhesive, adhesive removers, film-forming curing compounds, silicate penetrating curing compounds, sealing, hardening, or parting compounds, alkaline salts, excessive carbonation or laitance, mold, mildew, and other foreign materials that might affect the rate of moisture dissipation from the concrete, the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below.
- Concrete substrates shall be cured per the concrete manufacturer's recommendations. They must have a minimum compressive strength of 3,000 psi and a minimum dry density of 150 pounds per cubic foot.
- The installation of a permanent, effective moisture vapor retarder is required under all on or below grade concrete floors. The vapor retarder shall be puncture and tear resistant with a minimum thickness of 0.010" and a permeance of 0.1 y. (Refer to the latest version of ASTM E 1745.) Every concrete floor slab on or below grade to receive resilient flooring shall have a water vapor retarder (often improperly called a vapor barrier) installed directly below the slab.
- Surface cracks, grooves, depressions, control joints or other non-moving joints, and other irregularities must be filled or smoothed with a suitable Portland based patching compound recommended for use under commercial resilient flooring products. Refer to the ***Substrate Preparation Section*** of this document for additional information.

Thick Poured Lightweight Cellular Concrete Underlayment

(Refer to the latest version of ASTM F 2471.)

- Lightweight cellular concrete underlayment shall be structurally sound, rigid, smooth, flat, clean, and permanently dry. The surface must be free of all foreign materials including, but not limited to, dust, paint, grease, oils, and solvents, curing and hardening compounds, sealers, asphalt, and adhesive residue.
- Lightweight cellular concrete underlayment shall have a minimum compressive strength of 2,000 psi for use over wood subfloors and 3,000 psi for use over concrete subfloors, with a minimum density of 110 pounds per cubic foot.
- Lightweight cellular concrete underlayment is not suitable for use on concrete slabs on or below grade due to potential moisture problems unless there is an effective moisture vapor retarder installed directly below the slab. The vapor retarder shall be puncture and tear resistant with a minimum thickness of 0.010" and a permeance of 0.1 y. (Refer to the latest version of ASTM E 1745.)
- Imperfections such as chips, spalls, cracks, and joints must be repaired using suitable patching and leveling materials. Always follow the manufacturer's recommendations for the use and application of these products. Refer to the ***Substrate Preparation Section*** of this document for additional information.
- **NOTE: Additional steps may be necessary to ensure that substrates are not excessively porous or dusty. Such conditions can impact the adhesive performance. Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system and that a secure bond can be achieved. It is strongly suggested to contact the concrete manufacturer for specific recommendations when installing resilient flooring over this type of underlayment. Any performance, compatibility or other qualities are the responsibility of the concrete manufacturer, not Forbo.**

Thick Poured Lightweight Gypsum Concrete Underlayment

(Refer to the latest version of ASTM F 2419.)

- Lightweight gypsum concrete underlayment shall be structurally sound, rigid, smooth, flat, clean, and permanently dry. The surface must be free of all foreign materials including, but not limited to, dust, paint, grease, oils, and solvents, curing and hardening compounds, sealers, asphalt and adhesive residue.
- Lightweight gypsum concrete underlayment shall have a minimum compressive strength of 2,000 psi for use over wood subfloors and 3,000 psi for use over concrete subfloors, with a minimum density of 105 pounds per cubic foot.
- Lightweight gypsum concrete underlayment is not suitable for use on concrete slabs on or below grade due to potential moisture problems unless there is an effective moisture vapor retarder installed directly below the slab. The vapor retarder shall be puncture and tear resistant with a minimum thickness of 0.010" and a permeance of 0.1 y. (Refer to the latest version of ASTM E 1745.)
- Imperfections such as chips, spalls, cracks, and joints must be repaired using suitable patching and leveling materials. Always follow the manufacturer's recommendations for the use and application of these products. Refer to the ***Substrate Preparation Section*** of this document for additional information.
- **NOTE: Additional steps may be necessary to ensure that substrates are not excessively porous or dusty. Such conditions can impact the adhesive performance. Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system and that a secure bond can be achieved. It is strongly suggested to contact the concrete manufacturer for specific recommendations when installing resilient flooring over this type of underlayment. Any performance, compatibility or other qualities are the responsibility of the concrete manufacturer, not Forbo.**

Wood Substrates

(Refer to the latest version of ASTM F 1482.)

- Wood substrates must be structurally sound, rigid, smooth, flat, clean, and permanently dry. The wood surface must be free of all foreign materials including, but not limited to, dust, paint, grease, oils, solvent, inks, sealers, asphalt, adhesive residue, mold, mildew and other foreign materials that might prevent adhesive bond or cause staining of the flooring.
- Wood substrates must be double construction with a minimum total thickness of 1". All wood substrates must have at least 18" of well-ventilated air space below.
- Forbo products should not be installed over wooden substrates built on sleepers over on or below grade concrete floors without first taking adequate precautions to ensure the structural integrity of the system and to prevent moisture migration from the concrete slab. Proper planning and design will minimize the potential for flooring system failures generally associated with this type of construction.

Strip Wood/Plank Flooring

Because of the expansion and contraction of strip and plank flooring during seasonal changes, 1/4" or thicker underlayment panels must be installed over these types of floors.

Underlayment Panels

- Underlayment panels are used to correct deficiencies in the subfloor and to provide a smooth, sound surface on which to adhere flooring. Underlayment panels should be acclimated to site conditions as prescribed by the underlayment manufacturer. In lieu of specific recommendations, ensure panels are acclimated to site conditions for a minimum of 48 hours prior to installation.
- Underlayment panels must be a minimum of 1/4" (6.35mm) nominal thickness with one fully sanded face and recommended for use as underlayment for fully adhered resilient flooring. Underlayment panels must be free of any foreign material that may prohibit a secure bond or cause the discoloration of resilient flooring as defined by the latest version of ASTM F1482.
- Installation of Forbo products is NOT recommended over particle board/chip board, tempered hardboard, Luan plywood, fire retardant plywood, or pressure treated plywood.
- Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system and to ensure that a secure bond can be achieved. Refer to the ***Adhesive Mat Bond Testing Section*** of this document for additional information.
- **NOTE: The use of a skim coat of patching material over wooden substrates may cause more problems than it resolves, especially in the joint areas. Moisture from patching materials may be absorbed by the wood, causing the wood fibers to swell and may cause the panel surface and/or joints to telegraph through the newly installed floor covering. Proper installation of a wooden subfloor and underlayment panels is critical to the successful installation of resilient flooring. Regardless of the type or brand of underlayment used, any problems or failures directly related to the performance of the underlayment is the responsibility of the underlayment manufacturer and/or installation contractor, not Forbo. Always follow the panel manufacturer's recommendations for panel installation and preparation.**

Existing Resilient Flooring

Forbo products installed over an existing resilient flooring system may be more susceptible to indentation due to the PSI rating of the existing material. There is also the possibility that the existing flooring may telegraph through the new flooring. Forbo products may be installed over a single layer of non-cushioned resilient flooring provided it meets the following conditions:

- Where an existing resilient flooring system is installed over concrete that is on, above and below grade, moisture test results must not exceed the requirements of the existing resilient flooring system or the product to be installed. Refer to the ***Moisture Testing Section*** of this document for additional information.
- The substrate and underlayment must meet the requirements of the existing and the new floor covering.
- The existing flooring must be fully adhered and properly bonded.
- The existing flooring must not be embossed or textured.
- All cuts, gouges, dents, and other damage must be repaired with flooring material that is the same or similar to the existing, or with patching materials suitable for that purpose. Always follow the manufacturer's recommendations for use and application of patching materials.
- All waxes and finishes must be removed from the existing resilient flooring, and the surface rinsed with clean water. After cleaning, pH tests should be conducted to ensure all chemical residues have been removed.
- When installing over existing non-porous floors, the adhesive may be slow to set up. The addition of a minimum 1/8" blotter layer of an appropriate patching or leveling compound is recommended.
- The use of embossing levelers is not recommended for commercial installations.
- Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system and that a secure bond can be achieved. Refer to the ***Adhesive Mat Bond Testing Section*** of this document for additional information.
- The responsibility for determining if the existing resilient flooring is suitable to be installed over rests solely with the installer and flooring contractor. If there is any doubt as to its suitability, the existing flooring should be removed or an acceptable underlayment installed over it.

WARNING!

Do not sand, dry sweep, dry scrape, drill, saw, bead blast, or mechanically chip or pulverize existing resilient flooring, backing, lining felt or asphaltic "cut-back" adhesives. These products may contain either asbestos fibers or crystalline silica. Avoid creating dust. Inhalation of such dust is a cancer and respiratory tract hazard. Smoking by individuals exposed to asbestos fibers greatly increases the risk of serious bodily harm. Unless positively certain that the product is a non-asbestos containing material, you must presume it contains asbestos. Regulations may require that the material be tested to determine asbestos content. The RFCI's recommended work practices for removal of resilient floor coverings are a defined set of instructions which should be followed if you must remove existing resilient floor covering structures.

Poured Floors (Epoxy, Polymeric, Seamless)

Forbo products may be installed over most poured floors, provided they meet the following conditions:

- Where poured flooring is installed over concrete that is on, above, and below grade, moisture test results must not exceed the requirements of the existing flooring or the product to be installed. Refer to the ***Moisture Testing Section*** of this document for additional information.
- The poured floor must be totally cured and well bonded to the concrete. It must be free of any residual solvent and/or petroleum derivatives.
- Loose, damaged areas and irregularities must be repaired with a patching compound suitable for that purpose. Always follow the manufacturer's recommendations for use and application of patching materials.
- The texture must be smooth. Sand or wet stone the surface to remove any grit and texture.
- All waxes and finishes must be removed from the existing flooring, and the surface rinsed with clean water. After cleaning, pH tests should be conducted to ensure all chemical residues have been removed.
- When installing over existing non-porous floors, the adhesive may be slow to set up. The addition of a minimum 1/8" blotter layer of an appropriate patching or leveling compound is recommended.
- Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system, and to ensure that a secure bond can be achieved. Refer to the ***Adhesive Mat Bond Testing Section*** of this document for additional information.
- The responsibility for determining if the existing flooring is suitable to be installed over rests solely with the installer and flooring contractor. If there is any doubt as to its suitability, the existing flooring should be removed, or an acceptable underlayment installed over it.

Radiant Heated Floors

Forbo flooring products may be installed over radiant heated floors providing the maximum surface temperature of the substrate does not exceed 85° F (29° C) under any condition of use. To enable a secure bond of the adhesive to the substrate, the radiant heating system should be turned off, or set to the lowest temperature, for a minimum of 48 hours prior to installation of the Forbo flooring product. The temperature of the substrate must not exceed 65° F (18.3° C) during the installation of the flooring material. If necessary, an alternate heating source should be used to maintain the room temperature at a minimum of 65° F (18.3° C) prior to, during, and for 72 hours after installation. The temperature of the radiant heating system can be increased 72 hours following the installation. When raising the floor temperature, do so gradually so the substrate and flooring material can adapt to the temperature change together. A rapid temperature change could result in bonding problems.

For additional information, contact Forbo's Product Support & Education Services at 1-800-842-7839 or www.forboflooringNA.com.

Substrate Evaluation: Alternative Substrates

Forbo products can be installed on many types of alternative substrates. Substrates to receive Forbo products must be structurally sound, rigid, smooth, flat, clean, and permanently dry. The substrates must be free of all foreign materials including, but not limited to, dust, solvent, paint, wax, oils, grease, residual adhesive, adhesive removers, film-forming curing compounds, silicate penetrating curing compounds, sealing, hardening or parting compounds, alkaline salts, excessive carbonation or laitance, mold, mildew, and other foreign materials that might affect the rate of moisture dissipation from the substrate, the adhesion of the Forbo product to the substrate or cause a discoloration of the material. Due to the chemical composition of some alternative substrate materials, reactions between the substrate and adhesive may be possible. Materials such as sealants, plasticizers, factory coatings or fire retardants may cause potential bonding issues. It is strongly recommended to contact the manufacturer of the substrate materials and secure any guarantees for suitability of the substrate in combination with the installation of the Forbo product. The following guidelines will help ensure a successful installation of Forbo products over alternative substrates:

- Ensure that all recommendations for jobsite conditions as outlined in Forbo's installation guidelines are met prior to beginning the installation. For additional information, refer to the ***Jobsite Conditions Section*** of this document.
- Forbo adhesives **must** be used and all published Forbo installation recommendations **must** be followed.
- Always conduct adhesive mat bond tests before beginning the installation to identify the working characteristics of the adhesive as well as any potential bonding issues.
- Any alternative substrate must be of a gauge or thickness to eliminate flexing or movement as well as provide structural integrity for the finished material.

Metal Substrates

- All substrates must be free of contaminants that may cause staining or interfere with the adhesive bond. For metal substrates, this includes possible oils or corrosion. Degreasing and/or abrading the surface may be necessary to remove these contaminants. When performing these procedures, always use appropriate personal protective equipment and follow all local safety regulations. Surfaces which exhibit rust build up or any disintegration of metal may indicate moisture, chemical exposures or reactions which may result in bond failure. When such signs are present, the source of the contamination should be identified and the substrate repaired prior to proceeding with the installation. Ensure that any residual contaminants are completely removed from the substrate prior to installation. Most metal substrates are smooth and non-porous. Abrading the surface may improve the adhesive bond to the substrate. As metal substrates are non-porous, an extended open time may be necessary prior to placing the material. The flooring material must remain in contact with the adhesive while the adhesive is drying and curing. For additional information on each Forbo Flooring product, refer to the ***Adhesive Mat Bond Testing Section*** of this document for additional information.
- Regardless of the specific type of substrate that is being installed over, the final determination of suitability for that purpose is the responsibility of the installer and/or flooring contractor.

Refrigerated and Freezer spaces

All installations in refrigerated or freezer spaces require the use of Forbo 660 adhesive.

Substrate Evaluation: Wall Substrates

Many Forbo products can be successfully installed directly on walls. The following guidelines will help ensure a successful installation:

- All wall substrates must be compression and deformation resistant, permanently dry and clean. They must be sound, smooth, rigid, flat dry, and free of all foreign materials including but not limited to dust, grease, oils, solvent, adhesive residue, mold, mildew or any substance that could prevent achieving a secure bond.
- If walls are concrete, refer to the ***Concrete Substrates Section*** of this document for additional information.
- It is not recommended to install Forbo products over any existing wall covering material such as but not limited to paper or vinyl.
- Ensure that all recommendations for jobsite conditions as outlined in Forbo's installation guidelines are met prior to beginning the installation. For additional information, refer to the ***Jobsite Conditions Section*** of this document for additional information.
- Fill in irregularities on non-smooth walls such as grout lines on block, joints on sheetrock and plywood with a suitable patching compound designed for that purpose.
- Lightly sand oil painted surfaces. Remove any existing wall covering and sand off any adhesive residue.
- When performing these procedures, always use appropriate personal protective equipment and follow all local safety regulations.
- Using a primer/sealer will provide a uniform porosity over the entire surface of the wall, reduce the absorbency of porous substrates, improve bond over dry surfaces, and improve the working characteristics of the adhesive. When choosing a primer/sealer, always choose products of the highest quality and always follow the manufacturer's recommendations for use and application. Any liability for the performance of primer/sealers rests solely with the user and/or manufacturer of the product, not Forbo.
- Always conduct adhesive mat bond tests before beginning installation. Bond testing will aid in identifying both the working characteristics of the adhesive (open time and working time) for the site conditions, and also any potential bonding issues. For additional information, refer to the ***Adhesive Mat Bond Testing Section*** of this document for additional information.
- Regardless of the specific type of substrate that is being installed over, the final determination of suitability for that purpose is the responsibility of the installer and/or installation contractor.

Drywall Substrates

- Drywall substrates must be securely fastened and finished in accordance with the latest version of ASTM C 840, minimum of level 3.
- Drywall must be primed with a high-quality primer/sealer.
- Existing drywall finishes must be in good condition and well secured. Glazed or glossy surfaces should be fully sanded using coarse grit sandpaper. Textured surfaces must be sanded smooth and/or smoothed using appropriate materials and primed with a high-quality sealer/primer. Do not install over existing paper or vinyl wallcovering materials.
- Regardless of the specific type of substrate that is being installed over, the final determination of suitability for that purpose is the responsibility of the installer and/or installation contractor.

Wood Panels Substrates

- Underlayment panels must be a minimum of 1/4" (6.35mm) nominal thickness with one fully sanded face and recommended for use as underlayment for fully adhered resilient flooring. Underlayment panels must be free of any foreign material that may prohibit a secure bond or cause the discoloration of resilient flooring as defined by the latest version of ASTM F 1482.
- Installation of Forbo flooring products is NOT recommended over particle board/chip board, tempered hardboard, Luan plywood, fire retardant plywood, or pressure treated plywood.
- Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system and to ensure that a secure bond can be achieved. For additional information, refer to the ***Adhesive Mat Bond Testing Section*** of this document for additional information.
- Regardless of the specific type of substrate that is being installed over, the final determination of suitability for that purpose is the responsibility of the installer and/or installation contractor.
- For additional information, refer to the ***Underlayment Panels Section*** of this document.

Testing:

Moisture Testing

In order to ensure that the moisture condition of concrete substrates is within acceptable limits, it is essential that moisture testing be conducted on ALL concrete substrates regardless of age or grade level, including those where resilient flooring has already been installed. Moisture testing should only be conducted once a stable, conditioned environment as described in the ***Jobsite Conditions Section*** of this document has been established.

The environment in which the tests are conducted directly influences moisture test results. Results of tests conducted prior to establishing a stable, conditioned interior environment should not be relied upon when determining if suitable conditions exist for the installation of resilient flooring materials. Changes in the interior environment subsequent to such testing may cause concrete moisture conditions to change and lead to installation failures.

Forbo recommends the following two moisture tests be performed by a certified concrete moisture testing professional on ALL concrete surfaces regardless of age or grade level.

Calcium Chloride Moisture Vapor Emission Testing

The moisture vapor emission rate (MVER) of concrete substrates should be determined by testing conducted in strict accordance with the latest version of ASTM F 1869. This test method is used to obtain a quantitative value indicating the rate of moisture vapor emission from the surface of a concrete floor and whether or not that substrate is acceptable to receive resilient floor covering. The moisture vapor emission rate only reflects the condition of the concrete floor at the time of the test. The MVER from the concrete must not exceed the requirements of the Forbo adhesive being used.

In order to obtain accurate test results when performing calcium chloride moisture vapor emission tests, you must:

- Perform tests in a controlled environment. The test site should be at the same temperature and humidity expected during normal use. If this is not possible, then the test conditions must be 75°± 10° F (23.9° ± 5.5° C) and 50 ± 10% relative humidity. Maintain these conditions 48 hours prior to, and during testing.
- Properly prepare the concrete surface. Any potential impediment to moisture vapor emissions (such as sealers, curing compounds, adhesive residue, excessively finished, etc.) must be completely removed prior to testing.
- Ensure an airtight seal between the test dome and the concrete surface.
- Use the correct formula when calculating the test results.
- Accurately document and report the testing data.
- Perform three (3) tests for the first 1,000 square feet (100 square meters) and at least one additional test for each additional 1,000 square feet (100 square meters).

In situ (Internal) Relative Humidity Testing

The internal relative humidity of concrete substrates should be determined by testing conducted in accordance with the latest version of ASTM F 2170. This test method is used to obtain a quantitative determination of the percentage of relative humidity in concrete slabs. The internal relative humidity of the concrete must not exceed the requirements of the Forbo adhesive being used. Moisture test results indicate the moisture condition of the slab only at the time of the test. In order to obtain accurate test results when performing in situ relative humidity tests, you must:

- Follow the test equipment manufacturer's guidelines for proper use.
- Perform tests in a controlled environment. Concrete floor slabs shall be at service temperature and the occupied air space above the floor slab shall be at service temperature and service relative humidity for at least 48 hours before making relative humidity measurements in the concrete slab.
- Ensure that the holes are drilled to the proper depth, adequately cleaned and/or that the test sleeve has been inserted properly and is adequately sealed.
- Ensure the test equipment has been acclimated to site conditions.
- Use test equipment that is properly calibrated. Test equipment should have an accuracy of ± 3% and be calibrated on a regular basis.
- Properly document and report the testing data.
- Perform three (3) tests for the first 1,000 square feet (100 square meters) and at least one additional test for each additional 1,000 square feet (100 square meters).

As noted, these two testing methods measure different components of the overall concrete moisture condition. The in situ relative humidity test is gaining favor in the floor covering industry and many consider the MVER as unimportant. It is Forbo's position however, that comprehensive evaluation enables a better understanding of the overall moisture condition of concrete substrates, and therefore enables a better-informed judgment when decisions must be made.

A minimum of three (3) tests of each type should be conducted for the first 1,000 square feet (100 square meters). On projects over 1,000 square feet (100 square meters), an additional test of each type should be conducted for each additional 1,000 square feet (100 square meters) of area. A diagram of the area showing the location of each test and the corresponding test results should be submitted to the

architect, general contractor, and end-user prior to the installation of the flooring material. If any test result exceeds the limitations specified, the installation ***SHOULD NOT PROCEED*** until the problem has been corrected. The installation of Forbo products where moisture conditions exceed specified limits may result in partial or complete failure. Failure to follow this recommendation is an implied acceptance of site conditions by the flooring contractor/installer.

Forbo recommends conducting both of the following moisture tests on gypsum surfaces:

Polyethylene Sheet Test

This test is performed by securing a vapor-retardant plastic sheet to the gypsum surface for a period of 72 hours. Presence of visible liquid water on the underside of the plastic sheet or the appearance of a wet or damp surface indicates that the gypsum is insufficiently dry for the application of floor coverings.

Electronic Surface Moisture Meter

(Refer to the latest version of ASTM F 2659.)

This test is performed by using a surface moisture meter (such as Delmhorst or Tramex) to measure the relative level of moisture of the gypsum. Depending on the amount of moisture present, the meter will give a measurement ranging from "wet" to "dry."
NOTE: If these methods of testing indicate the possible presence of elevated moisture, further investigative testing is recommended. Refer back to the product manufacturer for additional information. All guidelines and recommendations from the product manufacturer should be strictly followed.

pH Testing

(Refer to the latest version of ASTM F 710.)

It is essential that pH tests be conducted on all concrete floors regardless of age or grade level. During the curing and drying of concrete and as moisture migrates through the concrete, it will dissolve alkali salts that are contained in the concrete. When the moisture reaches the surface of the concrete it evaporates, leaving behind an alkali salt residue on the surface. These alkali salts may cause several installation and material problems, such as adhesive failure, discoloration, shrinkage, and softening of the floor covering.

Testing the concrete pH should be done in several locations throughout the area to receive flooring. As a rule of thumb, conduct pH tests at each calcium chloride test location as the calcium chloride tests are removed.

To test for pH at the surface of a concrete slab, use wide range pH paper, its associated pH chart, and distilled or deionized water. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1" (25mm) in diameter. Allow the puddle to set for 60 ± 5 seconds and then dip the pH paper into the water. Remove immediately and compare to chart to determine pH reading. Other pH testing methods such as pH pencils or pH meters, or both, are available and may be used to measure pH.

If the pH exceeds the limitation of the specified adhesive, it must be reduced prior to beginning the installation. Lightly abrading the surface and vacuuming up the residue will often reduce the concrete surface pH. Damp mopping with neutral pH cleaner properly diluted with clean water can be used to reduce the pH level on the surface of the concrete. When damp moping, do not flood the floor. Ensure that all water or slurry is removed from the substrate with a wet vacuum. Allow the substrate to fully dry before proceeding with any installation procedures. Retest to assure the pH has been reduced. If pH levels remain high, contact Forbo's Product Support & Education Services for additional information.

For additional information about the moisture and pH tolerance levels of the Forbo adhesives, refer to ***Forbo's Adhesive Technical Data Sheets***.

IMPORTANT: The Forbo limited warranty covers manufacturing defects only. Failures that are the direct result of circumstances beyond the control of Forbo, including substrate moisture related failures, are NOT covered under warranty. The recommendations in the Forbo Installation Guidelines are intended to inform the users of Forbo products about reliable installation methods as well as some of the potential risks that could lead to installation failure. The purpose of these guidelines is to provide the necessary information to best ensure a successful installation. Moisture test results reflect the concrete moisture condition at the time of testing only. The absence of an acceptable vapor retarder under the slab, changes in the environment, or other circumstances beyond Forbo's control, may result in changes of the moisture condition of the concrete subsequent to the time of testing. Forbo's warranty shall not be extended to cover damage or failures caused by moisture conditions in excess of specified limits that occur after the time of initial testing or installation.

Substrate Porosity

(Refer to the latest version of ASTM F 3191)

Substrate porosity has a significant influence on the working characteristics of adhesives (open time and working time). It is important for installers to recognize and understand this relationship so that adhesives are used properly. Where the substrate is non-porous, overly porous, or substrate porosity is inconsistent, adjustments will have to be made to installation procedures.

It is the installer's responsibility to recognize the working characteristics of the adhesive for any given situation and make any necessary adjustments in preparation or installation techniques that may be required to achieve a secure bond.

An easy way to determine the porosity of the substrate is to use a drinking straw or an eye-dropper and place a row of water drops on the surface of the substrate. If the drops are not absorbed into the substrate within 60 seconds, the substrate should be considered non-porous.

Non-Porous

When the substrate is non-porous, the adhesive may require an extended open time. There must be **100% wet transfer** of adhesive to the material backing in order to achieve a secure bond. **100% wet transfer is a continuous film of adhesive when wet on both the backing of the material and the substrate, with no trace of trowel marks or ridges**. For additional information, refer to ***Forbo's Adhesive Technical Data Sheets***.

If a substrate is non-porous, a curing compound, hardener, sealer, or other bond inhibiting material may be present. Conducting adhesive mat bond tests will aid in identifying such contaminants.

Non-porous substrates can be made porous by either mechanically abrading or placing a blotter layer of a minimum thickness of 1/8" (3.175mm) of an appropriate patching or leveling compound.

Overly Porous

When a substrate is overly porous, the adhesive may have a shortened open time and may require that the adhesive be applied incrementally. There must be **100% wet transfer** of adhesive to the material backing in order to achieve a secure bond. **100% wet transfer is a continuous film of adhesive when wet on both the backing of the material and the substrate, with no trace of trowel marks or ridges**. For additional information, refer to ***Forbo's Adhesive Technical Data Sheets***. Overly porous substrates may require the application of a primer.

Primers

The use of a primer may be necessary to improve adhesive bond to non-porous substrates such as terrazzo, existing resilient flooring, or power troweled concrete. A primer may also be necessary to reduce the porosity of overly porous substrates or to create a uniform porosity.

All guidelines and recommendations from the manufacturer of the product chosen should be strictly followed.

Regardless of the type or brand of primer chosen, any liability for the performance of the primer rests with the product manufacturer and/or applicator, not Forbo.

Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system, and to ensure that a secure bond can be achieved.

Adhesive Mat Bond Testing

(Refer to the latest version of ASTM D 3311)

NOTE: When using Forbo Sustain 100 adhesive, refer to ***Forbo's Sustain 100 Technical Data Sheet*** for Adhesive Mat Bond Testing information specific to Sustain 100.

Adhesive mat bond testing can identify potential bonding problems and is essential for ensuring the integrity of the flooring system prior to the installation. Adhesive mat bond tests should be conducted using the adhesive(s) and material(s) to be used on the project **after** all remediation and/or preparation work has been completed.

Conduct adhesive mat bond tests by adhering 3' x 3' squares of material, following Forbo's installation guidelines, in various locations throughout the area where flooring is to be installed. Although the number of tests required may vary, enough tests should be performed to allow an evaluation of the entire area where material will be installed. This will help identify the effects of the site-specific conditions that will influence the open time and working time of the adhesive. There are four main site conditions that influence open time and working time of adhesives: porosity of the substrate, ambient temperature, ambient humidity and air flow. Be sure to conduct bond tests on **ALL** substrates, including but not limited to; concrete, thick poured lightweight cellular concrete underlayment, thick poured lightweight Gypsum concrete underlayment, wood, metal, existing resilient, anywhere patching and/or leveling materials, moisture control systems or primers have been used. Wait a minimum of 72 hours before removing the test squares.
NOTE: Some substrates may require additional time to achieve an adequate bond before removing the test squares.

Failure Modes in Adhesive Mat Bond Testing:

The results of adhesive mat bond testing are a measure of the resistance of the floor covering to separation from the substrate when force is applied. This result allows for the determination of the failure mode. Three type of adhesive mat bond failure seen most frequently are substrate failure, adhesion failure or cohesive failure.

Substrate Failure

This failure mode is expressed when the substrate or flooring material is weaker than the adhesive and cohesive bonds. It is characterized by either the material breaking apart and/or the substrate being separated into pieces or destroyed. This typically indicates high bond strength.

Adhesion Failure

This failure mode is expressed when the bond between the substrate or flooring material and the adhesive is broken. It is characterized by all or most of the adhesive releasing from the substrate or from the material. This typically indicates the presence of a contaminant, very low porosity of the substrate or incorrect installation of the material into the adhesive.

Cohesive Failure

This failure mode is expressed when the bond between the molecules within the adhesive is forced to failure because the external force being applied exceeds the cohesive bond. This typically indicates high bond strength.

There are very few industry-specific pass/fail criteria defined in standards for adhesive mat bond tests. Expected adhesion testing results are often predetermined by and agreed upon by the parties concerned. These results can include but are not limited to:

- The required force to remove the test samples being deemed adequate to provide satisfactory performance of the flooring system for its intended purpose.
- The perceived bond strength.
- The determination of the failure mode and its impact on the flooring system.

Test results are based on the adhesive layer being fully cured. The following is what the anticipated results should be for all Forbo products.

Forbo 660 Two-Part Polyurethane Adhesive

Many Forbo products can be installed using Forbo 660 adhesive. When using Forbo 660 adhesive, the point of failure during bond testing should be in the material. **The anticipated result is that the material will be destroyed when removing the sample.**

Marmoleum Modular & MCT

When evaluating adhesive mat bond tests using T 940, Sustain 1195, or Sustain 100 adhesive, significant force should be required to remove the test sample. The impression of the tile backing should be readily seen in the adhesive layer. The tile should be fully embedded in the adhesive with no appearance of trowel ridges. The adhesive layer should remain substantially on the substrate with the tile separating from the adhesive bed. **The anticipated failure mode should be either substrate or cohesive.**

When evaluating adhesive mat bond test using Forbo EZ-ON 100, it is required to allow the adhesive to fully gel. Fully gelled adhesive will not provide wet transfer when touched with a finger. A slight oily residue may be noticed when touching, however the adhesive will not displace under pressure from the finger. Install the material and roll with 100 lb. roller to ensure proper adhesive transfer. Proper placement and rolling will result in a complete impression of the material backing into the face of the gelled adhesive. When properly used, Forbo EZ-ON 100 Adhesive will provide significant bond strength immediately after installing the material. The adhesive will continue to build further bond strength as the polymers cure. Upon removal of the test sample, the imprint of the material backing should be seen on the face of the adhesive. Because the adhesive polymers will bond tenaciously to all substrates, when removing material, the adhesive layer may tear apart with some adhesive remaining on the substrate and some adhesive on the material backing. Removal of the material should require significant force when fully cured and will cause damage or stress to the material.

Marmoleum & Linoleum Sheet Products (including Bulletin Board & Furniture Linoleum)

When evaluating adhesive mat bond tests using Forbo L 885, Sustain 1195, Sustain 100, or L 910W adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

NOTE: Forbo L 910W adhesive is for wall applications only.

Marmoleum Decibel & Corkment

When evaluating adhesive mat bond tests using Forbo Sustain 1195 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the polyolefin backing and the jute when the test sample is removed. **The anticipated failure mode should be either substrate or cohesive.**

Marmoleum Ohmex

When evaluating adhesive mat bond tests using Forbo C 930 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

Flotex Modular

Standard Installation (with Releasable Adhesive): When evaluating adhesive mat bond tests using Forbo V 1190 or FST 1299 adhesive, light to moderate force should be required to remove the test sample. **The anticipated failure mode should be adhesion (between the material and the adhesive).**

Permanent Installation: When evaluating adhesive mat bond tests using Forbo Sustain 1195 or T 940 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

Flotex Sheet

When evaluating adhesive mat bond tests using Forbo V 1190, FST 1299, or Sustain 1195 adhesive, significant force should be required to remove the test sample. **The anticipated failure mode should be either substrate (within the two cushioned backings on the material) or cohesive.**

Allura Dryback

When evaluating adhesive mat bond tests using Forbo T 940 or Sustain 1195 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

Allura Flex

When evaluating adhesive mat bond tests using Forbo Sustain 1195 or T 940 adhesive, light to moderate force should be required to remove the test sample. **The anticipated failure mode should be adhesion (between the material and the adhesive).**

Allura Decibel

When evaluating adhesive mat bond tests using Forbo V 1190 or Sustain 1195 adhesive, significant force should be required to remove the test sample. The impression of the tile backing should be readily seen in the adhesive layer. The tile should be fully embedded in the adhesive with no appearance of trowel ridges. The adhesive layer should remain substantially on the substrate with the tile separating from the adhesive bed. **The anticipated failure mode should be either substrate or cohesive.**

Eternal & Sphera

When evaluating adhesive mat bond tests using Forbo V 1190, or Sustain 1195 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

Eternal Step Aqua

When evaluating adhesive mat bond tests using Forbo 660 adhesive, significant force should be required to remove the test sample. Removing the test sample should destroy the material. **The anticipated failure mode should be either substrate or cohesive.**

Colorex SD | EC

When evaluating adhesive mat bond tests using Forbo C 930 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

Sphera SD | EC

When evaluating adhesive mat bond tests using Forbo V 1190 and C 930 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

Coral Tile

Standard Installation (with Releasable Adhesive): When evaluating adhesive mat bond tests using Forbo V 1190 or FST 1299 adhesive, light to moderate force should be required to remove the test sample. **The anticipated failure mode should be adhesion (between the material and the adhesive).**

Permanent Installation: When evaluating adhesive mat bond tests using Forbo Sustain 1195 or T 940 adhesive, significant force should be required to remove the test sample. The bond failure should occur within the adhesive layer when the test sample is removed. There should be approximately the same amount of adhesive on the substrate and the material backing. **The anticipated failure mode should be either substrate or cohesive.**

Coral Sheet

When evaluating adhesive mat bond tests using Forbo 660 adhesive, significant force should be required to remove the test sample. Removing the test sample should destroy the material. **The anticipated failure mode should be either substrate or cohesive.**

ArmorCove

When evaluating adhesive mat bond tests using Forbo ArmorFix adhesive, significant force should be required to remove the test sample. Removing the test sample should destroy the material. **The anticipated failure mode should be either substrate or cohesive.**

It is the installer's responsibility to identify and correct potential bonding issues, ensuring an optimal bond can be achieved *prior* to beginning the installation.

For additional information, contact Forbo's Product Support & Education Services at 1-800-842-7839 or www.forboflooringNA.com.

Substrate Preparation:

Vacuuming the substrate with a commercial vacuum is the preferred method of removing dirt and dust. Damp mopping can be used to remove fine dust from concrete substrates. When damp moping, do not flood the floor. Ensure that all water or slurry is removed from the substrate with a wet vacuum. Allow the substrate to fully dry before proceeding with any installation procedures. A clean substrate enables a secure bond between the substrate and the floor covering.

Patching and Leveling Materials

(Refer to the latest version of ASTM F 2678.)

There are two main categories of patching and leveling materials available in the marketplace. One category is calcium sulfate/ plaster/ gypsum-based compounds, and the other is Portland cement-based compounds.

There are a wide range of patching and leveling materials currently available for the purpose of smoothing and patching substrate irregularities, and their quality and performance will vary. The user of such products should research performance specifications, warranties and choose only the highest quality materials when installing Forbo flooring products. All guidelines and recommendations from the manufacturer of the product chosen should be strictly followed.

Regardless of the type or brand of patching or leveling material used, any liability for the performance of the patching or leveling material rests with the product manufacturer and/or applicator, not Forbo.

Always conduct adhesive mat bond tests prior to the installation to ensure the integrity of the flooring system, and to ensure that a secure bond can be achieved. For additional information, refer to the ***Adhesive Mat Bond Testing Section*** of this document for additional information.

Adhesive Residue

WARNING REGARDING COMPLETE ADHESIVE REMOVAL: Some solvent based asphaltic "cut-back" adhesives may contain asbestos fibers that are not readily identifiable. Do not use power devices which create asbestos dust in removing these adhesives. The inhalation of asbestos dust may cause asbestosis or other serious bodily harm. Smoking greatly increases the risk of serious bodily harm.

Forbo does **not** recommend the use of solvents or adhesive removers to remove adhesive residue. Any solvent or adhesive remover residue left within the substrate may affect the new adhesive and new floor covering. Where existing asphaltic (cut-back) or other types of adhesives are present, they must be dealt with in one of three ways:

- If the adhesive is non-asbestos containing, it may be mechanically removed down to a residual staining. This can be achieved by grinding, bead blasting, scarifying, scraping, etc.
- The adhesive residue* may be encapsulated with a suitable patching or leveling compound. Follow the patching or leveling manufacturer's recommendations for intended use and application.
- The adhesive residue* may be encapsulated with a suitable product designed for the purpose of encapsulating adhesive residue. Follow manufacturers' recommendations for intended use and application.

** Adhesive residue is defined as residual staining that is left after all adhesive has been scraped away down to the concrete surface.*

Concrete Joints:

Expansion and Isolation Joints

Expansion and isolation joints in concrete are designed to allow for the expansion and contraction of the concrete. All movable joints must be honored in order to eliminate buckling and telegraphing in the finished resilient flooring caused by movement in the concrete. Expansion joint products designed for use with resilient floorings must be used at all movable joints.

Construction and Control Joints (Saw Cuts)

All such non-moving joints should be properly cleaned and prepared using suitable fillers and/or patching and leveling materials. Always follow the manufacturer's recommendations for the use and application of these products. For additional information, refer to the ***Substrate Preparation Section*** of this document.

NOTE: Trenches and repairs must be treated as new concrete. For recommended practices, refer to the ***Substrate Preparation Section*** of this document.

Forbo Limited Warranty

Forbo warrants that our products and their recommended adhesives will be free from manufacturing defects. Failures that are the direct result of circumstances beyond the control of Forbo, such as movement in the concrete and/or moisture coming from the joint subsequent to the installation of resilient flooring materials causing buckling or telegraphing of the joint are NOT covered under warranty. The recommendations in the Forbo Installation Guidelines are intended to inform the users of Forbo products about reliable installation methods as well as some of the potential risks that could lead to installation failure. The purpose of this information is to provide the necessary information to ensure a successful installation.

Additional Resources

Reference documents for proper specification requirements are:

- ASTM C 840 - Standard Specification for Application and Finishing of Gypsum Board.
- ASTM E 1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
- ASTM F 141 - Standard Terminology Relating to Resilient Floor Coverings
- ASTM F 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
- ASTM F 1482 - Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
- ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emissions Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
- ASTM F 2419 - Standard Practice for Installation of Thick Poured Gypsum Concrete Underlayments and Preparation of the Surface to Receive Resilient Flooring
- ASTM F 2471 - Standard Practice for Installation of Thick Poured Lightweight Cellular Concrete Underlayments and Preparation of the Surface to Receive Resilient Flooring
- ASTM F 2659 - Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and other Floor Slabs and Screeds Using a Non- Destructive Electronic Moisture Meter
- ASTM F 2678 - Standard Practice for Preparing Panel Underlayments, Thick Poured Gypsum Concrete Underlayments, Thick Poured Lightweight Cellular Concrete Underlayments, and Concrete Subfloors with Underlayment Patching Compounds to Receive Resilient Flooring
- ASTM F 3191 - Standard Practice for Field Determination of Substrate Water Absorption (Porosity) for Substrates to Receive Resilient Flooring

Forbo's General Installation Guidelines contain additional information and are available for download at www.forboflooringNA.com. For additional information, contact Forbo's Product Support & Education Services at 1-800-842-7839.