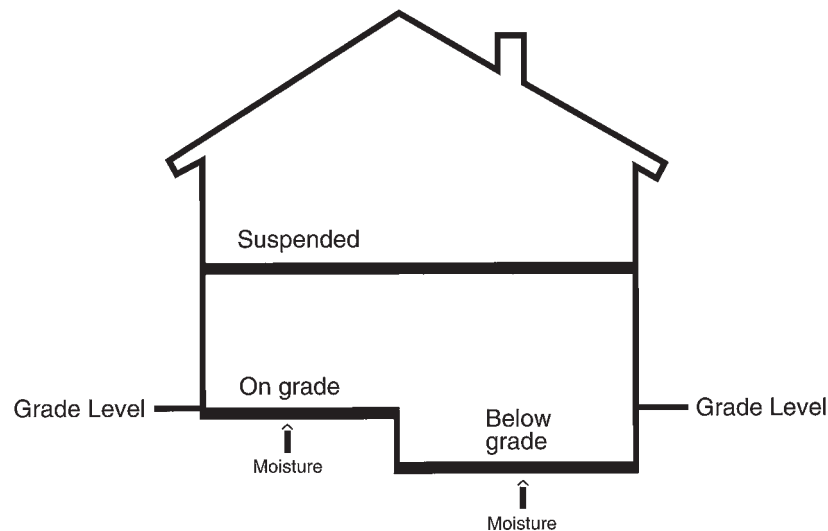


Substrate Evaluation and Preparation

No floor covering can be any better than the substrate over which it is installed. The finished appearance and performance of the floor covering will be determined and affected by the condition of the substrate. It is essential that all substrates be structurally sound, rigid, smooth, flat, clean, and permanently dry. The substrate surface must be free of all contaminants or foreign materials such as dust, wax, paint, grease, oils, solvents, curing and hardening compounds, sealers, and existing adhesives. Substrate evaluation and preparation should not begin until a stable, conditioned environment as described under Jobsite Conditions has been established.

NOTE: The results of moisture testing, pH testing, and adhesive 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 of resilient flooring materials. Changes in the interior environment subsequent to such testing may cause conditions to change and lead to installation failures.



6.1 - DEFINITIONS

Grade Levels:

On Grade – A location for a finished floor with no portion below ground level, and with the floor and the ground in contact or separated by less than 18 inches of well-ventilated space between the bottom of the lowest horizontal structural member and the ground at any point.

Above Grade (Suspended) – A location for a finished floor where the floor is not in contact with the ground and which provides at least 18 inches of well-ventilated space between the bottom of the lowest horizontal structural member and the ground at any point.

Below Grade – A location for a floor structure which is in contact with the ground or with less than 18 inches of well-ventilated space between the bottom of the lowest horizontal structural member and the ground, at any point and if part or all of the floor is below ground level.

Subfloor – that 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.

Underlayment – The layer of material installed on or over the subfloor to provide a smooth, clean surface to receive the resilient floor covering.

Substrate - the underlying support surface upon which the flooring is directly installed.

Subfloor–Underlayment Combination – Designed to meet both the structural requirements and to provide a smooth surface to receive the floor covering.

• **Note:** Subfloor-Underlayment Combinations are usually only suitable for the installation of textile type floor coverings. For resilient floor coverings, underlayment should be installed.

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, and finish flooring materials.

(Refer to ASTM F141 for additional definitions)

Substrate Evaluation and Preparation

6.2 - SUBSTRATE EVALUATION

6.21 - Concrete Subfloors (Refer to ASTM F710)

Concrete substrates shall be structurally sound, rigid, smooth, flat, clean, and permanently dry. The concrete surface must be free of all contaminants or foreign materials such as dust, paint, wax, grease, oils, solvents, curing and hardening compounds, sealers, and existing adhesives.

Concrete substrates shall have a minimum compressive strength of 3500 psi and a dry density of at least 150 pounds per cubic foot.

Concrete subfloors on or below grade shall have an acceptable vapor retarder underneath. The vapor retarder shall be puncture and tear resistant with a minimum thickness of 15 mils, and have a permeability rating of 0.3 perms or less. Refer to ASTM E1745. If no vapor retarder is present, contact Forbo Technical Services for additional information.

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. (see Substrate Preparation)

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 covers designed for use with resilient floorings must be used at all movable joints.

Construction and Control Joints (sawcuts) - all such non-moving joints should be prepared using suitable fillers and/or patching and leveling materials. Always follow the manufacturer's recommendations for the use and application of these products. (see Substrate Preparation)

Note: If movement in the concrete and/or moisture coming from the joint subsequent to the installation of resilient flooring materials causes buckling of the flooring material or telegraphing of the joint, it is a structural or site related condition. Any such damage resulting from those conditions is not covered under Forbo's warranty. Having the areas to receive floorcoverings conditioned as described under Jobsite Conditions will reduce the potential for such occurrences.

It may be difficult to determine if curing compounds, hardening compounds, and/or sealers have been used. Always conduct adhesive bond tests prior to the installation to ensure the integrity of the flooring system, and to ensure that a secure bond can be achieved.

6.22 - Wood Subfloors (Refer to ASTM F1482)

Wood substrates shall be structurally sound, rigid, smooth, flat, clean, and permanently dry. The wood surface must be free of all contaminants or foreign materials such as dust, paint, wax, grease, oils, solvents, curing and hardening compounds, sealers, and existing adhesives.

Wood subfloors should be double construction with a minimum total thickness of 1". All wood subfloors must have at least 18" of well-ventilated air space below.

Forbo floor coverings should not be installed over wooden subfloors built on sleepers over on grade or below grade concrete floors without first making sure that adequate precautions have been taken 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 resilient flooring. Underlayment panels should be acclimated to site conditions as prescribed by the manufacturer. In lieu of specific recommendations, acclimate panels for a minimum of 48 hours prior to installation.

Underlayment panels should be a minimum of 1/4" in thickness, of underlayment grade with one fully sanded face, and recommended for use as underlayment for fully adhered resilient flooring (APA Underlayment Grade plywood or equal). Underlayment panels must be free of any foreign material that may prohibit a secure bond or cause the discoloration of resilient flooring, such as adhesives, sealers, inks, solvents, etc.

Always follow the panel manufacturer's recommendations for panel installation and preparation. In lieu of specific installation recommendations, successful panel installation may be accomplished as follows:

Using narrow crown, divergent point staples that will not extend completely through the subfloor, begin fastening the panel in one corner and proceed in a fan pattern across the panel. Place staples four to six inches apart in the middle of the panel and two to three inches apart at the panel edges.

Substrate Evaluation and Preparation

Staples should be no closer than 3/8" from the panel edge. Panels should be lightly butted, with no pressure. After fastening, sand all panel joints flush.

Years of experience have identified a number of wood substrates that may cause problems when resilient flooring products are installed over them. 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 bond tests prior to the installation to ensure the integrity of the flooring system, and to ensure that a secure bond can be achieved.

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, and not Forbo.

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 will be absorbed by the wood, causing the wood fibers to swell and potentially causing 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.

6.23 - Existing Resilient Flooring

Forbo floor coverings installed over existing resilient flooring may be more susceptible to indentation, and there is always the possibility that the existing flooring may telegraph through the new flooring.

Forbo floor coverings may be installed over a single layer of non-cushioned resilient flooring provided it meets the following conditions:

1. Where existing resilient flooring is installed over concrete that is on, above and below grade, there should be no history of moisture related problems and moisture test results must not exceed the requirements of the existing resilient flooring or the product to be installed (see Moisture Testing).
2. The substrate and underlayment must meet the requirements of the existing and the new floor covering.
3. The existing flooring must be fully adhered and well bonded.
4. The existing flooring must not be embossed or textured.

5. All cuts, gouges, dents, and other damage must be repaired with flooring material that is the same or similar to that installed, or with patching materials suitable for that purpose. Always follow manufacturer's recommendations for use and application of patching materials.
6. 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 assure stripper residues have been removed.

The use of embossing levelers is not recommended for commercial installations.

Note: Application of a skim coat of patching material over the existing resilient flooring may cause more problems than it resolves; such as bonding failures, cracking and indentations.

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

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 RCFI'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.

Substrate Evaluation and Preparation

6.24 - Poured Floors (Epoxy, Polymeric, Seamless)

Forbo floor coverings may be installed over most poured floors provided they meet the following conditions:

1. Where poured flooring is installed over concrete that is on, above and below grade, there should be no history of moisture related problems and moisture test results must not exceed the requirements of the existing resilient flooring or the product to be installed (see Moisture Testing).
2. The poured floor must be totally cured and well bonded to the concrete. It must be free of any residual solvents and petroleum derivatives.
3. Loose, damaged areas and irregularities must be repaired with a patching compound suitable for that purpose. Always follow manufacturer's recommendations for use and application of patching materials.
4. The texture must be smooth. Sand or wet stone the surface to remove any grit and texture.
5. 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 assure stripper residues have been removed.

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

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.

6.25 - Radiant Heated Floors

Forbo floor coverings may be installed over radiant heated floors providing the maximum temperature of the surface 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 the temperature lowered, for at least 48 hours prior to installation of the Forbo flooring material. This is to ensure the surface temperature of the substrate does not exceed 650 F during the installation of the flooring material.

If necessary, an alternate heating source must be used to maintain the room temperature a minimum of 68° F prior to, during, and for 72 hours after installation. 72 hours following the installation, the temperature of the radiant heating system can be increased. When raising the floor temperature, do so gradually so that the substrate and flooring material can adapt to the temperature change together. A rapid temperature change could result in bonding problems. For more information, contact Forbo Technical Services.

6.26 - Moisture Testing

It is essential that moisture tests be taken on ALL concrete slabs regardless of age or grade level, including those where resilient flooring has already been installed. Moisture tests should not be conducted unless a stable, conditioned environment as described under Jobsite Conditions 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 installation of resilient flooring materials. Changes in the interior environment subsequent to such testing may cause conditions to change and lead to installation failures.

Forbo recommends that two types of moisture testing be conducted:

1. **Calcium Chloride Moisture Vapor Emission Testing**
Testing should be done in accordance with ASTM F1869. The moisture vapor emissions from the concrete must not exceed the requirements of the flooring product(s) and adhesive(s) being used.

When conducting calcium chloride moisture vapor emission tests, unreliable or erroneous test results are most often the result of:

- Conducting tests in an uncontrolled environment.
- Failure to properly prepare the concrete surface. Any existing flooring and/or adhesive must be completely removed prior to testing.
- An inadequate seal between the dome and the concrete surface.
- Not subtracting the area of the calcium chloride dish when calculating results.
- Lack of proper documentation and reporting.

2. **Relative Humidity Probe Testing**

Testing should be done in accordance with ASTM F2170. The relative humidity measured from the center of the concrete slab must not exceed 75%.

When conducting relative humidity probe tests, unreliable or erroneous test results are most often the result of:

- Conducting tests in an uncontrolled environment.
- Failure to ensure that the drilled hole was properly sealed.
- Test equipment that has not been properly acclimated to site conditions
- Test equipment out of calibration. Equipment should have an accuracy of +/- 3%.
- Lack of proper documentation and reporting.

Substrate Evaluation and Preparation

A minimum of three tests of each type should be conducted on every job. On larger jobs, an additional test of each type should be conducted for each additional 1,000 sq. ft. over 1,000 sq. ft. of flooring to be installed. 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. Installation of Forbo flooring products where moisture conditions exceed specified limits may result in partial or complete failure, and any damage or failure caused by excessive substrate moisture is the responsibility of others, and not Forbo.

Failure to honor this recommendation is an implied acceptance of site conditions by the parties involved.

Moisture tests indicate conditions at the time of the test only. The absence of an acceptable vapor retarder under the slab, changes in the environment, or other circumstances beyond Forbo's control, may lead to adverse changes in the moisture condition of the concrete. 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.

6.27 - pH Testing

It is essential that pH tests be conducted on all concrete floors regardless of the age or grade level. During the curing and drying of concrete, or whenever moisture is present and working its way through the concrete, moisture 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 or discoloration, shrinkage, and softening of the floor covering.

Testing the concrete pH should be done in several locations throughout the area to receive flooring. The best rule to follow is to conduct pH tests at each calcium chloride test location as the calcium chloride tests are removed. Conduct the pH test by placing a small drop of distilled or de-ionized water on the surface of the concrete. The concrete surface should remain wet for a minimum of 60 seconds; the more porous the concrete, the larger the drop should be. Slight agitation of the surface of the concrete may be necessary to ensure that any alkaline salts have dissolved into the water. Place a full range pH test strip in the water and wait until the color stops changing. Compare the color of the test strip to the chart that comes with the test strips. If the pH is greater than 10, 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. Retest to assure the pH has been reduced. There are also commercially available pH blockers. Check with your local flooring supply house, or in trade publications for availability of these products.

6.28 - Substrate Porosity

Substrate porosity has a significant influence on the working characteristics of adhesives (open time and working time). It is important for the installer to recognize and understand this relationship so that adhesives will be used properly, especially for "wet set" installations. Where the substrate is non-porous, very porous, or if substrate porosity is not uniform, adjustments will have to be made in installation procedures to compensate. Where the substrate is less porous, the adhesive will dry more slowly, extending the "open time" required to allow the adhesive to develop "body" before placing the material. Where the substrate is more porous, the adhesive will dry more rapidly and may require that the adhesive be applied incrementally so that the material can be placed and rolled while the adhesive is still wet enough to achieve the transfer necessary for a secure bond. It is the installer's responsibility to recognize the working characteristics of the adhesive for a 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 eye-dropper of water, and place a row of water drops on the surface of the substrate. If within 60 seconds the drops are not absorbed into the substrate, the substrate should be considered non-porous.

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

Abrading the surface of uncontaminated, non-porous substrates may be necessary to achieve a secure bond. Primers may also be useful in improving the adhesive bond to smooth, non-porous substrates. For very porous substrates, a primer may be useful for reducing the substrate porosity and improving the working characteristics of the adhesive. A primer may also be necessary to provide a uniform porosity over surfaces where substrate porosity is inconsistent. (see Primers)

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

Substrate Evaluation and Preparation

6.29 - Adhesive Bond Testing

Adhesive bond testing will identify most potential bonding problems and is essential for ensuring the integrity of the flooring system prior to the installation. Adhesive 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. Adhesive bond tests should also be used to evaluate test areas for proposed remediation or preparation procedures.

Conduct adhesive bond tests by adhering 3' X 3' squares of material in various locations throughout the area where flooring is to be installed. The number of tests required will vary, but should be representative of evaluating the entire surface where material will be installed. Be sure to conduct tests where patching/leveling materials have been used, or anywhere moisture control systems or primers have been used. Allow the adhesive to dry for a minimum of 72 hrs., and then remove the test squares.

Interpreting the results of an adhesive bond test will vary depending on the substrate, adhesive, and the flooring material used. Generally, when using Forbo single component adhesives over standard substrates (concrete, wood, existing flooring) and following "wet set" installation recommendations, 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. If all or most of the adhesive is on the material backing, there is very likely a contaminant on the substrate. If all or most of the adhesive remains on the substrate, the adhesive most likely dried too much before placing the material, or the material was not rolled properly. If the failure occurs within or between other components of the flooring system, there may be a problem with those components.

Note: When evaluating adhesive bond tests using Forbo T940 adhesive and Marmoleum Dual Tile, the failure will generally occur between the adhesive and the tile backing rather than within the adhesive layer. This is normal so long as significant force is required to remove the test sample, and the impression of the tile backing can be readily seen in the adhesive layer. The tile must be fully bedded in the adhesive with no significant appearance of trowel ridges.

There is no standard criteria for evaluating adhesive bond tests, but a bond test is generally considered "passed" when there is no apparent "bond failure" within any component of the flooring system, and the force required to remove the test sample is judged adequate to provide satisfactory performance of the flooring system for the intended application. For additional information, contact Forbo Technical Services.

It is the installer's responsibility to identify and correct potential bonding problems and to ensure that a satisfactory bond can be achieved prior to beginning the installation.

6.3 - SUBSTRATE PREPARATION

Vacuuming the substrate with a commercial shop vacuum is the preferred method of removing dirt and dust. For concrete floors, damp mopping the substrate is an excellent way to remove fine dust. A clean substrate enables a secure bond between the substrate and the floor covering.

6.31 - Patching and Leveling Materials

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

Historically, the use of gypsum based materials has been discouraged by resilient flooring manufacturers because of performance concerns such as lower compressive strength, bonding issues, and the potential for promoting the growth of mold and mildew. Improvements in technology however, have led to the development of gypsum based leveling compounds in particular, that have much improved performance characteristics than earlier products.

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 and 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, and not Forbo.

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

Substrate Evaluation and Preparation

6.32 - Primers

The use of a primer may be necessary to improve adhesive bond to extremely smooth, non-porous substrates such as terrazzo, existing resilient flooring, or power troweled concrete. A primer may also be necessary to reduce the porosity of extremely porous substrates, or to create a uniform porosity where spot patching has been done over a non-porous substrate for example.

Forbo Moisture Limitor may be used as a primer. Refer to Moisture Limitor guidelines for complete instructions. There are also third party products available for this purpose. Always strictly follow the manufacturer's recommendations for their use and application.

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

6.33 - Existing Adhesives

Warning!

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.

- Never use solvents or adhesive removers to remove old adhesive residue. Any residue left within the substrate may affect the new adhesive and new floor covering. Conducting pH tests and adhesive bond tests prior to the installation will help in identifying the possible use of these materials.

Where existing asphaltic (cut-back) or other type of adhesive is present, it must be dealt with in one of 3 ways:

1. It may be mechanically removed by grinding, bead blasting, scarifying, etc.
2. The adhesive residue* may be encapsulated with a suitable self-leveling underlayment. Follow the self-leveling manufacturer's recommendations for intended use and application.
3. The adhesive residue* may be encapsulated with Forbo Moisture Limitor. Refer to Moisture Limitor guidelines for complete instructions.

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

6.4 - ADDITIONAL RESOURCES

6.41 - Specification Requirements/Reference Documents

Reference documents for proper specification requirements are:

- ACI 302--Guide for Concrete Floor Construction
- ASTM E1745--Specification for Vapor Retarders
- ASTM F1482 - Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
- ASTM F710--Preparing Concrete Floors to Receive Resilient Flooring

6.42 - Organizations

Additional information and guidelines regarding substrates and substrate preparation can be obtained by contacting the following organizations:

APA - The Engineered Wood Association
7011 So. 19th, Tacoma, WA 98466
(253) 565-6600 / Fax: (253) 565-7265
www.apawood.org

ACI - American Concrete Institute
P.O. Box 9094
Farmington Hills MI 48333
(248) 848-3700
www.aci-int.net

PCA - Portland Cement Association
5420 Old Orchard Rd.
Skokie, IL 60077
(847) 966-6200 / Fax: (847) 966-8389
800-868-6733
www.cement.org

RFCI - Resilient Floor Covering Institute
401 E. Jefferson Street, Suite 102
Rockville, MD. 20850
(301) 340-8580
www.rfci.com

ASTM - American Society for Testing and Materials
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
(610) 832-9585 / Fax: (610) 832-9555
www.astm.com