The Euclid Chemical Company

Concrete Floor Systems Design Guide

Guidelines for High Performance Slab-on-Grade Construction

How to use this guide

The Euclid Chemical Company originally developed this floor design guide in order to integrate current design standards with proper construction practices and the selection of suitable materials. This updated edition reflects the current standards on floor slab construction that are found in ACI 302.1R-04, Guide for Concrete Floor and Slab Construction. References to this document are made throughout this guide if the reader wishes to consult the appropriate section of ACI 302 for more detail. Recommendations on how to improve construction practices will be made where appropriate.

Many floors are designed and installed with high expectations only to fail in service due to improper or inferior material selection. Quality products manufactured by The Euclid Chemical Company are referenced in this guide where appropriate and should be used for the purposes specified.

This guide is useful to anyone involved with floor slabs, but the following will find it most beneficial:

Facility Owners
The owner must live with the floor long after it has been installed and accepted. This guide is useful for choosing a particular floor finish suitable for the owner's operation.

Engineers/Architects
The design professional will be able to find those items most pertinent to the specification for a particular floor type. It will save time in quickly locating this information.

Contractors
The installer will find useful information on material application and can use design parameters in situations where specifications are unclear or left up to the contractors' discretion. The guide will improve the probability of achieving satisfaction with the final results.

Use of this guide is very straightforward and requires following a few simple steps:

Step 1: Go to the "Table of Floor Classifications" found on page 2. Review the list of floor uses and service conditions to determine the "class" of floor needed.

Step 2: Go to pages 3 and 4 and review the "Table of Design Parameters." This table provides a complete review of the design considerations for the class of floor being specified.

Step 3: Go to the appropriate Floor Application/Product section on pages 7-15 to select the products that are most appropriate for a particular floor design.

Building "Green"
The LEED (Leadership in Energy & Environmental Design) Green Building Rating System provides a national standard for defining an environmentally friendly, sustainable "green" building. Points are awarded to building projects based on water savings, energy efficiency, materials and indoor environmental quality.

The Euclid Chemical Company manufactures many products that can contribute points toward the LEED certification of a building. These products are designated with a ▲ symbol in the performance and usage charts. For further information on an individual product for a "green building" design, contact The Euclid Chemical Company.

Every effort has been made to make this guide a useful tool. However, not every detail may be covered. If any questions arise or more information is required, please contact your local Euclid sales representative or The Euclid Chemical Company.

Contents

Table of Floor Classifications[1]

	Class	Anticipated Type of Traffic	Use	Special Considerations	Final Finish
Single Course	1	Exposed surface — foot traffic	Offices, churches, commercial, institutional, multi-unit residential Decorative	Uniform finish, non-slip aggregate in specific areas, curing Colored mineral aggregate, color pigment or exposed aggregate, stamped or inlaid patterns, artistic joint layout, curing	Normal steel-troweled finish, non-slip finish where required As required
	2	Covered surface — foot traffic	Offices, churches, commercial, multi-unit residential, institutional with floor covering Decorative	Flat and level slabs suitable for applied coverings, curing. Coordinate joints with applied coverings	Light steel-troweled finish
	4	Exposed or covered surface — foot and light vehicular traffic	Institutional and commercial	Level and flat slab suitable for applied coverings, non-slip aggregate for specific areas, curing. Coordinate joints with applied coverings	Normal steel-troweled finish
	5	Exposed surface — industrial vehicular traffic, that is, pneumatic wheels, and moderately soft solid wheels	Industrial floors for manufacturing, processing, and warehousing	Good uniform subgrade, joint layout, abrasion resistance, curing	Hard steel-troweled finish
	6	Exposed surface — heavy duty industrial vehicular traffic, that is, hard wheels, and heavy wheel loads	Industrial floors subject to heavy traffic; may be subject to impact loads	Good uniform subgrade, joint layout, load transfer, abrasion resistance, curing	Special metallic or mineral aggregate surface hardener; repeated hard steel-troweling
Two Course	3	Exposed or covered surface — foot traffic	Unbonded or bonded topping over base slab for commercial or non-industrial buildings where construction type or schedule dictates	*Base Slab* — good uniform level surface tolerance, curing *Unbonded topping* — bond-breaker on base slab, minimum thickness 3 in. (76 mm), reinforced, curing *Bonded topping* — properly sized aggregate, 3/4 in. (19 mm) minimum thickness curing	*Base slab* — troweled finish under unbonded topping; clean, textured surface under bonded topping *Topping* — for exposed surface, normal steel-troweled finish. For covered surface, light steel-troweled finish
	7	Exposed surface — heavy duty industrial vehicular traffic, that is, hard wheels, and heavy wheel loads	Bonded two-course floors subject to heavy traffic and impact	*Base Slab* — good uniform subgrade, reinforcement, joint layout, level surface, curing *Topping* — composed of well-graded all-mineral or all-metallic aggregate. Minimum thickness 3/4 in. (19 mm). Mineral or metallic aggregate surface hardener applied to high-strength plain topping to toughen, curing	Clean, textured base slab surface suitable for subsequent bonded topping. Special power floats for topping are optional, hard steel-troweled finish
	8[2]	As in Class 4, 5, 6	Unbonded toppings — on new or existing floors or where construction sequence or schedule dictates	Bond breaker on base slab, minimum thickness 4 in. (102 mm) abrasion resistance, curing	As in Class 4, 5 or 6
Single Course or Topping	9	Exposed surface — superflat or critical surface tolerance required. Special materials-handling vehicles or robotics requiring specific tolerances	Narrow-aisle, high-bay warehouses; television studios, ice rinks, or gymnasiums. Refer to ACI 360 for design guidance	Varying concrete quality requirements, curing Special application procedures and attention to detail are recommended when shake-on hardeners are used. F_f35 to F_f125 ("superflat" floor)	Strictly follow finishing techniques as indicated in ACI 302.1R-04, section 8.9

1. See ACI 302.1R, Table 2.1.
2. Class 8 floors are special cases for service conditions that fall under classes 4, 5 and 6.

Note: Much investigation should go into the service conditions intended. No type of facility always falls into a single class of floor. Classes may vary depending on the service conditions peculiar to a given operation. Floor class may vary even in the same facility, as service conditions vary from one part of a facility to the next.

Table of Design Parameters

Class		Concrete Parameters				
		28-Day Compressive Strength	Suggested Minimum Thickness[1]	Slump[2]	Air Content[4]	Admixtures[3]
	ACI Reference	Table 6.1 psi (MPa)	See ACI 360 Inch (mm)	Table 6.1 Inch (mm)	Section 6.2.3 Also see ACI 201.2R	Section 5.7
1	Light Foot/Residential	3000 (20.7)	4" (102)	5" (127)	Varies with exposure	All types
2	Foot/Offices etc.	3000 (20.7)	4" (102)	5" (127)	Varies with exposure	All types
3	Foot, Pneumatic Wheel Exterior Walks & Drives	3000 (20.7)	4" (102)	5" (127)	Varies with exposure	All types
4	Foot & Light Vehicular Commercial	3500 (24.1)	5" (127)	5" (127)	Varies with exposure	All types
5	Industrial Pneumatic Traffic	3500 (24.1)	5" (127)	5" (127)	Varies with exposure	All types
6	Industrial Hard Wheel Traffic	3500 (24.1)	6" (152)	5" (127)	Varies — no air with special surface	Non-chloride with metallic finishes
7	Base	3500 (24.1)	5" (127)	5" (127)	Varies	Non-chloride with metallic finishes
	Topping	5000 (34.5)	3/4" (19)	3” (76)		
8	Topping	4000 (27.6)	2 1/2" (63)	3" (76)	Varies	Varies
9	Superflat	4000 (27.6)	5" (127)	5" (127)	No air typically	All types

1. Minimum thickness should be checked against the design charts found in ACI 360 or in The Portland Cement Association publications.

2. Slumps are for concrete mixes containing an approved water-reducing admixture. Higher slumps may be achieved with the use of properly designed mixes containing the specified high-range water-reducing admixture (superplasticizer). The optimum concrete workability should be discussed/resolved prior to the start of slab placement. A successful test placement onsite is required to verify proper workability, finishability and setting time.

3. Admixtures will vary greatly depending on their composition and quality control. The required concrete quality with respect to acceleration, retardation, water content, degree of workability, early strength development, etc., should be discussed at the pre-job meetings. Most specifications require all admixtures to be non-corrosive and non-chloride based to minimize the potential for steel corrosion.

4. Air content in interior steel trowel surfaces shall be a maximum of 3% (no air-entraining admixture added). Air content should be verified by air meter and unit weight tests.

Table of Design Parameters

Joints			Special Surfaces		Surface Finishes and Textures	Curing	Sealing and Protection
Isolation	**Contraction[5]**	**Construction**	**Surface Hardeners**	**Toppings**			
Section 3.2.5.1	**Section 3.2.5.3**	**Section 3.2.5.2**	**Section 8.6 and 8.13**	**Section 8.7**	**Section 8.3 – 8.13**	**Section 9.1 and 9.2**	
Expansion joint fillers at walls and footings — all restraint points	Tooled or sawed 10′ to 12′ (3 to 3.6 m) on center typically	Thickened edges with 1 to 5 slope 5′ (1.5 m) apart	N.A.	Self-leveling underlayment or finish course[7]	Troweled smooth	• Membrane • Water • Polyethylene • Curing Paper	• Acrylic • Urethane • Epoxy • Penetrants
Same as Class 1	Same as Class 1	Same as Class 1	• Non-slip (mineral) aggregate • Colored shakes • Light reflective shakes	Same as Class 1	• Troweled smooth • Broomed • Floated • Exposed aggregate	Same as Class 1	Same as Class 1
Same as Class 1	Tooled or sawed at intervals equal to slab widths	Same as Class 1	Same as Class 2	N.A.	Same as Class 1	Same as Class 1	• Acrylic • Penetrants
Same as Class 1 with blockouts around columns	Sawed spacing in feet 2-3 times slab thickness in inches	Doweled and/or Keyed	Same as Class 2	Same as Class 1	Troweled smooth	Same as Class 1	Same as Class 1
Same as Class 4	Same as Class 4	Same as Class 4	Same as Class 2	N.A.	Troweled hard	Same as Class 1	Same as Class 1
Same as Class 4	Same as Class 4	Same as Class 4	• Metallic shakes • Silica shakes • Non-slip aggregate • Light reflective shakes	N.A.	Troweled hard	Same as Class 1	Same as Class 1
Same as Class 4	Same as Class 4[6]	Same as Class 4	Natural or metallic shakes over topping	• Natural aggregate topping • Metallic aggregate topping Troweled hard	Same as Class 1	Same as Class 1	See appropriate class
See appropriate class	See appropriate class	See appropriate class	See appropriate class	Natural aggregate topping	See appropriate class	Same as Class 1	See appropriate class
Same as Class 4	Same as Class 4	Same as Class 4	Same as Class 6	See Class 7 or 8 if appropriate	Troweled hard	Same as Class 1	Same as Class 1

5. Contraction joints using an early-entry saw should be cut to a minimum depth of 1″. Saw-cut joints should be 1/4 of the slab depth using wet or dry conventional saw-cut methods. A semi-rigid joint filler should be installed to support joint edges (See ACI 302, Section 3.2, 5.12, 9.10) where the joint is exposed to small hard wheeled traffic and/or continual traffic or has exhibited joint breakdowns in a similar existing facility.

6. Bonded toppings should be cut to 1/2 the topping thickness directly over the joints in the base slab (see ACI 302, Section 8.7.2).

7. Self-leveling underlayments and toppings are not covered by ACI 302, but are commonly used for restoring smoothness and levelness to deficient floors.

Base Concrete Placement

Production of a quality concrete slab requires proper techniques and adequate planning. The following key areas have been identified as the most critical to achieving a satisfactory result. References to ACI Guide for Concrete Floor and Slab Construction are given where appropriate.

1. Subgrade
The subgrade must be properly compacted and drained in order to give the bearing support assumed in design. Without support, the slab has little chance of supporting design loads (Section 3.1). Maximum deflection under a fully loaded ready mix truck should be 1/2" (13 mm).

2. Vapor Barrier/Vapor Retarders
Any slab-on-ground that will be covered by materials such as linoleum, wood, carpet, and non-breathable coatings should be protected from the transmission of moisture and vapor upward through the slab from sources in the base and sub-base.

Vapor barriers and vapor retarders are used to minimize moisture and vapor transmission. ASTM E 1745 lists performance requirements for plastic vapor retarders. The type of vapor barrier/retarder selected is based on the amount of protection required and the moisture sensitivity of the floor covering to be installed. Vapor barriers/retarders can be placed directly beneath and in contact with the concrete slab, or a layer of granular fill may be installed between the concrete and the barrier/retarder. Direct placement of concrete on top of a vapor barrier can contribute to problems such as plastic and drying shrinkage cracking and curling.

Each vapor barrier/retarder installation should be evaluated on an individual project basis. Figure 3.2 in ACI 302 should be used to assist in making decisions regarding vapor barrier/retarder placement. Low w/cm mixes are often used to reduce the time required for the concrete to reach a moisture level suitable for an adhesive application.

3. Contraction (Control) Joint Location
Contraction joints are normally located on column lines with additional intermediate joints located equally spaced between column lines. See Figure 3.3 of ACI 302 for details. There are several factors to consider when designing the spacing of contraction joints including the thickness of the slab, location and type of reinforcement, potential for slab shrinkage, and many others. In unreinforced slabs, contraction joints should be spaced in feet, 2 - 3 times the slab thickness up to a maximum of 18 ft. Spacing in reinforced slabs can be slightly increased beyond the recommendation for unreinforced slabs when a low shrinkage mix design is used. Dowel baskets can be used to give support to joint dowels and maintain alignment. Often, structural fibers are used in these slabs to hold cracks tight. Consult ACI 360R for specific details regarding design and spacing of contraction joints.

4. Construction Joints
Construction joints are used where individual concrete placements meet. Each joint should be located at least 5 ft. (1.5 m) or more from any other joint to which it is parallel.

If hard-wheeled traffic or heavy loads are expected to travel over construction joints, dowels are recommended to tie the slabs together so that both sides of the joint are displaced equally when under load. Dowels can be round, square,

rectangular, or diamond-shaped. Diamond dowels are recommended for construction joints as they have movement in four directions. Round dowels are not as effective in restricting curling because of the installation procedure, which results in a sleeve, or larger than desirable cavity, and there is no movement allowed in the direction perpendicular to the dowels. Dowels should be properly aligned and smooth so that the joint can open as the concrete shrinks. Support should be provided to dowels during the concrete placement and finishing operations so that they remain parallel in both planes (horizontal and vertical).

Keyed joints do not provide effective load transfer, and should not be used in areas of heavy traffic loads.

5. Isolation Joints
Preformed joint materials are used to create isolation joints between the floor and walls, columns, equipment foundations, footings, drains and other separate building members. Isolation joints allow for freedom of movement of the floor independent of these building elements. Figures 3.4, 3.5, and 3.6 in ACI 302 illustrate the different types of isolation joints used.

6. Admixtures
Admixtures are used to effect a specific improvement in the properties of freshly mixed or hardened concrete. Admixtures should be used in accordance with the instruction and principles provided in ACI 212.1R and 212.2R with attention to the guidelines for chloride limits given in ACI 302.1R-04, Section 5.7.3 (also check recommendations on chloride limitations in ACI 201 and ACI 318). Testing should be performed to determine how the admixture(s) will affect the properties of the concrete given the specified job materials, as well as the anticipated conditions and construction procedures. Often, admixtures are used in combination with one another. A second admixture can significantly affect the dosage requirement of both admixtures. Preliminary tests are recommended to ensure the optimum dosage of each admixture. Successful placements onsite will verify proper workability, finishability and setting time.

It is important to consult the manufacturer and applicable MSDS for specific material handling, dosage and application instructions.

Admixture(s) that are used in concrete should meet the appropriate specifications (see page 7 of this guide).

7. Air Entrainment
Proper air entrainment is required for exterior slabs subject to freeze/thaw cycles and de-icing salts (Section 6.2.3). However, for interior industrial slabs, air entrainment is not desirable because of adverse effects on finishability and difficulty in applying surface hardeners. Air content should not exceed 3% for these types of slabs.

8. Synthetic Fibers
Synthetic fibers for use in concrete floors increase the cohesiveness of concrete and should meet the requirements outlined in ASTM C 1116. The most widely used synthetic fibers are polypropylene and nylon, although other types are available. Fibers are generally available in both fibrillated and monofilament forms. Structural macro-fibers (larger coarse fibers) can be used to provide equivalent post-crack strength to conventional reinforcement depending on the specific fiber dosage (see page 8 of this guide for further information). Synthetic macro fibers can also be used to reduce plastic shrinkage cracks as well as minimizing drying shrinkage cracks when used in a low shrinkage mix (0.04% @ 28 days or less). Synthetic micro-fibers, polypropylene and nylon, are most widely used to reduce the formation of plastic shrinkage cracks and to hold cracks tight.

9. Placing Sequence
In many cases, the most efficient way to place concrete in large areas is in long alternating strips. Strip placements allow superior access to the sections being placed. A checkerboard sequence of placement has been used in the past in an effort to permit earlier placements to shrink, and to obtain minimum joint width. However, experience has shown that shrinkage of the earlier placements occurs too slowly for this method to be effective. Access is more difficult and expensive, and joints may not be as smooth. The ACI 302 committee recommends that the checkerboard sequence of placement not be used. It is important to note, large block placements, up to two bays wide, are often used on laser screed projects.

10. Bleeding
Excessive bleeding is a major deterrent to achieving quality slab surfaces. Proper concrete mix proportioning, the use of a well graded aggregate with a water reducing admixture and/or a high range water reducing admixture (superplasticizer), along with low water content and "normal" setting characteristics contribute to quality results. Additionally, controlled vibration and slump, the use of compactible fill as a blotter over vapor barriers and concrete temperature controls help alleviate this problem. Collected bleed water should be removed before the start of finishing operations or the application of dry shake surface hardeners or toppings (Section 8.16).

11. Evaporation
Rapid evaporation and moisture loss can result in plastic shrinkage cracking in the slab surface. This undesirable appearance can be minimized or prevented by dampening the subgrade, cooling water and aggregates, using windbreaks or sunshades, eliminating vapor barriers, using fog sprays, and/or treating the concrete with a monomolecular film just after bullfloating (Section 11.2.2.1). EUCOBAR, manufactured by The Euclid Chemical Company, is recommended where a monomolecular film is desired.

12. Surface Tolerances (Based on ACI 302, Section 8.15)
In the past, floor profile quality had been specified by limiting the size of the gap measured under a 10 ft. (3 m) long straightedge placed anywhere on the floor. Today, the Face Floor Profile, or "F-number" system provides a more accurate method for specifying, executing, and measuring the surface tolerance of a floor.

Two separate "F-numbers" are required to define the shape of the worst acceptable floor profile:

1. The flatness F-number, F_F, controls the floor surface bumpiness by limiting the magnitude of successive 1 ft. (0.30 m) slope changes measured on a pre-determined line. Flatness is usually controlled by construction methods and finishing techniques. The "highway straightedge" and pan floats are pieces of equipment often used to ensure floor flatness during finishing operations.

2. The levelness F-number, F_L, defines the relative conformity of the floor surface to a horizontal plane as measured over a 10 ft. (3 m) distance. Levelness is controlled by precise forming, or by the use of a laser screed.

The F-number pair is always written in order F_F / F_L. In theory, the range of flatness and levelness F-numbers extend from zero to infinity. However, in practice these numbers usually fall between 12 and 45. The minimum F_F / F_L values should never be less than F_F13 / F_L10, since these numbers represent the worst local results to be expected from any concrete floor construction method. A more detailed discussion of floor flatness/ levelness is given in ACI 117.

Although less definitive results are obtained with the 10 ft. (3 m) straightedge, this method is occasionally used. When used, the 10 ft. (3 m) freestanding unleveled 10 ft. (3 m) straightedge would be placed anywhere on the slab within 72 hours after slab concrete placement. The gap at any point between the straightedge and the floor should not exceed the following:

Classification	
Conventional	
Bullfloated	1/2 in. (13 mm)
Straightedged	5/16 in. (8 mm)
Flat	3/16 in. (4.8 mm)
Very flat	1/8 in. (3.2 mm)

The range of floor tolerances being achieved is evident after several floor placements by the contractor. A change in technique termed "restraightening" using a 10 ft. or 12 ft. (3 or 3.6 m) highway straightedge has increased the floor flatness from 30% to 50%. The timing and number of restraightening operations necessary to achieve the specified requirements varies. ACI 302 tables 8.1 and 8.2 provide typical composite F_F / F_L values for various construction and finishing methods.

Admixtures

Modern admixtures can provide a range of benefits including water reduction, paste reduction, and therefore, reduced shrinkage, improved workability, finishability and overall quality, increased resistance to freeze/thaw cycles and sulfate attack, acceleration or retardation of setting, and control of strength development. This section is intended as a practical guide to the types of chemical admixtures that are available and offers general guidance on their use and application in modern concrete construction.

ASTM C 494 and AASHTO M 194 are the industry specifications covering the general and physical properties of the seven types (Types A - G) of chemical admixtures. Air entraining admixtures are specified separately in ASTM C 260 and AASHTO M 154, while superplasticizers should meet the requirements of ASTM C 1017.

The Euclid Chemical Company offers a full line of EUCON high performance concrete admixtures. Additional information on these products can be obtained by calling The Euclid Chemical Company.

Accelerators - ASTM C 494, Types C & E
Accelerating admixtures speed up hydration, and are added to concrete either to shorten the setting time, increase the rate of early strength development, or both. Accelerators can improve finishability as well. Set-accelerators are primarily used in cold weather concreting to counteract the slowing effect of cold temperatures on hydration. They are also used in normal temperatures where early set or strength is required such as early formwork stripping, or to allow more immediate structural use following repairs. Because of problems associated with chloride-induced corrosion, a non-calcium chloride admixture should be used in concrete when risk factors associated with chloride corrosion are present (Section 5.7.3). Check with your local Euclid Chemical admixture representative to find the right non-chloride accelerator to use.

Retarders - ASTM C 494, Types B & D
Set-retarding admixtures relieve many of the difficulties involved in placing and finishing concrete in a range of difficult conditions, and are especially beneficial in warm weather construction. Retarders delay the hydration of cement without affecting the long-term mechanical properties. As a result, they are most commonly used to counteract the effect of high temperatures which decrease setting times, or where a delay in setting time is required to ensure sufficient placement, vibration or compaction time, such as in long hauls, long wait times and undermanned placement crews. Retarders are also popular in prestressed applications to keep concrete workable throughout the length of the vibrating operation and to allow the use of high-temperature curing without affecting the ultimate strength of the concrete.

Air Entrainers - ASTM C 260
Air entraining admixtures help develop a proper air void system within concrete, which will increase the freeze-thaw durability and scaling resistance of concrete. The use of air entraining admixtures enhances workability during placement, and also reduces bleeding and segregation of fresh concrete. Air entrainers should be used when there is the risk of exposure to freeze/thaw conditions, deicing salts or sulfate attack, but floors receiving dry shake hardeners should have less than 3% air content to avoid delamination.

Water Reducers

Conventional Water Reducers - ASTM C 494, Types A, D & E are used to lower concrete's water content without reducing workability or compromising strength. Water reducers are also known to improve the quality of concrete in terms of freeze/thaw resistance and durability. Conventional water reducers produce a minimum 5% water reduction and can increase slump 1-1/2 to 2 in. (40 - 50 mm) without the addition of water.
Mid Range Water Reducers can typically produce a 5 – 12% water reduction without excessive set retardation. Stable over a wider range of temperatures, mid-range water reducers are known to have more consistent setting times and are most effective in a designed slump range of 5 to 7 in. (130 - 180 mm). Benefits include outstanding strength gain, enhanced workability, finishability and concrete durability, especially in concrete exposed to salt or low temperatures. Concrete containing mid range water reducers can be pumped and placed at much higher slumps than untreated concrete without increasing water content.
High Range Water Reducers (HRWR's) -
ASTM C 494, Types F & G or superplacticizers are a special class of water reducers for very low water to cement ratios with slump ranges of 6 to 10 in. (150 - 255 mm) to produce very flowable concrete. HRWR's are classified according to their water content reduction capacity which can range from 12% to as much as 40%.

Specialty Admixtures
Specialty admixtures address the needs of particular applications for specific markets. Contact The Euclid Chemical Company for information on specialty admixtures including:

- Corrosion Control
- Viscosity Modifiers
- Silica Fume
- Alkali Silica Reactivity Control
- Cement Stabilizers
- Anti-Washout
- Shrinkage Reducers

Alkali-Silica Reactivity Control
Alkali-silica reactivity (ASR) is a chemical reaction that occurs between reactive silica in certain types of concrete aggregates and cement alkalis in the presence of water. This reaction causes the formation of a compound that surrounds aggregates, absorbs water and swells. This creates internal pressure that can lead to cracking and deterioration of concrete. If it is known that reactive aggregate will be used in a concrete mix, the use of a lithium nitrate admixture such as EUCON INTEGRAL ARC will prevent damaging ASR reactions. If an ASR problem has been identified on an existing slab, a lithium nitrate surface treatment, EUCO ARC TREATMENT, can be used to halt the process and reduce the expansion and cracking associated with ASR.

The Euclid Chemical Company manufactures a wide range of high quality admixtures and provides technical support for applications involving the use of these products. For more information on EUCON admixtures, contact The Euclid Chemical Company.

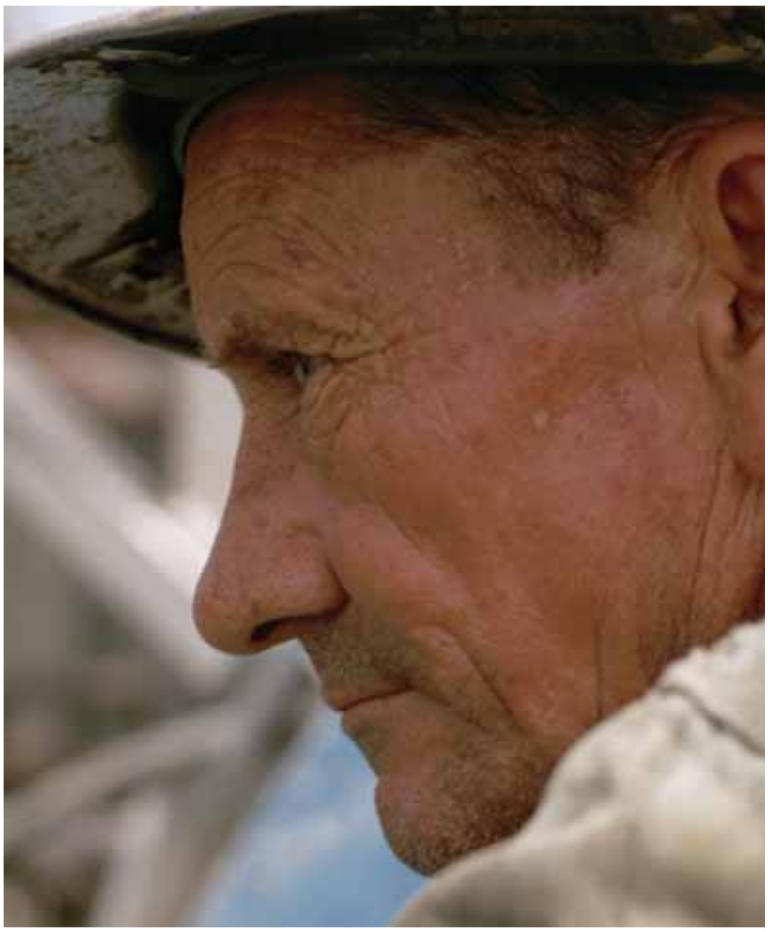
Synthetic Fibers

In North America, use of synthetic fiber reinforced concrete has increased in pre-cast, shotcrete, slab-on grade and topping applications. Synthetic fibers can increase the tensile strain capacity of plastic concrete, which tends to reduce the formation of plastic shrinkage and settlement cracks at the surface and can also provide "toughness" or load carrying capacity to concrete depending on the fiber quantity and type. The use of synthetic micro and macro-fibers in concrete can often greatly improve the overall durability and long-term performance of concrete structures. Synthetic fibers are described in Section 5.9.3.

The design of slabs on grade have traditionally been performed whereby the concrete thickness resists the implied loads and reinforcing is supplied to resist any stresses due to plastic and temperature induced shrinkage. Secondary reinforcing can be supplied by the use of synthetic micro-fibers which are available in monofilament and fibrillated forms of polypropylene and monofilament polyester fibers from The Euclid Chemical Company under the product line name FIBERSTRAND. It has been shown that the use of these fibers can reduce the formation of plastic shrinkage cracking in concrete by as much as 88% at fiber dosages ranging from 0.5 to 1.5 lbs/yd^3 (0.3 – 0.9 kg/m^3).

For providing a fiber reinforced solution equivalent in strength to specified steel, the use of a synthetic macro-fiber may be warranted. This can be accomplished with the use of Euclid's TUF-STRAND SF™, a patented, self-fibrillating polypropylene / polyethylene fiber blend specifically engineered to be a direct replacement to steel fibers, welded wire fabric and light gage steel reinforcing for slabs on grade. To provide equal performance, a synthetic macro-fiber reinforced alternative must provide the same post-crack tensile strength as the specified steel fiber, welded wire fabric or light reinforcing bar configuration.

With regards to selecting an appropriate TUF-STRAND SF fiber dosage, each project must be treated individually. These fibers are generally used in pre-cast concrete, shotcrete applications and floor or slab on grade construction in quantities ranging from 3.0 to 20 lb/yd^3 (1.8 to 11.5 kg/m^3). Pre-cast concrete and shotcrete applications will be provided with fiber dosages to match the required bending moment capacities of existing concrete designs. Slabs on grade will be analyzed as either a structural or non-structural element with respect to



reinforcing. Non-structural slabs will be provided with a fiber dosage based on equivalent or minimum PCA requirements to specified steel. For structural slabs on grade, the subgrade modulus, concrete flexural strength, vehicle, post and rack, and forklift loads will be computed by The Euclid Chemical Company's proprietary design software to calculate a fiber dosage satisfying ultimate limit states design. The software can then be used to optimize slab thickness versus fiber dosage.

Synthetic micro and macro-fibers are ideally suited to a range of applications including elevated and on-ground slabs, parking structures, pavements, bridge decks, pre-cast structures and shotcrete applications.

All Euclid Chemical Company synthetic micro and macro-fibers meet or exceed the requirements of ASTM C 1116 which defines Type III Synthetic Fiber Reinforced Concrete or Shotcrete. This standard requires documentary evidence confirming fibers' long term resistance to deterioration when in contact with the moisture and alkalies present in cement paste or the substances present in air entraining and chemical admixtures.

Special Floor Finishes

Dry shake floor hardeners come in mineral aggregate and metallic varieties. The selection of a dry shake hardener is dependent on the specific solution intended for the particular application. Floor hardeners provide a dense, tough surface capable of withstanding the abrasion and impact loading seen by floor slabs in a wide range of commercial, industrial and manufacturing facilities. Dry shake hardeners provide 2 to 8 times the abrasion resistance of plain, cured concrete. Most manufacturers offer hardeners in a range of colors.

Metallic floor hardeners are formulated with graded, non-oxidizing or oxidizing metallic aggregate in a high strength cementitious binder. Mineral hardeners contain a mixture of well graded, non-metallic aggregates, plasticizer and cement binder. Both are recommended for use in either interior or exterior applications where a hard, long wearing, heavy duty floor is required. Metallic hardeners should not be applied to concrete with intentionally added chloride.

Non-oxidizing metallic and mineral aggregates come in a light reflective version designed to increase reflectivity to improve lighting levels. In combination with providing increased abrasion resistance, this type of dry shake floor hardener can boost reflectivity in excess of 60%. Benefits can include lower electrical requirements and fewer light fixtures resulting in significant cost savings.

The use of embedded mineral or metallic hardeners is usually intended for industrial floors exposed to moderate or heavy traffic. In some cases, floor hardeners are applied where impact resistance is required. The manufacturer's recommendations should be followed along with the procedures described in Section 8.6.

Accordingly, dry shake floor hardeners should be embedded near the top surface of the slab to obtain the required surface hardness, toughness and impact resistance. It is recommended that the total air content of normal weight concrete should not exceed 3% except when service conditions expose the concrete to freeze/thaw cycling and the slab is not hard-trowel finished. Consult the manufacturer and ACI for specific installation guidelines since these vary slightly between metallic and mineral hardeners due to differences in their properties. In general, it is advised that good construction practices be followed. This includes obtaining flat and level surfaces and joints, using proposed mix proportions when installing test panels or placements and making any required adjustments at that time. A concrete mix design review should be conducted prior to installation of a dry shake floor hardener with all appropriate parties present. Issues such as air content, use of blended cements, concrete admixtures, and placing and finishing techniques should be discussed and agreed upon before the project begins.

Special Floor Finishes

PRODUCT USAGE CHART FOR DRY SHAKE FLOOR HARDENERS

Product Name		Application Rate		Typical Applications						
		minimum pounds per square ft. (kg/m²)	maximum pounds per square ft. (kg/m²)	Warehouse/Distribution Floors	Loading Docks	Processing Plants	Industrial Floors	Aircraft Hangars	Retail Floors/ Showrooms	Pedestrian Traffic
METALLIC	[1]DIAMOND PLATE	1.0 (4.9)	2.5 (12.2)	◆	◆	◆	◆			
	[1]DIAMOND PLATE LIGHT REFLECTIVE	1.0 (4.9)	2.5 (12.2)	◆	◆	◆	◆	◆		
	EUCO FLAT PLATE	1.0 (4.9)	Up to 2.5 (12.2)	◆			◆			
	EUCO PLATE HD	1.5 (7.3)	Up to 3.0 (14.6)	◆	◆	◆	◆			
	EUCO PLATE HD LIGHT REFLECTIVE	1.5 (7.3)	Up to 3.0 (14.6)	◆	◆	◆	◆	◆		
MINERAL	SURFLEX	0.5 (2.4)	2.0 (9.8)	◆	◆	◆	◆	◆	◆	
	LIGHT REFLECTIVE SURFLEX	1.0 (4.9)	2.5 (12.2)	◆	◆	◆	◆	◆	◆	
	SURFLEX TR	0.75 (3.7)	2.0 (9.8)	◆	◆		◆		◆	
	NON-SLIP AGGREGATE	1.0 (4.9)	1.0 (4.9)			◆				◆

[1] Non-oxidizing metallic dry shakes provide an aesthetic appearance ideal for architectural concrete.

Proper curing of dry shake floor hardeners is critical to maximize the full potential of the floor. There are several options for curing. The best choice depends on the intended use of the floor. If a one-step curing and sealing is desired, a high solids acrylic product such as SUPER DIAMOND CLEAR (solvent-based) or SUPER AQUA-CURE VOX (water-based) should be used. For an exceptionally dense surface and increased wear resistance, cure the floor with a dissipating and removable curing compound such as KURED DR VOX and seal with EUCO DIAMOND HARD.

When appearance is a concern, sheet curing of dry shake hardeners is not recommended, as surface discoloration and mottling can occur.

Concrete Curing Compounds and Sealers

Concrete Curing Compounds and Sealers
Curing is the process of maintaining a sufficient amount of moisture in the concrete to promote proper cement hydration and strength gain. Properly cured concrete is more durable and resistant to freeze-thaw damage, and is less susceptible to dusting, scaling, and carbonation of the surface.

Liquid membrane-forming curing compounds are applied to fresh concrete immediately after finishing operations are complete, when the concrete surface is damp but without standing bleed water. Curing compounds form a film on the surface that restricts the amount of water that can evaporate from the concrete. These products can be formulated to be dissipating over time, allowing for easy removal before any subsequent floor coating or covering is installed. Some curing compounds contain a white pigment to reflect sunlight helping to keep outdoor concrete cool. Generally, curing compounds do not provide any long-term protection or enhanced appearance to concrete.

Because of regulations controlling the amount of volatile organic compounds in concrete curing products, most curing compounds are water-based. Curing compounds should meet or exceed the requirements of ASTM C 309, a specification that includes performance properties such as moisture retention, drying time, and reflectance.

Concrete curing and sealing compounds are used in the same way as curing compounds, but with the added benefit of imparting a lasting seal on the concrete surface. Curing and sealing products often provide a glossy appearance or "wet-look" to the concrete as well. These products can be reapplied when traffic or weathering wear away the protective seal and diminish its effectiveness. Curing and sealing compounds can be either solvent or water-based, and are sometimes offered in colors to further enhance the appearance of the concrete.

ASTM C 1315 specifies the performance characteristics for concrete curing and sealing products. This specification is more demanding than ASTM C 309, including additional requirements such as UV degradation and yellowing resistance, acid and alkali resistance, and compatibility with tile cements. The specification for moisture retention is more stringent in ASTM C 1315 as well.

Water-repellent penetrating sealers for concrete form a barrier within the surface that helps prevent damage from the ingress of water and salts, without changing the appearance of the concrete. These products provide a highly effective chloride screen and water barrier, protecting both the concrete and reinforcing steel from the harmful effects of deicing salts, moisture, and freeze-thaw cycling. Water-repellent sealers do not cure concrete; they are normally applied to concrete that has been properly cured and is at least 28 days old. Because penetrating sealers must be able to soak into the concrete, the surface must be free of any curing compounds or curing and sealing products, as the presence of these films will prohibit penetration. Therefore, the curing method should be carefully considered if a penetrating sealer is to be used. A dissipating curing compound, wet cure, or sheet cure method should be used to cure the concrete before application of a penetrating sealer.

Water-repellent penetrating sealers are formulated with polymers known as silanes, siloxanes, or a blend of both. Silanes and siloxanes are both effective water and salt repellents, but there are advantages of each that are dependent on the characteristics of the concrete to be treated and the environmental conditions of the jobsite. Always consult the sealer manufacturer for assistance in choosing the best product for your specific project.

Liquid densifiers can be used to increase the durability of a well designed and properly placed concrete floor, or as a remedial treatment on concrete surfaces that are soft or dusting. Liquid densifiers are based on silicoflouride, silicate or siliconate technology – compounds that react to form extremely hard crystalline minerals within the open pores and capillaries in the concrete surface. Siliconates provide a liquid repellent seal on the surface and are best when blended with silicates to provide both surface densifying and sealing. A concrete floor treated with a silicate-siliconate densifier will develop an attractive sheen over time. Silicoflourides are used to improve the condition of a deficient concrete slab that is soft or dusting by chemically "gluing" the loose particles together within the concrete surface.

It is important to note that liquid densifiers should not be used to take the place of natural or metallic aggregate floor hardeners when exceptional abrasion resistance is required. Polishing of concrete floors with specialized diamond grinding equipment and a liquid densifier as the polishing medium is becoming a popular method to both improve the appearance and increase the density of a concrete floor.

Why do well designed concrete floors dust? Factors that contribute to this problem include:

- ***Finishing while bleed water or condensation moisture is on the surface***
- ***Insufficient curing or no curing***
- ***Using gasoline powered equipment (heaters, generators, mixers) in the vicinity of new concrete without proper ventilation***
- ***Inadequate protection of freshly placed concrete from rain, snow, or drying wind***

CHART RATING SYSTEM

Recommended (RD) - The product is primarily designed for this application.
Acceptable (AC) - The product may be used in this application but might experience a change in appearance or reduced service life in certain situations. (In most cases there will be a product offered that may be better suited for the particular application).
Not Recommended (NR) - The product is not recommended for this application.
Excellent (E) - The product is unaffected when exposed indefinitely to the particular environment.
Good (G) - The product shows functional performance when exposed to the particular environment but may exhibit some discoloration or show a slightly reduced service life.
Poor (P) - The product does not normally show acceptable performance when exposed to this environment. Another product should be selected.

USAGE CHART CRITERIA

Interior - Primarily industrial or commercial floor slab areas not exposed to direct sunlight or freeze/thaw cycles.
Exterior - Concrete exposed to the elements (may include interior concrete exposed to temperature fluctuations (freezer floors) or an area near an exit (loading docks).
Architectural - Concrete (interior or exterior) where the appearance of the concrete surface is a design consideration (includes stamped concrete, acid stained concrete, exposed aggregate concrete, and integrally colored concrete).

SUNLIGHT/ULTRAVIOLET RESISTANCE - UV rays that make up a portion of sunlight may affect the resin materials in some curing compounds and sealers, when exposed to direct sunlight and some types of interior lighting. Some products may discolor, and others may completely disintegrate over time.

BLUSH RESISTANCE - Some sealers, when exposed to high humidity or continual immersion, will discolor and/or show a "milky" appearance. Though the sealing capacity of the product is not normally reduced, the appearance is usually less than desirable.

ABRASION RESISTANCE - The profile indicates relative wear resistance when compared to other products on the selection guide. The test used for the comparison was ASTM D 4060 (Taber Abrader), which is generally considered a good indicator of resistance to rubber wheeled traffic.

CURING AND SEALING PRODUCTS – PERFORMANCE AND USAGE GUIDE

		PRODUCTS	ASTM C 309	ASTM C 1315	Interior	Exterior	Architectural	EXPOSURE RESISTANCE: Yellowing	Abrasion	Blush	COVERAGE RATES ft²/gal (m²/liter): 1st Coat	2nd Coat
SOLVENT-BASED	Best for Sealing Only	EverClear	◆	◆	AC	RD	RD	E	E	E	300-400 (7.4-9.8)	400-500 (9.8-12.3)
	Curing and Sealing	BrownTone CS	◆	◆	NR	RD	RD	G	G	G	300-400 (7.4-9.8)	400-450 (9.8-11.0)
		SUPER FLOOR COAT	◆	◆	AC	AC	NR	P	G	G	450-500 (11.0-12.3)	500-550 (12.3-13.5)
		REZ-SEAL	◆	◆	AC	AC	NR	P	G	G	300-350 (7.4-8.6)	350-400 (8.6-9.8)
		SUPER REZ-SEAL	◆	◆	AC	AC	NR	P	G	G	400-450 (9.8-11.0)	450-500 (11.0-12.3)
		DIAMOND CLEAR	◆	◆	AC	RD	AC	E	G	E	300-350 (7.4-8.6)	350-400 (8.6-9.8)
		SUPER DIAMOND CLEAR	◆	◆	AC	RD	RD	E	G	E	300-400 (7.4-9.8)	400-450 (9.8-11.0)
WATER-BASED	Curing and Sealing	DIAMOND CLEAR VOX	◆	◆	AC	RD	NR	E	G	G	250-300 (6.1-7.4)	300-400 (7.4-9.8)
		SUPER DIAMOND CLEAR VOX	◆	◆	RD	RD	NR	E	G	G	300-400 (7.4-9.8)	400-500 (9.8-12.3)
		AQUA-CURE VOX	◆	◆	RD	AC	AC	G	G	G	200-300 (4.9-7.4)	300-400 (7.4-9.8)
		SUPER AQUA-CURE VOX	◆	◆	RD	AC	AC	G	G	G	300-400 (7.4-9.8)	400-500 (9.8-12.3)
		REZ-SEAL VOX	◆	◆	RD	AC	NR	G	G	G	300-350 (7.4-8.6)	350-450 (8.6-11.0)
		EUCOCURE VOX	◆	◆	RD	AC	NR	G	G	G	300-350 (7.4-8.6)	350-450 (8.6-11.0)
	Curing Only	KUREZ DR VOX	◆		RD	RD	NR	P	P	P	200-300 (4.9-7.4)	NR
		KUREZ W VOX	◆		RD	RD	NR	G	P	P	200-300 (4.9-7.4)	NR
		KUREZ WHITE PIGMENTED VOX	◆		RD	RD	NR	G	P	P	200-300 (4.9-7.4)	NR

PENETRATING SEALERS AND LIQUID DENSIFIERS – PERFORMANCE AND USAGE GUIDE

	PRODUCT NAME	TYPE	ASTM D4887: INTERIOR	EXTERIOR	ARCH	APPLICATIONS: SEALING	DUST-PROOF	HARDEN/ DENSIFY	WATER-REPELLENT	CHLORIDE-BARRIER	EXPOSURE RESISTANCE: YELLOWING	ABRASION ASTM D 4060	BLUSH	COVERAGE RATE ft²/gal (m²/liter): 1st Coat	2nd Coat
SOLVENT-BASED	EUCO-GUARD 100	10% Siloxane	NR	RD	AC	◆			◆	◆	E	N/A	E	75-125 (1.8-3.1) wet on wet application	
	EUCO-GUARD S-40	40% Silane	NR	RD	AC	◆			◆	◆	E	N/A	E		
	EUCO-GUARD 200	20% Siloxane	NR	RD	AC	◆			◆	◆	E	N/A	E		
	LINSEED OIL TREATMENT	Natural Oil	NR	RD	NR						P	N/A	N/A	400 (9.8)	400 (9.8)
WATER-BASED	EUCO-GUARD VOX	Water-based Silane/Siloxane Blend	RD	RD	AC	◆			◆	◆	E	N/A	E	100-150 (2.4-3.7) wet on wet application	
	EUCO DIAMOND HARD	Silicate/Siliconate Blend	RD	AC	NR	◆	◆	◆	◆		E	G	E	200-250 (4.9-6.2)	
	EUCO #512 VOX	Epoxy	RD	AC	NR	◆	◆				P	G	E	200-300 (4.9-7.4)	400-600 (9.8-14.8)
	SURFHARD	Silicofluoride	RD	AC	NR		◆	◆			E	N/A	G	150-300 (3.7-7.4) For 3 coats	
	EUCOSIL	Sodium Silicate	RD	AC	AC	◆	◆	◆			E	N/A	G	200-500 (4.9-12.3)	

Joint Fillers and Sealants

Selection of Joint Fillers and Sealants

Joint fillers are hard, semi-rigid materials typically used to fill control and construction joints in concrete floors. The joint filler transfers the load of heavy wheeled traffic across the joint, protecting the joint edges (also called "shoulders") from damage. Joint fillers are not flexible, and are not meant for use in any joint where significant movement is expected. Joint fillers are epoxy or polyurea based materials that must be 100% solids and have a minimum Shore A hardness of 80.

Joint sealants are flexible materials that expand and contract along with the concrete. Their main purpose is to prevent water, other liquids, and debris from entering the joint. They can also improve the appearance of a floor. Most sealants are available in colors and can make the joints "disappear". Sealants are one or two-component polyurethanes and should not be used on floors that will receive heavy traffic or loads because sealants will not support and protect the joint edges.

Timing of Joint Filling and Sealing

ACI 302 advises that joint filling be postponed as long as possible to minimize joint filler splitting and cracking. This condition occurs because the concrete slab shrinks and the joint itself widens. Semi-rigid epoxy and polyurea fillers are not flexible enough to withstand joint widening, and may split within the filler and along the filler/joint wall interface. This splitting is normal if the joints are filled before most of the concrete shrinkage has occurred (concrete undergoes the most significant shrinkage during the first year, especially the first 60 to 90 days). If the construction project requires joints to be filled before the slab shrinkage has occurred, provisions should be made for repair of the filler cracks or separation. A low-viscosity epoxy can be used to fill these areas.

Choosing a Joint Filler or Sealant

A semi-rigid epoxy or polyurea product must be used on floors exposed to heavy wheel traffic or loads. Polyureas have the added benefit of a quick cure and fast turn-around time. Many semi-rigid fillers are available in colors to either match or contrast the color of the surrounding concrete. Epoxies and polyureas may discolor in UV light, and may not be suitable for outdoor use if aesthetic appearance is critical.

Flexible polyurethane sealants are suitable for light-duty floors and pavements. These products are UV stable and good for outdoor use. Like the semi-rigid fillers, flexible polyurethane sealants are available in a range of colors to meet design requirements.

JOINT FILLERS AND SEALANTS — PRODUCT SUMMARY SHEET

Product	Joint Type	Generic Type	Durometer Reading Per ASTM D2240 Hardness Classification	Applications	Primer	Packaging		Application Information		
						Packaging Options	Mix Ratio by Volume	Procedure	Pot Life @ 75° F. (24° C)	Normal Traffic @ 75° F. (24° C)
[1]EUCO 700	Control and construction joints	2 part epoxy	D55 A>100 Semi-rigid	• ACI 302 sec 5.12 • Industrial floors • Pavements • Hard wheels • Minimal slab movement	No	1 and 10 gal. (3.8 and 37.8 liter)	1:1	Pour by hand or install with mechanical pump or bulk hand gun	15 min.	24 hrs.
[1]EUCO 800		2 part epoxy	D50 A90 Semi-rigid		No	2 gal. (7.6 liter)	1:1		50 min.	24 hrs.
[1]EUCO QWIKjoint 200	Control and construction joints	2 part polyurea	D38 A90	• ACI 302 sec 5.12 • Industrial floors • Pavements • Hard wheels • Minimal slab movement • Freezers	No	10 gal. (37.8 liter) and 600 mL cartridges	1:1	Install with mechanical pump or cartridge gun	< 1 min.	30 min.
EUCOLASTIC I and II	Control Construction or moving joints	1 or 2 part polyurethane, gun grade (non-sag) or pourable grade	A30 Elastomeric	• All pavements • Exterior • Interior • Extensive movement	Yes; Depends on Joint Type	2 gal. (7.6 liter) and 11 and 30 oz. cartridges	Varies	Cartridge gun or pour by hand	Varies with grade	3 to 5 days
EUCO #452-P	Control Construction	2 part epoxy	D85 A>100	Prisons	No	1 and 3 gal. (3.8 and 11.3 liter)	2.7:1	Use bulk gun or pour by hand	50 min.	24 hrs.

1 On floors where joint filler "overfill" staining is undesirable and appearance is critical, use EUCO Clean-Cut joint filler stain prevention film in combination with these semi-rigid joint fillers. EUCO Clean-Cut is a water-based polymer film-forming liquid that is applied with roller or brush to concrete, adjacent to joints. The product dries in 15-20 minutes and can be removed with water immediately after joint filling operations are complete.

High Performance Coatings

Guidelines for Selection of High Performance Coatings

High performance epoxy and polyurethane coatings provide an attractive appearance as well as chemical and abrasion resistance. However, these coatings are very sensitive products and certain procedures for concrete placement and coating application must be followed to ensure a successful installation.

Concrete Placement

Along with the standard requirements for subgrade preparation, a vapor retarder should be installed for slabs on grade where a non-breathable coating is intended. Vapor retarders reduce moisture from passing through the slab. Moisture passing through the slab can interfere with application of coatings as well as with the performance of installed systems.

Concrete curing is very important, however, membrane forming curing and sealing compounds should not be used on floors to receive non-breathable coatings because curing membranes interfere with the bond of most products. Instead, curing paper, polyethylene, water curing or dissipating curing compounds (such as KUREZ DR VOX) are recommended. The concrete must be a minimum of 28 days old prior to coating application.

Concrete of any age must be properly prepared prior to application of a coating. The surface should be textured and free of any oil, grease, laitance, moisture, or any other debris including curing or sealing compounds that will prevent bonding to the surface.

Choosing the Proper Coating

High performance coatings are used in many environments: auto/truck repair bays, airplane hangars, laboratories, warehouses, chemical retaining areas, animal shelters, and manufacturing plants. Each facility has its particular requirements. To achieve a long lasting durable surface, many questions should be asked.

- What appearance and texture is desired?
- Must the product(s) be U.S.D.A. approved?
- What type(s) of traffic is expected?
- What are the service condition challenges?
  - Chemical exposure: type, concentration, frequency
  - Traffic and load demand
  - Maintenance requirements

These questions are very common, however they are just the beginning since the range of considerations can vary considerably depending on each unique application. The High Performance Coatings Usage Chart provides additional information on Euclid Chemical coatings. If further information is required on an individual product consult the product technical data sheet or contact The Euclid Chemical Company.

HIGH PERFORMANCE COATINGS USAGE CHART

	EUCOPOXY TUFCOAT	EUCOPOXY TUFCOAT VOX	EUCOPOXY TUFCOAT HB+	EUCOPOXY TUFCOAT DBS	EUCOTHANE	EUCOTHANE VOX
TYPE	2 component solvent-based epoxy coating	2 component water-based epoxy coating	2 component 100% solids high-build epoxy coating	2 component 100% solids epoxy and colored quartz aggregate decorative broadcast system	2 component solvent-based polyurethane coating	2 component solvent-based polyurethane coating
Mix Ratio By Volume: A to B	1:1	color 4.5:1 clear 3.9:1	2:1	2:1	2:1	2:1
Solids Content	55-60%	55-60%	100%	100%	55-60%	65-70%
Primer Required	NO	NO	YES	NO	YES	YES
Coverage Rate ft^2/gal (m^2/L)	250 (6.1)	250 (6.1)	125 (3.1)	See technical data sheet	325 (8)	325 (8)
Wet Film Thickness (per coat)	6-7 mils	6-7 mils	13 mils	10-20 mils	5 mils	5 mils
Dry Film Thickness (per coat)	3-4 mils	3-4 mils	13 mils	1/16" – 1/8"	3 mils	3-4 mils
Drying Time 70°F tack free	2 hrs	4 hrs	6 hrs	8-10 hrs	5-6 hrs	5-6 hrs
Recoat	4-6 hrs	6-8 hrs	8-10 hrs	5-7 hrs	6-10 hrs	6-10 hrs
Application Method	spray, roll, brush	spray, roll, brush	roll, brush, squeegee	roll, squeegee	spray, roll, brush	spray, roll, brush
Variety of Colors	YES	YES	YES	YES	YES	YES
Finish/Appearance	semi-gloss	semi-gloss	semi-gloss	semi-gloss	high gloss	high gloss
U.S.D.A.	YES	YES	NO	YES	YES	YES
U.V. Resistance	FAIR	FAIR	FAIR	FAIR	EXCELLENT	EXCELLENT

Concrete Repair

ACI 302 describes concrete as a "forgiving" construction material that provides a durable, serviceable and attractive surface. However, floor and slab surface imperfections can, and do occur, and are often caused by conditions over which the designer or contractor has little control. For instance, many well designed and expertly placed concrete structures are adversely affected by drying shrinkage cracking simply due to the characteristics inherent in portland cement concrete. While some curling and cracking can be expected on every project, most common imperfections result from failure to follow the basic rules of concrete curing (Section 9.1-9.9) and finishing (Section 8.3.3 and 8.3.5). In almost all cases, imperfections stem from a combination of factors rather than a single cause. By carefully avoiding the various causes of imperfections, satisfactory results are more likely to be obtained. Sections 11.2 through 11.11 provide a thorough explanation of these causes and resulting imperfections including cracking, low wear resistance, dusting, scaling, popouts, blisters, delamination, spalling, discoloration, low spots and poor drainage, and curling.

The cause of most surface imperfections can be determined by performing a petrographic (microscopic) analysis on samples of the concrete in accordance with ASTM C 856. A petrographic analysis evaluates and reports on the probable cause and extent of the distress, as well as the general quality, expected durability and performance of the concrete.

Given all the planning and preparation, in reality, there always will be situations that occur that will warrant repair of floors and slabs. The two most commonly used repair materials are cement-based and epoxy-based. The Euclid Chemical Company has a complete line of repair and restoration products and expert technical support, and can provide the appropriate solution for floor or slab imperfections.

Specific installation guidelines for repair products depend on the product chosen. Refer to Euclid's technical data sheet for information. Consult your local representative or contact The Euclid Chemical Company for assistance with repair products selection.

Product Name	Thickness of Repair		Designed Placement	Material Type	Typical Applications									
	Minimum Inch (mm)	Maximum Inch (mm)			Commercial Warehouse Floors	Loading Docks	Multi-Unit Residential, Pavements, Ramps and Walkways	Industrial Floors	Food Processing	Cracks, Spalled Concrete	Parking Decks	Self-leveling Light Duty Repair	Floor Toppings	Decorative Showrooms, Foyers, Walkways, Driveways
VERSASPEED & VERSASPEED LS	1/4" (25.4)	6" (152)	Patching and Repair/Floor Topping	Rapid Set Cementitious	X	X	X	X			X		X	
EUCO-SPEED & EUCO-SPEED MP	1/2" (12.7)	8" (203)	Patching and Repair	Rapid Set Cementitious /Magnesium Phosphate	X	X	X	X			X			
THIN-TOP SUPREME	1/16" (1.6)	3/8" (9.5)	Patching and Repair/Floor Topping	Cementitious	X	X	X	X			X			
CONCRETE-TOP SUPREME	3/8" (9.5)	2" (51)	Patching and Repair/Floor Topping	Cementitious	X	X	X	X			X			
EUCOCRETE	1" (25.4)	6" (152)	Patching and Repair/Floor Topping	Cementitious	X	X	X	X			X		X	
EUCOCRETE SUPREME	1" (25.4)	6" (152)	Patching and Repair/Floor Topping	Cementitious	X	X	X	X			X		X	
POLY-PATCH	Feather edge 1/16" (1.6)	2" (51)	Patching, Resurfacing, Facing	Cementitious						X				
EUCO #456 & #456S MORTAR	1/8" (3.2)	2" (51)	Surface Resurface Overlays	Epoxy	X	X		X	X					
ULTRA-TEX	Skim Coat 1/8" (3.2)	Skim Coat 1/8" (3.2)	Decorative Overlay	Cementitious										X
EUCO #452 EPOXY	NA	NA	Moisture insensitive adhesive and binder for concrete	Epoxy						X				
EUCOPOXY INJECTION RESIN	NA	NA	Pressure Injection of Cracks	Epoxy						X				
FLO-TOP & SUPER FLO-TOP[1]	Feather edge 1/16" (1.6)	1" (25.4)	Underlayment	Cementitious								X	X[1]	

Services and Solutions

Customer Solutions
The Euclid Chemical Company is unique in our offering of a comprehensive line of superior products, unparalleled customer service, and industry support. Comprised of highly trained professionals, the Euclid team delivers a range of value-added resources and in-depth industry experience to architects, designers, engineers, building contractors and owners, assisting in product selection, specification, installation and related technology.

These individuals serve Euclid's customers, as well as supply field evaluations, recommendations and application problem solving on a project-by-project and technology basis. Our experts are active technical committee members with ACI, ICRI and ASTM. Euclid's professionals are available in local offices nationwide.

The Euclid Chemical Company's experienced field team is available to support you and your projects using Euclid Chemical's extensive product line of highly engineered products manufactured under the stringent standards of our 9001:2000 Certified quality system. Our staff of experts are available for pre-design meetings, assisting in clarifying specifications and recommending product selection. This trained team is also available to support you by providing proper pre-installation instructions and methods for achieving quality results.

Pre-job Conference Support
Euclid Chemical stresses the importance of a pre-job conference attended by the owners, architects, engineers, contractors and others allied to the project. In addition, a "sample slab" should be produced before the actual construction begins in order to practice placement and perfect finishing techniques, especially if new materials are being used. If any questions arise or more information is required, please contact your local Euclid sales representative or The Euclid Chemical Company's Marketing and National Accounts group.

The Euclid Chemical Company does not stop there. Backing these field experts is an exceptional team of professional Certified Technicians utilizing our world-class laboratory and call center with state-of-the-art technology.

TECHNICAL SERVICE

Technical Support
Our Technical Support group provides real-time solutions via telephone and e-mail regarding product and application questions. If you're more Internet minded, product information and support data is available at our website 24 hours a day, 7 days a week.

Laboratory Services
The Euclid Chemical Company proudly serves the concrete construction industry, utilizing our world-class laboratory to deliver precise solutions to customers' problems and advance concrete technology for the benefit of all users. Our CCRL inspected facilities are equipped with state-of-the-art technologies and staffed by our exceptional team of professional, ACI certified technicians. These outstanding resources provide The Euclid Chemical Company the capability to offer comprehensive analytic and petrographic evaluation and testing services via programs that conform to the standards prescribed by the American Society for Testing and Materials, the U.S. Army Corps of Engineers, the American Concrete Institute and the International Concrete Repair Institute.

Training
Euclid Chemical seeks to advance the concrete and masonry industry as a whole, and generously shares technical knowledge through training and seminars conducted for project owners and design professionals. Many programs are AIA/CEU registered, allowing eligible attendees to earn professional development hours. These range from helping customers identify and work with properly trained installation crews to offering a large variety of programs on concrete and related technologies. The Euclid Chemical Company is proud to sponsor these opportunities for our associates and colleagues as part of our ongoing commitment to the industry.

Industry Leadership
For almost 100 years, The Euclid Chemical Company has served as a leading supplier to the concrete and masonry industry with a full line of engineered concrete admixture and construction products marketed under the EUCO brand name. These products include concrete admixtures, block and masonry additives, curing and sealing compounds, epoxy adhesives, floor and wall coatings, structural grouts for columns, equipment and machinery, joint fillers and repair products. The Euclid Chemical Company strives to bring innovative technologies and products to the concrete market with industry leading customer service. The Euclid Chemical Company is an RPM International, Inc. company. For more information, contact The Euclid Chemical Company at 800.321.7628, or log onto the web site at www.euclidchemical.com.

In Association with the Best:

ASCE American Society of Civil Engineers
American Society of Concrete Contractors — Enhancing the Capabilities of Those Who Build with Concrete
aci international
Canadian Standards Association
ASTM International — Standards Worldwide
NRMCA National Ready Mixed Concrete Association
ICRI International Concrete Repair Institute
SME
CPG
CSI
UL Registered Firm
Registered to ISO 9001:2000 Quality Systems

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An RPM Company

The Euclid Chemical Company, *founded in 1910, is today a worldwide supplier of quality products and services for the concrete and masonry industry. Marketed under the EUCO name, we offer a full line of admixtures, repair and maintenance products based on the latest technologies. We provide complete specification assistance and laboratory support as well as on-site service for guidance on proper product usage. EUCO materials are warehoused in over 200 locations in the USA and are available world-wide through international affiliates.*