



GUIDE SPECIFICATION

{Note to Specifier: The paragraphs below are meant to be incorporated into Parts 1, 2 and 3 of a standard CSI 3 Part Format specification, project's General Structural Notes or directly onto the plans. They must be carefully reviewed by a qualified design professional and edited to meet the particular requirements of the project at hand, assure compliance with any governing building codes, and coordinate with other specification sections and drawings. In no case shall these Guide Specifications be considered to be Contract Documents or serve as installation instructions for the product being discussed. In any cases of discrepancy, the manufacturer's most recently published data sheet shall take precedent.}

This document contains hidden instructions the specifier. It should be viewed with hidden language visible.

Product names in bright blue are active links to more product information on the Euclid Chemical website.

**SECTION 03 31 00
CAST-IN-PLACE CONCRETE
DRY SHAKE-ON HARDENER FLOOR FINISH**

PART 1 - GENERAL

1.01 RELATED WORK:

- A. Joint Fillers – [Eucolastic](#), [Tammsflex](#), [Dural 340](#), [Qwikjoint UVR](#)
- B. Concrete Repair:
 - 1. Vertical and Overhead: [Euco V-100](#), [Tamms Structural Mortar](#)
 - 2. Horizontal: [Express Repair](#), [VersaSpeed](#)
 - 3. Form and Pour: [Euconcrete](#)
- C. Crack Repair/Injection: [Dural 452 LV](#), [Dural Fast Set Epoxy Gel](#)
- D. Bonding Agents: [Duralprep A.C.](#), [Dural 452 MV](#)
- E. Waterproofing/Dampproofing : [Tamoseal](#), [Vandex Super](#), [Hey'Di K-11](#), [Vandex BB75](#)
- F. Architectural Coatings: [Tammscoat](#), [Tammolastic](#)
- G. Anti-Graffiti Coatings: [AG 100](#), [AG-400](#),
- H. Traffic Deck Coatings: [Tammsdeck](#), [Flexdeck](#)
- I. Decorative Floor Coatings: [Duraltex](#)
- J. Epoxy Chemical Resistant Coatings: [Duralkote 240](#), [Duralkote 500](#), [Duraltex 1705/07](#), [Duraltex 1805/07](#)
- K. Penetrating Water Repellents:
 - 1. Horizontal and Vertical: [Baracade WB 244](#), [Baracade 100C](#), [Baracade Silane 40 IPA](#)
 - 2. Vertical: [Chemstop WB Regular/Heavy Duty](#)
- L. Penetrating Epoxy Sealer: [Euco #512 VOX Epoxy Sealer](#)
- M. Cathodic Protection: [Sentinel Galvanic Anodes](#)

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 SUMMARY

- A. This Section refers to cast-in-place concrete, including reinforcement, concrete materials, dry shake floor hardener, concrete mixtures and proportioning, placement procedures and finishes.

- B. Furnish and install all reinforcing bars, dowels, mesh, ties, etc., as noted and required for all reinforced concrete work as shown.

1.04 SUBMITTALS

- A. Submit Product Data: For each manufactured material and product indicated.
- B. Submit Concrete Mix Design(s)
 - 1. Submit mix design for each proposed concrete mix.
 - 2. Submit aggregate gradations for all aggregates proposed for use in concrete mixture proportions.
 - 3. Submit items as specified in ACI 301.
- C. Submit Shop Drawings: Include details of steel reinforcement placement including material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports.
- D. Submit Material certificates and test reports.
- E. Submit Ready Mix Concrete Producer NRMCA certification. Certification shall not be more than twelve months old.
- F. Submit Testing Agency Qualifications
- G. Submit Concrete Sub Contractor Qualifications
- H. General Contractor and Concrete Sub-Contractor shall execute provided Conformance Submittal for curing materials, dry shake floor hardener, liquid densifier/sealer, and joint filler specified.

1.05 QUALITY ASSURANCE

- A. Ready Mix Concrete Producer Qualifications: A firm experienced in producing ready-mixed concrete that complies with ASTM C 94 requirements for production facilities and equipment. Comply with ACI 301, unless modified by the requirements of the Contract Documents.
- B. Ready Mix Concrete Producer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II
- D. Concrete Sub-Contractor Qualification: Concrete Sub-Contractor crew responsible for placing and finishing concrete for the interior floor slab, including dry shake floor hardener, shall include a minimum of three (3) crewmembers that are certified by the American Concrete Institute (ACI) as Concrete Flatwork Finishers, or by the American Society of Concrete Contractors (ASCC). Concrete Sub-Contractor shall include in their

bid package to the General Contractor, their certification numbers, and sufficient proof of certification. Concrete Sub-Contractor shall further provide evidence of having installed at minimum of (5) projects of similar size and scope incorporating a dry shake floor hardener system similar to the specified system. The Concrete Sub-Contractor's crew proposed for the work specified herein shall have participated in the majority of the referenced projects, and crew foreman and crew shall remain the same for every placement of dry shake floor hardener and through the duration of this project.

- E. Concrete Laboratory Testing Technician shall visit the ready-mix plant one day prior to each scheduled placement and visually verify that sufficient aggregate and sand to complete the next day's placement is present and adequately protected from weather.

- F. Pre-Concrete Floor Slab Conference: At least **[40]** days prior to the start of concrete slab construction, the General Contractor shall conduct a meeting at the project site to review mix designs, inspection and testing agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction, contraction and isolation joints, forms and form removal limitations, shoring and re-shoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, floor and slab flatness and levelness measurement, concrete repair procedures and concrete protection to achieve the requirements of this specification. The General Contractor shall send a pre-concrete conference agenda (at the end of this section), including proposed concrete mixes, to all attendees 10 days prior to the scheduled date of the conference.
 - 1. The General Contractor shall require responsible representatives of every party concerned with the concrete work to attend the conference, including but not limited to the following:
 - a. General Contractor's Project Manager and Project Superintendent.
 - b. Testing Agency responsible for concrete mix(s) and field quality control.
 - c. Subgrade Sub-Contractor.
 - d. Concrete Sub-Contractor (Crew Foreman for dry shake floor hardener installation).
 - e. Ready-Mix Concrete Producer.
 - f. Admixture Manufacturer.
 - g. Dry Shake Floor Hardener Manufacturer.
 - h. Approved Liquid Densifier installer
 - i. Joint filler Applicator
 - i. **[Grind and polish subcontractor]**

 - 2. Pre-Placement Conference Minutes:
 - a. Within five days of the meeting, minutes of meeting shall be recorded, typed, and distributed by General Contractor to all parties, including Owner's representative, Architect, and Structural Engineer.
 - b. Minutes shall include a statement by Ready Mix Concrete Producer stating that proposed concrete mix design will produce concrete quality required by these specifications.
 - c. Minutes shall include a statement by Concrete Subcontractor that proposed concrete mix design will provide appropriate workability and setting times, to ensure that Concrete Subcontractor can achieve requirements of this specification, including successful incorporation and finish of dry shake floor hardener.

- G. Interior Floor Test Slab and Mockup: Following Pre-Concrete Floor Slab Conference, Concrete Sub-Contractor shall construct a test slab mockup using the same materials, personnel, equipment, tools and methods for finishing and curing the test slab as will be used for the remaining interior floor slab. The test slab (200 sf minimum), shall be located **[as indicated on drawings][in preapproved location]**, and be of the same thickness as intended floor slab. Interior floor slab construction and concrete placements shall not commence until the Owner has accepted the interior floor test slab mockup.
- H. Application of liquid densifier/sealer shall be performed by an approved applicator of the liquid densifier/sealer manufacturer General Contractor shall contact Euclid Chemical to obtain a list of Approved Liquid Densifier / Sealer Applicators located within the geographic region of the project. General Contractor shall solicit and accept pricing only from those Applicators as included in the Manufacturer's list. **[The approved applicator for this application shall be the same as for the polishing process and additional application of liquid densifier/sealer.]**

PART 2 - PRODUCTS

2.01 FORM MATERIALS

- A. Formwork: Furnish formwork and form accessories according to ACI 301.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars (when indicated on drawings): Shall conform to ASTM A615, Grade 60, medium grade. All bars shall be deformed and shall be free of rust or other matter, which would affect its bonding properties.
- B. Alternate: Reinforcement in Slab or retaining walls (if indicated on drawings): Deformed-Steel Structural welded wire reinforcement (S.W.W.R.) shall conform to ASTM A496 and ASTM A497. The structural Engineer of record must approve the substitution of S.W.W.R. for rebar.
- C. Slab on Ground Plate Dowels: Plate material shall be ASTM A36 steel, size 1/4" x 4½" dowels. Do not shear plates. Remove burrs at edges of plates
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.03 FIBER REINFORCEMENT

- A. Synthetic Macrofiber: Polypropylene/polyethylene synthetic macrofiber complying with ASTM C1116 Type 3, minimum 2 inch length, aspect ratio 50 to 90.
 - 1. Basis of Design: **TUF-STRAND SF**; by Euclid Chemical www.euclidchemical.com
 - 2. Fiber manufacturer shall have ISO 9001 certification.

3. Synthetic macrofiber shall be tested in concrete to meet the requirements of ICC-AC308

2.04 CONCRETE MATERIALS:

A. Allowable Cementitious Materials

1. Portland Cement: ASTM C150/C 150M, [Type I] [Type II] [Type III] [Type V], [gray] [white].

- a. Concrete to receive dry shake hardener shall not contain Type III Portland Cement.

2. Blended Hydraulic Cement: ASTM C595/C 595M Type IL, cement.
3. Concrete to receive dry shake hardeners shall not contain flyash, slag cement, silica fume or any other supplementary cementitious materials.

B. Maximum Coarse-Aggregate Size: [1-1/2 inches (38 mm)] [1 inch (25 mm)] [3/4 inch (19 mm)] <<Insert dimension>> nominal.

1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M)

C. Coarse and Fine Aggregates: Shall conform to ASTM C33 Class 3S. Provide aggregates from a single source. Fine aggregate shall have a fineness modulus range of 2.5 to 3.0. Combined aggregate gradation for interior floor slab and other designated concrete shall be 8% - 18% for large top size aggregates (1½ inch) or 8% - 22% for smaller top size aggregates (1 or ¾ inch) retained on each sieve below the top size and above the No. 100 sieve.

D. Minimum total coarse aggregate content for slabs on grade and topping slabs shall be 12 cubic feet per cubic yard for 1 ½ inch or larger top size aggregate; 11.5 cubic feet per cubic yard for top size aggregate 1 ¼ inch or larger but less than 1 ½ inch; 11 cubic feet per cubic yard for top size aggregate 1 inch or larger but less than 1 ¼ inch; or 10.5 cubic feet per cubic yard for top size aggregate less than 1”

E. Water: ASTM C94 and potable. Mixing water shall be clear and apparently clean. Do not use wash out water from mixer washout operations or recycled water.

2.05 ADMIXTURE MATERIALS

- A. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding 0.05 percent. Do not use calcium chloride or admixtures containing calcium chloride.
- B. Air-Entraining Admixtures: ASTM C 260/C 260M
 - 1. Air-Entraining admixtures shall NOT be used for interior concrete work or concrete receiving dry shake hardeners.
- C. Water Reducing Admixture: Shall conform to ASTM C-494, Type A or Type F. Unless otherwise permitted, use one of the admixtures listed below:
 - 1. Basis of Design: Eucon Series by Euclid Chemical; www.euclidchemical.com
- D. Water Reducing, Retarding Admixture: Shall conform to ASTM C494, Type D. Unless otherwise permitted, use one of the admixtures listed below:
 - 1. Basis of Design: Eucon Retarder Series by Euclid Chemical; www.euclidchemical.com
- E. Water Reducing, Non-Corrosive Accelerating Admixture: Shall conform to ASTM C-494, Type C or Type E. Unless otherwise permitted, use one of the admixtures listed below:
 - 1. Basis of Design: Accelguard Series by Euclid Chemical; www.euclidchemical.com

2.06 FLOOR SLAB TREATMENTS

- A. Dry Shake Hardener: Material shall be proprietary blend of wear resistant aggregates, plasticizer, and cement binder. Product shall be delivered in original, unopened packaging labeled with the manufacturer's name, product name and lot number. Store materials at job site, off ground, under dry conditions and at temperatures between 60°F and 80°F.
 - 1. [\[Basis of Design: Non-Metallic **\[SURFLEX\]****\[SURFLEX LIGHT REFLECTIVE\]****\[SURFLEX E\]****\[SURFLEX TR\]** , by Euclid Chemical; \[www.euclidchemical.com\]\(http://www.euclidchemical.com\)\]](#)
 - a. [\[Application Rate: **\[0.5\]****\[1.0\]****\[1.5\]****\[2.0\]** lbs per square foot and as required to achieve finish in approved mockup.\]](#)
 - 2. [\[Basis of Design: Non-Oxidizing Metallic **\[DIAMOND-PLATE\]****\[DIAMOND-PLATE LIGHT REFLECTIVE\]** , by Euclid Chemical; \[www.euclidchemical.com\]\(http://www.euclidchemical.com\)\]](#)
 - a. [\[Application Rate: **\[1.0\]****\[1.5\]****\[2.0\]****\[2.5\]****\[3.0\]** lbs per square foot and as required to achieve finish in approved mockup.\]](#)
 - 3. [\[Basis of Design: Metallic **EUCO-PLATE HD**>>, by Euclid Chemical; \[www.euclidchemical.com\]\(http://www.euclidchemical.com\).\]](#)

- a. **Application Rate: [1.5][2.0][2.5][3.0] lbs per square foot and as required to achieve finish in approved mockup.]**

- 4. Color to be chosen by architect from manufacturers list of standard colors.

- B. Contractor shall ensure enough shake hardener is on-site to complete the placement without interruption.

2.07 CURING MATERIALS

- A. Liquid curing compounds and evaporation retarders applied to dry shake hardeners shall be manufactured by the same manufacturer as dry shake floor hardener.

- B. Reactive silicate-based compounds shall not be used as curing treatments.

- C. Evaporation Retarder: Spray-applied, waterborne, monomolecular film, to aid in the prevention of rapid moisture loss from shake hardener and/or fresh concrete surfaces during the finishing operations.

- 1. Basis of Design: [EUCOBAR](#) by Euclid Chemical; www.euclidchemical.com

- D. Concrete curing compound. A ready-to-use, dissipating compound for use on new, interior and exterior, horizontal and vertical concrete surfaces. Product shall conform to:

- 1. ASTM C 309, Types 1 and 1D, Class A & B Dissipating
- 2. AASHTO M 148, Types 1 and 1D, Class A & B
- 3. Basis of Design: [\[KUREZ DR VOX\]](#)[\[KUREZ DR-100\]](#)[\[TAMMSCURE WB\]](#) by Euclid Chemical; www.euclidchemical.com

- E. Moisture Retaining Fabric conforming to ASTM C171: A naturally colored, non-woven polypropylene fabric with a 4 mil non perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.

2.08 LIQUID FLOOR TREATMENTS

- A. Interior Liquid Densifier / Sealer: Silicate / silicate blend containing at least 24 percent solids by weight 50 percent of which is silicate. Product shall be by same manufacturer as dry shake hardener.

- 1. Basis of Design: [EUCO DIAMOND HARD](#) by Euclid Chemical www.euclidchemical.com

2.09 ACCESSORY MATERIALS

- A. Expansion/Isolation Joint and Column Wrap: Flexible foam expansion joint filler' ½" thick

- 1. Basis of Design: "Ceramar" by W.R. Meadows (800-342-5976)

- B. Semi-Rigid Polyurea Joint Filler: shall be a two (2) component, 100% solids, UV Resistant compound, with minimum shore "A" hardness of 80. Product shall be by same manufacturer as dry shake hardener.

- 1. Basis of Design: [QWIKjoint UVR](#) by Euclid Chemical www.euclidchemical.com
- 2. Color to be chosen by architect from manufacturers list of standard colors.

2.10 CONCRETE MIXTURES

- A. Comply with ACI 301 requirements for concrete mixtures.
- B. Synthetic macrofibers may be used to replace WWF in concrete on metal deck in accordance with IBC2015 and ANSI/SDI-C 1.0. Minimum dosage for synthetic macrofiber shall be 4.0 lbs per cubic yard of concrete. Steel over negative moment areas as shown on drawings shall not be replaced.
- C. Synthetic macrofibers may be used to replace WWF or steel bars in slabs on grade and topping slabs. Dosage for synthetic macrofibers fibers shall be determined based on the required residual strength (f_{e3}) in accordance with ASTM C1609 and general recommendations of ACI 544.4r-18. Contractor shall submit fiber manufacturers recommended dosage rate and testing indicating that specified (f_{e3}) value is satisfied. Under no circumstances shall minimum dosage rate be less than 3 lbs per cubic yard. These minimum dosage rates shall apply to any required (f_{e3}) values of 100 psi or less. The following table may be used for estimating the required residual strength (f_{e3}). Contact fiber manufacturer for recommended dosage to meet required (f_{e3}).

FIBER REPLACEMENT OF STEEL - REQUIRED RESIDUAL STRENGTH (f_{e3}) TABLE

SLAB THICKNESS	W2.9 6"X6"	#3@18" OCEW	#3@16" OCEW	#3@12" OCEW	#4@18" OCEW	#4@16" OCEW	#4@12" OCEW
4 INCH	115 PSI	150 PSI	170 PSI	225 PSI	265 PSI	300 PSI	400 PSI
5 INCH	100 PSI	120 PSI	135 PSI	180 PSI	210 PSI	240 PSI	320 PSI
6 INCH	100 PSI	100 PSI	110 PSI	150 PSI	175 PSI	200 PSI	265 PSI
8 INCH	100 PSI	100 PSI	100 PSI	110 PSI	135 PSI	150 PSI	200 PSI
10 INCH	100 PSI	100 PSI	100 PSI	100 PSI	105 PSI	120 PSI	160 PSI

- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results or other circumstances warrant; at no additional cost to Owner and as accepted by Owner. Laboratory test data for revised concrete mix and strength results shall be submitted to and accepted by Owner before using in work. Both the concrete testing and inspection agency and the Concrete Sub-Contractor shall satisfy themselves that the proposed concrete mix will produce a concrete which will meet the specifications for this project. In addition, the General Contractor and Concrete Sub-Contractor shall verify that the workability, finishability and setting times are appropriate for slab installations. Placement shall be made by chute directly from concrete trucks. If pumping of the concrete is contemplated for any special locations, the proportions specified shall not be altered to suit the capabilities of pumping equipment.
- E. Slump: Concrete mixes shall be proportioned to achieve a maximum slump of 8" for concrete containing high range water reducing admixture, 6" for concrete containing a mid-range water reducing admixture. Mixes shall have a water slump of 2" – 3" (3" to 4" for concrete receiving a "dry-shake" hardener). Maximum 4" water slump for all other concrete.
- F. Concrete to receive dry shake on hardener shall have maximum air content of 3 percent.
- G. Concrete to Receive Shake Hardener: Concrete shall conform to ACI 301 and be designed to meet 4000 psi compressive strength at 28 days. The mix shall contain the specified water reducing admixture and achieve a W/Cm ratio of 0.53 (max). Concrete shall be non-air entrained and in no case shall the concrete be designed for less than 4000 psi @ 28 days. Proposed concrete mix shall be similar to the following prototype mix. Mix constituents will vary dependent on top size aggregate chosen.

Materials	Prototype Mix
Cément	517-564 lbs.
Fly Ash/Slag	Prohibited
Coarse Aggregate (Maximum size 1 ½")	12 Cubic Feet ± .50 (Coarse aggregate)
Fine Aggregate	7 Cubic Feet +/- (Adjust as Necessary)
Water Content	274 – 298 lbs.
Air Content (Entrapped Air Only)	3.0% (Max.)
Mid-Range Water Reducer (Type A/F)	3oz.-10oz./100wt +/-
W/cm	0.53 (Max.)
Initial Slump (Water, before admixture)	3" to 4"
Final Slump (After addition of admixture)	4.5 – 5.5" (Max.)

2.11 ADMIXTURE USAGE

- A. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
- B. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- C. Use water-reducing or high range water reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, fiber reinforced concrete and concrete with a w/c ratio below 0.50.

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with ASTM C 94. Ready Mix Concrete operations shall meet DOT approval. All mixers shall be in proper operating condition and the drum fins shall be clean of residue.
- B. Fibers shall be added at plant location or jobsite and shall be mixed in concrete for a minimum of 4 minutes.
- C. When air temperature is between 85° and 90° F, reduce mixing and delivery time from 1½ hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.
- D. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.
- E. Batch Tickets: Provide batch tickets for each batch discharged and used in the work, indicating project identification name and number, date, mix type, mix time, quantity, and

amount of water added. Batch tickets shall state the quantity of water that may be added at jobsite without violating submitted mix design criteria, including w/c ratio. Record approximate location of final deposit in structure. Concrete Laboratory Testing Technician shall be responsible for collecting batch tickets and recording the location of load placement to associated batch ticket.

2.13 CONCRETE TESTING

- A. Testing Agency: An independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated, as documented according to ASTM E548. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade 1. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's placement of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Slump: Test in accordance with ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's placement of each concrete mixture. Perform additional tests when concrete consistency appears to change. Concrete used to receive shake hardener shall have every load checked for slump. Any load, after hold-back water is added, shall have a target slump of 5".
 3. Air Content: Test in accordance with ASTM C 231, pressure method, for normal-weight concrete; one test for first concrete delivery and one test for every five deliveries thereafter. Interior Floor: Air entrainment is not allowed for concrete receiving shake hardener. One test for first concrete delivery and one test for every five deliveries thereafter. Allowable entrapped air is 3.0% (maximum). Test results shall be immediately provided to the Contractor and Owner. Do not place shake hardener on concrete containing more than 3% entrapped air.
 4. Concrete Temperature: Test in accordance with ASTM C 1064; one test hourly when air temperature is 40°F and below; and when 80°F and above, one test for each composite sample.
 5. Compression Test Specimens: Test in accordance with ASTM C 31.
 6. Compressive-Strength Tests: Test in accordance with ASTM C 39.

Note to Specifier: Delete first subparagraph below if field-cured specimens are not required.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results, including air content, shall be reported in writing to Owner, Ready Mix Concrete Producer, and General Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Non-Compliant Test Reports: All test reports indicating non-compliance shall be emailed or faxed immediately to all parties on the test report distribution list. Copies shall be on different color paper.

10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air content, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

PART 3 EXECUTION

3.01 INSTALLATION (GENERAL)

- A. Formwork: Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.
- B. Wood Form Work: Form all slabs, stairs and other formed concrete with ¾ inch form plywood. For exposed surfaces use plywood with an undamaged face. Form ties shall be snap ties. Form release agent shall be a VOC compliant, light viscosity, non-staining oil. Coat all removable wood and metal forming with form-release agent and allow excess liquid to drain off before forms are placed. .
- C. Vapor Retarder: (If indicated on drawings) Install, protect, and repair vapor-retarder sheets according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of placement.
 1. Seal vapor retarder completely around all pipes and conduits. Inspect vapor retarder thoroughly and repair all punctures and tears immediately prior to placing concrete. All laps shall be 18 inches minimum, and sealed with a completely continuous pressure sensitive tape.
 2. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- D. Steel Reinforcement (if indicated on drawings): Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- E. Install all anchors, ties, chairs and other supports as requested to insure reinforcing is supported at proper locations. All reinforcing shall be wired in place using #16 annealed wire. Wood or clay brick chairs are not acceptable.
- F. Interior Floor Slab Tolerances: Slabs shall be measured as soon as control joints are cut and in accordance with ASTM E 1155 and ACI 117. Unless otherwise noted on drawings, all interior floor slabs shall be constructed as a single course slab with a minimum of three passes of the trowel machine. Additional slabs shall not be cast until the Owner project manager has accepted the measurements from the previous day. Owner will conduct flatness and levelness testing.
 1. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 2. Unless otherwise noted on drawings, all interior concrete floor slabs shall be constructed to an overall specified FF<<insert value>> /FL<<insert value>> requirement with a minimum local value of FF<<insert value>>/FL<<insert value>>. The overall area is a "Test Section" as defined in ASTM E 1155. The minimum local area is the area of a single placement.

3. Slabs shall be measured in accordance with ASTM E 1155 within 72 hours after casting. Additional slabs shall not be cast until an Owner's representative has accepted the measurements from the previous day.

3.02 CONCRETE PLACEMENT

- A. Carbon Monoxide and Carbon Dioxide Exposure: General Contractor shall be responsible for monitoring interior concrete floor exposure to excessive exhaust gases containing carbon dioxide (CO₂) or carbon monoxide (CO) during delivery, placement and finishing of concrete and until concrete floor is protected by specified curing method.
 1. CO₂ levels shall not exceed 4,500 parts per million. CO levels shall not exceed 15 parts per million at concrete surface within 5 feet of any source of exhaust gases.
 - a. Levels shall be monitored utilizing appropriate meter from company similar to CEA Instruments, Inc., 16 Chestnut Street, Emerson, NJ 07630; Phone (201-967-5660);
 2. Unvented combustion heaters shall not be in operation during concrete placement.
 3. Limit combustion engine equipment inside building during concrete to only that equipment necessary to place and finish concrete.
 4. Only two concrete trucks shall be in building at any given time and under no circumstance shall there be any earth moving equipment, dump trucks, grading equipment, or any other motorized equipment in operation until after the interior concrete floor is placed and protected by specified curing method.
- B. Comply with requirements in ACI 301 for measuring, mixing, transporting, and placing concrete.
 1. Concrete shall be mixed and delivered in accordance with the requirements of ASTM C94.
 2. Cooperate with all other trades. Confer with electrical, mechanical, plumbing, carpenters, steel workers, etc., to ensure that all sleeves, anchors, inserts, conduit, floor boxes, pipes, fittings, and other items are installed before placing concrete. Make provisions for door saddles, and thresholds.
 3. General Contractor shall ensure the accuracy, placement and alignment of all under-slab work. Placement of all boxes shall be square, level and true in all respects.
 4. Install stone base material in accordance with recommendations of ACI 302 and ACI 360 to the minimum compacted thickness as indicated on drawings. Prior to installation, General Contractor shall verify proper sub-grade elevations to assure that minimum thickness of stone base can be achieved. Crushed stone base material shall be compacted to 98 percent Modified Proctor density in accordance with ASTM D1557. The in-place density shall be tested for compliance no more than 48 hours prior to concrete placement using ASTM D1556, ASTM D2167, or ASTM D2922. One copy of test results shall be forwarded to the Owner and Engineer.
- C. Transport: Dump concrete at point of use and consolidate with a concrete vibrator. Do not allow concrete to become segregated. Maximum free fall for concrete is 3 feet. A vibrator is required for placement of concrete in walls, piers, footings and turndowns.
- D. Slab on Ground: Place on firm, undisturbed earth or properly compacted fill. Consolidate without segregation, by vibrating.
 1. Place and protect concrete as required in ACI 301.

2. Concrete shall be placed before initial set has occurred and in no event after it has contained its water content for more than 1½ hours.
 3. All concrete shall be placed upon clean, damp, smooth surfaces that are free from running water. All base materials shall be compacted and rut free. Proof-rolling, observed and evaluated by the Structural Engineer, should be accomplished by a loaded tandem-axle dump truck, a loaded truck mixer, roller or equivalent. Any depression in the surface deeper than ½" should be repaired. Repair should include, but not be limited to, raking smooth or consolidating with suitable compaction equipment.
 4. Concrete shall be consolidated and worked, into all corners and angles of the forms and around reinforcement and embedded fixtures in such a manner as to prevent segregation of the coarse aggregate as required in ACI 301.
- E. Bar supports for reinforcing steel shall be used in all footings in order to assure proper mechanical strength. Wood or clay brick chairs are not acceptable.
- F. Concrete shall not be placed until the forms, reinforcement and other conditions are complete and until all pipes, conduit, sleeves, thimbles, hangers, anchors, and other work required are properly installed.
- G. Vibrate concrete without segregating, thoroughly, to insure contact with forms at all points. Dusting with cement is not permitted.
- H. During concrete slab on ground placement, carefully protect all exposed walls by covering them with waterproof paper, or turn vapor barrier up walls a minimum of 36 inches.
- I. Install all inserts, reglets, hangers, anchors, sleeves, blocking dowels, angles, nailers, etc., required for fastening of other work.
- J. Water shall only be added at the job site under the direct supervision of a representative from the field quality control testing agency. Water may be added in accordance with ASTM C 4. Do not add more water than is indicated as allowable on the batch ticket. Water added at the job site shall be documented on the batch ticket.

3.03 FORMED SURFACE FINISHES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding ¼ inch in height rubbed down or chipped off.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Completely remove fins and other projections. All exposed concrete walls are to be grouted and hand rubbed.
1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, or painting.
 2. Do not apply rubbed finish to smooth-formed finish.
 3. Apply smooth-rubbed finish, defined in ACI 301, to smooth-formed finished concrete.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching

adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.04 INTERIOR FLOOR SLAB FINISH

- A. General: Concrete shall be placed, screeded, re-straightened, and finished as necessary to meet the FF and FL requirements. Do not wet concrete surfaces during finishing operations.
- B. Laser screeds, vibratory screeds, highway straightedges and wood or resinous bull floats shall be used to initiate screeding and floating process to form a uniform and open-textured surface plane before excess moisture or bleed water appears on the surface.
 - 1. A back-up laser screed is required during concrete placement of the interior sales floor slab.
- C. Remove excess water before floating operations start. Do not further disturb surfaces before finishing operations start.
- D. Concrete mix receiving specified dry shake on hardener shall meet the requirements specified herein. Air content of concrete receiving the specified dry shake on hardener shall be 3% or less. Fly ash, micro silica, slag and calcium chloride or admixtures containing more than 0.05 percent chloride ions are not permitted.
- E. Ambient Conditions: Apply specified dry shake on hardener at temperatures of between 60°F and 80°F. Conditions such as high winds, low humidity or hot or cold weather require concrete mix changes and adjustments in application and/or finishing procedures. Coordinate with dry shake on hardener manufacturer.
- F. In hot, dry and windy conditions, use the specified evaporation retarder to help retain moisture. Ideally, building walls and roof are in-place, protecting concrete from direct environment. If that is not the case, wind screens shall be installed to reduce moisture evaporation during placement of the specified dry shake on hardener.
- G. Pre-stack bags of the specified dry shake on hardener in amount required per square foot, at each bay to be placed that day. Document the total number of bags applied on each placement.
- H. Calibrated mechanical spreader shall be capable of a first-pass application rate of 8,000 lbs per hour. Prior to concrete placement, the mechanical spreader shall be calibrated by the Concrete Sub-Contractor to ensure accurate and even application of the specified dry shake on hardener. The mechanical spreader must also be re-calibrated every 3000 square feet to ensure continued accuracy. To ensure accuracy, calibration readings shall be taken by the Concrete Sub-Contractor and reported to the Testing Agency, including location of specified dry shake on hardener application at time of calibration reading. Concrete Sub-Contractor is responsible for maintaining the mechanical spreader and ensuring a consistent application rate of specified dry shake on hardener.
- I. Natural Color Dry Shake On Hardener Single Pass Application: Non-colored or natural colored dry shake on hardeners shall be applied in the following manner and in accordance with manufacturers written recommendations.
 - a. After concrete is hand or mechanically screeded, use a wood or canvas-resin bullfloat to open the surface and to flatten out or remove any imperfections on the surface of the wet slab. Care shall be taken not to "close" the surface of the concrete.
 - b. Immediately apply the full amount of dry shake on hardener, by calibrated mechanical spreader. Defer initial floating operations until the dry shake on

- hardener is completely “wetted out”, concrete reaches initial set and has stiffened enough to accept the weight of a walk-behind machine equipped with clip on float shoes.
- c. Using walk-behind or a ride-on power-trowel with float shoes, dry shake on hardener must be thoroughly worked into the slab. After the shake on hardener has been worked into the concrete and the slab has been given time to further “tighten up”, begin final troweling procedures.
 - d. Highway Straightedge: Once the shake is floated into the surface, a highway straightedge shall be used to achieve the specified flatness tolerances. Highway straightedge operations shall continue before, during and after troweling operations. During highway straightedge operations, care must be taken to retain the shake hardener in the surface of the concrete.
 - e. Trowel Finish: Concrete Sub-Contractor shall wait to apply the troweled finish until after the bleed water has escaped the freshly placed and floated surface to prevent delamination of specified dry shake on hardener finish. Apply trowel finish using troweling machines with adjustable blades. All finishing blades shall be in new condition and completely clean of any deleterious materials.
 - f. Finish the slab according to specifications, paying close attention not to burnish the surface. Final finish shall match accepted mockup.
- J. Colored Dry Shake On Hardener Dual Pass Application: Colored dry shake on hardeners shall be applied in the following manner and in accordance with manufacturers written recommendations:
- a. After concrete is hand or mechanically screeded, use a wood or canvas-resin bullfloat to flatten out or remove any imperfections on surface of wet slab. Care shall be taken not to “close” surface of concrete.
 - b. Allow the slab to dry sufficiently to point where weight of finishers and their power-trowel equipment do not leave any indentations.
 - c. If any excess bleed water remains on the surface, use a rubber hose to drag the water from the concrete.
 - d. Using a walk behind or ride on power trowel with float shoes, break the surface of the slab open and immediately apply 2/3 of the specified amount of dry shake on hardener by calibrated mechanical spreader.
 - e. Once shake on hardener has fully darkened due to absorption of moisture, continue floating process with walk-behind or ride on power trowel with float shoes to work shake hardener into the surface.
 - e. Once first application of shake on hardener has been successfully worked into the slab, immediately place the remaining 1/3 of the dry shake on floor hardener.
 - f. Continue the floating process with walk-behind or ride on power trowel with float shoes to work the second application into the slab.
 - g. Highway Straightedge: Once dry shake on hardener is floated into surface, a highway straightedge shall be used to achieve the specified flatness tolerances. Highway straightedge operations shall continue before, during and after troweling operations. During highway straightedge operations, care must be taken to retain the shake hardener in the surface of the concrete.
 - h. Trowel Finish: Concrete Sub-Contractor shall wait to apply the troweled finish until after the bleed water has escaped the freshly placed and floated surface to prevent delamination of the specified dry shake on hardener finish. Apply trowel finish using troweling machines with adjustable blades. All finishing blades shall be in new condition and completely clean of any deleterious materials. Use 6 inch wide finish style steel-reinforced plastic blades on final passes. Trowel the surface sufficiently to produce a smooth, tight, abrasion resistant surface. Do not overwork or burn the surface.
1. Do not use magnesium floats on this surface. Use only wood or laminated canvas-resin floats available from the following manufacturer:

3.05 CONSTRUCTION, ISOLATION AND CONTROL JOINTS

A. Construction Joints:

1. Construction joints shall be true to line with faces perpendicular to surface plane of concrete (refer to drawings), so as not to impair strength or appearance of concrete at locations indicated or as approved by Architect or Engineer.
2. Construction joints in slab on grade shall be butt joints with plate dowels as specified herein. Do not use metal keyways.

B. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Wrap base of columns with appropriate height material to cover top of slab to top of base plate. Product shall be secured to column with sealant as recommended by manufacturer. Additional 4 inch high wrap shall extend from top of main wrap layer to above slab placement without use of sealant. Exposed portion of additional wrap shall be removed after all floor curing and finishing operations, but prior to painting of columns

C. Sawed Control Joints: Utilizing one of the following methods, form control/contraction joints in concrete with power saws equipped with shatterproof abrasive or diamond rimmed blades. Cut 1/8 inch (3.2 mm) wide joints into concrete when cutting action does not tear, ravel, abrade or otherwise damage surface and before concrete develops random cracks.

1. For slabs on grade and topping slabs up to 9 inches thick an early entry saw shall be used to cut control joints to a minimum depth of 1-1/4 inches immediately after final finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Concrete containing synthetic macrofiber or steel fiber shall be cut to 1/3 slab thickness (d/3).
2. A conventional saw shall be used to cut control joints to a minimum depth of 1/4 slab thickness (d/4), or 1/3 slab thickness (d/3) if concrete contains synthetic macrofiber or steel fiber. Begin cutting as soon as possible after final finishing when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.06 INTERIOR FLOOR PROTECTION AND CURING

A. Protection: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 305 for hot-weather protection and ACI 306 for cold-weather protection during placing and curing. For concrete placement during hot, dry and windy conditions, Concrete Sub-Contractor shall use the specified evaporation retarder as per manufacturer instructions and wind breaks as necessary to maintain a moist condition and to minimize plastic drying shrinkage cracking at the surface of the freshly placed concrete.

B. Apply specified dissipating resin curing compound in accordance with manufacturer's written instructions immediately after finishing operations when such application will not mar or damage surface.

3.07 LIQUID FLOOR TREATMENT APPLICATION

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- A. Liquid Densifier Sealer Application: Prepare, apply, and finish liquid densifier sealer according to manufacturer's written instructions.
 - 1. Remove dissipating resin curing compound residue utilizing standard degreasers and mechanical scrubbing equipment.
 - 2. Prior to application, remove curing compounds residue, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 3. Do not apply to concrete that is less than 28 days' old.
 - 4. Apply liquid densifier sealer at a coverage rate of no less than 225 square feet (21 sq. m) per gallon until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.08 SEMI-RIGID POLYUREA JOINT FILLER INSTALLATION

- A. New concrete must be a minimum [28][45][90][120] days old.
- B. Prepare joints in accordance with manufacturer's written instructions. Remove dirt, debris, saw cuttings, laitance, curing compounds, sealers, and other foreign materials from joints; leave contact faces of joints clean and dry.
 - 1. Minimum depth of saw cut joints to receive semirigid joint filler shall be 1 inch (25 mm).
 - 2. Clean inner joint walls mechanically using dustless dry-cut saw, or similar tool, to full depth of saw cuts and 2 inches (50 mm) minimum depth in construction joints to remove form release agents, curing compounds, sealer residues, and other surface contaminations that may interfere with bond of the specified joint filler material. Then clean dust and debris from mechanically prepared joints by vacuuming joint.
 - 3. The final step in cleaning shall be the complete removal of all residue with a vacuum cleaner or pressure washing. Substrate must be dry prior to application of Semi-Rigid Joint Filler.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.
 - 1. Mix and install sealant and filler in accordance with manufacturer's written instructions.
 - 2. Use primer if recommended for specific application.
 - 3. Install semirigid joint filler full depth in saw-cut joints. **NO BACKER ROD IS ALLOWED.**
 - 4. Overfill joint and trim joint filler flush with top of joint after hardening. Concave joints are unacceptable.
- D. Construction Joints Through Slab: Fill by one of the following methods:
 - 1. Fill joint with dry-bagged silica sand to within 2 inches (50 mm) of slab surface.
 - 2. Fill joint with joint filler. Overfill joint and trim joint filler flush with top of joint after hardening. Concave joints are unacceptable.

3.09 PROTECTION

- A. Protect concrete surfaces as follows:
 - 1. Protect from petroleum stains.
 - 2. Diaper hydraulic equipment used over concrete surfaces.

3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03310

