

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work required under this heading shall include all labor, materials, tools, equipment and services necessary for and reasonably incidental to the fabrication and delivery to site as shown on the drawings and/or as herein specified.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
 - 1. Footings
 - 2. Foundation walls
 - 3. Slab on grade
 - 4. Exterior sidewalks, ramps and platforms
 - 5. Slabs on metal deck
 - 6. Other items shown on the drawings
- B. Related items specified elsewhere:
 - 1. Section 033543 "Polished Concrete Finishing and Floor Sealer" for concrete floors scheduled to receive a polished concrete finish and floor sealer
 - 2. Section 079200 "Joint sealants"
 - 3. Section 312316 "Excavation"
 - 4. Section 321313 "Concrete Paving" for exterior site concrete work
 - 5. Section 012100 "Allowances" for Quality Control Services Testing and Inspection allowances for Owner specified or indicated Testing and Inspections.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
 - 1. All design mixtures shall be submitted with historical data showing concrete compressive strength test data of each mix design submitted.
- C. Shop Drawings:
 - 1. For steel reinforcement.
 - 2. Control/construction joint pattern layout.
 - 3. All resubmittals shall have changes clouded. Failure to cloud changes will result in rejection.
- D. Material test reports.
 - 1. Aggregates

- E. Material Certificates:
 - 1. Cementitious materials
 - 2. Admixtures
 - 3. Steel reinforcing accessories
 - 4. Curing compounds
 - 5. Floor slab and treatment
 - 6. Vapor barriers
 - 7. Sealer/Dustproofer
- F. Field Quality – control test reports.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the 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 conducting 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.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete,"
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- D. AASHTO T318 - Measurement of Water Content of Fresh Concrete Using the Microwave Oven.
- E. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints. Class 1 or better.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, $\frac{3}{4}$ " x $\frac{3}{4}$ " minimum.
- D. Form Release Agent: Commercially formulated agent that will not bond with, stain, or adversely affect surface and will not impair subsequent treatments of surfaces.

- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- C. 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."
- D. Joint Dowel Bars: ASTM A615/A615M, Grade 60

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I or II.
 - a. Fly Ash: ASTM C 618, Class F Maximum of 25% may be used.
- B. Normal-Weight Aggregates: ASTM C 33, graded, coarse-aggregate.
 - 1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement. Lignite free.
 - 2. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smallertop size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100.
 - 3. Chloride Ion Level: Chloride ion content of aggregate shall be tested by the laboratory making the trial mixes. The total chloride ion content of the mix including all constituents shall not exceed the limitations set forth in Table 4.5.4 of ACI 318-05 for concrete subjected to deicers or exposed to chloride in service (0.15 chloride ions by weight of cement).
- C. Water: ASTM C 94/C 94M and potable.
- D. Air-Entraining Admixture: ASTM C 260.
 - 1. Products
 - a. Euclid Chemical Company (The); Air Mix or- { AEA-92 Series.
 - b. W. R. Grace & Co.; - Darex or Daravair Series.
 - c. BASF; MB-VR or MB-AE.
 - d. Or approved equal

- E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Calcium chloride thiocyanates or admixtures containing more than 0.05 percent chloride ions are not permitted.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - a. Products
 - 1) Euclid Chemical Company (The), Eucon Series, www.euclidchemical.com
 - 2) BASF, Pozzoloth Series, www.buildingsystems.basf.com
 - 3) WR Grace & Co, WRDA Hycol www.na.graceconstruction.com
 - 4) Or approved equal
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - a. Products
 - 1) Euclid Chemical Company (The), Eucon Series, www.euclidchemical.com
 - 2) BASF, Pozzoloth Series, www.buildingsystems.basf.com
 - 3) WR Grace & Co, WRDA Hycol www.na.graceconstruction.com
 - 4) Or approved equal
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - a. Products
 - 1) Euclid Chemical Company(The), Eucon Series, www.euclidchemical.com
 - 2) BASF, Pozzoloth Series, www.buildingsystems.basf.com
 - 3) WR Grace & Co, WRDA Hycol www.na.graceconstruction.com
 - 4) Or approved equal
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - a. Products
 - 1) Euclid Chemical Company (The), Eucon 37 or Plastol Series www.euclidchemical.com
 - 2) BASF, Rheobuild 1000 or Glenium Series www.buildingsystems.basf.com
 - 3) WR Grace & Co, Daracem or Adva series www.na.graceconstruction.com
 - 4) Or approved equal
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - a. Products
 - 1) Euclid Chemical Company (The), Eucon 537 or Plastol Series www.euclidchemical.com
 - 2) BASF, Glenium Series www.buildingsystems.basf.com
 - 3) WR Grace & Co, Daracem or Adva series www.na.graceconstruction.com
 - 4) Or approved equal
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 - a. Products
 - 1) Euclid Chemical Company, Eucon 537 www.euclidchemical.com
 - 2) BASF, Rheobuild Series www.buildingsystems.basf.com
 - 3) WR Grace, Daracem Series www.na.graceconstruction.com
 - 4) Or approved equal
- F. Non-Chloride, Non-Corrosive Accelerating Admixture: The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Provide the following:
- a. Euclid Chemical Co Accelguard (The) 80, 90 or NCA . www.euclidchemical.com
 - b. BASF: Pozzoloth NC 534 or Pozzutec 20. www.buildingsystems.basf.com
 - c. W.R. Grace & Co Daraset". www.na.graceconstruction.com
 - d. Or approved equal

- G. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of admixtures will be required from the admixture manufacturer prior to mix design review by the Engineer.

2.4 VAPOR BARRIERS

- A. Plastic Vapor Barrier: ASTM E 1745 Class A (Plastics) vapor barrier, not less than 15 mils thick. Permeance as tested after mandatory conditioning equal to or less than 0.01 perms as tested by ASTM E 96 or ASTM F 1249. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.
 - 1. Basis of Design:
 - a. Stego Wrap Vapor Barrier by STEGO INDUSTRIES LLC
 - 2. Other acceptable products:
 - a. Vaporguard by Reef Industries
 - b. Vaporblock 15 by Raven Engineered Films

2.5 CURING MATERIALS – Must be Soy Based Products

- A. Coordinate and verify compatibility and requirements at interior floor slabs to receive polished concrete finishing and sealer materials. Refer to Section 033543 "Polished Concrete Finishing and Floor Sealer."
- B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- C. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- D. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- E. Water: Potable.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

- A. Coordinate and verify compatibility and requirements for polished concrete finishing and sealer materials. Refer to Section 033543 "Polished Concrete Finishing and Floor Sealer."
- B. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751. asphalt-saturated cellulosic fiber with removeable "zip strip" edge for installation of sealant.
- C. Semi-rigid Joint Filler: Two component, semi-rigid, 100 percent solids, with a minimum shore A hardness of 80 per ASTM D 2240.
 - 1. Products:
 - a. Metzger McGuire Corp.; MM-80
 - b. Euclid Chemical Company (The); Euco 700
- D. Sealer / Dustproofer: Water – based sodium solution, 0g/L VOC content. Provide one of the following or approved equal.
 - 1. "Eucosil", manufactured by the Euclid Chemical Company.
 - 2. "Kure-N-Hard", by BASF.
- E. Bentonite Waterstop: 75% sodium bentonite and 25% butyl-rubber composite.

1. Products:
 - a. Colloid Environmental Technologies Company (CETCO); Volclay Waterstop-RX

2.7 SURFACE REPAIR MATERIALS

- A. Admixture Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
 1. Products:
 - a. Euclid Chemical Company (The); Flexcon or Akkro 7T.
 - b. W. R. Grace Co.; Daraweld.
- B. Epoxy Bonding Adhesive: ASTM C 881, 100% solids, 100% reactive compounds, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements. Designated repairs shall be made, with prior approval of the Engineer, as to method and procedure, using these epoxy adhesives and/or epoxy mortar. Where epoxy injection procedures must be used, an approved low viscosity epoxy made by these manufacturers shall be used.
 1. Products:
 - a. Euclid Chemical Company (The); Eucopoxy #452 or Duralcrete.
 - b. W. R. Grace Co.; Thiopoxy.
- C. Extended Open Time Epoxy Bonding Agent: Three component, water based, epoxy modified portland cement bonding agent and anti corrosion protection coating providing up to 24 hours open time in which to apply repair mortar. Product shall be capable of achieving bond strength of 2,700 psi per ASTM C 882.
 1. Products
 - a. Euclid Chemical Company (The); Duralprep AC.
- D. Surface Patching Mortar: Polymer modified, cementitious repair mortar achieving 3 day minimum compressive strength of 3,000 psi and 28 day minimum compressive strength of 5,000 psi, per ASTM C 109.
 1. "Tamms Thin Patch", "Speedcrete Red Line with Akro 7T" or "Speedcrete PM" Euclid Chemical
 2. "RenderRock HBA and HB2," BASF Construction Chemicals, LLC.

2.8 GROUTS

- A. Non-shrink Grout: Conforming to ASTM C1107 "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink). Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 7000 psi in 28 days;
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); NS Grout.
 - b. BASF; Masterflow 928.
 - c. U.S. Grout Co; Five Star Grout.

2.9 LIQUID FLOOR TREATMENTS

- A. Coordinate treatment with any sealers, retarders or curing compounds for compatibility as well as mix design for admixtures and fly ash content. At interior floor slabs coordinate floor finish

schedule and polished concrete finishing and sealer materials. Refer to Section 033543 "Polished Concrete Finishing and Floor Sealer."

2.10 CONCRETE MIXTURES, GENERAL

- A. Water/Cementitious Ratio:
 - 1. All concrete subject to freezing and thawing shall have a maximum water/cementitious ratio of 0.45 (4000 psi at 28 days or more).
 - 2. All concrete subjected to deicers and/or required to be watertight shall have a maximum water/cementitious ratio of 0.45 (4500 psi at 28 days or more).
 - 3. All trowel finished interior slabs shall have a maximum w/c ratio of 0.45.
- B. Air Content:
 - 1. All concrete exposed to freezing and thawing and/or required to be watertight shall have an air content of 4.5% to 7.5%.
 - 2. All interior slabs and all slabs to receive dry-shake shall have a maximum air content of 3%.
- C. Slump:
 - 1. All concrete containing the high-range water-reducing admixture (superplasticizer) shall have a maximum slump of 9" unless otherwise approved by the Structural Engineer. The concrete shall arrive at the job site at a slump of 2" to 3", (3" to 4" for concrete receiving a dry-shake hardener), be verified, then the high-range water-reducing admixture added to increase the slump to the approved level.
 - 2. All other concrete shall have a maximum slump of 4."
- D. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- E. Cementitious Materials:
 - 1. Fly Ash: 25 percent.
- F. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or high-range water reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use non-corrosive accelerator for all concrete, less than 8 inches thick, placed at air temperatures below 50 degrees Fahrenheit.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3000 psi at 28 days.
 - 2. Minimum Portland Cement Content: 470 lbs per cubic yard.
 - 3. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 4. Slump Limit: 5 inches, 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
 - 5. Air Content: 0 < 3%.
 - 6. Fly Ash: 25 % maximum.

- B. Interior Slabs: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.42.
 3. Slump Limit: 4 inches, plus or minus 1 inch. 9 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture (3" to 4" for concrete receiving a dry-shake hardener or lightweight concrete).
 4. Air Content: < 2%.
 5. Fly Ash: Not permitted.
- C. Interior Slabs on Metal Deck: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch. 9 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture (3" to 4" for concrete receiving a dry-shake hardener or lightweight concrete).
 4. Air Content: None.
 5. Fly Ash: Not permitted.
- D. Exterior Slabs: Proportion mixes to provide concrete with the following properties.
1. Minimum Compressive Strength: 4,000 p.s.i. at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches.
 4. Air Content: 4 to 8 percent at point of placement.
 5. Fly Ash: Not permitted.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete as shown on drawings.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 VAPOR BARRIER

- A. Plastic Vapor Barriers: Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions. Vapor Barriers shall be a minimum thickness of 15mil unless noted otherwise.
 - 1. Lap Vapor Barrier over footings and seal to foundation walls.
 - 2. Overlap joints 6 inches and seal with manufacturer's tape.
 - 3. Seal all penetrations (including pipes) per manufacturer's instructions.
 - 4. No penetration of the Vapor Barrier is allowed except for reinforcing steel and permanent utilities.
 - 5. Repair damaged areas by cutting patches of Vapor Barrier, overlapping damaged area 6 inches and taping all four sides with tape.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: A Soff Cut saw shall be used to cut control joints to a depth of 1 ¼ inches immediately after final finishing. when cutting action will not tear, ravel, abrade, or otherwise damage surface and before concrete develops random contraction cracks. A conventional saw, shall be used 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 to a depth of ¼ slab thickness or 1/3 slab thickness if steel-fiber or structural synthetic macro fiber reinforcement is used.
 - 2. Saw cut plan must be submitted and approved by the Engineer
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 305.1.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 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 defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. 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.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish and measure surface so gap at any point between concrete surface and an unveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/4 inch.
- C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated or required.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

- E. Flatness and Levelness: Finish surfaces to flatness and levelness tolerances as follows and as measured according to ASTM E1155. Grind smooth high spots and surface defects that would telegraph through applied floor covering systems.
 - 1. Slabs (on grade) shall meet the following floor flatness requirements:
 - a. Specified values: FF – 25; FL – 20

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Protect concrete floor slabs indicated to remain exposed to view (no applied finish floor covering) from construction damage. Cover with protection boards, tarps, etc... to resist surface wear, soiling, paint overspray, adhesive or solder droppings, and other construction activities which may damage the finished surface.
 - 1. For concrete surfaces indicated to receive stained finish, use protection materials and methods recommended by stain manufacturer.
- C. Coordinate treatment with any sealers, retarders or curing compounds for compatibility as well as mix design for admixtures and fly ash content. At interior floor slabs coordinate floor finish schedule and polished concrete finishing and sealer materials. Refer to Section 033543 "Polished Concrete Finishing and Floor Sealer."
- D. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound (Exterior Concrete Slabs): Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound

manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound (Exterior Concrete Slabs): Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 LIQUID FLOOR TREATMENTS

- A. Coordinate treatment with any sealers, retarders or curing compounds for compatibility as well as mix design for admixtures and fly ash content. At interior floor slabs coordinate floor finish schedule and polished concrete finishing and sealer materials. Refer to Section 033543 "Polished Concrete Finishing and Floor Sealer."
- B. Soy Based Penetrating Densifiers and Sealers: Apply this compound on exposed concrete slabs, not indicated or scheduled for other floor finish system. Application shall be made by factory certified applicator, and in strict accordance with the directions of the manufacturer and just prior to completion of construction. Spray, squeegee or roll on liquid densifier to clean, dry concrete surface at a rate no greater than 225 sf per gallon. The liquid should be scrubbed into the surface with a mechanical scrubber. Keep the surface wet with the densifier during the application process. When the product thickens, but not more than 60 minutes after initial application, the surface shall then be squeegeed or vacuumed to remove all excess liquid.
- C. Carbon Monoxide / 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). To minimize potential damage to interior concrete floor during slab placement and curing periods, maximum CO₂ levels shall be 4,500 parts per million and maximum CO levels shall be 15 parts per million at concrete surface within 5 feet of any source of exhaust gases. Unvented combustion heaters shall not be in operation during concrete placement, and equipment inside the building during concrete placement shall be limited to the equipment necessary to place and finish concrete. Only two concrete trucks shall be in the 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. Carbon Monoxide and Carbon Dioxide shall be checked using an appropriate meter from a company similar to the following: CEA Instruments, Inc., 16 Chestnut Street, Emerson, NJ 07630; Phone (201-967-5660)

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair defective areas, utilizing specified Repair Materials when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
 1. Patch a test area at inconspicuous location with specified surface patching mortar to color match. Obtain architect's approval before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
- B. Mortar Scrub Coat: To be used when bonding fresh concrete to existing concrete. Mix trowel consistency bonding coat mortar consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve. Mixing liquid shall consist of specified latex admixture bonding agent diluted with clean potable water at manufacturer's recommended dilution ratio. Utilize only enough mixing liquid to create trowel consistency mortar.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified surface patching mortar scrub coat mixed per manufacture's recommendations.. Fill and compact with specified surface patching mortar before scrub coat has dried. Fill form-tie voids with specified surface patching mortar or cone plugs secured in place with scrub on surfaces exposed to view
 2. Patch a test area at inconspicuous location with specified surface patching mortar to color match. Obtain architects approval before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
- E. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
- F. After concrete has cured at least 14 days, correct high areas by grinding.
- G. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with specified surface patching mortar or fresh concrete
- H. Correct other low areas scheduled to receive floor coverings with the specified repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
- I. Correct other interior low areas scheduled to remain exposed with an approved repair overlayment. Cut out low areas to ensure a minimum repair overlayment depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair overlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- J. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or more in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply mortar scrub coat. Mix original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- K. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with specified surface patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply surface patching mortar scrub coat. Place patching mortar before scrub coat agent. has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- L. Perform structural repairs of concrete, subject to Structural Engineer's approval, using epoxy adhesive and/or polymer repair mortars. The Engineer must approve the proposed repair methods and procedures.
- M. Repair materials and installation not specified above may be used, subject to Architect's or Structural Engineer's approval.

3.13 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - 1. Testing Services: Tests shall be performed according to ACI 301.
 - 2. Non-Compliant Test Reports: All test reports indicating non-compliance shall be emailed or faxed immediately to all parties on the test distribution list.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Contractor shall schedule inspection of vapor barrier installation prior to placement of floor slabs with vapor barrier manufacturer. Submit a written report indicating acceptable installation or remedial action required.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: 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 pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 6. Water content of freshly mixed concrete: AASHTO T318 "Measurement of Water Content of Fresh Concrete Using the Microwave Oven"; tested each time cylinders are made and as directed by the Engineer.

7. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 8. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 9. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 10. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 11. 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.
 12. Test results shall be reported in writing to Architect, Structural Engineer, concrete manufacturer, and 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.
 13. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 14. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 15. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 16. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- E. Flatness and Levelness Tests: Floor flatness and levelness tests on each Floor Section shall be conducted in accordance with the provisions set forth in ASTM E 1155.
1. For the purposes of this paragraph, a Floor Section shall be any rectangular area bound by column and/or half-column lines, exterior walls, interior bearing walls, or a combination thereof (i.,e. minimum section area = approximately 750 sq.ft.).
 2. Floor tolerance measurements shall be coordinated by the Contractor and made by the Testing Agency within 16 hours after completion of the final troweling operation – and in all cases before forms and/or shores (if any) have been removed.
 3. Results of all floor tolerance tests shall be provided to the Contractor, Construction Manager, Architect and Owner within 24 hours after data collection. (Note: Weekends and holidays shall be ignored when computing the testing and reporting deadlines specified above.)
 4. All Floor Sections measuring below either (or both) of the specified Minimum Local F-Numbers shall be removed and replaced (in the case of slabs-on-grade), or (in the case

of elevated slabs) ground and/or re-topped as directed by the Architect and Flooring Installer.

END OF SECTION 033000

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 033543 - POLISHED CONCRETE FINISHING AND FLOOR SEALER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Polished concrete finishing including application of hardener and sealer. Includes hand held polishing at edges and corner conditions.
 - 2. Hardener and Sealer applications for polished locations PC-1 and locations not receiving polishing labeled as SC-1. Coordinate locations with Finish Schedule, and Plans.
 - 3. Concrete for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing as specified in Section 033000 "Cast-in-Place Concrete."
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete"

1.3 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.
- B. Concrete Sawing and Drilling Association (CSDA): Standard CSDA ST 115 - Measuring Concrete Micro Surface Texture.
- C. ASTM C309 - Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.
- D. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
- E. ASTM D523 - Standard Test Method for Specular Gloss.
- F. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- G. ASTM E1155 - Standard

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site. Notify Architect in advance of confirming meeting schedule.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Contractor's superintendent.

- b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Polished concrete finishing Subcontractor.
2. Review concrete curing procedures, construction joints, concrete repair procedures, concrete sealing, finishing and polishing (by machine equipment and handheld equipment), and protection of polished concrete.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product requiring color selection.
- C. Samples for Verification: For each type of exposed finish of 18"x18"x2". And shall show full range of expected color/finish variation.
- D. Test Reports: Independent Laboratory reports confirming compliance with documents.
- E. Maintenance Data

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 1. Repair materials.
 2. Liquid floor treatments.

1.7 QUALITY ASSURANCE

1. Manufacturer has minimum of 5 years' experience in manufacturing components of or exceeding requirements of this project.
- B. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 1. Build mockups in the location and of the size 50sq ft, as directed by Architect.
 2. Demonstrate curing, finishing, and protecting of polished concrete. Including but not limited to showing substrate preparation, operation of equipment, material application, gloss and standard of workmanship.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
 4. Mockups are subject to rejection by Architect if mockups do not meet requirements, and shall be demolished and removed from the site and shall cast additional mockups as required until mockups have been identified as approved by the Architect.
 5. Mockups may be performed on concrete scheduled to receive floor covering. Flooring shall not be installed over approved mockups until Architect determines that ALL polished installations have met specified requirements.

1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting concrete floor topping performance.
- C. Comply with manufacturer's recommendations for curing times and methods for slabs scheduled to receive polished finish.
- D. Minimum concrete strength required to commence polishing operations: 3500 psi. or as specified or noted otherwise in related sections or structural requirements.

1.9 PERFORMANCE REQUIREMENTS

- E. Coefficient of Friction: Exceed OSHA and ADA recommendations and requirements of 0.5 standard value for the Static Coefficient of Friction when tested per ASTM C 1028. Measure slip resistance using BOT-3000 slip-tester by Universal Walkway Testing, or equivalent unit, to ensure compliance with specified slip resistance rating.
- F. Abrasion Resistance: ASTM C779, Up to 400% increase in abrasion resistance.
- G. Reflectivity: Increase of 35% as determined by gloss meter.
- H. Waterproof Properties: RILEM Test Method 11.4, 70% or greater reduction in absorption.
- I. Impact Strength: ASTM C805, Up to 21% increased impact strength.

1.10 COORDINATION

- A. Coordinate protection requirements with trades involved in other construction activities adjacent to or above slabs scheduled to receive polished finish. Slab protection must be maintained at all times.
- B. Concrete Floor Flatness Rating: Coordinate concrete slab installation and finish to achieve specified minimum concrete floor levelness ratings.
 - 1. Cure concrete slabs a minimum of 45 days prior to application of floor polishing materials, unless otherwise directed by the polished floor system manufacturer.
 - 2. Apply floor polishing system a minimum of 10 days prior to installation of equipment and Substantial Completion

1.11 COORDINATION

- A. Special Warranty: Manufacturer's standard form in which manufacturer warrants that the polished floor surface will remain dustproof, hardened, water repellent, abrasive and food resistant for ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: "Husqvarna Hiperfloor Commercial," ground, honed, treated and polished floor system.
- B. Basis of Design Manufacturer: Subject to compliance with the Contract Documents, provide product/s from:

Husqvarna Construction Products
17400 West 119th Street, Olathe, KS 66061
P: 800-288-5040
Web: www.husqvarnacp.com

- C. Substitutions: Equivalent products complying with specified requirements will be considered, provided a manufacturer submit a request for consideration to the Architect prior to date established for receiving bids.

2.02 PRODUCT

- A. Basis of Design Product: Husqvarna 'Hiperfloor Commercial', ground, honed, treated and polished floor system.
- B. Scheduled as Finish Type 'PC-1' on the Interior Finish Legend for polished locations. Refer to both Finish Plans and Finish Schedule. Where exposed concrete finish is identified but shall not receive polishing shall remain as SC-1 sealed concrete (coordinate locations receiving floor covering for compatible floor surface requirements); coordinate with drawings for locations. Notify Architect of any and all discrepancies.

2.03 MATERIALS AND EQUIPMENT

- A. **PC-1** Polishing Materials: Husqvarna products, as follows:
1. Grouting Mix: "GM3000."
 2. Concrete Densifier: "Hiperhard."
 3. Impregnating Sealer: "Hiperguard."
 4. Cleaning Solution: Concrete neutral PH solution acceptable to polishing material and manufacturers.
 5. Grinding and Polishing Equipment: As manufactured by Husqvarna Construction Products.
 6. Dust Extraction System and pre-separator for grinding/polishing: As manufactured by Husqvarna Construction Products as follows:
 - a. Type: Heavy-duty industrial filtration vacuum system, suitable for extracting and containing large quantities of fine concrete dust in conjunction with manufacturer ecommended pre-separator.
 - b. Power: Three-phase, built-in phase correction.
 - c. Particle Filtration: 99.9% @ 1 micron
 - d. Filter: Three-way filtering; maximum dust containment.
- B. **SC-1** Hardener/Sealer Materials: Husqvarna products, as follows:
1. Concrete Densifier: "Hiperhard."
 2. Impregnating Sealer: "Hiperguard."
 3. Cleaning Solution: Concrete neutral PH solution acceptable to polishing material and manufacturers.

PART 3 3.01 PROTECTION

- A. Protect concrete slabs to receive polished floor finish until fully cured and from initial installation to final inspection at time of Substantial Completion in accordance with manufacturer's
1. Do not allow pipe cutting, store construction materials, or allow similar operations on slabs scheduled to receive polished finish.
 2. Provide covers and protections approved by polished flooring system manufacturer to protect floors from oil, hydraulic fluids and operations of other trades.
 3. Do not store or place steel materials on slabs scheduled to receive polished finish or allow

3.02 PREPARATION

- A. Verification of Conditions: Examine areas and conditions under which work will be performed and identify conditions detrimental to proper and timely completion of work. Do not proceed until satisfactory conditions have been corrected.

1. Patching and Repair: Comply with manufacturer's recommended methods and materials if patching or repair of slabs scheduled for polished floor finish.
2. Verify that base slab meet finish and surface profile requirements specified in Section 03 30 00.
3. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F1869 or other testing acceptable to polished system manufacturers. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. in 24 hours, unless manufacturers' require more stringent vapor transmission rates.
4. Completely remove all dirt, form oil, stains, oil, and grease by methods recommended by manufacturer.
5. Close areas to traffic before, during and after polished concrete floor system application

3.03 FINISHING REQUIREMENTS

A. Aggregate Appearance:

1. Interior exposed finished slab areas must consist of the following:
 - a. Slab surface must meet the desired sheen, as discussed in Pre-Installation meeting and be consistent with approved Mock-up.
 - b. Slab surface must have a consistent look and exhibit a finish that has no evidence of streaking or burnish marks.
 - c. White residue or hazy appearance is not acceptable.
 - d. Exposure of aggregate beyond Concrete Polishing Council (CPC) Class is not acceptable.
 - 1) Aggregate Exposure Class: B - Fine Aggregate (Salt and Pepper Finish):
 - (a) Surface Exposure: 85-95% fine aggregate and 5-15% blend of cement fines and coarse aggregate.
 - (b) Surface Cut: 1/64 - 1/8 inch of the cream is removed by grinding the surface, exposing small amounts of medium aggregate randomly throughout. All surface paste is removed.

B. Gloss Appearance: Interior exposed finished slab areas must consist of the following Concrete Polishing Council (CPC) Gloss Level:

1. Finished Gloss Level 2: Satin (Honed):
 - a. Image Clarity Value = 10-39%

3.04 POLISHING CONCRETE FLOORS

A. Polishing Process:

1. Allow concrete floor slab to cure minimum of 28 days prior to commencing polished concrete finishing.

B. Initial Grinding:

1. Use grinding equipment with metal bonded grinding pads.

C. Treating Surface Imperfections:

2. Fill surface imperfections. Work compound and treatment until color differences between concrete surface and filled surface imperfections are not noticeable when viewed from 20 feet away under lighting conditions that will be present after construction.

D. Liquid Densifier Application: Apply undiluted solution to point of rejection and allow to cure according to manufacturer's instructions.

E. Grout Grinding:

1. Use grinding equipment and appropriate grit grinding pads.
2. While applying fresh grout material prior to, grind concrete in direction perpendicular to initial grinding to remove scratches.
3. Vacuum floor using squeegee vacuum attachment after each pass.

F. Honing:

1. Use grinding equipment with resin bonded grinding pads.
2. Hone concrete in one direction starting with 100 grit pad; make as many sequential passes as required to remove scratches, each pass perpendicular to previous pass, up to 400 grit pad reaching maximum refinement with each pass before proceeding to finer grit pads.
 - a. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.

G. Polishing:

1. Use polishing equipment with resin bonded polishing and burnishing pads.
2. Begin polishing in one direction starting with 800 grit pad.
3. Make sequential passes with each pass perpendicular to previous pass using finer grit pad with each pass.
4. Achieve maximum refinement with each pass before proceeding to finer grit pads.
5. Auto scrub or vacuum floor using squeegee vacuum attachment after each pass.
6. Continue polishing until gloss appearance, as measured according to ASTM E430, matches approved mockup.
7. Final Polish: Use burnishing equipment and finest grit abrasive pads, burnish to uniform reflective sheen matching approved field mock-up.

3.05 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least 28 days. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, laitance, curing compounds, sealers and other foreign materials from joints. Leave contact faces of joints clean and dry.
 1. Clean inner joint walls mechanically using dustless dry-cut saw, or similar tool, to the full depth of saw cuts and 2 inch minimum depth in construction joints so as to remove any 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.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening. Concave joints are not acceptable.
 1. Mix and install sealant and filler in accordance with manufacturer's recommendations.
 2. Use primer if recommended for specific application.
 3. Install semirigid joint filler full depth in saw-cut joints.
 - a. Construction Joints Through Slab: Fill by one of the following methods:
 - 1) Fill joint with dry-bagged silica sand to within 2 inches of slab surface.
 - 2) Insert compressible backer rod to a minimum depth of 2 inches below slab surface.

3.06 SEALING

- A. Apply sealer to manufacturer's recommended coverage. Leave to cure for at least one hour or until touch dry.
- B. Remove excessive sealer.
- C. Using burnishing equipment and finest grit burnishing pads, burnish to uniform sheen matching approved mockup.

3.07 CLEANING, REPAIR AND PROTECTION

- A. The premises shall be kept clean and free of debris at all times. Remove spatter from adjoining surfaces, as necessary.
- B. Neutralize and clean polished floor surfaces.
- C. Repair damages to surface caused by cleaning operations.
- D. Repair defective stain areas. Match repairs to color, texture and uniformity of surrounding surfaces.
- E. Protect finished work until fully cured and from completion to final inspection at time of Substantial Completion in accordance with manufacturer's recommendations.
- F. Dispose of materials and debris resulting from dyed and polished floor finish operations in separate, closed containers in accordance with local regulations.

3.08 TRAINING

- A. Polishing sub-contractor shall train owner's designated personnel in proper procedures for maintaining polished concrete floor.

END OF SECTION 033543